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Corporate Finance for Long-Term Value

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Corporate Finance for Long-Term Value

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Dirk Schoenmaker and Willem Schramade have set the example: corporate finance teaching can be adapted to focus on sustainable finance without compromising on the rigour and fundamentals of the core finance curriculum. Social and environmental objectives deserve their role in business decisions. Corporate Finance for Long-Term Value brings it to the classroom.
—**Arnoud Boot**, *Professor of Corporate Finance at University of Amsterdam*

Whereas traditional Finance Theory is well established, the methods for the inclusion of environmental and social issues are still lagging behind. By integrating sustainability in corporate finance models, this book establishes a concrete link between sustainability and finance and transforms the idea of long-term value into standard procedures. Creating these methods and educating people on their use will make long-term value creation the standard among companies.
—**Lea Schütze**, *Master of Finance student at Rotterdam School of Management*

This groundbreaking book contains the key to unlock our economic system for long-term value. To business and investors, it provides the tools and incentives to accelerate the transformations towards a net-zero, nature-positive, and equitable world.
—**Peter Bakker**, *President World Business Council for Sustainable Development*

This book is highly relevant to any investor looking to make long-term decisions and seeking better outcomes. It is both innovative and practical.
—**Peter Harrison**, *CEO Schroders*

Online resources

Corporate Finance for Long-Term Value is supported by teaching materials and cases available at http://www.rsm.nl/corporatefinanceforlongtermvalue.

Preface

This book is about *Corporate Finance*. In our finance course based on our earlier book *Principles of Sustainable Finance* (Oxford University Press), students were enthusiastic about integrating the fields of sustainability and finance. But they were also critical: Where are the methods and calculation examples such as those we are taught in other finance classes?

This book aims to cater to this demand from students. In the 3-year journey of writing this book, three issues became clear to us:

1. Not investors, but companies take centre stage when integrating sustainability into finance; companies cause positive and negative impact in the real world;
2. There is no need for completely new methods; we just need to think and work hard to rigorously incorporate social and environmental value, alongside financial value, in existing corporate finance methods; and
3. Financial value and social and environmental value (also called impact) are often aligned in the long term. Hence, the title *Corporate Finance for Long-Term Value*.

The core of the book is on corporate finance. One major overlap with the field of investments and asset pricing is in the area of risk and return. Hence, Part 4 on risk, return, and impact might be of particular interest to investment students.

In our 3-year journey to complete this book, we discussed the updating of corporate finance with our colleagues within Rotterdam School of Management (RSM), Erasmus University, and at other universities. We are very grateful to them for engaging discussions, great suggestions, and constructive feedback on draft chapters.

At RSM: Dion Bongaerts, Dieuwertje Bosma, Mathijs Cosemans, Steve Kennedy, Thomas Lambert, Florian Madertoner, Daniel Metzger, Arjen Mulder, Erik Peek, Eva Rood, Annebeth Roor, Peter Roosenboom, Claus Schmitt, Marta Szymanowska, Mathijs van Dijk, and Alex Witkowski.

At other schools of Erasmus University: Robert Dur, Derk Loorbach, Karen Maas, and Jaap Winter.

And at other universities: Arnoud Boot (University of Amsterdam), Christian Gollier (Toulouse School of Economics), Abe de Jong (Monash University), Tineke Lambooy (Nyenrode Business University), Basma Majerbi (University of Victoria, British Columbia), Dennis Vink (Nyenrode Business University), and Tram Vu (Monash University).

We also learned a lot from conversations with, and got useful comments from, practitioners in the corporate sector, finance, and consultancy. First, many thanks to our impact friends at Impact Institute and the Impact Economy Foundation: Reinier de Adelhart Toorop, Adrian de Groot Ruiz, Michel Scholte, Werner Schouten, and Arjan Udding.

Second, thank you to our colleagues at the Erasmus Platform for Sustainable Value Creation: Jaap van Dam (PGGM), Merel Hendriks (NWB Bank), Tjeerd Krumpelman (ABN AMRO), Hesse McKechnie (Deloitte), Cindy van Oorschot (De Nederlandsche Bank), Piet Sprengers (ASN Bank), and Hans Stegeman (Triodos Bank).

Third, much gratitude to our industry colleagues: Angus Bauer (Schroders), Herman Bril (PSP), Chris Greenwald (LGT), Diane Griffioen (PGGM), Hans Haanappel (Vantage Valuation), Andy Howard (Schroders), Lars Kurznack (ERM), Paul de Ruijter (De Ruijter Strategy), Johan Vanderlugt (Van Lanschot Kempen), Maria Teresa Zappia (BlueOrchard), and Daniël Zwier (PGGM).

We have been lucky with our students, both in our previous courses on the *Principles of Sustainable Finance* book and in new courses based on this book (in draft at the time). Their honest feedback sharpened the book. Their suggestions to include more examples and to explain overly complex methods in a more intuitive way make the book more accessible and readable. We are also grateful to our research assistants, Jurriaan Bos, Tim Mohr, Giorgio Serafini, and Victor van der Velde, for their dedication and assistance on this gigantic exercise, to our office-manager Myra Lissenberg for planning numerous meetings, and to our copy-editor Lesa Sawahata for smoothing the text.

We are fans of open access science. This book endeavour has been supported both morally and financially by RSM (thank you Pursey Heugens and Marno Verbeek) and the World Business Council for Sustainable Development (thank you Peter Bakker and Pepijn Rijvers). We would like to thank Rocio Torregrosa and Parthiban Gujilan Kannan at Springer for guiding the publication process.

Finally, the real moral support came from home. Our spouses, Jolanda and Christelle, have been our main sponsor during this project: supporting us throughout this exhausting journey, and also making the counterargument when needed. Thanks for your understanding and your love.

Rotterdam, the Netherlands
April 2023

Dirk Schoenmaker
Willem Schramade

About This Book

The aim of this textbook is to provide a corporate finance handbook for companies that want to create long-term value. It builds on recent academic literature on sustainable companies (Mayer, 2018; Schoenmaker & Schramade, 2019; Edmans, 2020). We start by analysing the United Nations' 17 Sustainable Development Goals (SDGs) as a strategy for the transition to a sustainable economy. Next, we translate the general concept of sustainability into core corporate finance methods, such as net present value for investment decisions, capital budgeting, valuing bonds and stocks, cost of capital, capital structure, mergers & acquisitions, and financial reporting.

Current corporate finance textbooks are based on the traditional shareholder model for maximising financial value. However, this book adopts the integrated model, which argues that companies have to serve the interests of current and future stakeholders. Doing business in a sustainable world means that companies move from simply maximising financial value to optimising integrated value, in which financial, social, and environmental value are combined. We set out this *why* in our previous book *Principles of Sustainable Finance* (Oxford University Press, 2019). The innovation of this corporate finance textbook is to demonstrate *how* to apply this new paradigm of integrated value. The basic methods of corporate finance remain the same, but are now expanded to encompass social and environmental factors along with financial factors. How these methods work with integrated value is illustrated with examples throughout.

There is a clear need for this: an increasing number of companies want to contribute to solving sustainability challenges—such as climate change, biodiversity loss, and social inequality—and want to do it based on solid business principles. The SDG agenda is the global strategy for governments and business to guide sustainability transitions. Major companies have adopted the SDGs into their purpose and strategy. The key challenge for companies is to balance profit and impact. This corporate finance handbook provides the tools for this balancing act.

The Modern CFO Creates Profit and Impact

Across the globe, we face major social and environmental challenges that need to be addressed with major reforms and investments. Society expects companies to actively participate in finding and providing solutions. The key to this is long-term value creation. In other words: long-term financial and societal value creation.

This requires a shift in mindsets and methods. Sustainability is typically perceived to cost money, and CFOs are often seen as an obstructing factor. But they don't need to be. Increasingly, companies put sustainability and sustainable transitions at the heart of their business strategy to improve their competitive position. This internalisation of (positive) impact ensures that impact and profit are increasingly interrelated. And the modern CFO is responding to these internalisation trends. This book shows how CFOs can focus on integrated value (which integrates financial, social, and environmental value) rather than just financial value.

Why Corporate Finance for Long-Term Value? Licence to Operate

What is the company's social responsibility? Following Milton Friedman's statement that "the business of business is business", shareholders have been playing an increasingly dominant role in business since the 1980s. Shareholders have the primary objective of maximising the financial value (F) of the company. But corporate models that adopt the shareholder value paradigm do not account for social and environmental externalities. These companies are focused on operating in the upper half of the value creation matrix: Quadrants 1 and 2 of Table 1. Without distinguishing between these two quadrants, the result is an overpopulation of Quadrant 1.

In response to the negative impact created by major companies in Quadrant 1, a debate about the 'licence to operate' of companies has arisen. This book takes the view that companies are also responsible for combatting social inequality (S) and environmental pollution (E). A survey of US citizens finds that 63% of American citizens—including 71% of millennials (born between 1981 and 1996)—expect business to take the lead in driving social and environmental change (Cone Communications, 2017). Addressing social and environmental problems cannot be unilaterally left to governments, which of course have an important role as legislator.

Table 1 Value creation matrix

	S + E value destroying	S + E value creating
F value creating	Quadrant 1 Overexploitation	Quadrant 2 Win-win
F value destroying	Quadrant 3 Collapse	Quadrant 4 Charity

Source: Adapted from Schramade (2020)

The sustainability agenda is summarised in the Sustainable Development Goals. These provide a compass for the sustainability strategy of companies (and governments) to move to Quadrant 2.

Within the larger SDG agenda, we identify four clusters of large transitions that are important for business:

1. *Climate*: the energy transition from fossil fuels to renewables;
2. *Raw materials*: the circular transition to redesign products and recycle materials;
3. *Biodiversity*: the transition to healthy food and nature-positive agriculture;
4. *Labour practices*: the social transition towards decent labour practices across the value chain of production.

With long-term value creation as a central objective, companies can actively contribute to these transitions (moving to Quadrant 2) and thus maintain their licence to operate. Another rationale for long-term value is to see it as a means to deal with uncertainty. Uncertainty means that the probability distribution over possible future outcomes is not known. There's uncertainty about the way the major transitions will unfold. And because of that uncertainty, companies are being advised to hedge their bets, preparing themselves for several transition scenarios. The adoption of the long-term value lens helps them to do this. So what exactly is long-term value, and how can CFOs create it?

What Is Corporate Finance for Long-Term Value? Alignment Between Financial Value and Social and Environmental Value

Long-term value implies an important shift in thinking: from static to dynamic. The major sustainability transitions result in changes in the markets for products and services. Frontrunner companies can strengthen their competitive position in the new market, while the laggards are in danger of disappearing. This is Schumpeter's process of "creative destruction". The transformation of the car industry is a good example. As one of the early frontrunners, Tesla brought the public's attention to the electric vehicle market, thereby creating financial and environmental value. Other car manufacturers, such as Volkswagen, are catching up and making large-scale investments in the production of electric vehicles.

The Dynamic Perspective: Four Driving Forces of Internalisation

The long-term value effects make transitions a matter for the chief financial officer—the CFO—to decide. After all, the CFO is responsible for investment decisions, financial planning, and the information flows needed. To survive in the long term, companies must move the strategic goals of their business models well ahead in time for the strategy to take effect. This book distinguishes four driving forces behind transitions, whereby social and environmental value are 'internalised' into financial value:

1. Licence to operate
2. Regulation and taxation
3. Technological advancement
4. Customer preferences

Each of these forces can accelerate the internalisation of social and environmental value.

The broader social trend of corporate responsibility creates expectations for companies; society looks to leading companies to contribute to the major transitions. For example, carbon taxes are accelerating the adoption of low-carbon production technologies and the phasing out of carbon-intensive ones. Technological advances in combination with economies of scale make wind and solar energy competitive with fossil energy for electricity generation.

In addition, authorities are currently preparing regulations for working conditions throughout the value chain. Customer preferences are also relevant. The campaign of chocolate manufacturer Tony's Chocolonely, for example, has ensured that consumers mainly buy Fairtrade chocolate, even when they buy other brands. These are examples of direct forms of internalisation.

Table 2 illustrates the long-term alignment between profit and impact with examples of the various combinations.

For example, Quadrants 2 and 3 exemplify the long-term alignment between profit and impact, either both being positive (Quadrant 2) or both negative (Quadrant 3). The challenge for a CFO is to steer the company towards a long-term sustainable business model in Quadrant 2 and avoid a drop to Quadrant 3.

In Quadrant 2 (in Table 2) are found leading nutrition and biotechnical companies such as DSM and Novozymes, which combine innovation with a profitable business model. In Quadrant 3 is the coal industry, from which investors are now withdrawing.

Table 2 Long-term alignment between profit and impact

	S+E value: negative impact	S+E value: positive impact
F value: profit	Quadrant 1	Quadrant 2
F value: loss	Quadrant 3	Quadrant 4

In Quadrant 1 is the fossil fuel industry, which has a major negative impact but is still—for now—profitable. However, it faces long-term decline as industrial companies (users of fossil fuels) are adopting net zero carbon strategies. Without a change in their business model, the major oil companies will eventually end up in Quadrant 3. The frontrunners are converting from fossil to renewable energy (moving from Quadrant 1 to Quadrant 2).

Until recently, electric vehicles were expensive but they have now become cheaper due to economies of scale in production and breakthroughs in battery technology. These advances see electric vehicle manufacturers moving from Quadrant 4 to Quadrant 2.

How Can Companies Be Financed for Long-Term Value? Steering for Integrated Value

Impact in the form of social and/or environmental value is an important indicator for future value creation. Companies that prepare a strategy to set the four large transitions in motion will be the winners. By contrast, companies that focus solely on financial value risk falling behind due to an outdated business model.

Today's CFO focuses on financial value (are the activities profitable?), as well as social and environmental value (are the activities future-proof?). Steering according to integrated value means that a CFO creates positive impact in all three value dimensions. The question is how to make steering on integrated value operational in company investment decisions. It might not be as easy as it sounds, because a simple integrated value decision rule with summation of the three value dimensions does not work. Companies might be 'netting' value dimensions, thinking they can compensate for their negative social and environmental impact with a high financial profit. But a pointed disregard of actual social and environmental impact is untenable.

Building on the net present value (NPV) rule, this book presents decision rules for investment projects to develop sustainable business models. These are the principles that underlie the decision model:

1. *Multi-value creation*: value creation is stimulated and is positive for all three value dimensions: financial, social, and environmental. This is the long-term goal for all decisions, but it is not always immediately possible for existing activities.
2. *Transition*: where value is destroyed, a path to recovery is established. This applies to all three value dimensions: financial, social, and environmental. The path to ending value destruction must be credible.
3. *Non-substitution*: netting is not allowed. In principle, negative effects on one value dimension cannot be compensated for by positive effects on other value dimension(s).

This book's decision model outlines how companies should weigh negative values more heavily than positive values so that there is an incentive to restore what might be a negative value profile (the second principle).

The ultimate goal is value creation on all three dimensions (the first principle) in Quadrant 2. The illustrations and examples of calculations are applied to subjects such as investment decisions, valuation, cost of capital, capital structure, and M&A.

Conclusions

This book shows how the CFO can prepare the company for the future by managing for profit and impact. Integrating social and environmental value (impact) into corporate strategy is the key to success.

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Preview of the Book

This preview sets out how corporate finance relates to long-term value.

Steering on Long-Term Value: Part 1

Society faces social and environmental challenges, which need to be addressed with reforms and investments. Society expects companies to actively participate in finding and providing solutions. The keyword is long-term value creation, in other words, long-term financial, social, and environmental value creation.

Companies play an important role in the transition to a sustainable economy, because social and environmental impacts are generated primarily in the corporate sector. These social and environmental impacts are internalised in transitions. Some companies will survive transition by providing valuable solutions; others will not, as their competitive positions are eroded. Sustainability is therefore also about corporate survival in the long run.

The starting point is the expansion of the goal (or objective) function of the company. The traditional goal is maximising financial value for shareholders. The goal function is broadened toward steering on financial value (FV), social value (SV), and environmental value (EV) in an integrated way. This is the process of optimising the company's integrated value (IV):

$$max\ IV = FV + SV + EV$$

Chapter 2 highlights the need to account for transitions, while Chap. 1 explains the need for companies to respect social foundations and planetary boundaries to keep their license to operate. Figure 1 summarises steering on IV, subject to these constraints.

Applying Long-Term Value in Value Flows and Cost of Capital: Parts 2–5

The core model of corporate finance is the discounted cash flow (DCF) model to determine the value V of a project or a company:

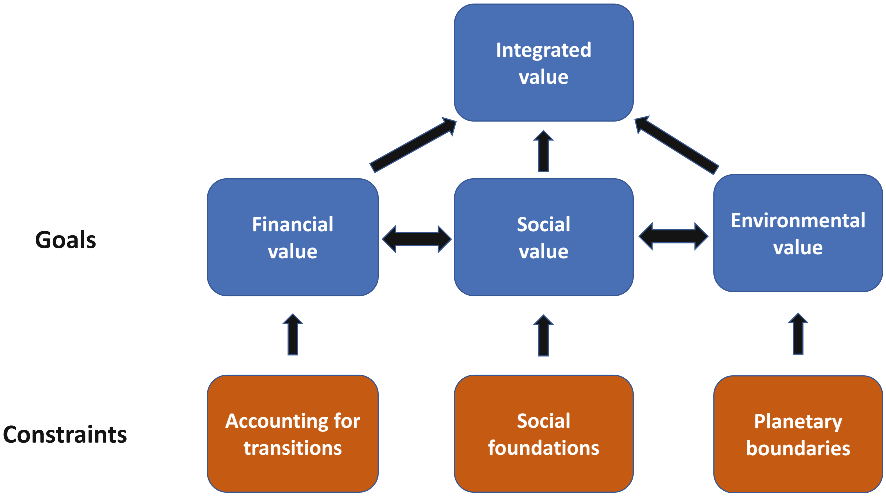


Fig. 1 Optimising integrated value subject to constraints

$$V = \sum_{n=0}^{N} \frac{CF_n}{(1+r)^n}$$

whereby *CF* reflects the cash flows, *r* the discount rate (also called the cost of capital), and *n* the number of periods over which cash flows are discounted. The standard DCF model is used to calculate financial value FV.

Social (S) and environmental (E) issues can be added to the DCF model. As explained in Chap. 5, S and E issues can be expressed in their own units *Q* (e.g. life years saved by medical treatment or carbon emissions by using fossil fuels) and then multiplied by their respective shadow price *SP* derived from welfare theory. The shadow price for one life year, for example, is $119,000 and the shadow price per 1 tonne of CO_2 equivalent is $224 (IEF, 2022). The value flows *VF* are calculated as follows:

$$VF = Q \cdot SP$$

These value flows can be discounted with the DCF model to obtain SV and EV. It could be argued that cash flows are a special form of value flows expressed in cash. Here, we use the more general term of value flows to calculate integrated value *IV*:

$$IV = \sum_{n=0}^{N} \frac{VF_n}{(1+r)^n}$$

Value Flows

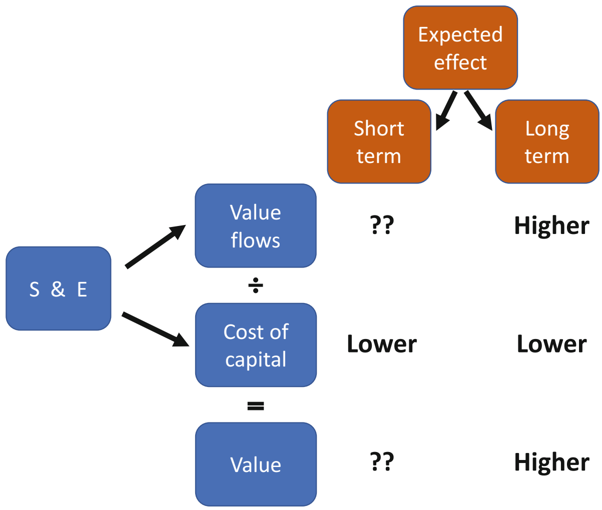
Sustainability transitions result in changes in the markets for products and services. In the process of transition, social and environmental externalities are internalised. Internalisation means that the burdens of externalities are increasingly shifted from society back to the companies (and consumers) who cause them. Companies that create FV at the expense of SV or EV (social and environmental externalities) will be often affected with lower FV if and when internalisation occurs. By contrast, companies that provide solutions for solving negative SV and EV are rewarded with stronger FV (see, for example, Kurznack et al. (2021) in Chap. 2).

The alignment between profit (FV) and impact (SV and EV) depends on one key assumption, namely that sustainability transitions will happen at some point in time. The timing of transitions—early or late—is difficult to predict. Investments for transitions are done today or in the near future, while the timing of the benefits is uncertain. The expected effect of sustainability improvements (S and E) on value flows is thus uncertain in the short term, but likely to be positive in the long term (see Fig. 2).

Cost of Capital

The cost of capital increases with social and environmental externalities (because of a risk premium for the systemwide dimension of social and environmental risk) and decreases with positive social and environmental impact (because of reduced risk). Negative externalities effectively increase the leverage of integrated capital. Chapter 12 provides the emerging evidence for the relevance of E and S to the cost of capital. In a global study covering 77 countries, Bolton and Kacperczyk

Fig. 2 Expected effect of improving S and E on value



(2023), for example, found a positive and significant relationship for short-term and long-term measures of carbon transition risk and return: higher risk leads to a higher cost of capital because of a positive risk premium. In a similar way, Hong and Kacperczyk (2009) found a positive risk premium for sin stocks, such as alcohol, tobacco, and gaming.

We can now turn the argument around. Lower S and E risk, which means better S and E performance, leads to a lower cost of capital in the short term *and* in the long term (see Fig. 2).

Value Effect

For positive S and/or E impacts, higher value flows (in the numerator) and a lower cost of capital (in the denominator) are expected to produce higher company value in Fig. 2. And vice versa for negative impacts.

So, companies with a positive impact are likely to produce more long-term value. In the long run, financial, social, and environmental values are largely aligned. The challenge lies in trade-offs across time and between types of value, which can interact in numerous ways. In Parts 2–5 of this book, we show how the nexus between impact and LT value works for the various corporate finance methods—NPV, valuation, cost of capital, and the corporate finance policies—capital structure, reporting and mergers and acquisitions.

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How to Use This Book

Transitions pose major challenges, and finance theory is not well equipped to deal with them or to produce integrated value. Therefore, finance needs to adapt, and this book sets out how to do that. The good news is that you don't need new corporate finance methods or models to steer companies for integrated value. You only need to incorporate social and environmental value alongside financial value in the existing methods and models.

This book takes an evolutionary approach that helps students, teachers, and practitioners transition from current corporate finance based on financial value, to modern corporate finance based on integrated value.

The first three chapters set the scene for modern corporate finance, and the subsequent chapters serve to explain the different value dimensions. Most chapters have this order of analysis (see also Fig. 3):

1. Explain the standard corporate finance methods: *financial value.*
2. Calculate the effects of environmental, social, and governance (ESG) factors on financial value: *ESG integrated.*
3. Calculate environmental and social value: *impact.*
4. Integrate the three values in the standard corporate finance methods: *integrated value*.

Finance academics and practitioners have started to explore the role of sustainability in finance, but hardly challenged the goal function. Until now, most work has been done on examining the effects of ESG factors on the financial or business value of the company (an inward view). This is still in the realm of shareholder primacy, with a focus on financial value. In sustainability terms, this is called the financial materiality of sustainability (see Fig. 4).

The next step would be to look at the impact of the company on society and the wider environment (an outward view). This outward view assumes that a company has a social responsibility to other stakeholders, such as employees, customers, suppliers, the communities in which they operate, and the environment. When calculating a company's social and environmental impact, we can determine whether the company is operating within social and planetary boundaries. This in turn determines whether a company can retain its licence to operate. In sustainability

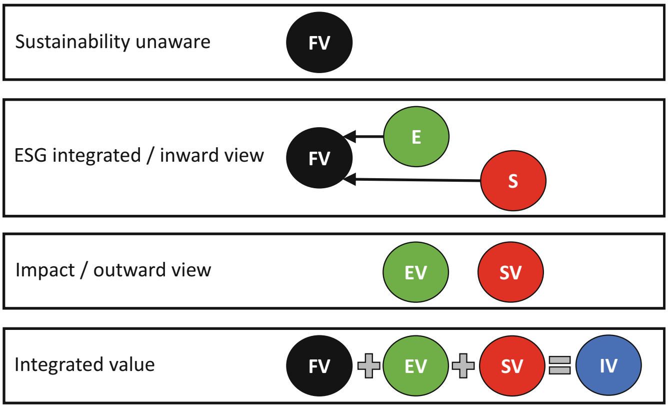


Fig. 3 Value dimension

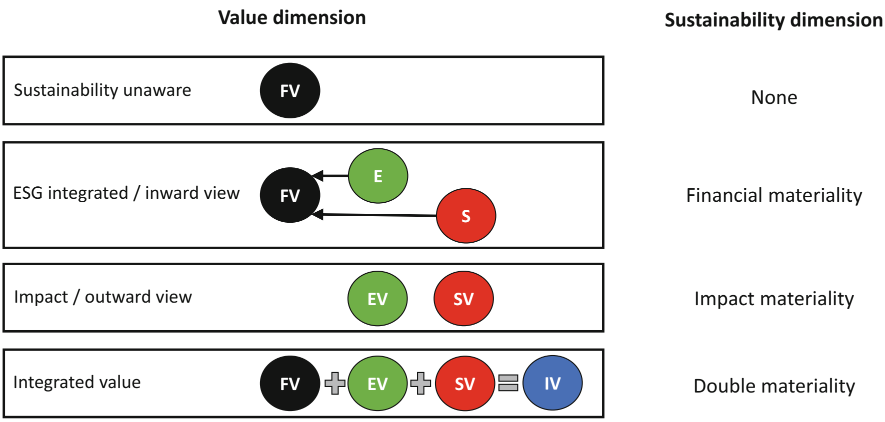


Fig. 4 Value and sustainability dimensions

terms, this dimension is called the impact materiality of sustainability (see Fig. 4) and this is the other side of the coin in double materiality.

When applying double materiality, you may wonder: are we not double counting the effect of social and environmental factors? In fact, we're not. The first step of ESG integration measures the effect of social and environmental issues on financial value. For example, if governments impose a carbon tax of €80 per tonne of CO_2, financial value will be reduced due to carbon taxation. The second step of impact measures the effect of carbon emissions on environmental value, which remains negative as long as the negative impact in the form of carbon emissions continues. Of course, the carbon tax incentivises the company to change its behaviour and switch to low-carbon or carbon-neutral technologies. The resulting reduction in carbon emissions would in turn improve environmental value and likely financial value as well.

The final step is to integrate the financial, social, and environmental value dimensions, which yields the integrated value. This book argues that the CFO should steer the company according to integrated value rather than financial value. In sustainability terms, integrated value is called double materiality (both financial and impact materiality) in Fig. 4.

Experienced finance professionals could skip the first sections of most chapters if they are already familiar with the standard finance approach. Other experienced readers might choose to read selected chapters based on their needs.

For less experienced readers, such as bachelor students of business, finance, and economics or those without any finance background, our advice is to read the book in its order of presentation.

Contents

Part V Corporate Financial Policies

About the Authors

Dirk Schoenmaker is a Professor of Banking and Finance at Rotterdam School of Management, Erasmus University, and Director of the Erasmus Platform for Sustainable Value Creation. He is a Research Fellow at CEPR and leads CEPR's Research and Policy Network on Sustainable Finance. His research covers the fields of sustainable finance, central banking, financial supervision, and European banking.

Before joining RSM, Dirk worked at the Bank of England and the Dutch Ministry of Finance. He obtained his master's degrees in economics and law at Erasmus University Rotterdam and his PhD in finance at the London School of Economics. Dirk is co-author of two textbooks *Principles of Sustainable Finance* (OUP) and *Financial Markets and Institutions: A European Perspective* (CUP) and single author of *Governance of International Banking: The Financial Trilemma* (OUP).

Willem Schramade is Head of Sustainability Client Advisory at Schroders, Professor of Finance at Nyenrode Business University, and Fellow of the Erasmus Platform for Sustainable Value Creation at Rotterdam School of Management, Erasmus University.

Before joining Schroders, Willem worked as an independent consultant, advising financial institutions and corporations on sustainable finance. Previously, he worked as a portfolio manager for listed impact equities at NN Investment Partners, and he held positions at Robeco, General Electric, PwC and Erasmus University, where he obtained his PhD in finance in 2006. Willem publishes about sustainable finance in scientific journals and teaches sustainable finance at Nyenrode Business University and Erasmus University. His academic textbook *Principles of Sustainable Finance* (co-authored with Dirk Schoenmaker) was published by Oxford University Press in 2019.

Abbreviations

Value

BV	Book value
EPV	Enterprise value
EV	Environmental value
FV	Financial value
IV	Integrated value
MV	Market value
PV	Present value
SV	Social value
TV	Terminal value
V	Value

Capital

FC	Financial capital
HC	Human capital
IC	Intellectual capital
MC	Manufactured capital
NC	Natural capital
SC	Social capital

Discount Rates

r_D	Debt cost of capital
r_E	Equity cost of capital
r^{EV}	Cost of environmental capital (social discount rate)
r_f	Risk-free rate
r^{FV}	Cost of financial capital (financial discount rate)
r_i	Cost of capital for company *i*
r^{IV}	Cost of integrated capital
r^s	Social discount rate
r^{SV}	Cost of social capital (social discount rate)
WACC	Weighted average cost of capital

Valuation

A	Assets
CF	Cash flow
CPN	Coupon
D	Debt
DCF	Discounted cash flow model
E	Equity
EPS	Earnings per share
FCF	Free cash flow
FV	Face value (in the case of bonds)
MP	Market price
P	Price of security (e.g. stock price or bond price)
P/E	Price-earnings ratio
SP	Shadow price
TA	Total assets
VF	Value flow
y	Yield
YTM	Yield to maturity

Investment Criteria

APV	Adjusted present value
IPV	Integrated present value
IRR	Internal rate of return
NPV	Net present value

Risk

β_i	Beta of company *i*
σ	Volatility
APT	Arbitrage pricing theory
CAPM	Capital asset pricing model
CRP	Credit risk premium
LGD	Loss given default
PD	Probability of default
PT	Probability of transition
RP_{EF}	Environmental risk premium
RP_{MKT}	Market risk premium
RP_{SF}	Social risk premium

Finance Terms

AMH	Adaptive markets hypothesis
CAPEX	Capital expenditures
EBIT	Earnings before interest and taxes
EBITDA	Earnings before interest, taxes, depreciation, and amortisation
EMH	Efficient markets hypothesis

M&A	Merger & acquisitions
NOPLAT	Net operating profit less adjusted taxes
NWC	Net working capital
ROA	Return on assets
ROE	Return on equity

Reporting

ESRS	European Sustainability Reporting Standards
FASB	Financial Accounting Standards Board
IASB	International Accounting Standards Board
IFRS	International Financial Reporting Standards
IP&L	Integrated Profit & Loss Account
ISSB	International Sustainability Standards Board
IWAF	Impact-Weighted Accounts Framework
P&L	Profit & Loss Account
VBA	Value Balancing Alliance

Options

C	Call option
P	Put option
S	Strike price

Part I

Why Corporate Finance for Long-Term Value?

1 The Company within Social and Planetary Boundaries

Overview

Society faces multiple sustainability challenges. On the environmental front, climate change, land-use change, biodiversity loss, freshwater shortages, and depletion of natural resources are destabilising the Earth system. On the social side, many people are afflicted by poverty, hunger, and lack of healthcare. *Sustainability* means that current and future generations have the resources needed, such as food, water, healthcare, and energy, without stressing the Earth system processes. The United Nations' Sustainable Development Goals (SDGs) are a guide for the transition towards a sustainable and inclusive economy.

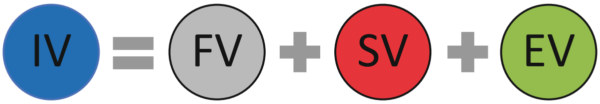
Companies play an important role in that transition to a sustainable economy because social and environmental impacts are generated primarily in the corporate sector. Some companies will survive the transition by providing valuable solutions; others will not, as their competitive positions are eroded. Sustainability is therefore also about corporate survival. Responsible companies are increasingly adopting the goal of integrated value creation, which unites financial, social, and environmental value.

This raises the fundamental question in corporate finance: what is the objective of the company? The traditional objective is maximising profit, which boils down to maximising financial value for shareholders. This does not incentivise companies to act in a sustainable manner. An alternative view is to broaden the objective of the company to optimising integrated value (IV), which combines financial value (FV), social value (SV), and environmental value (EV). Figure 1.1 depicts the new paradigm of integrated value. In that way, the interests of current and future stakeholders are equal and aligned with sustainable development. Applying this new paradigm of integrated value is the real innovation of this corporate finance textbook.

This integrated approach to value has profound implications for corporate finance. It challenges conventional thinking and practices regarding various aspects of financial decision-making, including corporate investments, valuation, and capital structure.

D. Schoenmaker, W. Schramade, *Corporate Finance for Long-Term Value*, Springer Texts in Business and Economics, https://doi.org/10.1007/978-3-031-35009-2_1

Fig. 1.1 Integrated value



Learning Objectives
After you have studied this chapter, you should be able to:

- Analyse the planet's social and environmental challenges
- Identify and interpret the United Nations Sustainable Development Goals
- Define the transition towards a sustainable world
- Critically review the objective of the company
- Demonstrate the concept of integrated value
- Identify the challenges of incorporating sustainability into corporate finance

1.1 Social and Planetary Boundaries in a Full World

Our economic models were developed in an empty world, with an abundance of goods and services produced by nature (Daly & Farley, 2011). These models assumed that labour and capital were the scarce production factors to optimise in economic production, while nature and its services were freely available. Human society became dependent on fossil fuels and other non-renewable resources. Technological advances allowed the unprecedented production of consumer goods, spurring economic and population growth. Urbanisation led to a reduction in arable land, driving further deforestation.

More recently, we have started to realise that natural resources are finite. In the early 1970s, the Club of Rome warned that the Earth system cannot support our rates of economic and population growth much beyond 2100. Its report *Limits to Growth* argues that humankind can create a society in which it lives indefinitely on earth. This requires a balance between population and production, for which humankind needs to impose limits on its production of material goods (Meadows et al., 1972).

Another step in awareness was the United Nations' (UN) Brundtland Report (1987), which argues that '...the *environment* is where we live; and *development* is what we all do in attempting to improve our lot within that environment. The two are inseparable'. The report defines *sustainable development as 'development that meets the needs of the present without compromising the ability of future generations to meet their own needs'*. The Brundtland report stresses that sustainability is about the future.

Climate change is one of the largest environmental risks affecting society. The United Nations Framework Convention on Climate Change (UNFCCC) is an international environmental treaty. Since 1995, it has been organising Conferences of the Parties (COP) to assess progress in dealing with climate change. In the 2015 Paris Agreement on climate change (COP21), countries reconfirmed the target of limiting the rise in global average temperatures relative to those in the preindustrial world to 2 °C (two degrees Celsius) and to pursue efforts to limit the temperature increase to 1.5 °C (UNFCCC, 2015). Achieving this would ensure that the stock of carbon dioxide (CO_2) and other greenhouse gases in the atmosphere does not exceed a certain limit. The Intergovernmental Panel on Climate Change (2023) estimates that the remaining carbon budget amounts to 1150 gigatonnes of CO_2 from 2020 onwards (for a probability of 67% for limiting global warming to 2 °C). If current global carbon emissions (approximately 40 gigatonnes a year) are not drastically cut, the 2 °C limit would be reached around the year 2048.[1]

The most pressing environmental and social challenges include climate risk, land-system change, biodiversity loss, green water, nitrogen and phosphorus flows, poverty, food, and health problems. Our economic system creates these environmental and social impacts on society; they are inseparable from production decisions. To highlight the tension between unbridled economic growth and sustainable development, we provide two examples. Box 1.1 describes the Deepwater Horizon oil spill. Box 1.2 illustrates the impact of the collapse of a factory building in Bangladesh. Both examples involve an underinvestment in safety to increase short-term profits.

Box 1.1: The Deepwater Horizon Oil Spill

Oil began to spill from the Deepwater Horizon drilling platform on 20 April 2010, in the BP-operated Macondo Prospect in the Gulf of Mexico. An explosion on the drilling rig led to the largest accidental marine oil spill in the history of the petroleum industry. The US Government estimated the total discharge at 4.9 million barrels.

A massive response ensued to protect beaches, wetlands, and estuaries from the spreading oil. Oil clean-up crews worked on 55 miles of the Louisiana shoreline until 2013. The months-long spill caused extensive damage to marine and wildlife habitats and the fishing and tourism industries.

Investigation pointed to defective cement on the well, laying the fault mostly with BP, but also with rig operator Transocean and contractor Halliburton. In 2011, a National Commission (2011) likewise blamed BP and its partners for a series of cost-cutting decisions and an inadequate safety system; it also concluded that the spill resulted from *'systemic'* root causes and that without *'significant reform in both industry practices and government policies, might well recur'*.

[1]The carbon budget for the more stringent 1.5 °C limit is 500 gigatonnes of CO_2 from 2020 onwards. That would be reached around the year 2032.

Box 1.2: Rana Plaza Factory Collapse

The Rana Plaza collapse was a disastrous structural failure of an eight-storey commercial building on 24 April 2013 in Bangladesh. The collapse of the building caused 1129 deaths, while approximately 2500 injured people were rescued alive from the building. It is considered the deadliest garment factory accident in history and the deadliest accidental structural failure in modern human history.

The building contained clothing factories, a bank, apartments, and several shops. The shops and the bank on the lower floors were immediately closed after cracks were discovered in the building. The building's owners ignored warnings to evacuate the building after cracks in the structure appeared the day before the collapse. Garment workers, earning €38 a month, were ordered to return the following day, and the building collapsed during the morning rush-hour.

The factories manufactured clothing for brands including Benetton, Bonmarché, the Children's Place, El Corte Inglés, Joe Fresh, Monsoon Accessorize, Mango, Matalan, Primark, and Walmart.

1.1.1 Planetary Boundaries

There can be no Plan B, because there is no Planet B.
Former United Nations Secretary-General, Ban Ki-moon

There is increasing evidence that human activities are affecting the Earth system, threatening the planet's future liveability. The planetary boundaries framework of Steffen et al. (2015) defines a safe operating space for humanity within the boundaries of nine productive ecological capacities of the planet. The framework is based on the intrinsic biophysical processes that regulate the stability of the Earth system on a planetary scale. The green zone in Fig. 1.2 is the safe operating space; orange represents the zone of uncertainty (increasing risk) and red (dark orange) indicates the zone of high risk. Table 1.1 specifies the control variables and quantifies the ecological ceilings.

Applying the *precautionary principle*, the *planetary boundary* itself lies at the intersection of the green and orange zones. To illustrate how the framework works, we look at the control variable for climate change, the atmospheric concentration of greenhouse gases. The zone of uncertainty ranges from 350 to 450 parts per million (ppm) of carbon dioxide. We crossed the planetary boundary of 350 ppm in 1988, with a level of 420 ppm in early 2023 (see Table 1.1). The upper limit of 450 ppm is consistent with the goal (at a fair chance of 67%) to limit global warming to 2 °C above the preindustrial level and lies at the intersection of the orange and red zones.

Another example in the orange zone of increasing risk is land-system change. The control variable is the area of forested land as a proportion of forest-covered land

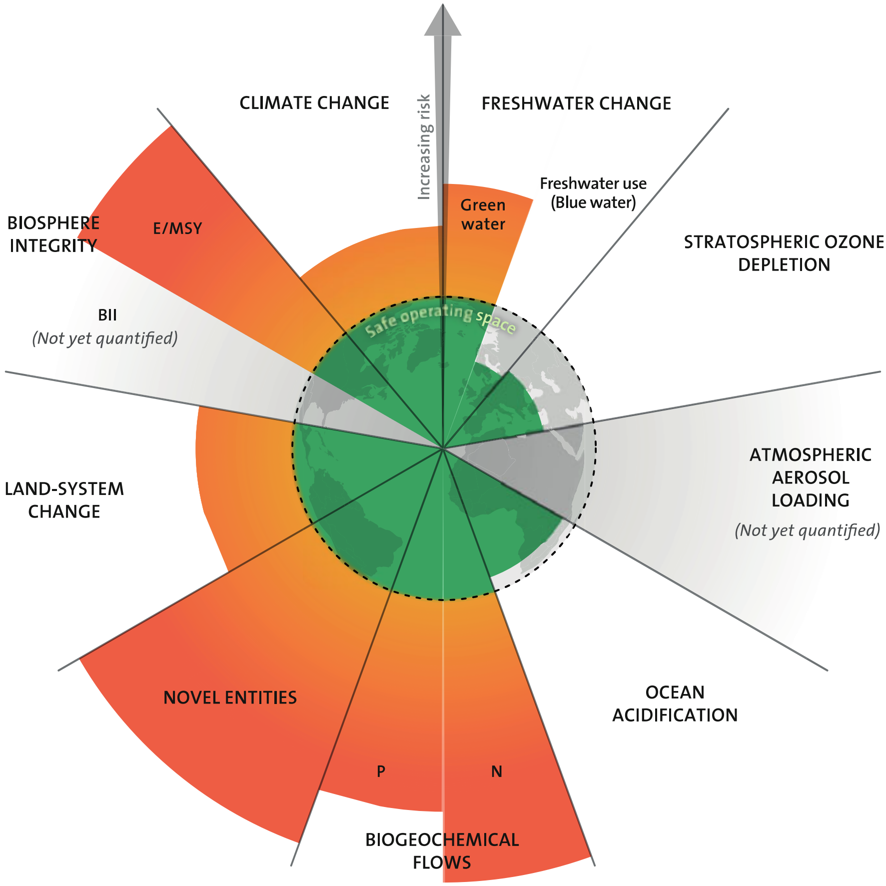


Fig. 1.2 The planetary boundaries. Source: Azote for Stockholm Resilience Centre, based on analysis in Persson et al. (2022), Steffen et al. (2015), and Wang-Erlandsson et al. (2022)

prior to human alteration. The planetary boundary is at 75% (safe minimum), while we are currently at 62%, and the percentage is falling (worsening).

The current *linear production and consumption system* is based on the extraction of raw materials (take), processing them into products (make), consumption (use), and disposal (waste). Traditional business models centred on a linear system assume the on-going availability of unlimited and cheap natural resources. This is increasingly risky because non-renewable resources, such as fossil fuels, minerals, and metals, are increasingly under pressure, while potentially renewable resources, such as forests, rivers, and prairies, are declining in their extent and regenerative capacity.

Moreover, the use of fossil fuels in the linear production and consumption system overburdens the Earth system as a natural sink (absorbing pollution). Baseline scenarios (i.e., those without mitigation) for climate change result in global warming in 2100 at approximately 3.0 °C compared to the preindustrial level (Intergovernmental Panel on Climate Change, 2023). Furthermore, food production leads to

Table 1.1 The ecological ceiling and its indicators of overshoot

Earth system pressure	Control variable	Planetary boundary	Current value and trend
Climate change	Atmospheric carbon dioxide concentration; parts per million (ppm)	At most 350 ppm	420 ppm and rising (worsening)
Biosphere loss	Genetic diversity: rate of species extinction per million species per year	At most 10	Around 100–1000 and rising (worsening)
	Functional diversity: biodiversity intactness index (BII)	Maintain BII at 90%	84% applied to southern Africa only
Land-system change	Area of forested land as a proportion of forest-covered land prior to human alteration	At least 75%	62% and falling (worsening)
Freshwater change	Green water: percentage of ice-free land area on which root-zone soil moisture is too low (or too high)	–	–
	Blue water consumption; cubic kilometres per year	At most 4000 km^3	Around 2600 km^3 and rising (intensifying)
Biochemical flows	Phosphorus applied to land as fertiliser; millions of tons per year	At most 6.2 million tons	Around 14 million tons and rising (worsening)
	Reactive nitrogen applied to land as fertiliser; millions of tons per year	At most 62 million tons	Around 150 million tons and rising (worsening)
Ocean acidification	Average saturation of aragonite (calcium carbonate) at the ocean surface, as a percentage of preindustrial levels	At least 80%	Around 84% and falling (intensifying)
Air pollution	Aerosol optical depth (AOD); much regional variation, no global level yet defined	–	–
Ozone layer depletion	Concentration of ozone in the stratosphere; in Dobson Units (DU)	At least 275 DU	283 DU and rising (improving)
Novel entities	Production volume of plastics	–	–
	Production volume of hazardous chemicals	–	–

Source: Updated from Persson et al. (2022), Steffen et al. (2015), and Wang-Erlandsson et al. (2022)

biodiversity loss because of the conversion of natural forests to agriculture (land-system change).

With this linear economic system, we are crossing planetary boundaries beyond which human activities might destabilise the Earth system. In particular, the planetary boundaries of climate change, land-system change (deforestation and land erosion), biodiversity loss (terrestrial and marine), green water (needed for vegetation), novel entities (plastics and chemicals), and biochemical flows (nitrogen and phosphorus, mainly because of intensive agricultural practices) have been crossed (see Fig. 1.2). A timely transition towards an economy based on sustainable production and consumption, including the use of renewable energy, reuse of materials and land restoration, can mitigate these risks to the stability of the Earth system.

1.1.2 Social Foundations

Mass production in a competitive economic system has led to long working hours, underpayment, and child labour, first in the developed world and later relocated to the developing world. Human rights provide the essential social foundation for all people to lead lives of dignity and opportunity. Human rights norms assert the fundamental moral claim each person has to life's essential needs, such as food, water, healthcare, education, freedom of expression, political participation, and personal security. Raworth (2017) defines the *social foundations* as the twelve top social priorities, grouped into three clusters, focused on enabling people to be:

1. Well: through food security, adequate income, improved water and sanitation, housing and healthcare
2. Productive: through education, decent work, and modern energy services
3. Empowered: through networks, gender equality, social equity, political voice, and peace and justice

While these social foundations only set out the minimum of every human's claims, sustainable development envisions people and communities prospering beyond this, leading lives of creativity and thriving. Sustainable development combines the concept of planetary boundaries with the complementary concept of social foundations or boundaries (Sachs, 2015). *Sustainability* means that current and future generations have the resources needed, such as food, water, healthcare and energy, without stressing processes within the Earth system.

Many people are still living below the foundational social boundaries of no hunger, no poverty (a minimum income of $2.15 a day), access to education and access to clean cooking facilities (see Table 1.2). Political participation, which is the right of people to be involved in decisions that affect them, is a basic value of society. The UN's Universal Declaration of Human Rights states that *'recognition of the inherent dignity and of the equal and inalienable rights of all members of the human family is the foundation of freedom, justice and peace in the world'*. Decent work can lift communities out of poverty and underpins human security and social peace. The 2030 Agenda for Sustainable Development (see Sect. 1.2 below) places decent work for all people at the heart of policies for sustainable and inclusive growth and development. Decent work has several dimensions: a basic living wage (which depends on a country's basket of basic goods), no discrimination (e.g. gender, race, or religion), no child labour, health and safety, and freedom of association.

From a societal perspective, it is important for business to respect these social foundations and to ban underpayment, child labour, and human rights violations.

Table 1.2 The social foundation and its indicators of shortfall

Dimension	Illustrative indicator (per cent of global population unless otherwise stated)	%	Year
Food	Population undernourished	11	2014–16
Health	Population living in countries with under-five mortality rate exceeding 25 per 1000 live births	46	2015
	Population living in countries with life expectancy at birth of less than 70 years	39	2013
Education	Adult population (aged 15+) who are illiterate	15	2013
	Children aged 12–15 out of school	17	2013
Income and work	Population living on less than the international poverty limit of $2.15 a day	29	2012
	Proportion of young people (aged 15–24) seeking but not able to find work	13	2014
Water and sanitation	Population without access to improved drinking water	9	2015
	Population without access to improved sanitation	32	2015
Energy	Population lacking access to electricity	17	2013
	Population lacking access to clean cooking facilities	38	2013
Networks	Population stating that they are without someone to count on for help in times of trouble	24	2015
	Population without access to the Internet	57	2015
Housing	Global urban population living in slum housing in developing countries	24	2012
Gender equality	Representation gap between women and men in national parliaments	56	2014
	Worldwide earnings gap between women and men	23	2009
Social equity	Population living in countries with a Palma ratio of 2 or more (the ratio of the income share of the top 10% of people to that of the bottom 40%)	39	1995–2012
Political voice	Population living in countries scoring 0.5 or less out of the 1.0 in the Voice and Accountability Index	52	2013
Peace and justice	Population living in countries scoring 50 or less out of 100 in the Corruption Perceptions Index	85	2014
	Population living in countries with a homicide rate of 10 or more per 10,000	13	2008–13

Source: Updated from Raworth (2017) and World Bank

Social regulations have been introduced in developed countries, but violations still occur in developing countries. A case in point is the use of child labour in factories in developing countries producing consumer goods, such as clothes and shoes, to be sold by multinational companies in developed countries. These factories often lack basic worker safety features (Box 1.2). Another example is the violation of the human rights of indigenous peoples, often in combination with land degradation and pollution, by extractive companies in the exploration and exploitation of fossil fuels, minerals, and other raw materials.

1.2 Sustainable Development Goals

To guide the transition towards a sustainable and inclusive economy, the United Nations has developed the 2030 Agenda for Sustainable Development (UN, 2015). This includes the 17 UN Sustainable Development Goals (SDGs), which aim to stimulate action over the period of 2015–2030 in areas of critical importance for humanity and the planet. Box 1.3 explains the SDGs.

Box 1.3: The Sustainable Development Goals

The following are the 17 UN Sustainable Development Goals (UN, 2015):

Economic Goals

- Goal 8. Promote sustained, inclusive, and sustainable economic growth, full and productive employment and decent work for all
- Goal 9. Build resilient infrastructure, promote inclusive and sustainable industrialisation, and foster innovation
- Goal 10. Reduce inequality within and among countries
- Goal 12. Ensure sustainable consumption and production patterns

Societal Goals

- Goal 1. End poverty in all its forms everywhere
- Goal 2. End hunger, achieve food security and improved nutrition, and promote sustainable agriculture
- Goal 3. Ensure healthy lives and promote well-being for all at all ages
- Goal 4. Ensure inclusive and equitable quality education and promote lifelong learning opportunities for all
- Goal 5. Achieve gender equality and empower all women and girls
- Goal 7. Ensure access to affordable, reliable, sustainable, and modern energy for all
- Goal 11. Make cities and human settlements inclusive, safe, resilient, and sustainable
- Goal 16. Promote peaceful and inclusive societies for sustainable development, provide access to justice for all and build effective, accountable, and inclusive institutions at all levels

Environmental Goals

- Goal 6. Ensure availability and sustainable management of water and sanitation for all
- Goal 13. Take urgent action to combat climate change and its impacts

(continued)

Box 1.3 (continued)

- Goal 14. Conserve and sustainably use the oceans, seas, and marine resources for sustainable development
- Goal 15. Protect, restore, and promote sustainable use of terrestrial ecosystems, sustainably manage forests, combat desertification, halt and reverse land degradation and halt biodiversity loss

Overall Goal

- Goal 17. Strengthen the means of implementation and revitalise the Global Partnership for Sustainable Development

To facilitate implementation, the 17 high-level goals are specified in 169 targets (see https://sustainabledevelopment.un.org/topics/sustainabledevelopmentgoals).

Following Rockström and Sukhdev (2016), we classify the SDGs according to several levels: the economy, society, and environment (Fig. 1.3). Nevertheless, we stress that the SDGs are interrelated. A case in point is the move to sustainable consumption and production (Economic Goal 12) and sustainable cities (Societal Goal 11), which are instrumental to combat climate change (Environmental Goal 13). Another example is appropriate income and decent work for all (Economic Goal 8), which is instrumental in attaining Societal Goals 1–4. Through a living wage, households can afford food, healthcare, and education for their family.

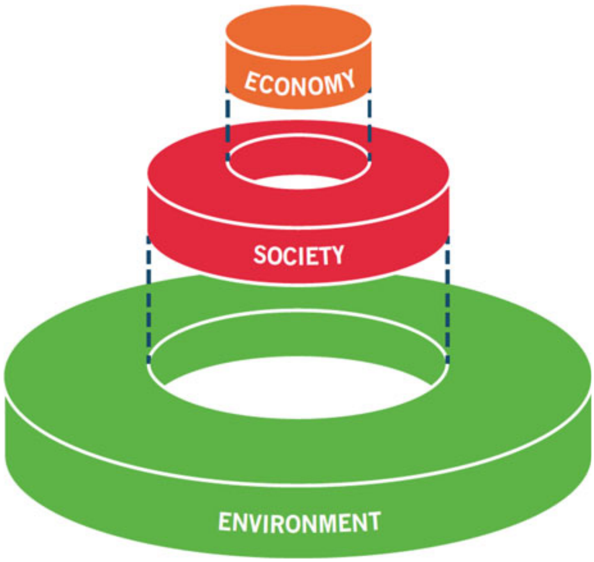


Fig. 1.3 Sustainable development challenges at different levels. Source: Adapted from Rockström and Sukhdev (2016)

1.2.1 Global Strategy

The UN SDGs are the global strategy of governments under the auspices of the United Nations and provide direction towards (future) government policies, such as the regulation and taxation of environmental and social challenges. This strategy is boosted by technological change (e.g. the development of solar and wind energy and electric cars at decreasing cost or the development of drip irrigation systems), which supplements government policies (e.g. carbon pricing or water pricing). Some companies are preparing for this transition (future makers) and are part of the solution (Mercer, 2015). Other companies are waiting for the transition to unfold before acting (future takers). A final category of companies is unaware of this transition and continues business as usual.

We, as authors, attach a positive probability to the scenario that the SDGs are largely met. Our observation is based on the success of the earlier Millennium Development Goals in reducing poverty, hunger, and child death rates in Southeast Asia and Latin America but less so in Africa. Of course, opinions can, and do, differ about the probability that the transition towards a sustainable economy will largely succeed. However, the 'business-as-usual' scenario, which assumes no transition, is highly implausible. While the pathway and the speed of the transition are uncertain and may even be erratic, with failures along the way, the sustainable development agenda gives direction to thinking about the future. This book is about the role corporate finance can play in shaping this future and making production and consumption more sustainable via future-proof investment decisions.

The UN SDGs address challenges at the level of the economy, society, and the environment (or biosphere). Figure 1.3 illustrates the three levels and the ranking between them. A liveable planet is a precondition or foundation for humankind to thrive. A cohesive and inclusive society is needed to organise production and consumption to ensure enduring prosperity for all. In their seminal book *Why nations fail*, Acemoglu and Robinson (2012) show that political institutions that promote inclusiveness generate prosperity. Inclusiveness allows everyone to participate in economic opportunities. Reducing social inequalities (SDG 10) is thus an important goal. Of course, there can be resource conflicts: unequal communities may disagree over how to share and finance public goods. These conflicts, in turn, break social ties and undermine the formation of trust and social cohesion (Barone & Mocetti, 2016; Berger, 2018).

1.2.2 System Perspective

While it is tempting to start working on partial solutions at each level, the environmental, societal, and economic challenges are interlinked. It is important to embrace an integrated social-ecological system perspective (Norström et al., 2014). Such an integrated system perspective highlights the dynamics that such systems entail, including the role of ecosystems in sustaining human well-being, cross-system interactions, and uncertain thresholds.

Holling (2001) describes the process of sustainable development as embedded cycles with adaptive capacity. A key element of adaptive capacity is the *resilience* of the system to deal with unpredictable shocks (which is the opposite of the vulnerability of the system). Complex systems feature adaptive cycles that aggregate resources and periodically restructure to create opportunities for innovation. However, some systems are maladaptive and trigger, for example, a poverty trap or land degradation (i.e., the undermining of the quality of soil as a result of human behaviour or severe weather conditions). Holling (2001) concludes that ecosystem management via incremental increases in efficiency does not work. For transformation, ecosystem system management must build and maintain ecological resilience as well as social flexibility to cope, innovate, and adapt.

1.2.2.1 Examples of Cross-system Interactions and Uncertain Thresholds

A well-known example of cross-system interaction is the linear production of consumption goods at the lowest cost contributing to 'economic growth' while depleting natural resources, using child labour and producing carbon emissions and other waste. In this book, we use carbon emissions as a shorthand for all greenhouse gas emissions, which include carbon dioxide CO_2, methane CH_4, and nitrous oxide N_2O.

Another example of cross-system interaction is climate change leading to increasingly intense weather-related disasters, such as storms, flooding, and droughts. The low- and middle-income countries around the equator are especially vulnerable to these extreme weather events, which could damage a large part of their production capacity. The temporary loss of tax revenues and increase in expenditure to reconstruct factories and infrastructure might put vulnerable countries into a downwards fiscal and macroeconomic spiral with an analogous increase in poverty. Social and ecological issues are thus interconnected, whereby the poor in society are more dependent on ecological services and are less protected against ecological hazards.

An example of an uncertain threshold combined with feedback dynamics is the melting of the Greenland ice sheet. New research has found that it is more vulnerable to global warming than previously thought. Robinson et al. (2012) calculate that a 0.9 °C increase in global temperature from today's levels could lead the Greenland ice sheet to melt completely. Such melting would create further climate feedback in the Earth's ecosystem because melting the polar icecaps could increase the pace of global warming (by reducing the refraction of solar radiation, which is 80% from ice, compared with 30% from bare earth and 7% from the sea) as well as rising sea levels. These feedback mechanisms are examples of tipping points and shocks, which might happen.

Another example of cross-system interaction between several planetary boundaries is biodiversity loss. Box 1.4 shows the direct drivers of biodiversity loss.

Box 1.4: Direct Drivers of Biodiversity Loss

There are five direct drivers of biodiversity loss:

1. **Climate change**, where a change in climate destabilises ecosystems
2. **Invasive species**, where animals or plants have been moved to places where they damage existing ecosystems, e.g., Japanese knotweed
3. **Land-use change**, such as cutting down a forest to make way for agriculture
4. **Overexploitation of natural resources**, where a resource is used up faster than it can be replaced, e.g., overfishing
5. **Pollution of air, land, or water**, such as overuse of fertiliser containing phosphorus and nitrogen

Source: CISL (2021).

We cannot understand the sustainability of organisations in isolation from the socioecological system in which they are embedded: what are the thresholds, sustainability priorities, and feedback loops? Moreover, we should consider not only the socioecological impact of individual organisations but also the aggregate impact of organisations at the system level. The latter is relevant for sustainable development.

1.3 The Objective of the Company

To discuss the role of companies in sustainability, we first need to establish the objective of the company. The classical shareholder model in corporate finance argues that companies should maximise *shareholder value* (Jensen, 2002). In contrast, the stakeholder model argues that large companies should act in the interests of financial as well as social stakeholders and optimise *stakeholder value* (Magill et al., 2015). The integrated model states that companies should optimise *integrated value*, which combines financial, social, and environmental value (Schoenmaker & Schramade, 2019). The choice of the value maximisation function has consequences for decision-making on corporate investment.

To classify the different corporate finance models, Fig. 1.4 shows our framework for managing sustainable development. At the level of the economy, the financial return and risk trade-off is optimised. This financial orientation supports the idea of profit maximisation by companies. Next, at the societal level, the impact of investment and business decisions on society is optimised. Finally, at the level of the environment, the environmental impact is optimised. As we have argued in Sect. 1.2, there are interactions between the levels. It is thus important to choose an appropriate combination of the financial, social, and environmental aspects.

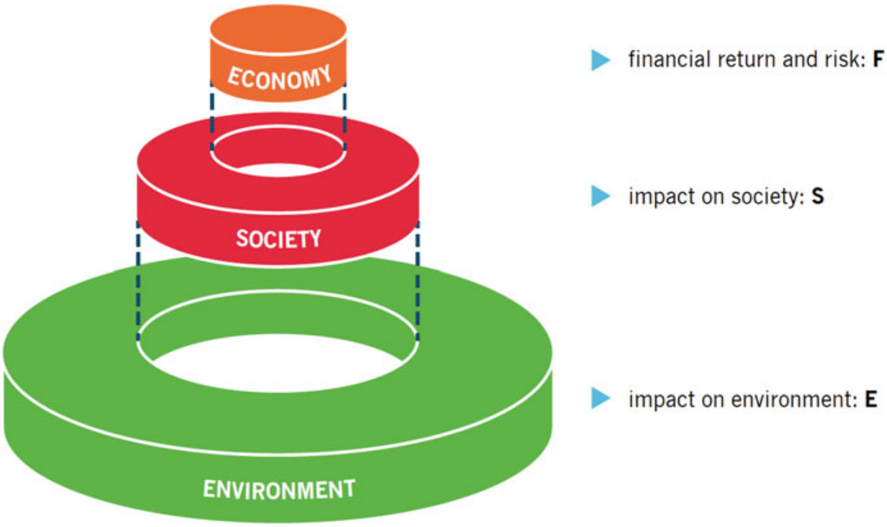


Fig. 1.4 Managing sustainable development. Source: Adapted from Schoenmaker and Schramade (2019)

Table 1.3 Corporate finance models

Corporate finance models	Value created	Main stakeholders	Ranking of factors	Optimisation of value V
Shareholder model	Shareholder value	Shareholders	FV	Max V = FV
Refined shareholder model	Shareholder value	Shareholders	FV SV & EV to extent they affect FV	Max V = FV + b·SV + c·EV $0 < b, c \ll 1$
Stakeholder model	Stakeholder value	Current stakeholders	STV = FV + SV	Max V = FV + b·SV $b = 1$
Integrated model	Integrated value	Current and future stakeholders	IV = FV + SV + EV	Max V = FV + b·SV + c·EV $b, c = 1$

Note: V, value; FV, financial value; SV, social value; EV, environmental value; STV, stakeholder value; IV, integrated value. In the refined shareholder model, SV and EV are relevant to the extent to which they affect FV

Source: Adapted from Schoenmaker and Schramade (2019)

Corporate finance has not yet caught up with the broader notion of business sustainability over the last decades. Table 1.3 shows the corporate finance models across four aspects:

(i) The value created
(ii) The main stakeholders

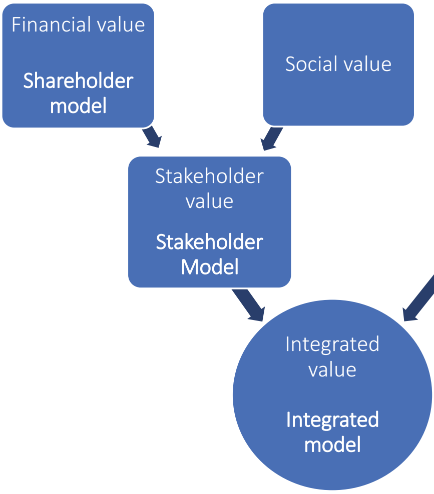


Fig. 1.5 Stages of corporate finance

(iii) The ranking of the three factors and
(iv) The optimisation method

Figure 1.5 highlights the broadening of corporate finance from *shareholder value* to *stakeholder value* and finally *integrated value*. The four stages of corporate finance in Table 1.3 are discussed one after another below. Figure 1.5 shows that the stages move from financial value to financial and social values combined and finally to financial, social, and environmental values equally (the ranking of factors in the fourth column of Table 1.3).

1.3.1 The Shareholder Model

In traditional corporate finance, the goal of the company is to maximise its financial value (Berk & DeMarzo, 2017; Brealey et al., 2020). This is the value of the securities (i.e. stocks and bonds) provided by the financiers (i.e. shareholders and creditors). Shareholders are deemed most important because they are residual, noncontractual claimants. They are paid after all contractual claims to other stakeholders, such as creditors, employees, customers, and government, are paid. Shareholders maximise financial value FV after the other stakeholders are satisfied. The formula for company value FV_0 at $t = 0$ is as follows:

$$FV_0 = \frac{CF_1}{(1+r)} + \frac{CF_2}{(1+r)^2} + \ldots + \frac{CF_N}{(1+r)^N} \tag{1.1}$$

where r is the discount rate used to determine the present value at $t = 0$ of a future cash flow CF_t. Future cash flows are discounted from $t = 1$ to N. The cash flows are those left to be distributed to financiers after all investments have been made. It is calculated as cash from operations minus cash into investments.

Corporate finance theory separates finance and ethics. Traditional finance is consistent with the argument of Friedman (1970) that '*the business of business is business*'. In this view, it is the task of the government to address social and environmental concerns. It is second nature for corporate managers to think and communicate in NPV terms (based on financial cash flows). This naturally affects the functions of valuation, allocation, and performance measurement in the investment process. It also affects how sustainability is integrated, how valuations are conducted, what investment approaches are favoured, and the role of corporate managers.

Where social and environmental *impacts* are important, a narrow focus on shareholder value can create scope for managers making morally dubious decisions. For example, maximising shareholder value might ex ante (i.e. beforehand) justify cutting costs and accepting the risk of low-probability but very large environmental disasters (see Box 1.1 on The Deepwater Horizon oil spill). Even if such a disaster triggers legal actions that bankrupt the committing company, its shareholders are protected by limited liability and thus lose only the value of their shares. Box 1.5 illustrates the difficulties of enforcing legal standards, as companies control the information flows.

The key question remains how to rank shareholder and other stakeholder interests. Should shareholder interests come first, or should all interests be put on equal footing?

Box 1.5: The Dark Waters of DuPont

Company disasters might be discouraged by exposing directors to personal liability should they occur. But directors usually have liability insurance, which limits their personal exposure. Shapira and Zingales (2017) show how a respected company, like DuPont, willingly caused environmental damage by disposing a toxic chemical used in the making of Teflon in its West Virginia Plant. This case was turned into a legal thriller film called Dark Waters. The harmful pollution was a rational decision: under reasonable probabilities of detection, polluting was ex ante optimal from the company's perspective, albeit a very harmful decision from a societal perspective. Shapira and Zingales (2017) examine why different mechanisms of control, like legal liability, regulation and reputation, can all fail to deter socially harmful behaviour. One common reason for the failures of deterrence mechanisms is that the company controls most of the information and its release.

1.3.2 The Refined Shareholder Model

Although the shareholder model cannot fully satisfy the interests of stakeholders, there are also problems with the stakeholder model (Tirole, 2001). The manager has to serve all interests. Managers may, in that case, choose an objective function that is most closely relevant to their own interests (Jensen, 2002). Stakeholder theory may thus leave managers unaccountable, as optimising several objectives simultaneously is difficult to measure and control.

Jensen (2002) argues that shareholder value maximisation is best achieved in practice by catering to all stakeholders—an approach he calls Enlightened Value Maximisation. This view defends stakeholder interests as a means to the end goal of shareholder value maximisation. However, it fails to resolve the many situations of clear conflict between the interests of shareholders and different stakeholders. It also fails to value impacts that the company may inflict on more distant stakeholders, such as the environment.

Nonetheless, the approach has a single roughly measurable objective, refined shareholder value, while explicitly recognising that good relations with stakeholders can boost firm value by easing contracting costs and facilitating surplus creation. Companies put systems in place for energy and emissions management, sustainable purchasing, IT, building and infrastructure to enhance environmental standards and all kinds of diversity in employment. The underlying objective of these activities remains economic. Although introducing sustainability into business might generate positive side effects for some sustainability aspects, the main purpose is to reduce costs and business risks, to improve reputation and attractiveness for new or existing human talent, to respond to new customer demands and segments, and thereby to increase profits, market positions, competitiveness, and shareholder value in the short term. Business success is still evaluated from a purely economic point of view and remains focused on serving the business itself and its economic goals (Dyllick & Muff, 2016).

The formal objective function of the refined shareholder model is as follows:

$$\max \ V = FV + b \cdot SV + c \cdot EV \qquad \textit{with}\ 0 < b, c \ll 1 \tag{1.2}$$

where SV and EV represent the social and environmental value of the company, respectively. Because companies only consider negative social and environmental impacts to the extent relevant for maximising financial value, the refined shareholder model applies relatively low weights for social and environmental value, b and c.

Examples of such negative impacts are using child labour, unsafe work conditions, and/or pesticides in the production process. Innovations in technology (measurement, information technology, data management) and science (life cycle analyses, social life cycle analyses, environmentally extended input–output analysis, ecological economics) make the quantification and monetisation of social and environmental impacts possible (see Chap. 5 how these can be calculated). Box 1.6 provides an example of the use of pesticides in agriculture.

Box 1.6 Balancing the Negative Impact of Pesticides

An example of negative impact is the use of pesticides in agriculture. On the upside, pesticides combat unwanted insects and thus boost the unhindered growth of crops. This leads to higher profits for the farmer, thus improving *FV*. On the downside, pesticides may pollute the ground water, which now cannot be used for drinking water. This negative impact, measured as negative *EV*, is not reflected in the farmer's income, but can be quantified by applying the local drink water price to the quantity of affected ground water. Alternatively, when the ground water is still used for drinking water, the additional health care costs of the local people and the potential loss of income due to (chronical) illness can be calculated as *SV*. When the calculated negative impact of *EV* or *SV* becomes too large, the farmer should not use pesticides according to the refined shareholder model. The exact cut-off point depends on the weights b and c in Eq. (1.2), but these typically rise when public opinion turns negative on the use of pesticides.

1.3.3 The Stakeholder Model

The stakeholder model argues that managers should balance the interests of all stakeholders, which include financial agents (shareholders and debt holders) as well as social agents (consumers, workers, suppliers). Magill et al. (2015) show that a large firm typically faces endogenous risks that may have a significant impact on the workers it employs and the consumers it serves. These risks generate externalities (or impacts) on these stakeholders, which are not internalised by shareholders. As a result, in competitive equilibrium, there is underinvestment in the prevention of these risks.

Magill et al. (2015) suggest that this underinvestment problem can be alleviated if companies are instructed to maximise the total welfare of their stakeholders rather than shareholder value alone (stakeholder equilibrium). The stakeholder equilibrium can be implemented by introducing new property rights (employee rights and consumer rights) and instructing managers to maximise the stakeholder value of the company (the value of these rights plus the shareholder value).

The formal objective function of the stakeholder model is as follows:

$$\max \; STV = FV + b \cdot SV \qquad with \; b = 1 \tag{1.3}$$

where *STV* represents the stakeholder value of the company. The weight b indicates the importance of social value. In the standard case with $b = 1$, the financial and social value components are equally weighted. This indicates that companies have little scope for increasing value for one stakeholder at the expense of other stakeholders.

Tirole (2001) formulates three problems with serving various stakeholders in the stakeholder model. First, the stakeholder model may reduce pledgeable income (income available for financiers), as cash flows are distributed to various stakeholders. Second, it may lead to a less clear mission and fewer incentives for managers, as they have to serve multiple masters. Third, divided control among multiple stakeholders may lead to deadlock in decision-making.

The first two problems can be addressed by formulating an aggregate measure of value for the various stakeholders. Stakeholder value, defined in Eq. (1.3), provides such an aggregate measure. Another example is integrated value, defined in Eq. (1.4) below. Chapter 3 on corporate governance addresses the third problem of decision-making in a company serving multiple stakeholders.

1.3.4 The Integrated Model

While the stakeholder model incorporates social value alongside financial value into the company's objective, it does not deal with environmental value. Hart and Zingales (2017) argue that social and environmental impacts are not perfectly separable from production decisions. Therefore, companies face a choice in the degree of sustainability in their business model.

Schoenmaker and Schramade (2019) introduce integrated value, which combines financial, social, and environmental value in an integrated way. A *responsible company* maximises this integrated value in the interest of current and future stakeholders by managing and balancing profit (financial value) and impact (social and environmental value). The inclusion of future stakeholders who will face the consequences of (lack of) environmental actions today ensures that environmental impacts are incorporated. While the Hart-Zingales model argues that (prosocial) shareholders decide on corporate policy, the Schoenmaker-Schramade integrated model states that the managing board is accountable to all stakeholders. Chapter 3 addresses decision-making in a multiple stakeholder setting.

A new business language is emerging around 'the integrated value' of the company. Traditional financial reports record assets, liabilities, and profits solely on the basis of financial and manufactured capitals (financial value). Integrated financial reports broaden this range to six capitals by adding human and social capitals (social value), natural capital (environmental value), and intellectual capital (all three values); see Chap. 17 on integrated reporting. These capitals incorporate the social and environmental impacts and are expressed in money. This single language of integrated reporting enables managers to analyse the trade-offs for decision-making.

The concept of integrated value creation means that a company aims to optimise its financial, social, and environmental value in the long term. The optimisation requires a careful balancing of the three dimensions whereby interconnections and trade-offs are analysed, but none should deteriorate in favour of the others. The formal objective function for optimising the integrated value is:

$$\max\ IV = FV + b \cdot SV + c \cdot EV \qquad with\ b, c = 1 \tag{1.4}$$

where *IV* represents the integrated value of the company. In the standard case with b, $c = 1$, the financial, social, and environmental value components are equally weighted. To make Eq. (1.4) operational, corporates need to calculate and balance the three values. Chapter 6 provides decision rules for this multicriteria decision problem. An important premise of these integrated decision rules is that companies cannot just improve *FV* to compensate for negative *SV* and *EV*.

Box 1.7 provides an example of a company that pursues integrated value creation. KPN, a Dutch telecom operator, communicates long-term goals with all stakeholders, including customers, employees, investors, society, and the environment and balances the goals. These goals are published in KPN's annual report. It should be noted that the production and publication of integrated balance sheets and integrated profit & loss accounts (IP&L) is work in progress (see Chap. 17). Standards for the new capitals are emerging, and auditing of the new information has just begun.

Box 1.7: Integrated Value Creation at KPN

Dutch telecom operator KPN could maximise short run return on invested capital (ROIC) by cutting operating costs (e.g. marketing costs for new customers) and capital investments (e.g. large investments in new network technology), which would look great for short-term-minded shareholders. However, it would also effectively kill its business, as ROIC would soon drop sharply as market share and product margins would fall. To restore market share, KPN would have to spend more than the initial costs and investments needed to pursue its long-term strategic goals.

The company therefore manages five goals: shareholders, customers, employees, society, and the environment. It has key performance indicators on all five and reports on each one of them, which should give a much better understanding of long-term value drivers than the old reporting system based on financial indicators did. In particular, the net promoter score (NPS) for customers is found to be very powerful. Figure 1.6 shows the importance of balancing the goals. This balanced approach puts KPN's business on a more solid and less volatile footing.

The integrated model and the sustainable development agenda are connected. By managing financial, social, and environmental resources in an integrated way, companies contribute to sustainable development at the global level. Figure 1.7 illustrates the key goals in both approaches.

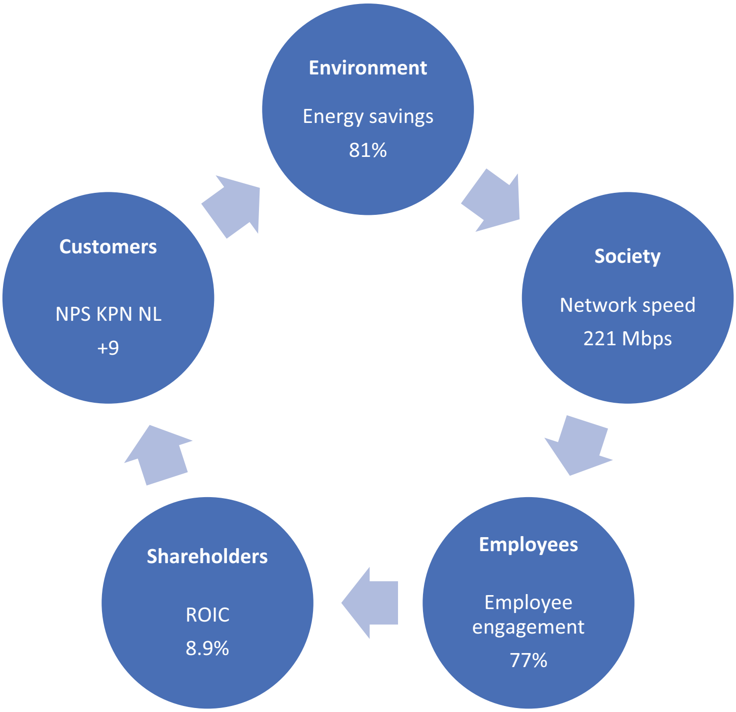


Fig. 1.6 Delivering value for current and future stakeholders. Note: Environment is measured as energy savings by customers; society as download speed of broadband fixed at mega-bits per second (Mbps); employees as employee engagement; shareholders as return on invested capital (ROIC); and customers as net promoter score (NPS). Source: KPN Integrated Annual Report 2018

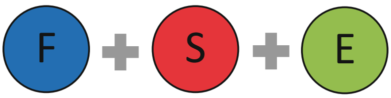


Fig. 1.7 Goal of both the integrated model (company level) and sustainable development (global level)

1.4 Integration of Sustainability into Corporate Finance

An obvious way to deal with social and environmental issues is to put them in our economic models and methods. However, these models treat many of the social and environmental issues as *external impacts* or external effects (externalities), which affect other parties without these effects being reflected in market prices. Neo-classical models employ market prices as relevant signals for decision-making (e.g., investment, financing, production, or consumption decisions) and do not incorporate social and environmental impacts. Governments can use regulation or

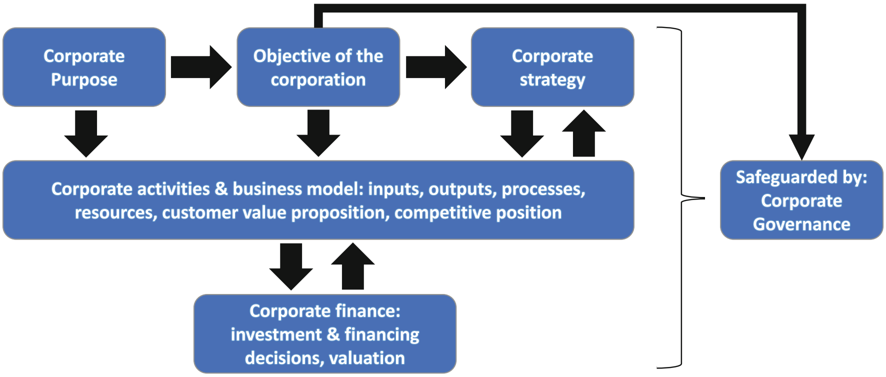


Fig. 1.8 Overview of the company

taxation to price or internalise external impacts. Societal forces can also put pressure on business to internalise social and environmental impacts (see Chap. 2).

Figure 1.8 provides an overview of the company that helps explain the set-up of this book *Corporate Finance for Long-Term Value*. At the top, in the middle, is the objective of the company. The integrated model argues that responsible companies serve the interests of current and future stakeholders. As a company moves from simply maximising financial value (FV) to optimising integrated value (IV), the question arises of what the company wants to achieve and where and how it can achieve most.

What are companies for? According to Friedman (1970), companies exist to maximise profitability, since that is what their owners (shareholders) want. In practice, however, companies are not just run or started for making as much money as possible. They operate in a societal context in which much more is expected from them than just making money. Often, companies are started because their founder identifies a large unmet need, or invented a brilliant technological innovation. For example, the founder of Lever Brothers (now Unilever) wanted to popularise cleanliness and hygiene in 1890s England. Companies exist for a purpose (Chap. 2; and Mayer, 2018). Based on that purpose, the company determines in whose interest it wants to achieve its objective: for shareholders, for current stakeholders, or for current and future stakeholders. Finally, the company sets its strategy and business model to meet societal needs with its products and/or services. Sustainability is an important driver of societal needs.

Disconnects between the owners or shareholders of a company, its managers, and the society in which it operates can and do happen. There is a key role for *corporate governance*, which refers to the mechanisms, relations, and processes by which a company is controlled and directed (Fig. 1.8 on the right; and Chap. 3). It involves balancing the many interests of the stakeholders of a company. Modern insights from corporate governance go beyond financial factors. As corporate ownership varies around the world, so do corporate governance challenges.

The remainder of the book addresses the investment and financing decisions that constitute the core of corporate finance. Its leading paradigm is integrated value, which combines financial, social, and environmental values. Applying this new paradigm is the real innovation of this corporate finance textbook. It uses the same basic methods and concepts, such as net present value, capital budgeting, valuation, and cost of capital, but adapts them to include social and environmental factors. The application of integrated value to these methods is illustrated with company examples throughout the book.

In sum, integrated value is relevant for companies in the following ways:

- Making investment decisions
- Measuring and reporting performance
- Conducting risk management
- Developing incentives
- Taking structural decisions (e.g. capital structure, M&As)

Part II of the book explains the basics of discount rates and investment decision rules. New decision rules based on integrated present value are introduced. Part III sets out the valuation of companies. Part IV addresses risk, return, and impact and derives the cost of integrated capital. Finally, Part V analyses corporate financial policies such as capital structure, payouts, reporting, and mergers and acquisitions in a multiple capital setting.

Applying Long-Term Value in Corporate Finance: Preview of the Book

At the end of this chapter, we show briefly what the expected effect of including social and environmental factors is on long-term value. This is basically a preview of the book.

The core model in corporate finance is the discounted cash flow (DCF) model to determine the value V of a project or a company:

$$V = \sum_{n=0}^{N} \frac{CF_n}{(1+r)^n}$$

whereby CF reflects the cash flows, r the discount rate (also called the cost of capital), and n the number of periods over which cash flows are discounted. The standard DCF model is used to calculate financial value FV.

Social (S) and environmental (E) issues can be added to the DCF model. As explained in Chap. 5, S and E issues can be expressed in their own units Q (e.g. life years saved by medical treatment or carbon emissions by using fossil fuels) and then multiplied by their respective shadow price SP derived from welfare theory. The shadow price for one life year, for example, is estimated at \$119,000 and the shadow price per 1 ton of CO_2 equivalent is estimated at \$224 (IEF, 2022). The value flows *VF* are calculated as follows:

$$VF = Q \cdot SP$$

These value flows can be discounted with the DCF model to obtain SV and EV. It could be argued that cash flows are a special form of value flows expressed in cash. Here, we use the more general term of value flows to calculate integrated value *IV*:

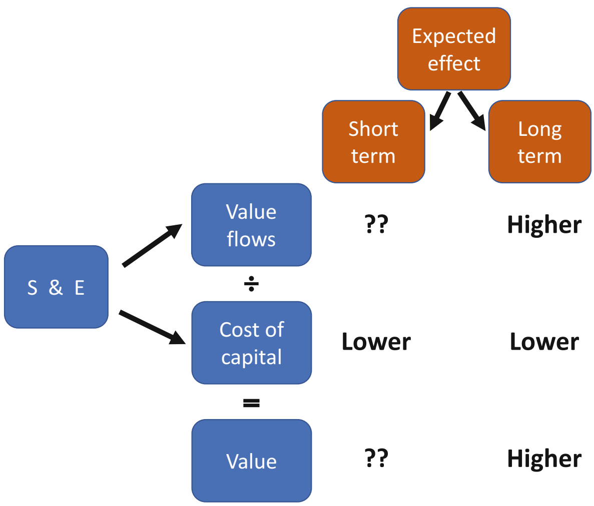
$$IV = \sum_{n=0}^{N} \frac{VF_n}{(1+r)^n}$$

Value Flows

Sustainability transitions result in changes in the markets for products and services. In the process of transition, social and environmental externalities are internalised. Internalisation means that the burdens of externalities are increasingly shifted back from society to the companies (and consumers) who cause them. Companies that create FV at the expense of SV or EV (social and environmental externalities) will often be affected with lower FV if and when internalisation occurs. By contrast, companies that provide solutions for solving negative SV and EV are rewarded with stronger FV (see, for example, Kurznack et al. (2021) in Chap. 2).

The alignment between profit (FV) and impact (SV and EV) depends on one key assumption, namely that sustainability transitions will happen at some point in time. The timing of transition—early or late—is difficult to predict. The investments for transitions are done today or in the near future, while the timing of the benefits is uncertain. The expected effect of sustainability improvements (S and E) on value flows is thus uncertain in the short term, but likely to be positive in the long term (see Fig. 1.9).

Fig. 1.9 Expected effect of improving S and E on value



Cost of Capital

The cost of capital increases with negative social and environmental externalities (because of a risk premium for the systemwide dimension of social and environmental risk) and decreases with positive social and environmental impact (because of reduced risk). Negative externalities effectively increase the leverage of integrated capital. Chapter 12 provides the emerging evidence for the relevance of E and S to the cost of capital. In a global study covering 77 countries, Bolton and Kacperczyk (2023), for example, found a positive and significant relationship for short-term and long-term measures of carbon transition risk and return: higher risk leads to a higher cost of capital because of a positive risk premium. In a similar way, Hong and Kacperczyk (2009) found a positive risk premium for sin stocks, such as alcohol, tobacco, and gaming.

We can now turn the argument around. Lower S and E risk, which means better S and E performance, leads to a lower cost of capital in the short term and in the long term (see Fig. 1.9).

Value Effect

For positive S and/or E impacts, higher value flows (in the numerator) and a lower cost of capital (in the denominator) are expected to produce higher company value in Fig. 1.9. And vice versa for negative impacts.

So, companies with a positive impact are likely to produce more long-term value. In the long run, financial, social, and environmental value are largely aligned. The challenge lies in trade-offs across time and between types of value, which can interact in numerous ways. In the remainder of this book, we show how the nexus between impact and long-term value works for the various corporate finance methods.

1.5 Conclusions

Coming from an 'empty' world with abundant natural resources, the Industrial Revolution brought prosperity in the form of economic and population growth. At the same time, this growth created social and environmental challenges. To address these issues, the United Nations developed the Sustainable Development Goals for 2030. Sustainability means that current and future generations have the resources needed, such as food, water, healthcare, and energy, without stressing the Earth system processes.

Corporate Finance for Long-Term Value looks at how corporate finance (investment decisions, valuation, reporting) interacts with economic, social, and environmental issues. This chapter shows how corporate finance has the potential to move from finance as a goal (shareholder value) to finance as a means towards integrated value creation. In his book *Finance and the Good Society*, Shiller (2012) provides some stimulating examples of how finance can serve society and its citizens.

We are in transition to a low-carbon and more circular economy. The impacts of the current carbon-intensive economy are becoming increasingly clear to the wider public. Examples are more catastrophic weather events, droughts, flooding in countries close to the equator, and air pollution. A case in point is California, where air pollution from heavy traffic in the 1990s prompted environmental regulations and stimulated innovations, such as the electric cars of Tesla and solar technology. Finance is about anticipating such events and incorporating expectations into today's valuations for investment decisions. Finance can thus contribute to a swift transition to a low-carbon economy.

Key Concepts Used in This Chapter

Corporate governance refers to the mechanisms, relations, and processes by which a company is controlled and directed. It involves balancing the many interests of the stakeholders of a company.

Environmental issues or ecological issues are abiotic or biotic issues that influence living organisms; see *planetary boundaries* for the most critical ecological issues

Impacts (also called external impacts or externalities) refer to consequences of activities that affect other (or third) parties without this being reflected in market prices

Integrated model means that a company should balance or optimise the interests of its current and future stakeholders: customers, employees, suppliers, shareholders, the community, and the environment

Integrated value is obtained by combining the financial, social, and environmental value in an integrated way (with regard for the interconnections)

Linear production and consumption system is based on the extraction of raw materials (take), processing into products (make), consumption (use), and disposal (waste)

Living wage is a wage for a full-time worker sufficient to provide their family's basic needs for an acceptable standard of living; a living wage varies with the local cost of living

Planetary boundaries framework consists of nine planetary boundaries within which humanity can continue to develop and thrive for generations to come; these boundaries include climate change, biosphere integrity, land-system change, freshwater change, biochemical flows, ocean acidification, atmospheric aerosol loading, stratospheric ozone depletion, and novel entities (plastics and chemicals)

Precautionary principle states that an action should not be taken (or a boundary should not be crossed) if the consequences are uncertain and potentially dangerous

Resilience of a system (e.g. an ecosystem or organisation) is the adaptive capacity of a system to deal with unpredictable shocks

Responsible company manages and balances profit (financial value) and impact (social and environmental value)

Resource abundance refers to the plentiful availability of natural resources such as minerals, metal ores, fossil fuels, land, and freshwater

Shareholder model means that the ultimate measure of a company's success is the extent to which it enriches its shareholders

Social foundations consist of the twelve top social priorities, grouped into three clusters, focused on enabling people to be (1) well: through food security, adequate income, improved water and sanitation, housing and healthcare; (2) productive: through education, decent work and modern energy services; and (3) empowered: through networks, gender equality, social equity, having political voice and peace and justice

Stakeholder model means that a company should balance or optimise the interests of all its stakeholders: customers, employees, suppliers, shareholders, and the community

Sustainability means that current and future generations have the resources needed, such as food, water, healthcare and energy, without stressing processes within the Earth system

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2 Integrated Value Creation

Overview
Chapter 1 gave us a clear starting point: responsible companies create integrated value based on financial value (FV), social value (SV), and environmental value (EV). Therefore, optimising integrated value should be the basic corporate objective. But what does that mean and imply? This chapter outlines what value creation is, and how the various types of value creation can be prioritised. For the alignment of all types of value, the prospect of internalisation is crucial. Internalisation means that the burdens of externalities are increasingly shifted back from society to the companies and consumers who cause them. If companies' FV depends on the exploitation of an external impact (i.e., FV at the expense of SV or EV), that FV will be affected if and when internalisation occurs. The internalisation of external impacts is part of the transition to a sustainable and inclusive economy.

Unfortunately, current corporate reporting does not facilitate the measurement or even estimation of SV and EV by external stakeholders (although company management has the data to do this). Therefore, to identify value creation on SV and EV, stakeholders can use analytical shortcuts such as the Value Creation Matrix. Measurement methods do exist but are not yet standardised or widely used. As responsible companies aim to create value based on FV, SV, and EV, they should have a clear picture of their current value creation profile and of their capabilities to create integrated value. Based on their purpose and area(s) of value destruction, companies can accordingly adjust their strategy and business model. In the case of serious value destruction, they should be able to outline a credible transition pathway. Companies can invest in their capabilities to adapt to sustainable business models. In that way, they increase their transition preparedness.

Learning Objectives
After you have studied this chapter, you should be able to:

- Identify value creation and value destruction across FV, SV, and EV
- Make a rough estimate of value creation/destruction on SV and EV, even in the absence of data

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- Relate value creation to a company's purpose and strategy
- Envisage transition pathways towards value creation on SV and EV
- Critically assess a company's transition preparedness

2.1 Basics of Integrated Value Creation

What Is Value Creation?

In financial terms, value creation is defined as an increase in the net present value (NPV) of a company's projects (see, for example, Koller et al., 2020). It is also what a company's stock price is supposed to reflect. A rise in its stock price implies either higher expected cash flows, lower cost of capital, or both. Of course, this is only financial value (FV). As discussed in Chap. 1, integrated value (IV) also encompasses social value (SV) and environmental value (EV). Value creation can be measured for all types of value, but this is typically not done for SV and EV. As a result, FV is often generated at the expense of SV and EV as resources are depleted without sufficient investments in maintaining them.

Responsible companies manage for integrated value creation (profit and impact) rather than merely shareholder value (profit). Managing for integrated value creation involves managing and balancing all types of value at the same time, often involving trade-offs. This can range from enlightened shareholder value to managing for purpose, seeing FV as a mere necessity instead of a goal in itself. As their goals differ, companies will have different decision rules for their investment decisions as well, as we will discuss in Chap. 6. Box 2.1 shows a few company statements on value creation.

Box 2.1: Company Statements on Value Creation

Daikin:

> Our aim is to use our world-class technologies to reduce environmental impact while at the same time providing new value in the form of a healthy, comfortable way of living.[1]

DSM:

> Our strategy centres on our continuing evolution towards being a Nutrition, Health and Sustainable Living company. The title, 'Growth & Value—Purpose-led, Performance-driven', speaks for itself. We want to continue generating value for all our stakeholders—from customers and shareholders to employees, and society-at-large.[2]

(continued)

[1] https://www.daikin.com/csr/newvaluecreation/sdgs.html

[2] Our strategy | DSM

Box 2.1 (continued)

Unilever:

> We believe that sustainable and equitable growth is the only way to create long-term value for our stakeholders. That is why we have placed the Unilever Sustainable Living Plan at the heart of our business model.[3]

The Alignment of FV, SV, and EV

Ideally, FV, SV, and EV are aligned: companies that create more social and environmental value are also financially more successful since they deliver what customers value. While such alignment is possible, it is often absent due to distortions such as scarcity, market power (where companies can extract too much value from consumers, suppliers, etc.) or external impacts. *External impacts* (also called externalities) are costs or benefits that are created by organisations or persons but whose costs are borne by society as a whole. Examples include pollution, health effects, and child labour. Fossil fuels, tobacco, and the garment industry are classic examples of industries with large negative impacts. A way to improve the alignment between FV, SV, and EV is to ensure that companies charge true or integrated prices, i.e., prices that include all hidden costs. For example, Impact Institute (2019) calculates that the inclusion of such hidden costs in the price of a pair of jeans would result in a price increase of about €30 on average. Having integrated prices in place (through regulation, taxation, and transparency in the value chain) would give tremendous incentives for better behaviour and substantial reductions in social and environmental costs. It would not only raise the price of many products but would also make cleaner products more viable—see Fig. 2.1.

However, integrated prices would not solve all financial value creation at the expense of SV, EV, and other people's FV. Mariana Mazzucato (2018) argues that industries such as IT, pharma, and financial services extract much value from the rest of society as they exploit their market power (due to scale, technology, patents, regulation) by means of raising prices, manipulating media, and avoiding taxes.

Currently, many companies are value destructive on SV or EV—see Fig. 2.2 for an illustration. But we don't yet have the numbers on the extent of the value destruction on SV and EV. For society and the economy to operate within social and planetary boundaries, we need companies to stop being value destructive on SV and EV on aggregate, i.e. to have SV^{-} and EV^{-} largely disappear (the superscript represents negative values). Of course, this is hardest for those companies that are most value destructive—more on this in Sect. 2.5, transition pathways. The need to avoid value destruction on SV and EV also has implications for the corporate objective (as discussed in Chap. 1) and companies' purpose and strategy (see Sect. 2.4). Let us first consider why companies would want to manage for integrated value.

[3] https://www.unilever.com/Images/2495-how-we-create-value-100418_tcm244-521463_en.pdf

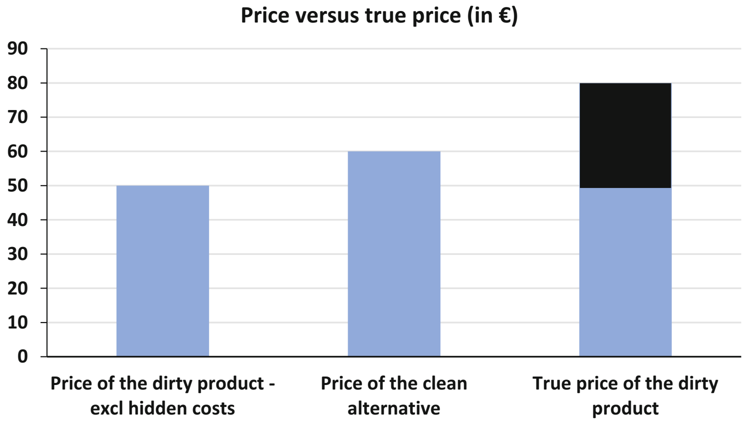


Fig. 2.1 Price versus integrated price. Source: Authors' calculation based on Impact Institute (2019)

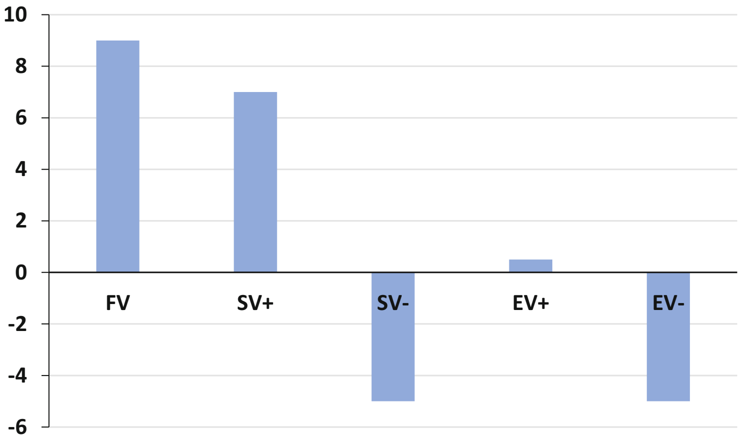


Fig. 2.2 The likely value creation profile of a typical company

Why Is It in Companies' Interest to Manage for Integrated Value Creation? Hard-nosed investors want companies to maximise FV for them. However, if company management neglects SV or EV, that will hurt long-term FV as well—but not necessarily short-term FV, which is what these investors might be after. As said before, FV, SV, and EV are often not aligned. However, such misalignment is not static. In fact, it is quite likely to be unstable. Companies that create FV at the expense of SV or EV are likely to lose their licence to operate at some stage (Kurznack et al., 2021; Mayer, 2018). An example is the tobacco industry in Fig. 2.3.

Conversely, companies that create value on SV and EV are more likely to create value on FV in the long run as well: as external impacts (both positive and negative) are being internalised, they affect FV. That is, the heavy polluter will see its FV

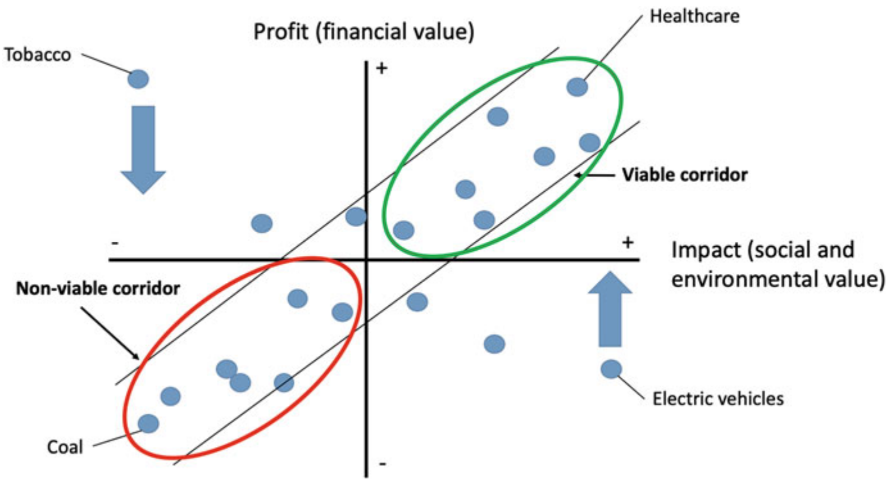


Fig. 2.3 Long-term alignment of profit and impact

diminished or even go negative, whereas the companies that provide solutions for solving negative SV and EV are rewarded with stronger FV. An example of the latter are manufacturers of electric vehicles that are becoming profitable (Fig. 2.3). Box 2.2 provides another example of a company that creates value on EV with a product that reduces emissions. The diagonal in Fig. 2.3 provides the long-term corridor, where FV and SV and EV become aligned through internalisation of external impacts. The alignment can be on the positive side (the viable part of the corridor) or on the negative side (the nonviable part of the corridor).

Box 2.2: Value Creation with a Product That Reduces Emissions

DSM, a Dutch multinational active in health, nutrition, and materials, has a product that reduces methane emissions by cows. According to DSM, 'just a quarter teaspoon of Bovaer per cow per day suppresses the enzyme that triggers methane production in a cow's rumen and consistently reduces enteric methane emission by approximately 30%. It takes effect immediately, and it is safely broken down in the cow's normal digestive system'.[4] If used widely, the product would help achieve a phenomenal reduction in methane emissions. However, in the absence of methane prices, the product is difficult to sell, since the product is costly for dairy farmers and does not provide them a direct benefit. That will all change as soon as methane emissions are internalised, i.e. charged to the dairy farms emitting them. Then, to avoid methane taxes, those dairy farmers will happily buy the DSM product since it helps them reduce their methane emissions and (crucially) the taxes associated with those emissions.

[4] see: Minimizing methane from cattle | DSM

Some argue that companies cannot afford to be less value destructive on SV and EV, since that will price them out of the market (Kaplan, 2020). However, the product competition argument is less strong in practice. It assumes implicitly that the impact is static, which is not the case. Impact can be internalised, as shown below. Furthermore, those companies with high margins can give up part of that margin by incurring higher costs without changing the pricing of their products. More generally, companies can adjust their business model and design transition pathways to reduce negative SV and EV over time (see Sect. 2.5). In terms of double materiality (see Fig. 2.6), this makes sense from a societal (outward) perspective. In the long run, it might also be better from a financial (inward) perspective.

Forced Internalisation

One could argue that quite a lot of companies are better off if they can continue to externalise their large costs on SV and EV. That sounds rational if (1) companies are not interested in double materiality, and (2) there is no threat of internalisation; and indeed that threat needs to be credible enough to make companies start to act. We distinguish four driving forces behind the internalisation of SV and EV into FV:

1. **Licence to operate**
2. **Regulation and taxation**
3. **Technological advancement** and
4. **Customer preferences**

The broader social trend of corporate responsibility creates expectations for companies; society looks to leading companies to contribute to the major transitions (energy, circularity, biodiversity, and labour practices). Next, carbon taxes are accelerating the adoption of low-carbon production technologies and the phasing out of carbon-intensive ones. Technological advances in combination with economies of scale make wind and solar energy competitive with fossil energy for electricity generation.

In addition, authorities are currently preparing regulations for working conditions throughout the value chain. Customer preferences are also relevant. The campaign of chocolate manufacturer Tony's Chocolonely, for example, has ensured that consumers buy mainly Fairtrade chocolate, even when they buy other brands. These driving forces of internalisation of social and environmental externalities raise the question of the appropriate division of labour between the various players: government, investors, companies, consumers, and civil society. Box 2.3 provides an overview of the key players in internalisation. The role of these players is complementary. Each can make its own contribution. A major challenge is avoiding the waiting game, where one player (for example, a company considering the adoption of a low-carbon technology) waits for another player (for example, the government contemplating raising the carbon tax) to act.

Box 2.3: Key Players in Internalising Externalities

We identify five main players, who can apply various internalisation mechanisms:

1. **Government**: A first best solution to internalise externalities is taxation or regulation by the government. Carbon taxes are, for example, an efficient way to get the public good of a low-carbon economy. In the case of severe externalities, the government may apply an outright ban through regulation. But the political economy of taxation and regulation highlights that governments face political constraints at the national level (voters) and the international level (international coordination) to achieve the first best solution. Mazzucato (2021) argues for government taking an active role (e.g. as initial investor in innovative technologies) to accelerate the sustainability transition in the economy and society.
2. **Investors**: Financial institutions can incorporate environmental, social, and governance (ESG) factors into their investment and lending strategy and engage with the corporates in which they invest. In particular, large institutional investors, such as pension funds, insurance companies, and investment funds, can put pressure on companies to speed up the transition to sustainable business models.
3. **Companies**: Companies can incorporate the costs of externalities into business practices across the value chain of production. This chapter examines how corporates can embrace sustainability in their strategy and change their business models. Chapter 5 shows how companies can measure and price externalities.
4. **Consumers**: Consumers may buy sustainable products and services. An emerging trend is the sharing or peer-to-peer economy, whereby participants mutualise access to products or services, rather than having individual ownership. This reduces consumption, since consumers do not need to buy the products or services individually. Examples are the sharing (for free or renting out) of cars, bicycles, equipment, houses (Airbnb), and taxis (Uber). Nevertheless, consumers are not (yet) the driving force of internalisation.
5. **Civil society**: Non-governmental organisations (NGOs) can raise awareness of social and environmental externalities through public voice in the media. The aim of public debate is to stimulate other players (government, investors, companies, and consumers) to behave responsibly and address externalities. Chapter 14 discusses the role of civil society.

If and when internalisation does happen, its impact can be quite counterintuitive, since it's not necessarily the worst polluters that are hit hardest: the impact depends on the company's preparedness and the relative size of its external impacts versus alternatives. For example, aluminium is an energy- and carbon-intensive industry that would be strongly affected by a high carbon price, but some aluminium companies would likely benefit from it.

The relationship between integrated prices and integrated profits is not linear. An integrated price can lead to higher costs for a producer and still increase profits. The following example shows that. Table 2.1 shows the profitability of an aluminium producer without (left) and with (right) a high carbon price. The carbon price increases both the costs and the turnover of the aluminium producer, because the demand for aluminium is likely to increase at the expense of steel (which weighs more and thus produces more fuel consumption and emissions in cars). But because this aluminium producer's production is cleaner than its competitors (for whom costs rise much faster), its costs rise less than its turnover, and its operating margin (profitability) increases.

Another way to illustrate this is by means of cost curves. Figure 2.4 shows the costs of six mining companies that compete directly on a specific product, such as copper or cobalt. The left panel of Fig. 2.4 shows the situation without a carbon price; the right panel the situation with a carbon price. All companies see their costs rise, but not to the same extent.

Since the marginal producer (the company with the highest cost price) becomes more expensive, the sales price (dotted line in Fig. 2.4) also rises. This, of course, also depends on demand. If the product becomes more attractive due to the tax (as the product is needed more as input for sustainable products or alternative products are more heavily taxed, for example), the price will rise more; if demand declines, the marginal producer goes out of business and the price rises less, or even falls. As costs and sales prices change, so do profits, which is shown in Fig. 2.5.

Table 2.1 The non-linear relationship between integrated prices and profitability for a transition-prepared aluminium company

	No carbon price	High carbon price	Change
Sales	50	55	10%
Costs	44	47	7%
Operating result	**6**	**8**	**33%**
Operating margin	12.0%	14.5%	21%

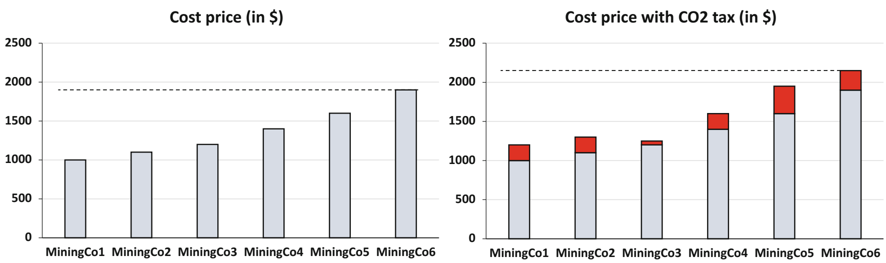


Fig. 2.4 Cost curves with and without carbon prices

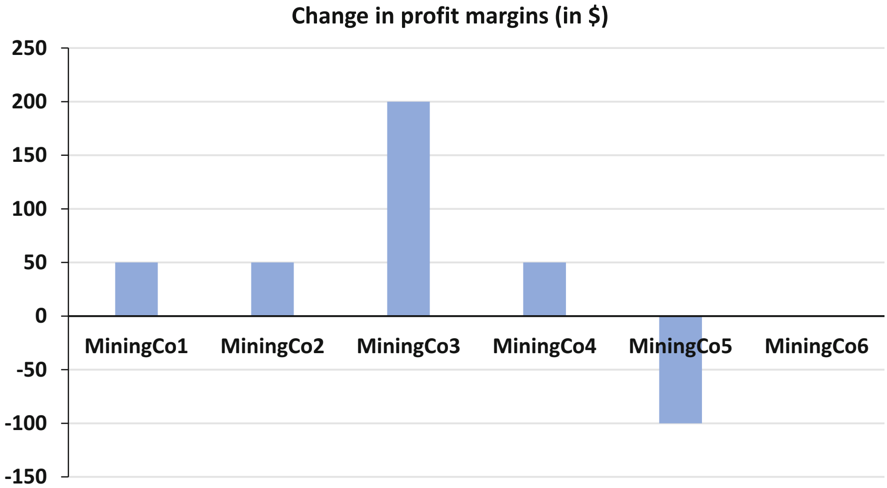


Fig. 2.5 Change in profits due to carbon prices

Mining Company 3 is the clear beneficiary in terms of profits, whereas Mining Company 5 is the loser. The reason is simple: for the cleanest producer (MiningCo3), the costs rise by $50, which is less than the industry average of $208; for the dirtiest producer (MiningCo5), costs rise by $350.

Internalisation is not a straightforward process. To assess a company's FV, it is important to do scenario analysis on the likelihood, speed, and nature of the internalisation of the company's SV and EV, both positive and negative. *Scenario analysis* is a process of analysing possible future events by considering alternative possible outcomes (sometimes called 'alternative worlds'). Thus, scenario analysis, which is one of the main forms of projection, does not try to show one exact picture of the future, but alternative scenarios. De Ruijter (2014) proposes a strategic approach in making scenarios for a company with the following steps:

1. **Determine the most important uncertainties** for the future and put them in a framework. This can be two axes representing two key uncertainties, but also a decision tree containing the most important questions for the future.
2. **Elaborate the scenarios**: fill them in with the developments, trends, uncertainties, and possible actions of actors from the transactional environment until each scenario forms a plausible and relevant whole leading to new insights.
3. **Represent the scenarios** to make them **appealing stories** about possible future situations and the path leading there.

A STEEP-type analysis can be used to identify the societal trends that shape product and service markets in the long term. STEEP is a tool to analyse driving forces or trends focusing on social (including demographic), technological, economic, environmental, and political factors. These trends cover sustainability transitions (social and environmental) and digital transitions (technology). While these trends are operating society wide, their impact is different across various sectors. In scenario analysis, a company can identify the most important societal trends for the industry in which it operates (including the likely internalisation of the main externalities) and assess its relative position (for example, degree of pollution or payment of living wages) within the industry. Importantly, a company can use scenario analysis as part of its strategy-setting (see Sect. 2.4) to take action to anticipate important trends and reduce the impact of negative scenarios.

There are societal forces that put pressure on companies to internalise social and environmental impacts. Companies are dependent on a vibrant and healthy society for their long-term functioning. This is the social licence to operate (see Chap. 1). The challenge of sustainable development is to what degree companies are able (or forced) to internalise the social and environmental impacts, as illustrated in Fig. 2.6. The concept of double materiality means that one is mindful of the company's relation with society and nature in two directions:

1. **Inward**: the company's dependencies on society and nature and
2. **Outward**: the company's impact on society and nature

Investors are often only interested in the first, but it is a costly error to ignore the second. They are, after all, related, and the company's impacts tend to affect its dependencies as well.

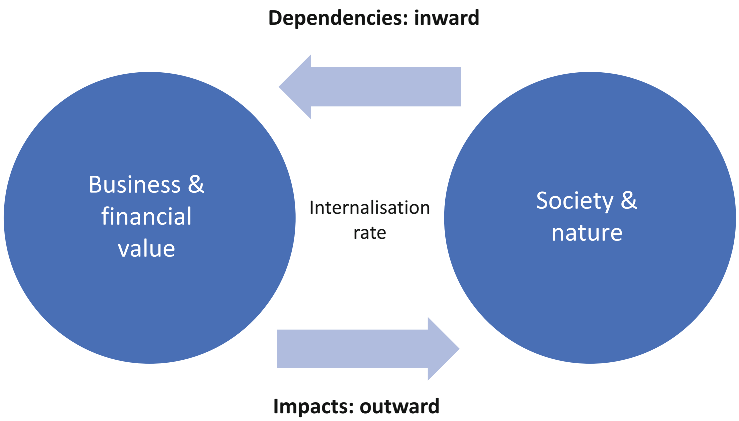


Fig. 2.6 Double materiality and the internalisation of social and environmental impacts

2.2 Identifying Value Creation and Value Destruction

Let us take a step back. In practice, information flows on SV and EV are typically missing or incomplete. That's no reason not to try, though. In an intuitive way, one can often make an educated guess about a company's SV and EV. For example, airlines' carbon emissions are so large that they result in highly negative EV, even if one uses low-carbon prices and/or ignores their effects on biodiversity—for which the size is a question mark, but the sign is not. In that way, one can fill out the value creation matrix in Table 2.2 for most companies, projects, and activities.

The best projects/activities/companies are situated in Quadrant 2 (win–win) of Table 2.2: they create value on both F and S&E. Thanks to the positive F, they will also be implemented by the market. The latter also applies to projects in Quadrant 1 (exploitation): they create value on F but destroy value on S&E. Given that destruction of value, they should not take place; but the market is not aware because SV & EV are not measured and not priced. The market is effectively blind to the difference between Quadrants 1 and 2. That is where the market fails and people can intervene: changes in transparency, behaviour, technology, regulation, etc. can make Quadrant 1 very small, and in theory even empty. This means that what is still in Quadrant 1 is effectively pushed to Quadrant 3 (collapse) or ideally to Quadrant 2—and if not, then at least it is moved to the right within Quadrant 1. Consider, for example, the transport sector: if it switches massively from fossil fuels to renewable energy sources, its EV goes from very negative to somewhat negative (because many materials such as metals are still needed), and its SV improves due to health effects. On balance, SV&EV is then probably located at the boundary of Quadrants 1 and 2. In the automotive industry, that movement has already been initiated under Tesla's leadership (though the lithium batteries have a negative environmental impact).

Of course, the value creation matrix also raises new questions. For example, how can it be created and populated with data for entire sectors and economies? How can we measure it and account for it? How can we change and move to Quadrant 2? As explained earlier, there are societal forces at work to measure and price social and

Table 2.2 Value creation matrix

	S + E value destroying	S + E value creating
F value creating	Quadrant 1 Overexploitation	Quadrant 2 Win-win
F value destroying	Quadrant 3 Collapse	Quadrant 4 Charity

Source: Adapted from Schramade (2020)

environmental externalities and thus stimulate companies to move to Quadrant 2. The foundations of monetising SV and EV are not only forced internalisation through regulation and taxes but are also ethically based—companies should operate within social and planetary boundaries (see Chap. 1). Ethical standards recognise the existence of universal rights of current and future generations and the corresponding responsibility of economic actors, including companies, to respect these rights (Impact Economy Foundation, 2022). These rights include the following:

1. **Human rights**, such as the rights to life, freedom from degrading treatment or punishment, access to health care and education
2. **Labour rights**, such as the rights to fair wages, to a safe and healthy work environment, to unionise, and to freedom from discrimination and
3. **Environmental rights**, such as the rights to a healthy environment and natural resources

2.3 Quantifying Integrated Value Creation

Measuring SV and EV is often dismissed as too difficult, and while this was long true, it is no longer a valid excuse. Although not yet standardised, the methods are now available to measure current and historical SV and EV, both at a product level and at a company level (De Adelhart Toorop et al., 2019; Serafeim et al., 2019).

Measuring Historical Value Creation
Measuring SV or EV takes a three-step process:

1. Determine material S and E issues
2. Quantify the S and E issues in their own units (Q)
3. Put a monetary value on those S and E units through shadow prices (SP)

Let us illustrate the three steps, using an airline as an example. In the first step, material S and E issues are determined, for example, by means of academic research, the SDGs, stakeholder interviews, or using checklists such as those of Impact Institute. For an airline, material E issues include carbon emissions, aerosol loadings, nitrogen emissions, and loss of biodiversity. The airline's material S issues likely include the employment benefits of employees, passenger well-being, health, and subsidies and taxation.

In the second step, the S and E issues are quantified. For some issues that is relatively straightforward to do, for example for carbon emissions where measurement standards are well-developed. The carbon emissions of many listed airlines can now be found in their annual report. Air France-KLM reports 34.2 million tons of carbon emissions over the 2019 fiscal year. It's harder to quantify for aerosol loadings and certainly harder for biodiversity, since the latter lacks a standard indicator. In such cases, estimates can be made, based, for example, on academic models or anecdotal evidence. On the social side, the value of passenger well-being related to family, holiday, or work-related visits can be estimated, and the value of work can be expressed in living wages.

In the third step, a monetary value is put on the units of S and E to arrive at values, i.e., SV and EV. For example, a company's carbon emissions can be multiplied by a shadow carbon price. Using a shadow carbon price of €100 and multiplying that by Air France-KLM's 2019 emissions of 34.2 million, we arrive at a negative value of €3.4 billion per year (i.e. a flow, not a stock), for one component of Air France-KLM's EV. This is highly material, as this component on its own is three times the size of the company's annual EBIT of that same year (€1.1 billion). Similar to EV, components of SV can be calculated by multiplying the well-being of visits by the monetary value of well-being and the worked hours by relevant wages. Passenger or consumer well-being is calculated as the consumer surplus, which is the difference between the price of a product and what consumers want to pay for it (we show in Chap. 5 how consumer surplus can be calculated). Note that these calculations give yearly amounts, i.e. flows for an integrated profit and loss (P&L) account, not the stocks to be used on a balance sheet. We will return to these issues in Chaps. 5 and 15. Box 2.4 calculates the integrated profit of Ambuja Cements.

Box 2.4: The Integrated Profit of Ambuja Cements

In 2014, True Price, together with EY, Deloitte, and PwC, published the report The Business Case for True Pricing. It includes, among other things, a calculation of the integrated price of roses from Kenya. The report also features a case study that calculates the integrated profits of Ambuja Cements, the Indian subsidiary of construction materials giant LafargeHolcim.

The study estimated Ambuja's E and S income at approximately €760 million, thanks to waste solutions for other industries, strategic social investment, and contributions to the local economy (see Fig. 2.7). This was compared to E and S costs of approximately €690 million, mainly due to emissions of CO_2, SOx (sulphur oxide), NOx (nitrogen oxide), and dust. Ambuja's total value, including the net social and environmental benefits of approximately €70 million, was 60% higher than its financial value. On balance, Ambuja's activities might be in Quadrant 2 (win–win), but—especially on E—there is also a lot in Quadrant 1 (exploitation). Moreover, the substantial amounts involved imply that the company is at risk if certain social costs are internalised—i.e. are no longer borne by society but paid for by Ambuja in the form of taxes or additional costs.

For Ambuja's management, the analysis showed that carbon emissions, water consumption, and social investment offer the best potential to improve the company's net social value at low operating costs.

Measurement can be done, but it is still the exception rather than the rule. Over time, companies will most likely be required to report on this, and standardised accounts will emerge. In the absence of sufficient reporting, we will need to estimate companies' value creation profiles, as we did for Air France-KLM.

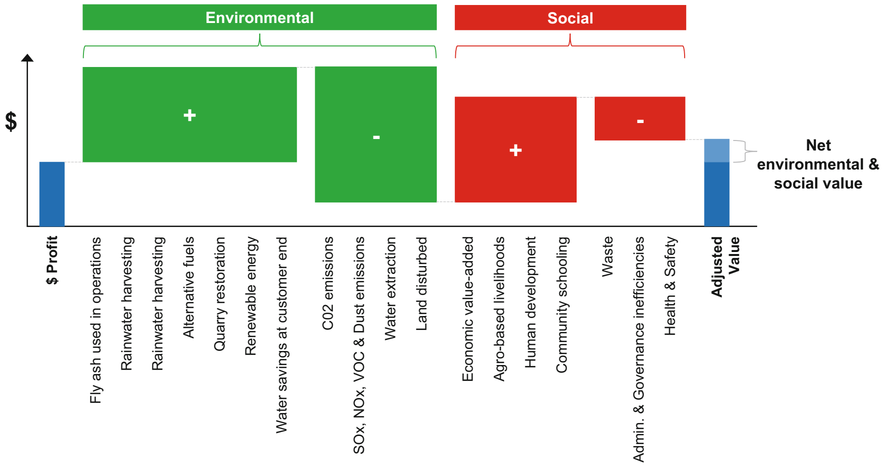


Fig. 2.7 Environmental and social impacts at Ambuja Cements. Source: Adapted from True Price (2014)

Estimating Future Value Creation

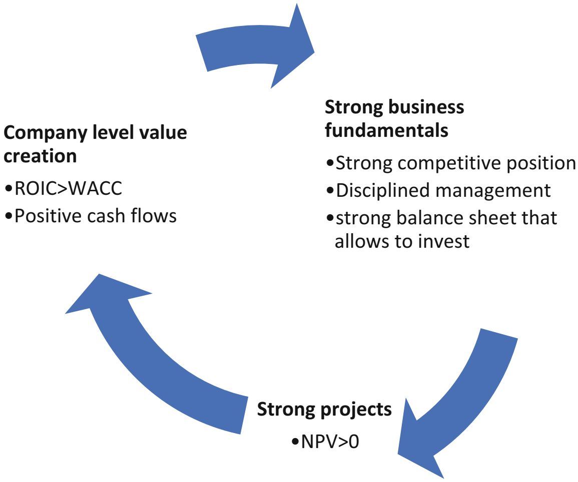
Note that the above calculations refer to historical value creation and value destruction, while finance is about the future. It therefore requires a view on and an assessment of value creation in the future. Therefore, when considering Air France-KLM, we need to ask how much value the company will be creating or destroying. We estimated the company's value destruction on carbon to be €3.4 billion per year for 2019. However, what will it be in 2025, 2026, etc.? We could estimate it by extrapolating its emissions and the shadow carbon price, which would likely result in gradually-rising value destruction (Table 2.3).

However, there is an interaction with the real carbon price. Air France-KLM's value destruction is so large exactly because it effectively does not have a carbon price: the European carbon pricing regime does not apply to the airline industry, there is no taxation of kerosene, and there is no VAT on ticket prices. That can all change though, through the process of internalisation. Internalisation means that the burdens of externalities are increasingly shifted back from society to the companies and consumers who cause them. In the case of Air France-KLM, internalisation can, for example, happen by means of taxation on ticket prices. If that happens, ticket prices will rise, and volumes (number of tickets sold, and hence the number of flights

Table 2.3 Projecting expected value creation/destruction

	2025	2026	...	2030
Expected carbon emissions (1)				
Shadow carbon price (2)				
Expected value destruction on carbon (3) = (1) × (2)				

Fig. 2.8 Value management (FV only)



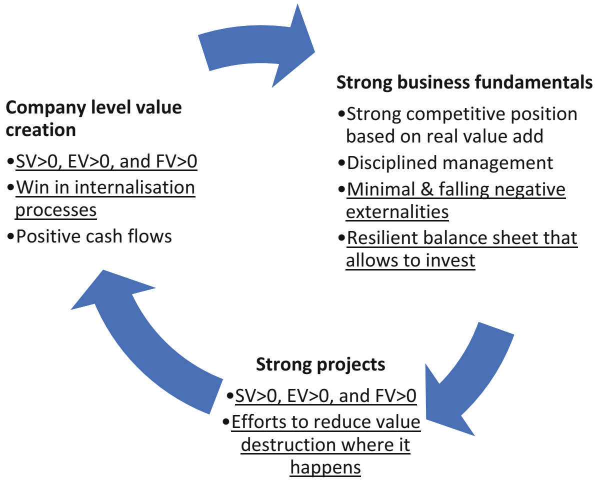
made) will fall. That means that both the company's profits and its emissions will fall, i.e., more value destruction on FV, less value destruction on EV. However, the second-order effects could be different. If Air France-KLM succeeds in emitting less per passenger than its competitors, then it will enjoy a cost advantage that might offset its rise in costs. Therefore, the company might actually improve on both FV and EV—see Table 2.1 as an illustration. Overall, internalisation means that the entire airline industry will have incentives to improve on EV since that helps them on FV as well (by avoiding future taxation).

The example highlights that it is not only important to understand whether companies are value creative or value destructive on SV, EV, and FV. It is also important to understand how to create or destroy such value, and how companies perform against their peers. In addition, how can we assess their ability to do so? Value management concerns efforts to improve a company's value. In the traditional financial view, it works as illustrated in Fig. 2.8.

It starts with strong business fundamentals (most notably a strong competitive position), which allow companies to undertake investment projects that create value, as measured by their positive net present value (NPV, see for more explanation Chaps. 4–6). Those projects have a return on invested capital (ROIC) that is higher than their cost of capital (WACC, or weighted average cost of capital). If all projects have ROIC>WACC, then the same applies to the company, which is then value creative as well.

The picture changes slightly in Fig. 2.9 when taking an integrated view of value. We now need to look at all types of value, as well as their interactions. This implies that we take externalities and internalisation into account. Competitive positions based on negative externalities are not tenable and should be viewed accordingly.

Fig. 2.9 Integrated value management (SV, EV, and FV)



The strong business fundamentals are now modified to include minimal negative externalities and a resilient balance sheet. The judgement of the strength of investment projects is no longer limited to a positive NPV but requires positive value creation on SV and EV as well. At the company level, this should result in value creation on all capitals and better preparedness for internalisation processes.

To better assess from the outside the extent to which companies succeed in managing for integrated value, they should report on this management of integrated value. Unfortunately, current corporate reporting practices give limited visibility to SV, EV, and even FV. Significant parts of FV do not appear on corporate balance sheets. The financial value of companies has shifted from tangible assets, such as land, buildings, and machinery, and financial assets, to intangibles such as human capital, processes, data, and innovation. This is particularly true in R&D-intense sectors such as healthcare and information technology and/or in service sectors such as consultancy. The intangibles of the S&P 500 companies have increased from 17% of market value in 1975 to 90% in 2020. For Europe, this trend holds as well, albeit to a lesser extent: intangibles of the S&P Europe 350 companies are valued at 75% in 2020 (Ocean Tomo, 2020). While intangibles account for the vast majority of company value, only a minority of them end up on the balance sheet, namely those that qualify for the strict definition of an asset (i.e. having control over it).

SV and EV tend to be almost completely off-balance sheet (see Fig. 2.10). That is a problem that is only partly mitigated by sustainability reporting, such as on emissions; or descriptions of value creation, such as those propagated by integrated reporting (see Chap. 17). Accountability needs to improve, at least to such a degree that investors and other stakeholders can make reasonable estimates of companies' value creation profiles. That is, they need to have sufficient information to determine the type of value creation profile in Fig. 2.11.

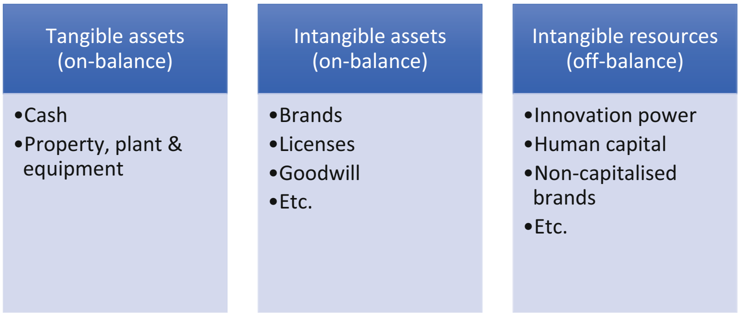
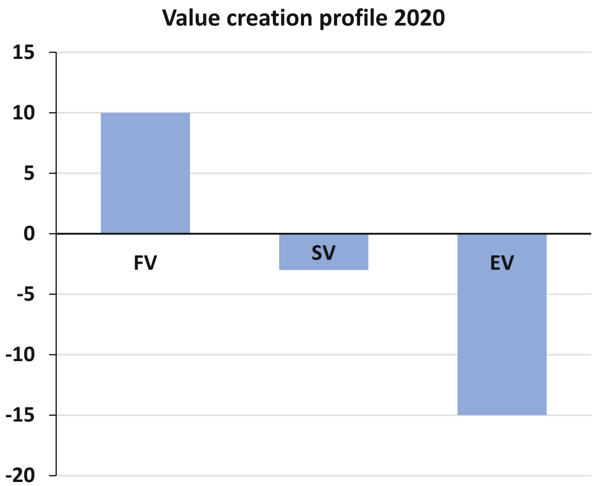


Fig. 2.10 Intangible resources are often off-balance sheet

Fig. 2.11 Corporate value creation profile



Accountability has several implications for companies. First, it means that companies have visibility of their value creation on FV, SV, and EV and provide a reasonable level of transparency on it. Second, they can explain and show how they trade off between creating and/or destroying FV, SV, and EV. Third, companies (and their managers) that are value creative on FV, SV, and EV are rewarded and incentivised accordingly. Fourth, companies that are value destructive on FV, SV, and EV will need to develop a path towards value creation across all value dimensions. Companies do not need to be sanctioned immediately if the value destruction is temporary. But they will have to show a clear and credible commitment to a transition pathway that brings them to zero or net positive value creation on their problematic value dimension.

2.4 Where Does Value Come from? Purpose, Strategy, and Business Models

Since integrated value means that FV, SV, and EV need to be positive, this raises the question of what to prioritise and how to balance these types of value. How do you know what to focus on? We will explore that question more deeply in Chap. 6, but for now we can say that focus and balancing should depend on the company's:

1. Purpose
2. Area(s) of value destruction

Purpose

A company finds focus in its mission or purpose (Mayer, 2018). Why and for what does the company exist? What societal need does it serve? What value does it provide for its customers? How does it do that in the best way? What type of value should it focus on, without losing sight of the other types? For example, Novo Nordisk exists to fight diabetes, which makes SV the most important type of value for this company. Box 2.5 shows a few company statements on purpose.

Box 2.5: Company Statements on Purpose

PepsiCo

> Performance with Purpose is about managing PepsiCo with an eye towards not only short-term priorities, but also long-term goals:
>
> - Products: PepsiCo continued to reduce added sugars and sodium in its beverage and food portfolios and move its business towards more nutritious products;
> - Planet: Nearly 80% of PepsiCo's directly sourced crops globally came from farmers engaged through the company's Sustainable Farming Program;
> - People: PepsiCo has now reached 6.4 million women and girls through increased investments in local communities around the world.[5]

Of course, one could argue that PepsiCo's negative impact is still large and inherent to its business model.

Philips:

> At Philips, we are striving to make the world healthier and more sustainable through innovation, with the goal of improving the lives of 2.5 billion people a year by 2030.[6]

(continued)

[5] https://www.pepsico.com/news/press-release/pepsico-reports-significant-strides-in-pursuit-of-performance-with-purpose-2025-07112018

[6] https://www.philips.com/a-w/about/company/our-strategy/our-strategic-focus.html

Box 2.5 (continued)

This purpose looks credible given Philips' track record and efforts.

Ørsted:

> We are a renewable energy company that takes tangible action to create a world that runs entirely on green energy.[7]

This purpose appears credible, as Ørsted has transformed itself from a fossil fuel-based energy company to a renewable energy company.

It's different, however, for companies with significant areas of value destruction. Air France-KLM exists to transport people quickly, safely, and comfortably over long distances, which suggests a focus on SV. However, given its large value destruction on EV (and often FV as well), its main challenge should be to operate with minimal environmental damage while taking financial viability into account. To get there, the company will have to take a serious look at its strategy and business model.

Strategy

Based on its mission, focus, and competitive landscape, a company can build its strategy. A strategy can be described as the plan chosen to achieve a desired future state. Hambrick and Fredrickson (2001) argue that many companies think they have a strategy while in fact they do not. For a so-called strategy to be truly a strategy, they claim it needs to have five parts:

1. **Arenas**: in which markets is the company going to be active?
2. **Vehicles**: how is it going to get there?
3. **Differentiators**: how can the company win in the marketplace?
4. **Staging**: what will be the speed and sequence of moves?
5. **Economic logic**: how can returns be obtained?

Achieving the strategic objectives requires building the right capabilities (key resources & processes) to succeed. This is especially challenging for companies that are stuck in an outdated business model that is highly value destructive on SV, EV, or FV or a combination thereof. The company then needs to adapt its strategy and business model in the transition to a sustainable and inclusive economy. Box 2.7 in Sect. 2.5 provides an example from the car industry.

Business Model

A business model is the representation of how a company creates and delivers value. Johnson et al. (2008) argue that a successful business model has three components:

[7] https://orsted.com/en/about-us

1. Customer value proposition: helps customers perform a specific 'job' that alternative offerings do not address
2. Profit formula: generates value for the company through factors such as the revenue model, cost structure, margins, and/or inventory turnover
3. Key resources and processes: the company has the people, technology, products, facilities, equipment, and brand required to deliver the value proposition to targeted customers. The company also has processes (training, manufacturing, services, etc.) to leverage those resources

For a company to seriously change its value creation profile on FV, SV, and EV, it typically involves strategic changes to the above components of its business model. These strategic changes depend on its competitive position in the markets where it operates. A company should make use of its comparative advantage to create value (Edmans, 2020).

Stakeholder Impact Maps

Companies often deal with SV and EV factors in isolation rather than taking a holistic approach. Additionally, they are not always aware which issues are material to their business. Many issues are potentially material for a company, but only a few are actually material in a specific case. To investigate what their most material issues are, companies can do both internal research and engage in stakeholder dialogues. To structure the investigation, one could devise a stakeholder impact map that outlines the company's main stakeholders, their main goals, and the way the company helps them (positive impact) or hurts them (negative impact). Table 2.4 provides a template for a stakeholder impact map.

Tables 2.5 and 2.6 provide examples for a pharmaceutical company and a social media company—as filled out by the authors and their students. A pharmaceutical company operates in a very different (business) environment than a social media company, and it also has different stakeholders, with different goals and impacts. Only the shareholders and the employees are similar in both examples. Governments show up in both stakeholder impact maps but with very different impacts and goals. When analysing such stakeholder impact maps, one should pay special attention to the frictions between the various goals and impacts, both within the same stakeholder and across stakeholders. Those frictions can be a good indication of the

Table 2.4 Stakeholder impact map

	Stakeholder group 1	Stakeholder group 2	Stakeholder group 3	Stakeholder group 4
Goals				
How the company helps those goals				
How the company hurts those goals				

Table 2.5 Stakeholder impact map for a pharmaceutical company

	Patients	Governments	Shareholders	Employees	Doctors and hospitals	Insurers
Short-term goals	Survival, affordability, and accessibility	Reduce healthcare costs	Maximise financial return	Good work–life balance and pay	Doctors get sweeteners; hospitals minimise costs	Minimise costs
Long-term goals	Better health outcomes at decent price	Better health outcomes at decent price	Maximise financial return	Personal development and financial security	Better health outcomes at decent price	Better health outcomes at decent price
Positive impact	Treatment and possibly cured	Population health	High prices and high growth, new drugs drive share price	Remuneration and job fulfilment	Good treatment outcomes	Fewer additional costly treatments
Negative impact	High cost	Fees (prices) paid	High R&D costs, high risk	Potential company reputation	High prices	High prices

Table 2.6 Stakeholder impact map for a social media company

	Users	Advertisers	Shareholders	Employees	Governments
Short-term goals	Connect and share	Get more customers	Maximise financial return	Good work–life balance and pay	Control of information, data security; battle distorted news
Long-term goals	A good life	Better understanding of customer needs	Maximise financial return	Personal development and financial security	Protect the state and the people
Positive impact	Connect people, widen their opportunity to express themselves	Reach users in a targeted way, save costs elsewhere	High growth drives share price	Remuneration and job fulfilment	Reach people
Negative impact	Privacy, addiction		Unease at high value (valuation)	Potential company reputation	Might affect public opinion in a way that undermines government

problems (or opportunities) ahead. Stakeholder maps are thus a good starting point for integrating sustainability into valuation (see Sect. 2.5).

2.5 Transition

The move from a negative social and/or environmental value (Quadrant 1 in Table 2.2) to a positive value profile across all three value dimensions—financial, social, and environmental (Quadrant 2 in Table 2.2)—is often part of a wider transition in the economy. *Transition* is about transformational change rather than incremental change. It is seen as an iterative process of building up a new regime and breaking down an old regime over a period of time, with disruptions along the way. Figure 2.12 shows the x-curve of transition dynamics.

The SDG agenda in Chap. 1 sets the stage for the transition to a sustainable and inclusive economy. Several transitions can be identified:

1. **Climate—energy transition**: Moving from the use of fossil fuels to renewable energy. This does not only have an impact on energy companies—oil and gas companies and electricity utilities—but also on other carbon-intensive sectors, such as manufacturing and mobility.
2. **Raw materials—circular economy**: Redesign and recycle products leading to less use of raw materials and fewer carbon emissions (e.g., recycling aluminium saves on carbon emissions in the production of aluminium).
3. **Biodiversity—healthy food and regenerative agri- and aqua-culture**: Trend towards healthy food production with respect for land and water. This implies moving from intensive to organic (and regenerative) farming to preserve the quality of the land without the use of fertiliser and pesticides. In addition to

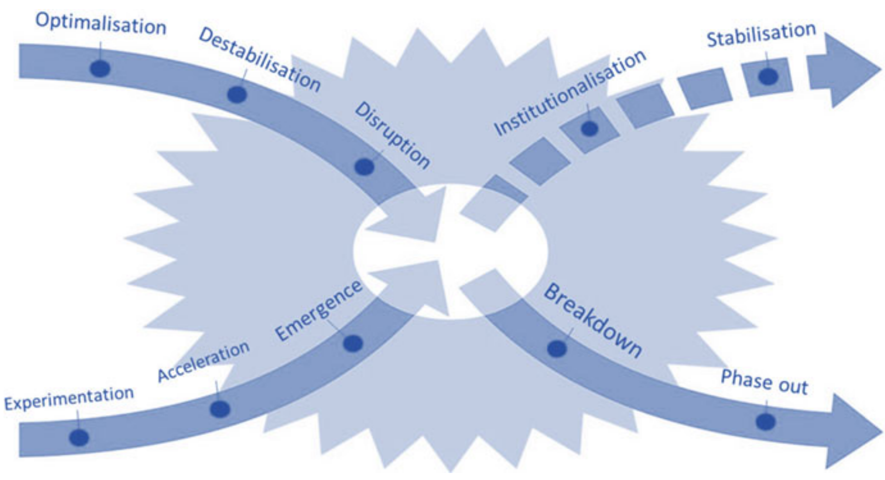


Fig. 2.12 The x-curve of transition dynamics. Source: Adapted from Loorbach et al. (2017)

preserving biodiversity, land restoration and reforestation provide watershed function and carbon absorption. Protecting biodiversity also implies no overfishing and preserving ocean health.

4. **Labour practices—social transition**: Trend towards decent labour practices across the value chain of production. Decent labour implies paying a living wage, ensuring safe working conditions and respecting human rights.

Transitions are, of course, not only constrained to moving to a sustainable economy. Other examples of major transitions in society are digitalisation and ageing population.

Transition and Value

Transitions can have major implications for company value. A company that adapts to the new world in a timely manner can realise its integrated value potential. In contrast, a company that follows a business-as-usual path and fails to adapt can lose its value and go bankrupt. An example is Kodak, which failed to see the digital transition in the photography industry (see Box 2.6 below).

Following Schoenmaker and Schramade (2022), we can formalise the expected transition losses ETL_{ij} for company i in sector j as follows:

$$\begin{aligned} ETL_{ij} &= EAT_{ij} \cdot PT_j \cdot LGT_i \\ &= b_j \cdot V_i \cdot PT_j \cdot (1 - a_i) \end{aligned} \tag{2.1}$$

where EAT_{ij} represents the exposure at transition. It measures which part b_j of company i's value V_i is exposed to transition: $EAT_{ij} = b_j \cdot V_i$. Figure 2.13 shows the extreme case of $b_j = 1$, where the full sector j is in transition from conventional to sustainable products. Transition exposure ranges from no transition to full transition: $b_j \in [0, 1]$. The assumption is that the sectoral transition b_j is representative of all companies i in that sector. Sectors that are characterised by large negative effects and the availability of substitutes (that address these negative effects) tend to have a high b_j.

The second variable PT_j represents the probability of transition for sector j. The size and timing of transition are uncertain. Scenario analysis (see Sect. 2.2) can be used to determine the probability of transition of a sector. This analysis contains different scenarios for the degree of transition and the timing of transition. Figure 2.12 shows that transitions do not happen smoothly, but shock-wise along a dynamic time-path. In the case of fundamental uncertainty about the timing and direction of transition, real option analysis can be used (see Chap. 19).

The final variable LGT_i is the loss given transition. This loss depends on company i's adaptability a_i to transition, whereby $LGT_i = (1 - a_i)$. A company can recover or retain its value by adapting to transition. In that way, it can limit its expected transition loss. A company can anticipate societal trends by building capabilities to learn about and serve these new societal needs as part of its strategy. a_i is non-negative with the following range: $a_i \in [0, 1]$. $a_i = 1$ denotes the case where a company can fully adapt to the new world, allowing it to reach its long-term value potential. As seen from Eq. (2.1), the expected transaction losses are then zero: $ETL_{ij} = b_j \cdot V_i \cdot PT_j \cdot (1 - 1) = 0$.

a_i depends on management quality. Doda et al. (2016) assess a company's management quality with regard to sustainability through the following five levels:

1. Unaware of (or not acknowledging) sustainability as a business issue
2. Acknowledging sustainability as a business issue: the company adopts a sustainability policy
3. Building capacity: the company develops its basic capacity, its management systems and processes, and starts to report on sustainability performance
4. Integrating into operational decision-making: the company improves its operational practices, assigns board responsibility, and provides comprehensive disclosures on its sustainability performance
5. Strategic assessment: the company develops a more strategic and holistic understanding of risks and opportunities related to the sustainability transition and integrates this into its business strategy and capital expenditure decisions

Those companies that are the first in the industry to incorporate sustainability into their strategy are the early adopters, who can capture first-mover advantages (e.g., higher margins with a price skimming strategy and a strong brand name capturing consumer surplus) or at a minimum avoid missing out on the new market standard. These early adopters thus minimise expected transition losses. Although early adopters face technological uncertainty (and related R&D investments), they can execute a successful price differentiation strategy that allows them to generate higher profit margins. The transition model of Eq. (2.1) shows that companies should be early in building the capabilities that give them the option to enter the market with new technologies and business models. The focus of the model is on companies' competitive position in navigating transitions.

We illustrate the working of transition valuation with company cases from the photography industry in Box 2.6 and the car industry in Box 2.7.

Box 2.6: Transition to Digital Photography: Kodak

The Eastman Kodak Company was established by George Eastman in 1881. It was a leading company in photography in the twentieth century. However, Kodak kept its print-based photos (business-as-usual) and failed to see the transition to digital photography $a_i = 0$. Kodak lost its full value and filed for bankruptcy in 2012.

In terms of Eq. (2.1): $ETL_{ij} = b_j \cdot V_i \cdot PT_j \cdot (1 - a_i) = 1 \cdot V_{Kodak} \cdot 1 \cdot (1 - 0) = 1 \cdot V_{Kodak}$.

Box 2.7: Transition Towards Electric Driving

The car industry is currently undergoing a transition to electric driving. Tesla, the US electric carmaker, is ahead in its capabilities and can quickly scale up its production capacity to serve increased demand. Traditional German carmakers are behind and are losing market share. Some traditional carmakers, such as Volkswagen, are catching up at high cost.

The difference in capabilities is summarised in the Bloomberg article titled *VW's Boss Warns the Troops: We Don't Want to End Up Like Nokia*: 'Volkswagen is at a critical juncture. It has electric cars rolling out but is well behind Tesla. And it has massive manufacturing scale but desperately needs to rethink its vehicles as rolling software devices. It is this last issue that CEO Herbert drives home with VW's more than 635,000 employees. The transition in competencies from industrial might to software prowess will be an immense challenge for automakers that are vast, deliberate and some say ripe for disruption. Car companies that get it wrong risk ending up like Nokia—failed hardware makers doomed by more nimble and technologically adept upstarts'. (Rauwald et al., 2020).

Figure 2.13 depicts the transition curve from 2010 to 2030. Over this 20-year period, the car industry is transitioning fully from traditional combustion engine cars to electric cars. In terms of Eq. (2.1), $b_j = 1$ and $PT_j = 1$. Tesla is fully prepared for the electric vehicle market with $a_{Tesla} = 1$, while VW is only partly prepared with $a_{VW} = 0.4$ (Kurznack et al., 2021). Therefore, transition losses may amount to 60% of VW's value: $ETL_{ij} = b_j \cdot V_i \cdot PT_j \cdot (1 - a_i) = 1 \cdot V_{VW} \cdot 1 \cdot (1 - 0.4) = 0.6 \cdot V_{VW}$.

These examples show the importance of adaptability or transition preparedness. A shortfall in adaptability has large value implications. Companies can invest in their

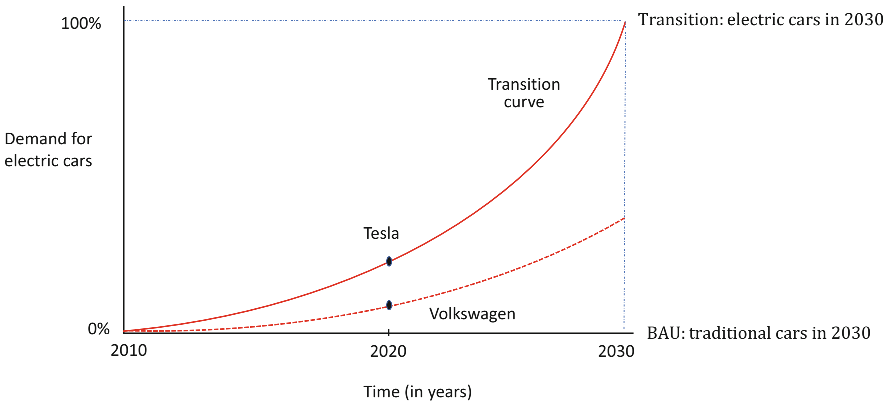


Fig. 2.13 Transition to electric driving

capabilities to adapt. The Volkswagen case in Box 2.7 shows that catching up not only comes at a high cost but also faces huge implementation challenges (i.e. hiring large numbers of software engineers). When deciding on investment in adaptability capabilities, a company can then compare the cost of the investment with the benefit of a reduction in expected transition losses. Example 2.1 shows the calculation for a major food company, such as Unilever, Danone, or Nestlé.

Example 2.1: Investing in Healthy Food

Problem

Consider a food company with a value of €10 billion. Half of the company's current product portfolio does not adhere to emerging standards of healthy food. The probability of transition to healthy food is 80%. It has a low adaptability for the fresh food transition of 0.3. The company can invest €1.5 billion to improve its adaptability to 0.8. Should the food company invest in this transition?

Solution

Step 1: calculate the expected transition losses with the current product portfolio using Eq. (2.1):

$$ETL_{ij} = b_j \cdot V_i \cdot PT_j \cdot (1 - a_i) = (0.5 \cdot €10\ \text{billion}) \cdot 0.8 \cdot (1 - 0.3) = €2.8\ \text{billion}$$

Step 2: calculate the expected transition losses after the investment in healthy food

$$ETL_{ij} = (0.5 \cdot €10\ \text{billion}) \cdot 0.8 \cdot (1 - 0.8) = €0.8\ \text{billion}$$

The reduction in expected transition losses is €2 billion (= €2.8 billion – €0.8 billion). This is the benefit. The cost of the investment is €1.5 billion. The food company should do the investment, which has a net present value of €0.5 billion. ◄

Transition Pathways

The transition model can be applied to companies. When a company is value destructive on any type of value—FV, SV, or EV—it needs to find a credible transition pathway in line with social and planetary boundaries towards positive value. Therefore, if a company has a value creation profile similar to that in Fig. 2.11, it should have a path towards net positive, as shown in Fig. 2.14.

It is great if a company can achieve such a shift, turning both SV and EV from negative to positive while maintaining positive FV. Having the vision is a start. However, 20 years is a long time and might imply making little to no changes for a long time—at the cost of significant value destruction. To be credible, the company will have to be more specific on how it's going to get to its goals. What concrete and quantifiable targets does the company have for reducing its value destruction in the near future? What indicators can investors and other stakeholders monitor to see if the company is on track? Are capital expenditures geared towards new capabilities instead of old business lines? Are those targets in line with a 1.5 degree global

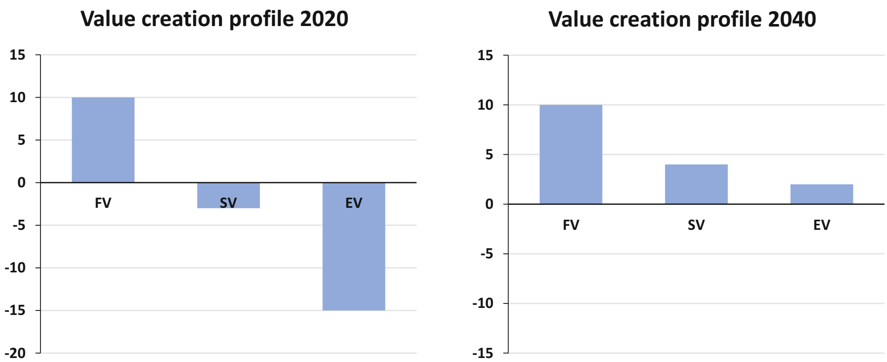


Fig. 2.14 Shifts in value creation profiles

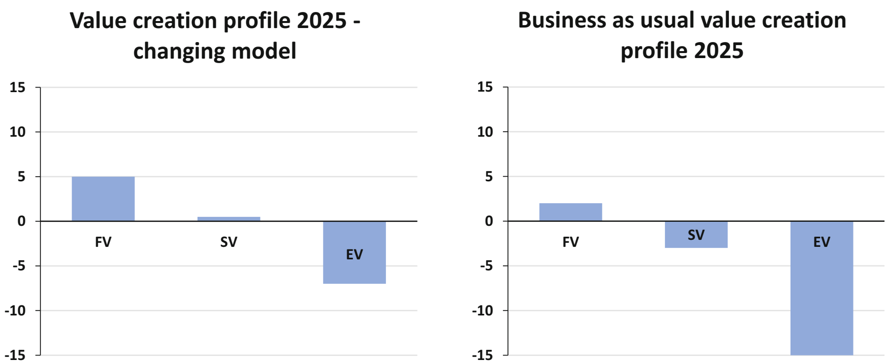


Fig. 2.15 Alternative shifts in value creation profiles

warming scenario? What will its value creation profile look like in 2025? It is quite plausible that some FV has to be given up to achieve the 2040 goals (see the left profile in Fig. 2.15). Not changing at all might force the company to give up FV to an even larger extent (right profile in Fig. 2.15). Business as usual is often an illusion. If an oil company claims to be serious about becoming carbon neutral, then why does it direct the majority of its capital expenditures towards finding new oil?

2.6 Steering Your Company on Integrated Value

This chapter shows how companies can survive in the market by adapting their business model to changing circumstances in a timely manner. Failing to do so would put company survival at risk, as witnessed by the case of Eastman Kodak. Chapter 1 highlights the need for companies to respect social foundations and planetary boundaries in order to keep their licence to operate. Figure 2.16 summarises steering on integrated value, subject to these constraints.

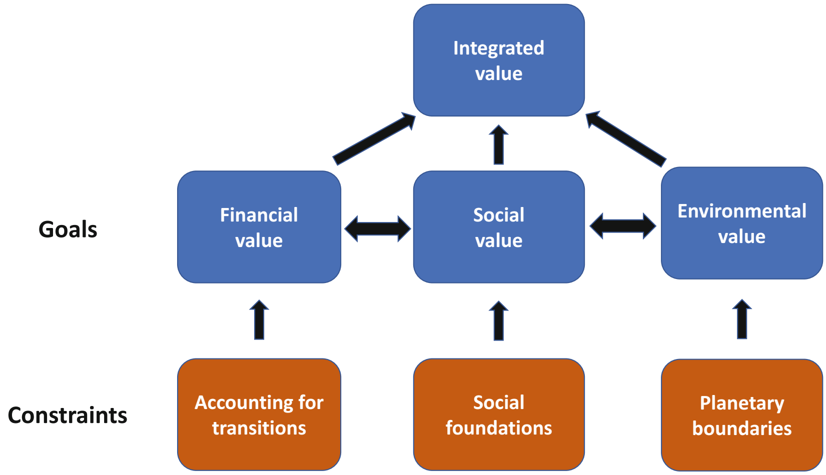


Fig. 2.16 Optimising integrated value subject to constraints

Figure 2.16 indicates that the company should steer according to financial value, social value, and environmental value in an integrated way. This is the process of optimising the company's integrated value. In this process, the company faces important constraints:

- Transitions
- Social foundations
- Planetary boundaries

The constraints work as follows. First, companies need to survive the transitions in the market. This chapter discusses how to do that. With a future-proof business model, companies can attract funding and avoid bankruptcy. Chapters 3–19 show how companies can do that.

Modern companies recognise that they also need to operate within social and planetary boundaries. The 'why' and 'what' of these social and planetary boundaries have already been discussed in Chap. 1. Again, Chaps. 3–19 show how companies can operate within these boundaries.

There we introduce the pillars of financial value, social value, and environmental value in subsequent sections. The final section integrates these three dimensions into integrated value, as there are interactions between the pillars.

2.7 Conclusions

This chapter discussed what it means for companies to create value on FV, SV, and EV. It requires a clear view of all types of value creation, and of how they are to be prioritised. For the alignment of all types of value, the prospect of internalisation is crucial. Internalisation means that the burdens of externalities are shifted back from society to the companies and consumers who cause them. If companies' FV depends on the exploitation of an external impact (i.e., FV at the expense of SV or EV), that FV will be affected if and when internalisation occurs. Moreover, there are ethical standards that companies are expected to meet to retain their social licence to operate.

Unfortunately, current corporate reporting does not facilitate the measurement or even estimation of SV and EV. Therefore, to identify value creation on SV and EV, stakeholders can use analytical shortcuts such as the Value Creation Matrix. Measurement methods do exist but are not yet standardised or widely used. Ultimately, reporting on value creation should be:

- Historical and forward-looking
- About all types of value that are material
- In their own units (e.g. tonnes of carbon emissions; life years saved) and
- In monetary terms (in $ or €) by applying shadow prices

As companies aim to create value on FV, SV, and EV, they should have a picture of their current value creation profile. Based on their purpose and area(s) of value destruction, they can then adjust their strategy and business model accordingly. In the case of serious value destruction, they should be able to outline a credible transition pathway. As the next chapter will discuss, governance and ownership structures play an important role in ensuring that companies are managed for integrated value. Good management is crucial to build a company's competitive position and navigate it through the upcoming sustainability transitions.

Key Concepts Used in This Chapter

Business model is the representation of how a company creates and delivers value

External impacts (also called externalities) refer to the consequences of activities that affect other (or third) parties without this being reflected in market prices

Environmental value (EV) refers to the natural capital embedded in a company's projects and activities

Financial value (FV) refers to the financial and manufactured capital embedded in a company's projects and activities

Intangibles are assets or resources that are not physical in nature; examples are human capital, goodwill, brand recognition, and intellectual property, such as patents, trademarks, and copyrights

Integrated value is obtained by combining the financial, social, and environmental value in an integrated way (with regard for the interconnections)

Integrated prices (also called true prices) refer to prices that include the hidden costs of social and environmental externalities

Internalisation means that the burdens of externalities are increasingly shifted back from society to the companies and consumers who cause them

Integrated value creation refers to the ability of responsible companies to create both financial and societal value over the long term

Materiality indicates relevant and significant
Purpose (or mission) refers to a company's desire to serve a societal need
Responsible company manages and balances profit (financial value) and impact (social and environmental value)
Scenario analysis is a process of analysing possible future events by considering alternative possible outcomes (sometimes called 'alternative worlds'); it can be used to analyse the effects of possible future events on the value of a company
Social value (SV) refers to the human and social capital embedded in a company's projects and activities
Stakeholder impact map outlines the company's main stakeholders, their main goals, and the way the company helps them (positive impact) or hurts them (negative impact)
Strategy is the plan chosen to achieve a desired future state
Transition is about transformational change rather than incremental change; it is an iterative process of building up a new regime and breaking down an old regime over a period of time, with disruptions along the way
Transition pathways refer to the strategic blueprint that a company applies to transform today's business and operating model to capture business opportunities and mitigate the risks posed by tomorrow's societal trends
Value creation refers to the increase in the integrated value of a company's projects and activities
Value destruction refers to the decrease in the integrated value of a company's projects and activities

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Corporate Governance

3

Overview

Corporate governance is about controlling and directing the company. The starting point is the objective of the company, a central theme in this corporate finance book. In the shareholder model, the ultimate control is with shareholders, although several mechanisms may limit the power of shareholders in practice. Shareholders aim to maximise company profits and thus put financial value as the company objective. In contrast, the stakeholder model includes other stakeholders, notably employees, alongside shareholders. Depending on its particular version, it may or may not include other important stakeholders, such as customers, suppliers, and local communities in which companies operate. The stakeholder model focuses on financial and social value as the company objective. Finally, the integrated model takes future stakeholders into account, by representing the environment and people not yet born. The integrated model expands the company objective to integrated value, which combines financial, social, and environmental value.

The emergence of the integrated model changes the discussion in corporate governance. Thus far the discussion has focused mainly on the question 'Is management acting in the interests of shareholders and other stakeholders of the company?' This question arises from the separation of ownership and management in the publicly listed company. The conflict of interest between managers and shareholders has been at the heart of corporate governance research for decades. To some extent, it has been challenged by stakeholder theory. However, the corporate governance debate should be broadened to include other stakeholders, the environment, and future stakeholders.

In corporate governance, there are two related problems: (1) asymmetric information between insiders and outsiders and (2) agency problems between management (agents) and stakeholders (principals). As corporate ownership varies around the world, corporate governance challenges differ. Nevertheless, corporate scandals occur in all corporate governance regimes.

The balancing of the interests of various stakeholders is central to corporate governance. But what information is used for this balancing: is it financial information only? Or is social and environmental information included as well?

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What ownership structures and governance mechanisms are most effective in balancing these interests? How can management be held accountable? The answers lie in the concept of integrated value as introduced in Chap. 1. It is instrumental in providing the required information and aligning the interests of financial, social, and environmental stakeholders in ex-ante decision-making and ex-post accountability. Integrated value can also provide guidance on dealing with trade-offs between the interests of various stakeholders. In contrast, the shareholder model gives priority to financial value, as most shareholders are financially driven. The stakeholder model lacks good measures of comparison and tends to focus on specific stakeholders while neglecting others.

Learning Objectives
After you have studied this chapter, you should be able to:

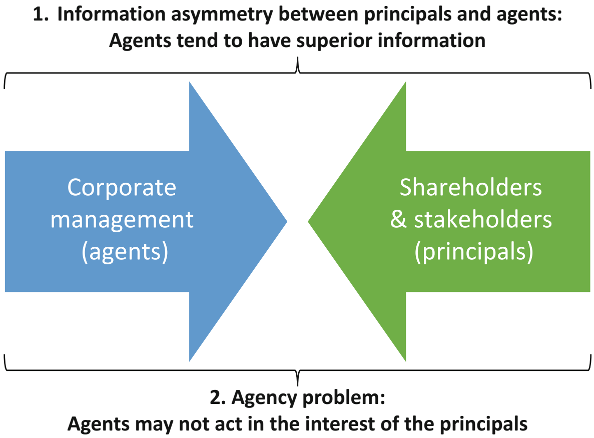
- Explain the role of corporate governance in steering companies' behaviours
- Analyse the influence of asymmetric information and agency problems
- Distinguish and analyse the main corporate governance models
- Explain how the interests of various stakeholders can be balanced
- Describe differences in ownership structures across the world

3.1 Current Corporate Governance Models

Disconnects between the owners or shareholders of a company, its managers, and the society in which the company operates can and do happen. Hence, the importance of *corporate governance*, which refers to the mechanisms, relations, and processes by which a company is controlled and directed. It involves balancing the many interests of a company's stakeholders. Modern insights from corporate governance go beyond financial factors. At the core of corporate governance, there are two problems (see Fig. 3.1).

The first is *asymmetric information* about a company between the insiders of the company (corporate management) and the outsiders (stakeholders). The second is the *agency problem* whereby the agents (corporate management) may not act in the interest of the principals (stakeholders). These two problems aggravate each other: the information asymmetry makes it harder to ascertain to what extent the agent works for the principals, while the agency problem gives incentives to the agents to worsen information asymmetry. This section reviews the current shareholder model and stakeholder models. Section 3.2 introduces the integrated model of corporate governance.

Fig. 3.1 The two main corporate governance problems



3.1.1 The Shareholder Model

As corporate ownership varies around the world, so do corporate governance challenges. Anglo countries (a group of English-speaking countries made up of the United Kingdom, Australia, the USA, Canada, and New Zealand) typically have companies with dispersed shareholders, and active trading in stock markets. La Porta et al. (1999) indicate that common law countries such as the UK, USA, Australia, and Canada fit this picture. In this setting, classical *agency theory* focuses on conflicts of interest between owners (i.e., shareholders) as principals and managers as agents (Jensen & Meckling, 1976). Does the manager put in enough effort? Does he or she act in the interest of the shareholder? Solutions are found in the control and incentivisation of managers. Examples are contracts for a limited term (typically 4 years) and performance-related pay (see Sect. 3.4). A strong element of the shareholder model is the accountability of management and the scope for correction, such as the removal of management or takeover of the company in case of underperformance (see Chap. 18).

However, these solutions can create new problems, because managers might become incentivised to focus on short-term profits only. Shareholder value is a long-term concept, because it incorporates all future cash flows. But there is evidence of managers focusing on short-term earnings targets (Graham et al., 2005). Furthermore, managers with short-term incentives, such as stock and options packages, cut investment to meet short-term earnings targets (Edmans et al., 2017). Short-termism can result in massive losses for both shareholders and stakeholders. Box 3.1 provides an example.

Box 3.1: Short-Termism at Boeing

As highlighted in this example from aircraft manufacturer Boeing, short-termism can result in massive losses for shareholders and stakeholders. Boeing hid significant instrument and flight-control risks in its 737 MAX aircraft from airlines. This resulted in two crashes in 2018 and 2019, in which 346 people died. A CNN article[1] argued that Boeing's 737 Max debacle could be the most expensive corporate blunder ever: 'Boeing has detailed about $20 billion in direct costs from the grounding: $8.6 billion in compensation to customers for having their planes grounded, $5 billion for unusual costs of production, and $6.3 billion for increased costs of the 737 MAX program'.

The article then went on to say that the indirect costs of cancelled orders could be double that number, resulting in total costs of well over $60 billion. A Los Angeles Times article[2] argued that Boeing had sacrificed quality on the altar of shareholder value: 'Chief Executive Dennis Muilenburg testified before Congress. He was awful. He kept saying that safety was part of Boeing's DNA, yet the evidence that angry legislators confronted him with—internal emails, for the most part—suggested just the opposite: that safety was no longer high on Boeing's list of priorities. What was ascendant was maximising shareholder value, with catastrophic consequences'.

Controlling Shareholders and the Risk of Tunnelling

In contrast to the common law countries, mainland Europe and Asia have more companies with controlling shareholders. This brings more direct relations with management and potentially, better monitoring. However, these companies may still disadvantage minority shareholders (and other stakeholders). A case in point is the illegal business practice of *tunnelling*, whereby a controlling shareholder directs company assets to themself for personal gain (e.g., to other parts of their business group) at the expense of minority shareholders (Bae et al., 2002; Bebchuk & Weisbach, 2010). Strong shareholder protection measures are, then, a solution to protect minority shareholders. The controlling shareholder, often the family or the state, can directly appoint the manager (La Porta et al., 1999). In these civil law countries, the market for corporate control is less active, and management is held less accountable and more entrenched than in common law countries. As a result, intervention in underperforming companies can be delayed—or not happen at all.

[1] 'Boeing's 737 Max debacle could be the most expensive corporate blunder ever', CNN, 17 November 2020.

[2] 'Boeing sacrificed quality on the altar of shareholder value', Los Angeles Times, 17 January 2020

3.1.2 The Stakeholder Model

Civil codes typically embrace the interest of a broad set of stakeholders, notably employees (Freeman, 1984). As explained in Chap. 1, the stakeholder model argues that managers should balance the interests of all stakeholders, which include financial agents (shareholders and debt holders) as well as social agents (employees, consumers, suppliers). The corporate law of stakeholder-oriented countries tends to specify that boards should act in the interest of the company and its stakeholders. Some countries, such as Germany, even enshrine the rights of employees in legislation. In the so-called system of codetermination, both shareholders and employees can appoint representatives to a company's board. This may still result in poor outcomes, with shareholder and employee interests being maximised at the expense of other stakeholders. For example, in the Dieselgate scandal at Volkswagen, the shareholders pushed for profits (F), the local government pushed for jobs (S), and the E suffered as engineers gamed engine software to artificially meet emissions standards (see Box 3.2 below).

Liang and Renneboog (2017) find that cross-country variation in companies' sustainability efforts is partly explained by legal origin. Legal origin refers to the distinction between common law (created by judges and written opinions) and civil law (rooted in Roman law, with core principles coded into a referable system), which are alternative systems of social control of economic life. Environmental, social, and governance (ESG) scores tend to be higher in civil law countries than in common law countries, reflecting social preferences for good corporate behaviour and a stakeholder orientation. Such social preferences are embedded in rule-based mechanisms that restrict firm behaviour ex ante. These mechanisms are more prevalent in civil law countries. In contrast, ex-post judicial settlement mechanisms are more important in common law countries. The English common law tradition emphasises shareholder primacy and a private market-oriented strategy of social control; and perhaps because of this emphasis, it is also less stakeholder-oriented (Liang & Renneboog, 2017).

Corporate Governance Codes

As legislation lacks flexibility, best practices in corporate governance are typically enshrined in corporate governance codes, which can be updated more frequently. Leading countries have a corporate governance committee or council with members drawn from industry, investors, trade unions, and academia. Corporate governance codes have started to address the narrow shareholder perspective and short-termism in financial markets. Interesting examples are the Dutch and UK corporate governance codes, which include long-term value creation for a company's various stakeholders as a corporate objective.

3.1.3 Governance and Company Value

Good governance contributes to the value of the company. Well-run companies are better able to realise their long-term (or integrated) value potential by making better decisions, including investment decisions. In contrast, bad governance depresses company value and can lead to corporate defaults (see Box 3.2). The higher valuation of well-run companies is a combination of expanding business (integrated value creation) and reducing risk (lower cost of capital). The strength of corporate governance varies across countries. First, the ownership structure varies across the world, as set out in Sect. 3.3. Next, there is a strong correlation between company-level governance and the broad institutional setting of a country. Leakage of capital from companies, which is accommodated by weak country-level institutions, is detrimental to building sustainable business (Khan, 2019).

No corporate governance model is immune to corporate scandals, which can and do happen in all major regions. Well-known examples are Enron in the USA, Volkswagen in Europe, and Olympus in Japan (see Box 3.2). These corporate scandals reveal classical agency problems in companies, whereby management has several ways to boost profits and hide problems. The aim of corporate governance is to mitigate these agency problems.

Box 3.2: Corporate Scandals Across the World

Enron

The collapse of Enron in 2001, at the time the largest corporate bankruptcy in American history, involved the use of accounting loopholes, special purpose entities, and poor financial reporting. In that way, management (i.e., the CEO and the CFO) of the energy company was able to hide billions of dollars in debt from failed deals and projects. These practices inflated Enron's accounts and performance. The bankruptcy of Enron also led to the closure of its accountant, Arthur Andersen.

Volkswagen

In 2015, the US Environmental Protection Agency found that many VW cars sold in America had a 'defeat device' (software) in diesel engines which could detect that the engines were being tested, changing the performance accordingly to improve results. Volkswagen engineers installed the software as they were under pressure from the company's major push to sell diesel cars in the US, backed by a huge marketing campaign proclaiming its cars' low emissions. Volkswagen admitted cheating emissions tests in the USA and paid billions in damages. As a response, there was a major overhaul of VW's management board in Germany.

Olympus

In October 2011, Michael Woodford was suddenly ousted as chief executive of optical equipment manufacturer Olympus, launching a scandal.

(continued)

Box 3.2 (continued)
Woodford's 'sin' was that he exposed 'one of the biggest and longest-running loss-hiding arrangements in Japanese corporate history'. Irregular payments for acquisitions resulted in very significant asset impairment charges in the company's accounts. The corruption scandal involved concealment of more than 117.7 billion yen ($1.5 billion) of investment losses and other dubious fees, as well as suspicion of covert payments to criminal organisations. By 2012, the scandal had wiped out 75–80% of the company's stock market valuation and had led to the resignation of much of the board.

3.2 The Integrated Model of Corporate Governance

To update the stakeholder model, the integrated model of corporate governance introduces integrated value, which combines financial, social, and environmental value, as a central company objective. The company then optimises the interests of both current and future stakeholders. Table 3.1 compares the three main models, which are explained in Chap. 1. The differences between the models follow from their different objectives. In the shareholder model, the company is supposed to be run in the interests of the shareholders, thus to maximise financial value. The other models hold that managers should act in the interests of the stakeholders, including shareholders, and expand the company objective to stakeholder value and integrated value, respectively.

The strength of the shareholder model lies in its single measure of success (shareholder value), which improves the simplicity of decision-making and accountability—but at the cost of ignoring social and environmental objectives. Chapter 2 shows how companies can create integrated value by combining economic (shareholder) and societal (other stakeholders) value. While the stakeholder and integrated models include these interests, the multiple objectives provide unclear guidance for decision-making and accountability (Tirole, 2001). The solution is to develop rules for balancing the interests of the various stakeholders. The balancing of interests for integrated value creation can be done qualitatively and quantitatively.

3.2.1 How Can Interests Be Balanced?

Mayer (2018, 2022) argues that directors should act according to the company's purpose: the reasons why the company was created, why it exists, and what it is there to do. These reasons should be the guiding star of the board, and not the rigid rules of shareholder rights or primacy that trump other interests. It is in light of the company's purpose, and its associated values, that the board's actions and performance should be judged. Directors have the right to act with judgement—business

Table 3.1 Comparing corporate governance models

Dimension	Shareholder model	Stakeholder model	Integrated model
Objective	Shareholder value	Stakeholder value	Integrated value
Optimisation	FV	$STV = FV + SV$	$IV = FV + SV + EV$
Stakeholders	Shareholders	Current stakeholders	Current and future stakeholders
Assumptions	• Shareholders, as residual claimants, 'own' the company and deserve control • Serving the interests of other stakeholders is instrumental to shareholder value	• Managers act in the interest of the company on behalf of financial and social stakeholders	• Managers act in the interest of the company on behalf of financial, social, and environmental stakeholders
Implications	• Shareholder value provides clear guidance for decision-making and accountability • Social and environmental value considerations come second, if considered at all	• Multiple objectives suggest unclear guidance and require balancing rules for decision-making and accountability • Financial and social value considerations incorporated • Environmental value considerations come second, if considered at all	• Multiple objectives suggest unclear guidance and require balancing rules for decision-making and accountability • Financial, social, and environmental value considerations incorporated

Note: FV, financial value; SV, social value; EV, environmental value; STV, stakeholder value; IV, integrated value
Source: Schoenmaker et al. (2023)

judgement—and they should exercise that judgement in a form that they believe is appropriate to the circumstances. By making corporate values explicit, management becomes accountable to deliver on corporate purpose. Mayer (2022) encourages a multiplicity of purposes across companies, and competition in models to deliver them, to stimulate innovation. This also means that companies should report on their performance in achieving their purpose. For example, if a company's purpose is to improve people's health, the company should collect data on the health improvements it achieves and report on it (see Chap. 17).

A different approach is taken by Edmans (2020). He develops principles of multiplication, comparative advantage, and materiality, which do not rely on calculations. Edmans (2020, p.61) stresses that *'value is only created when an enterprise uses resources to deliver more value than they could do elsewhere—the social benefits exceed the social opportunity costs'*. The three interrelated principles should guide a manager's judgement to deliver value in complex situations with multiple stakeholders. The principle of multiplication ensures that the social benefits exceed private costs, which is an easy hurdle to pass. The principle of comparative advantage requires the company to deliver more value with an activity than other companies would. Finally, the principle of materiality asks whether the stakeholders that benefit from the company's activity are material to the company. The combined application of these principles makes it likely that the activity creates profits by creating value for society. However, this does not necessarily mean that negative impacts are avoided.

The common element of these qualitative approaches is that a company should—in accordance with its purpose—deliver value to its main stakeholders. Both Mayer (2018) and Edmans (2020) argue that it is not only difficult or impossible to forecast the monetary effect on each stakeholder, but also difficult to weight the different stakeholders. Therefore, you cannot measure overall societal value. This leaves the problem of holding management accountable to its multiple stakeholders (Bebchuk & Tallarita, 2021; Tirole, 2001).

3.2.2 Integrated Measure

To address the accountability challenge, an integrated measure that captures overall societal value is needed. Chapter 6 develops an integrated value measure that balances financial, social, and environmental value. This is done by expressing social and environmental value in monetary terms and attaching different parameters to each type of value, depending on a company's purpose. The basic model for integrated value (see Eq. (1.4) in Chap. 1) is as follows:

$$IV = FV + b \cdot SV + c \cdot EV \tag{3.1}$$

where FV, SV, and EV represent financial, social, and environmental value (see Chap. 6 on the methods to measure social and environmental value). The parameters b and c are the weightings for the social and environmental value dimensions.

These decision rules allow for a structured balancing of stakeholder interests. The company board can set the parameters (b and c) of the decision rules in advance and in dialogue with the company's main stakeholders (Schoenmaker et al., 2023). As a result, management has clear guidance for selecting investment projects and can be held accountable by its main stakeholders on the delivery of integrated value (IV) against these rules. Chapter 6 explains the working and application of the integrated value measure in more detail. Appropriate measurement and reporting on integrated value (see Chap. 17) also help to reduce asymmetric information between management and stakeholders.

A key issue in the design of decision rules is the weighting across the value dimensions. While shareholder-driven companies only value the financial dimension ($b = c = 0$), companies that pursue integrated value creation also give a positive weight to the social and environmental dimensions ($b = c \gg 0$). But by how much? The current regime is characterised by a very small weighting of social and environmental value, in the order of magnitude of $b = c = 0.1$. This is quite close to the shareholder model.

What weights should a responsible company pursuing integrated value choose? There are two reasons to take social and environmental value into account. The first reason is normative: companies may want to behave responsibly ($b = c = 1$) to keep their license to operate, as explained in the Introduction of this book. The second reason is that companies may want to improve their competitive position by including social and environmental value in their business model ahead of the expected internalisation of negative impacts. The transition dynamics towards sustainable products and services can go fast, as explained in Chap. 2. Early adopters can build a competitive advantage.

The model allows companies to choose their degree of sustainability from intermediate ($b = c = 0.5$) and equal weights ($b = c = 1$)[3] to purposeful (higher weights for the social and environmental dimensions than for the financial dimension; $b = c > 1$). The majority of responsible companies may apply intermediate or equal weights, depending on the expected speed of internalisation. An example of a company that appears to be applying intermediate weights of approximately one half is the Dutch-Swiss nutrition company DSM-Firmenich. Through a combination of strategic acquisitions and internal restructuring, DSM has been transforming itself from a chemical company to a nutrition company anticipating the transition to healthy food (see Box 18.4 in Chap. 18 on the DSM transformation).

A minority of purposeful companies are leaders in the shift to operating within social and planetary boundaries by shaking up industries and supply chains. Those that are able to scale up their comparative advantage are the ultimate frontrunners that accelerate the transition to a sustainable economy (Edmans, 2020). An example of such a frontrunner is Patagonia, the outdoor clothing company, which sets very rigorous standards for sustainable clothing. Chapter 11 highlights the sustainability challenges for the fast-fashion industry.

Interestingly, Patagonia's founder announced in 2022 that he was giving away the company to protect its purpose. This is how he put it in an open letter[4]: 'Instead of "going public", you could say we're "going purpose". Instead of extracting value from nature and transforming it into wealth for investors, we'll use the wealth Patagonia creates to protect the source of all wealth. Here's how it works: 100% of the company's voting stock transfers to the Patagonia Purpose Trust, created to protect the company's values; and 100% of the nonvoting stock had been given to the Holdfast Collective, a non-profit dedicated to fighting the environmental crisis and defending nature. The funding will come from Patagonia: Each year, the money we make after reinvesting in the business will be distributed as a dividend to help fight the [environmental] crisis'.

[3] We only need two parameters to design relative weights for all three value dimensions in Eq. (3.1), because the effective weight for FV is 1. Equal weights means then a weight of 1 for all three value dimensions.

[4] 'Earth is now our only shareholder', Yvon Chouinard, September 2022

3.3 Ownership and Integrated Value Creation

3.3.1 The Public Company

From the onset of the Industrial Revolution, the public company emerged as the main corporate vehicle in the United Kingdom and the USA. It enabled external financing on stock markets for the large investments needed to build industrial factories and infrastructure. For example, in the USA in the nineteenth century, the largest stock-listed companies were railroad companies. These Anglo countries typically have widely held firms, with dispersed shareholders and active share trading in stock markets. Figure 3.2 indicates that the United Kingdom, the USA, Australia, Canada, and Ireland fit this picture (first panel). The shareholder model is the leading model in these common law countries.

In contrast, Continental Europe, Asia, and Latin America have more firms with controlling shareholders in the form of a family or a state (second and third panel). External finance is then raised predominantly through bank loans instead of shares. These countries typically adopt the stakeholder model. Figure 3.2 shows that family or state ownership is common in Switzerland, Germany, France, the Netherlands, Italy, Spain, South Korea, Hong Kong, Singapore, Argentina, and Mexico.

The public company is an important corporate vehicle, but there are alternative solutions for the organisational form of companies. An important question is to what extent these alternative forms of organisation can be scaled up.

3.3.2 Alternative Company Forms

Private Companies: Held by Families, Foundations, and Private Equity

The first alternative to the publicly listed and widely held company is the private company. As public companies have difficulties resolving agency problems between investors and managers, private companies financed by debt and private equity are gaining in importance (Kahle & Stulz, 2017). The private equity holder is directly involved with management and can intervene directly with the company (see Chap. 10). Private equity adopts absolute performance measurement, which is generally better aligned with company interests than the relative view of institutional investors on publicly listed companies (see Box 3.3). The private equity model can be scaled up, as institutional investors are an important source of capital for private equity. However, there are capacity limits in terms of the skills required and costs made.

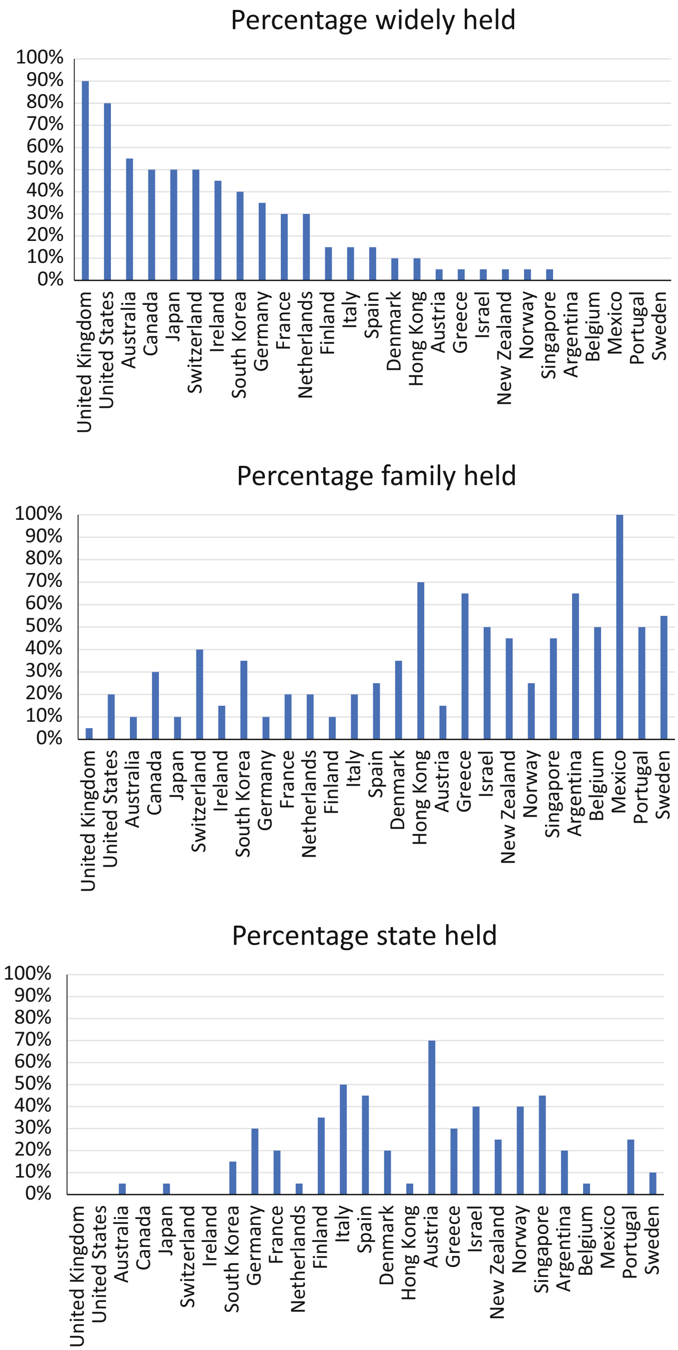


Fig. 3.2 Corporate ownership around the world. Note: The figures classify countries according to corporate ownership. They present means for each variable, using 10% as the criterion for control, for a sample of the 20 largest firms in 27 countries. Source: Adapted from La Porta et al. (1999)

Box 3.3: Relative Versus Absolute Performance Measurement

Investors in publicly listed companies typically focus on the relative performance of companies, as their own performance as investors is judged relative to the market index (see Chap. 12). They are thus less interested in the specifics of individual companies, which they label 'portfolio' companies, as long as the performance is in line with the market.

In contrast, private equity investors are interested in the absolute performance of their companies. In fact, they can hardly judge relative performance since they have difficulty comparing the performance of their company with that of other companies, as there are no stock prices available. Private equity investors perform fundamental analysis based on a company's cash flows, return on invested capital, EBIT margins, and growth prospects. All these metrics are used to arrive at an assessment of the intrinsic value of a company (De Jong et al., 2017).

Other sources of private equity with concentrated ownership are families and foundations. Industrial foundations are often created by the founder or their family, who typically wants to continue the family business. Members of the founding family remain active on the boards of many industrial foundations (Thomsen et al., 2018). Box 3.4 shows the example of the IKEA foundation. Thomsen et al. (2018) show that foundations are patient and committed shareholders, enhancing the longevity of companies. While the tension between shareholders and other stakeholders is still present in privately owned companies, some families or foundations are adopting integrated (or long-term) value creation as an investment goal (De Jong et al., 2017). Family firms excel at smoothing out industry shocks and manage to honour implicit labour contracts. This allows family firms to pay lower wages (Sraer & Thesmar, 2007).

Box 3.4: IKEA Foundation

IKEA is a well-known company that designs and sells ready-to-assemble furniture, kitchen appliances, and home accessories. Founded in Sweden in 1943 by the 17-year-old Ingvar Kamprad, IKEA has become one of the world's largest furniture retailers.

The founder created two foundations that own the IKEA group, INGKA foundation and Interogo foundation. In 2013, Ingvar Kamprad stepped down and appointed his youngest son Mathias Kamprad as chairman. Mathias and his two older brothers, who also have leadership roles at IKEA, work on the corporation's overall vision and long-term strategy.

The Cooperation

A second organisational form is the cooperation. A cooperation or cooperative is created by groups of people, such as customers or suppliers, working together for common or mutual benefit instead of profit. The interests of the major stakeholders (i.e. customers or suppliers) are then aligned with the company in the cooperation model. A major drawback, however, is that a cooperation cannot raise equity beyond its members. The lack of access to external equity can become a constraint on expansion when the cooperation grows large or makes a loss (eroding equity). Moreover, cooperatives do not always incorporate the interests of stakeholders beyond their membership. Cooperatives go back to the nineteenth century (see Box 3.5).

Box 3.5: Credit Cooperatives

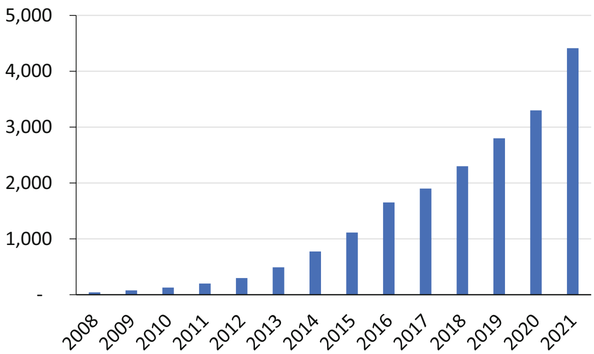
The credit cooperative was an answer to the problems farmers had in obtaining credit from regular banks during the agricultural depression in Germany in the 1850s. Raiffeisen created a firm jointly owned by German farmers: the credit cooperative. It was based on democratic governance by members, long-term horizon and relationships, locality, and combination of economic and social goals (Groeneveld, 2020).

The Raiffeisen cooperative model is still present today, for example in the Dutch Rabobank, the Austrian Raiffeisen Zentralbank, and the German Raiffeissen cooperatives.

B Corporation

A third organisational form is the B corporation, which is a company that is certified as meeting certain social and environmental standards (Kim et al., 2016). The B corporation certification is provided on a private basis to for-profit companies by B Lab, a global non-profit organisation. To be granted certification, and to preserve it, companies must receive a minimum score for 'social and environmental performance'. Public transparency and accountability for balancing profit and purpose are other requirements. However, the B corporation has no legal status, unlike the benefit corporation, which is a legal form conferred by State Law in the USA. Figure 3.3 shows the exponential rise of certified B corps. The number of B corps rose from 43 in 2008 to 4413 in 2021, spanning 77 countries.

Fig. 3.3 Number of certified B corporations. Source: Adapted from B Lab



The B corporation highlights the tension between the shareholder and the integrated model, described in Sect. 3.2. Danone, a global food company and one of the larger B corps, is an example where tensions came to the surface (see Box 3.6).

Box 3.6: Danone as B Corp

Danone is a global food company headquartered in France. It is an industry leader in implementing sustainable agricultural practices. While Danone aims for 100% B corp certification, several divisions of Danone have already acquired B corp certification.

B corps are accountable for balancing profit and purpose, which in this book we call integrated performance (financial, social, and environmental). In early 2021, activist investors started to pressure Danone on its poor financial performance and asked for the dismissal of its CEO, Emmanuel Faber, who championed Danone as B corp. Ideally, the CEO would have been held accountable for Danone's integrated performance by its stakeholders. However, the shareholders called the shots and fired the CEO because of poor financial performance.

Of course, companies need to meet financial, social, and environmental performance standards. However, accountability should be based on a holistic view of the three dimensions. In practice, this means that the board needs to ensure that profit (financial performance) and purpose (social and environmental performance) are well balanced. A prolonged shortfall on either side creates pressure.

Social Enterprise

A fourth organisational form is the social enterprise or foundation with a social or environmental objective (e.g., a hospital promoting health care). These social enterprises or foundations are non-profit, but to continue their operations they need to obtain sufficient funding, which may involve pressure from funders. Societal impact comes first at these organisations, reflected in a higher parameter value for b and/or c in Eq. (3.1). To prevent governance problems, these parameters are best set explicitly by management in discussion with its stakeholders.

Governmental Organisation

A fifth organisational form is a governmental organisation with a public objective. This ranges from a full governmental organisation to a (majority) state-owned company or a private company with government intervention (by means of strict regulations or Pigouvian taxes; see Chap. 2). The advantage of governmental organisations is that they are run for the public good. However, the challenge is to operate efficiently in the public domain, as the profit motive is missing. Moreover, governmental organisations are dependent on the public budget for expansion, which may lead to underinvestment when public finances are tight. Box 3.7 discusses the importance of state-owned companies in China.

Box 3.7: State-Owned Enterprises in China

State-owned enterprises (SOEs) play an important role in the Chinese economy. While SOEs have lower economic performance (due to low production efficiency), they also have advantages (Lin et al., 2020):

1. Government interventions in the market can benefit the economy by maximising resource mobility to capital-intensive industries, which are essential for the economy
2. SOEs are a second-best way to maintain social stability by offering employment during economic recessions
3. The government can use SOEs to maintain control over key elements of society: the 'commanding heights' of state control

The Chinese government can thus implement social and environmental policies in a more direct way through its SOEs. SOEs have two sets of agency problems. The first is between the controlling shareholder (the state) who has 100% of the voting rights and the minority shareholders (see Sect. 3.1). The second is between the controlling shareholder (the state) and the managers.

On the financing side, the Chinese banking sector is also controlled by the government. SOEs can therefore obtain long-term loans with low creditworthiness requirements, resulting in a large number of non-performing loans (Lin et al., 2020). Chinese SOEs are thus less constrained by the public budget than government organisations in other countries, but there is also an elevated risk of creating zombie companies. A zombie company is an uncompetitive company that needs a bailout to operate successfully, or an indebted company that is only able to repay interest on its debt.

3.3.3 Role of Institutional Investors

Institutional investors are (large) financial institutions that manage investments (equities, bonds, and alternative assets) for clients and beneficiaries. Traditional institutional investors include investment funds, pension funds, and insurance companies. Alternative institutional investors include sovereign wealth funds, hedge funds, and private equity. As professional parties, institutional investors have the means and knowledge to engage with companies. They play an increasingly important role in the investment landscape. Figure 3.4 shows that the size of traditional institutional investors has increased—from 67% of GDP in 1990 to 230% of GDP in 2016. Institutional investment is expected to rise further due to ageing, reduction of social security, and increased wealth (Darvas & Schoenmaker, 2018).

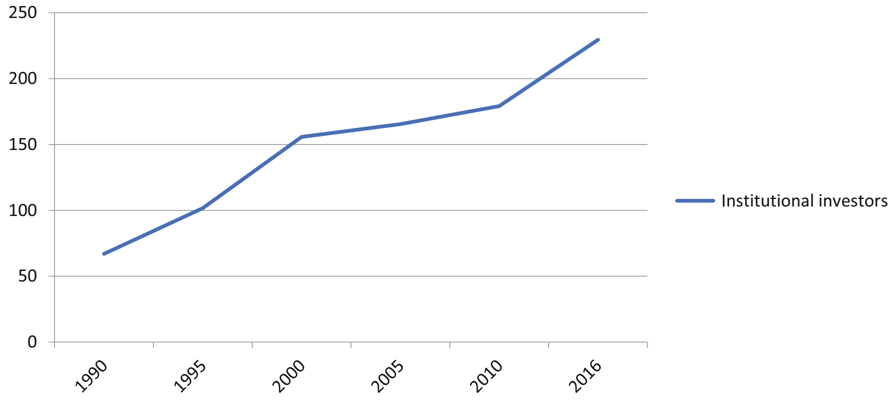


Fig. 3.4 Rise of institutional investors (assets as a % of GDP). Note: Assets of institutional investors (pension funds, insurers, and investment funds) of 15 large EU countries, Switzerland and the USA as % of GDP. Source: Authors' calculations based on ECB (2017) and OECD (2017)

Institutional investors have become important players in the stock market. Table 3.2 shows that their share of equity holdings has increased to approximately 65% across developed countries. Traditional institutional investors (investment funds, pension funds, and insurers) own 58% of equity holdings, and alternative institutional investors (sovereign wealth funds and hedge funds) own another 7%. Institutional investors are thus the dominant shareholders of publicly listed companies.

This means they can potentially wield a lot of power. How can investors exert influence on the companies in which they invest? Institutional investors have two choices for action if they are disappointed with an investee company:

(i) Voice (or direct intervention): they can engage with management to try to institute change and vote on shareholder resolutions at the annual general meeting or
(ii) Exit (or divestment): they can leave the company by selling shares, or threaten to leave

The drawback of exit/divestment is that the impact may be limited as another investor simply buys the shares without questioning management, and nothing may change. *Engagement* refers to investors' dialogue with investee companies on a broad range of ESG issues. Of course, the question then arises of how effective this engagement is.

Moreover, there are concerns that both voice and exit are limited by the rise of passive investments. These are investments in which institutional investors delegate much of their influence to a small number of index providers (Petry et al., 2021) and index funds (Fichtner et al., 2017) which have few incentives to exercise their voice and exit activities. Large investment funds, such as BlackRock and Fidelity, offer

Table 3.2 Share of institutional investors in equity (2016)

Type of institutional investor	Amount (in US$ trillion)	Share in equity markets (%)
Investment funds	24.0	41.1
Investment funds (excl. pension funds/ insurers)	11.2	19.1
Pension funds and insurance companies	22.9	39.1
Traditional institutional investors	**34.1**	**58.2**
Sovereign wealth funds	3.3	5.6
Hedge funds	0.9	1.6
Alternative institutional investors	**4.2**	**7.2**
Total institutional investors	**38.3**	**65.4**

Note: Pension funds and insurers invest directly in equity and indirectly via investment funds. This indirect investment is deducted from the equity managed by investment funds to avoid double counting. As only data for institutional investors in developed countries are available, the share is calculated as a percentage of developed equity markets
Source: Authors' calculations based on OECD (2017) and SIFMA (2017)

index funds (also called exchange-traded funds) that passively invest in the market index (see Box 12.3 in Chap. 12).

There is however a countermovement, with some pension funds building more concentrated portfolios based on active management and engagement with investee companies (Schoenmaker & Schramade, 2019). Institutional investors can increase their impact by forming coalitions to foster joint engagement. Dimson et al. (2021) provide evidence that collaboration among activist investors is instrumental in increasing the success rate of social and environmental engagements.

Emerging evidence indicates that large institutional investors, in particular pension funds, drive the social and environmental performance of companies (Dyck et al., 2019). These institutions are motivated by both financial and social returns. In contrast, hedge funds hold smaller shares (only 1.6% of aggregate equity in Table 3.2) but are very active shareholders, and more financially driven. Hedge fund campaigns are associated with three broad sets of outcomes for targeted companies: (a) an immediate but short-lived increase in market value and profitability; (b) decreases in the number of employees, operating expenses, R&D spending, and capital expenditures; and (c) the suppression of corporate social performance (DesJardine & Durand, 2020).

3.4 Corporate Governance Mechanisms

Section 3.2 has set out how the integrated model can broaden corporate governance to various stakeholders, and how the board can apply an integrated value measure to quantify and balance the underlying financial, social, and environmental value creation for these stakeholders. The next question is what mechanisms can be

Fig. 3.5 EU sustainable finance strategy

designed to make the integrated model operational: how to include the interests of the various stakeholders in board decision-making? This section reviews the mechanisms to include the interests of the various stakeholders on the board. These mechanisms can be enshrined in company law or in board mechanisms at the company level.

3.4.1 Role of Company Law

The European Union is most advanced in including the interests of the social and environmental stakeholders in legislation. Figure 3.5 illustrates the EU's sustainable finance strategy[5] with four key components.

Sustainability Disclosure

The starting point of the European legal framework is to create a consistent and coherent flow of sustainability information throughout the financial value chain. The first two components cover this information flow. The Corporate Sustainability Reporting Directive (CSRD, effective from January 2025) requires large companies to systematically disclose information in the way they manage social and environmental challenges, including negative impacts and double materiality (see Chap. 2). This helps investors, consumers, and other stakeholders evaluate the sustainability performance of companies, and it encourages these companies to develop a responsible approach to business.

Taxonomy

The investment side is covered by the EU taxonomy of green investment. This classification system establishes a list of environmentally sustainable economic activities. The taxonomy requires companies to disclose certain indicators about the extent to which their activities are environmentally sustainable, according to the taxonomy. By providing appropriate definitions to companies and investors on which economic activities can be considered environmentally sustainable, the

[5] European Commission, 'Strategy for financing the transition to a sustainable economy', 6 July 2021

taxonomy (1) creates security for investors, (2) protects private investors from greenwashing, and (3) helps companies to plan the transition. This will eventually help in the scale-up of sustainable investment. As of early 2023, the European Union is planning to expand the taxonomy in several ways: (1) to cover grey and brown investments that are detrimental to sustainability and (2) to include S(ocial) in addition to E(cological) activities. In this way, the EU would reward investors that transform brown or grey companies into green ones, such as done by the Follow This initiative, for example (see Box 3.8).

Box 3.8: Follow This and Oil Companies

Follow This is a non-governmental organisation (NGO) pressuring the oil industry. Marc van Baal, the founder, realised that to change the oil industry, he would have to become a shareholder. He bought the minimum amount of shares to file resolutions in the five major oil companies in Europe and the USA. He submitted resolutions asking the oil majors to align their emission targets with the Paris climate agreement. The management teams appealed to shareholders to vote against these resolutions.

The next step was to convince other (large) shareholders to vote in favour of the resolutions. Starting with 3% voting for it and another 3% withholding from voting at Shell's annual general meeting in 2016, Follow This obtained 30% voting for its resolution in 2021. The voting patterns for the other oil majors are similar. The boards of the oil majors have now started to talk to Follow This and feel the pressure to speed up the transition to renewable energy in order to meet the Paris targets.

Investor Duties

With respect to investors' duties, the European legal framework requires institutional investors to integrate sustainability considerations into their investment decision-making process. This supports the integrated model of corporate governance from the investor side.

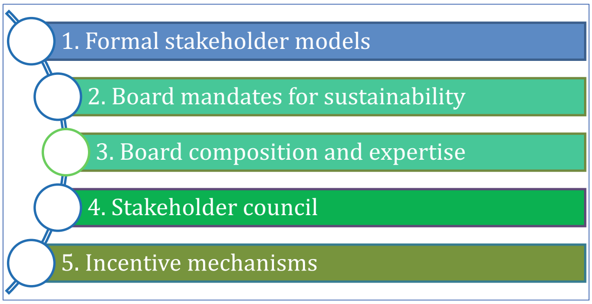
Corporate Governance

Finally, the European sustainable corporate governance initiative aims to encourage businesses to consider environmental, social, human, and economic impacts in their business decisions and to focus on long-term sustainable value creation rather than short-term financial value.

3.4.2 Board Mechanisms at the Company Level

There are several mechanisms to include the interests of the various stakeholders in board decision-making. Figure 3.6 provides an overview.

Fig. 3.6 Board mechanisms to foster stakeholder interests



Formal Stakeholder Models

Formal stakeholder models, such as codetermination (under which employees and possibly other groups elect directors along with shareholders), typically focus on the particular interests of the involved stakeholder groups rather than the general interest of the company. Moreover, the scope and number of stakeholders evolve over time, while formal mechanisms are static.

Board Mandates

A more flexible mechanism is formulating formal board mandates for sustainability at the company level. These formal board mandates can be incorporated into the company's charter or bylaws (Ramani & Ward, 2019). Such mandates make sustainability an explicit board priority and facilitate board sustainability oversight. To make it work, boards must disclose whether they discuss sustainability with management during board meetings. Boards can then work with management to identify specific social and environmental priorities for the company, include them in the company's strategy, and assess their impact on the company's integrated value.

Board Composition and Expertise

Another mechanism is the composition of a board and the expertise of its members. Coffee (2020) argues for broadly representative and diverse boards that are sensitive to the company's impact on society. Such broad and diverse boards are diverse not only in terms of gender, ethnicity, and age but also expertise. Without directors who have the proper sustainability expertise, boards do not possess the collective skillset and background to examine the impacts of complex social and environmental issues on corporate strategy. However, international evidence shows that less than 5% of executive and non-executive role specifications require sustainability experience or a sustainability mindset (Reus, 2018; Sørensen & Handcock, 2020). This seems to be a missed opportunity for companies in their pursuit of broader stakeholder interests.

Stakeholder Council

To foster accountability, a company can establish a stakeholder council comprised of the relevant stakeholders. The board would discuss, at least once a year, the sustainability performance of the company. The board can also consult the stakeholder council on important decisions with societal impact. To promote transparency, the stakeholder council reports annually about its activities and advice in the company's integrated annual report. A challenge is to include not only current stakeholders but also future stakeholders. An interesting mechanism, developed in Japanese local politics, is future design (Saijo, 2020). Future design aims to solve the dilemma between current stakeholders, who bear the cost of long-term investment, and future stakeholders, who reap the benefits (see Box 3.9).

Box 3.9: Future Design

The idea of future design is simple. If there is no one to protect the interests of future generations, then designate people to take on the role of future generations and have them stand in for future generations. This is the same reasoning as in role-playing scenarios used frequently in, for example, war games. Saijo (2020) calls the people who are to take on the role of future generations the 'imaginary future generation' or 'imaginary future persons'. It is found that the people who become members of an 'imaginary future generation' truly change their lines of thought and points of view, becoming clearly aware of the interests of future generations. As a result, they actually think and act in the interest of future generations. One or more persons with such a designated role can be added to the stakeholder council.

Incentive Mechanisms

Finally, incentive mechanisms play a role. While variable executive pay is related mainly to financial performance, companies are starting to include sustainability targets in executive remuneration. Using an international sample of ISS Executive Compensation Analytics, Ormazabal et al. (2023) show that the adoption of sustainability metrics in executive compensation contracts is rising rapidly, from 1% in 2011 to 38% in 2021. However, Table 3.3 indicates that the distribution is uneven. While 45.3% of European companies include sustainability targets in executive contracts, only 16.5% of US companies do so. One could of course question the ambition levels of these targets. However, it is encouraging that the authors also find that the adoption of sustainability variables in managerial performance is accompanied by improvements in sustainability performance and meaningful changes in the compensation of executives. Linking executive compensation

Table 3.3 Geographical distribution of adoption of sustainability targets in executive pay

Country	# of companies in empirical study	# of companies with sustainability target	% of companies with sustainability target
Europe	1408	638	45.3%
USA	2243	370	16.5%
Total	**3651**	**1008**	**27.6%**

Note: The empirical study covers executive contracts of companies during the period from 2011 to 2020

Source: Ormazabal et al. (2023) based on ISS Executive Compensation Analytics to sustainability goals helps boards make management accountable for sustainability performance (Ramani & Ward, 2019). Another incentive mechanism is deferral of variable compensation by up to 3, 5, or 7 years, for example. Such deferral helps to align executives' interests with the long-term interests of their company. The deferral of bonuses means they can be forfeit if evidence emerges of unexpectedly poor financial, social, or environmental performance by the executive, their team, or the company overall.

3.5 Conclusions

Corporate governance is about controlling and directing the company. In the shareholder model, the ultimate control is with shareholders, who are financially driven. The company objective in the shareholder model is financial value maximisation. The stakeholder model includes other stakeholders, such as employees, customers, and suppliers, alongside the shareholders. The stakeholder model thus adds social stakeholders and focuses on financial and social value as company objective. The integrated model also covers future stakeholders, representing the environment. It expands the company objective to integrated value, which combines financial, social, and environmental value.

The balancing of the interests of various stakeholders is central to corporate governance. Timely and reliable information on financial, social, and environmental factors is important to assess the status of the various interests. The concept of integrated value, introduced in Chap. 1, is instrumental in providing information and aligning interests in ex-ante decision-making and ex-post accountability. Integrated value can also provide guidance on dealing with trade-offs between the interests of various stakeholders.

Ownership structures are also relevant. While family- or foundation-owned companies typically have a long-term orientation, publicly listed companies have to serve a wide (and sometimes demanding) group of shareholders. Another important feature is the expertise of boards. Do board members have the expertise and mindset to apply integrated decision-making across the financial, social, and environmental value dimensions?

Key Concepts Used in This Chapter

Agency theory looks at conflicts of interest between people with different interests in the same assets. An important conflict is that between the principals (shareholders and other stakeholders) and the agents (managers) of companies

Asymmetric information refers to the difference in information about a company between its insiders (executive management) and its outsiders (shareholders and other stakeholders)

Corporate governance refers to the mechanisms, relations, and processes by which a company is controlled and directed. It involves balancing the many interests of the stakeholders of a company

Engagement refers to investors' dialogue with investee companies on a broad range of environmental, social, and corporate governance (ESG) issues

Fiduciary duty sets out the responsibilities that financial institutions owe to their beneficiaries and clients. The expectation is to be loyal to beneficiary interests, prudent in handling money with care, and transparent in dealing with conflicts

Institutional investors are (large) financial institutions that manage investments (equities, bonds, and alternative assets) for clients and beneficiaries. Traditional investors include investment funds, pension funds, and insurance companies. Alternative institutional investors include sovereign wealth funds, hedge funds, and private equity

Integrated model means that a company should balance or optimise the interests of its current and future stakeholders: customers, employees, suppliers, shareholders, creditors, the community, and the environment

Integrated value is obtained by combining the financial, social, and environmental values in an integrated way (with regard for the interconnections)

Integrated value creation refers to the objective of companies that optimise financial, social, and environmental value in the long run

Responsible company manages and balances profit (financial value) and impact (social and environmental value)

Shareholder model means that the ultimate measure of a company's success is the extent to which it enriches its shareholders

Short-termism refers to the myopic behaviour of executives, focusing on the short term

Stakeholder model means that a company should balance or optimise the interests of all its stakeholders: customers, employees, suppliers, shareholders, creditors, and the community

Tunnelling is a practice whereby a controlling shareholder directs company assets to himself for personal gain (e.g., to other parts of his business group) at the expense of the minority shareholders

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Part II

Discount Rates and Valuation Methods

4 Discount Rates and Scarcity of Capital

Overview

The previous chapters discussed why companies should aim for integrated value creation, which involves the balancing of capitals. When aiming for integrated value creation in investment decisions, one necessarily deals with the future. This raises the subject of present values and discount rates—the basics of corporate finance. The first section of this chapter therefore addresses discount rates and the time value of money. These concepts, and the effects of changes in discount rates, are illustrated with calculation examples.

Subsequently, the determinants of discount rates are discussed, starting with government bonds as a benchmark and then adding the premia on corporate bonds and equity. This all applies to financial capital. Next, we introduce the social discount rate for social and environmental capital. The counterparty of companies' social and environmental capital is the wider society, representing current and future generations. Leading economists argue for an equal treatment of current and future generations, which implies a low social discount rate.

Finally, we show how the financial discount rate can be expanded to an integrated discount rate that can be applied to integrated value, which also includes social and environmental value. It is shown that larger environmental and social liabilities raise the integrated discount rate. Conversely, environmental and social assets lower the integrated discount rate. Chapters 12 and 13 provide an in-depth analysis of the integrated discount rate. See Fig. 4.1 for an overview of this Chapter.

Learning Objectives

After you have studied this chapter, you should be able to:

- Interpret the time value of money
- Do basic interest calculations
- Understand and apply various types of interest rates
- Analyse the determinants of (financial) interest rates and the cost of equity
- Critically assess the determinants of discounting social and environmental capital

D. Schoenmaker, W. Schramade, *Corporate Finance for Long-Term Value*, Springer Texts in Business and Economics, https://doi.org/10.1007/978-3-031-35009-2_4

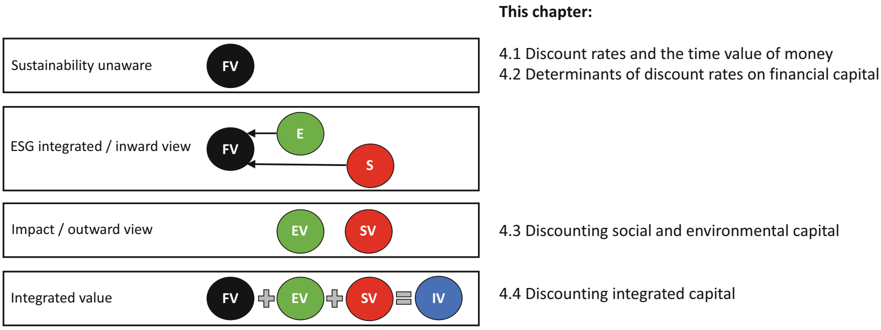


Fig. 4.1 Chapter overview

- Differentiate between discounting financial capital and discounting integrated capital

4.1 Discount Rates and the Time Value of Money

Demand and Supply of Financial Funds

Discount rates of financial capital are determined in a setting of markets with supply and demand of financial funds. Figure 4.2 illustrates the flow of financial funds from investors to users through financial markets and intermediaries (such as banks and institutional investors). A large supply of funds relative to demand lowers the price or discount rate of financial capital, ceteris paribus. Next, financial markets are influenced by government policies. While central banks can supply or withdraw (short-term) funds, governments make regulations to ensure a proper functioning of financial markets. Examples of such government regulations are protection of property rights, enforcement of contracts, transparency of price discovery, and supervision of financial markets and intermediaries (De Haan et al., 2020).

Time Value of Money

Most of the time, people prefer money today over money tomorrow, because of inflation and opportunity costs. This is called the *time value of money*: the difference in value between money now and money in the future. So, how to compare €100 today with €100 in 1 year? The difference is calculated by means of the *discount rate*, which is the interest rate r used to determine the *present value PV* of future cash

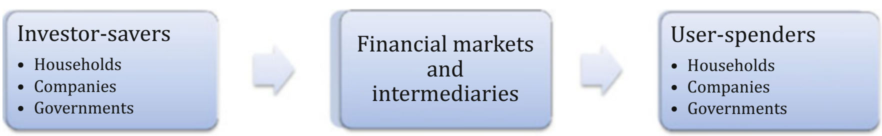


Fig. 4.2 Working of the financial system. *Source:* Adapted from De Haan et al. (2020)

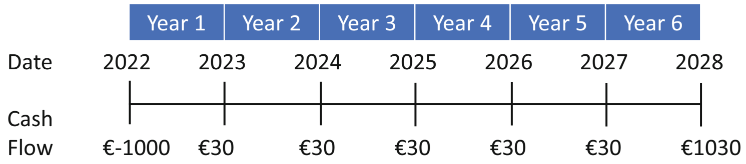


Fig. 4.3 Visualising a stream of cash flows

flows. The *discount factor* then is the factor by which a future cash flow *CF* over *n* periods must be multiplied in order to obtain the present value:

$$\frac{1}{(1+r)^n} \tag{4.1}$$

Suppose the €100 today is equivalent to €103 in 1 year ($n = 1$). The discount rate is then 3%. And the €100 today is referred to as the present value of €103 in 1 year.

$$PV = \frac{CF_n}{(1+r)^n} \tag{4.2}$$

Another way to express this: the €103 in 1 year is the future value of €100 today. *Future value FV* is the value of a cash flow now, expressed in euros in the future.

$$FV = PV \cdot (1+r)^n \tag{4.3}$$

One can also calculate the present value of a stream of cash flows. This often includes negative cash flows as well, in which case one refers to the *net present value NPV*, i.e. net of cash outflows. Let's take the example of a 6-year bond (a debt security issued by governments or companies to investors). Figure 4.3 visualises the annual cash flows of the bond, from the perspective of the bondholder (the investor).

The negative signs are for cash outflows, in this case the payment of the bond's principal (of €1000) in 2022 to the company or country issuing the bond. The principal or face value of a bond is the amount the investor pays to the issuer of the bond. In the years 2023–2028, a €30 coupon (reflecting an annual interest rate payment of 3% of €1000) is received, and in 2028 the principal is paid back by the issuer. Let's suppose the discount rate of the bond is 3%, equal to the coupon. The NPV of the bond is then calculated as presented in Table 4.1. It starts by multiplying each annual cash flow with its associated discount factor. Remember that the discount factor is $1/(1+r)^n$. If 2022 is right now, then $n = 0$ and its discount factor is $1/(1+r)^n = 1/(1.03)^0 = 1$. For 2023, the discount factor is $1/(1+r)^n = 1/(1.03)^1 = 0.971$. Multiplying the annual cashflows with their discount factors gives the annual present values. The sum of those PVs is the NPV. The NPV of a cash flow stream from $n = 0$ to N then becomes:

$$NPV = \sum\nolimits_{n=0}^{N} \frac{CF_n}{(1+r)^n} \tag{4.4}$$

Table 4.1 NPV of a stream of cash flows

Year	2022	2023	2024	2025	2026	2027	2028
Cash flow	–1000	30	30	30	30	30	1030
Discount factor	1	0.971	0.943	0.915	0.888	0.863	0.837
PV	–1000	29.1	28.3	27.5	26.7	25.9	862.6
NPV	**0**						

It might seem a coincidence that the NPV is exactly zero. However, in competitive markets, NPVs will often be zero or close to zero: competition between investors (arbitrage) will quickly result in the adjustment of prices of overpriced or underpriced securities (see Box 4.1 on arbitrage). In the above case, the NPV should be exactly zero, since the discount rate equals the coupon rate.

Box 4.1: Arbitrage and the Law of One Price

Arbitrage involves the buying and selling of the same or similar goods in different markets to benefit from price differences between these markets. Such arbitrage opportunities work if the law of one price does not hold. This 'law' says that the same (that is identical) products should sell at the same price. And if they don't sell at the same prices, the arbitrage mechanism usually makes sure that such differences disappear quickly. For example, if an ounce of gold sells for \$2000 in country A and for \$1800 in country B, then a trader can benefit from the price difference, by buying gold in country B and selling it in country A. Their profit will be \$200 (\$2000–\$1800) minus the transaction costs that they incur in making the trade, such as transportation costs and taxes. If those transaction costs are less than \$200, they have an incentive to do the trade. And as many traders spot this opportunity, they will drive down the price differential to approximately the transaction costs involved.

Interest rates are often news items. A headline might say that central banks keep interest rates low; or that low interest rates hurt banks and push up housing prices. How does that work? Central banks indeed have a crucial role in setting interest rates: they provide short-term money to the market at a certain interest rate, which is called the *policy rate*. Over the past years, many central banks have in addition bought large amounts of bonds, driving up the prices of those bonds and lowering their effective annual interest rates at longer maturities (see further below for calculations). Box 4.2 provides an overview of the principal financial markets.

On June 21, 2021, the following data could be found on CNBC, a provider of financial market news and data, about the Brazilian 10-year government bond *yield* (that is the expected return on a bond when held till maturity), as Table 4.2 illustrates:

Based on the above information, we can derive the cash flow schedule as in the top row of Table 4.3 for the bond. If the bond was priced at par (i.e. at 1000) and the

Table 4.2 Example of 10-year Brazilian government bond

Coupon	10.00%
Yield	9.05%
Maturity	1 January 2031
Price	1104.3

yield equalled the coupon rate at 10%, we obtain an NPV of 0 (Table 4.3). As a reminder, the discount factor is $1/(1 + r)^n$, so for 2022 (1 year after 2021, so n = 1), the discount factor equals $1/(1.1)^1 = 0.909$.

However, when we look at historical yields, we find that the yield was 6.9% on 1 January 2021. Hence, the yield was well below the coupon rate; and with that 6.9% yield, we arrive at an NPV of 218.7 in Table 4.4. The discount factor for 2022 is now $1/(1.069)^1 = 0.935$.

So, the cash flows are worth $218.7 more than the principal of 1000. Does that mean that the Brazilian government was giving money away? Probably not. Most likely, it acted rationally and priced the bond accordingly, at or close to $1000 + $218.7 = $1218.7. At that price, the NPV of the bond was 0, holding up the law of one price (Table 4.5).

Table 4.3 NPV of a 10-year Brazilian government bond—yield equals coupon rate

Time	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031
Cash flow	–1000	100	100	100	100	100	100	100	100	100	1100
Discount factor	1.000	0.909	0.826	0.751	0.683	0.621	0.564	0.513	0.467	0.424	0.386
PV	1000	90.9	82.6	75.1	68.3	62.1	56.4	51.3	46.6	42.4	424.1
NPV	**0**										

Table 4.4 NPV of a 10-year Brazilian government bond—yield well below coupon rate

Time	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031
Cash flow	–1000	100	100	100	100	100	100	100	100	100	1100
Discount factor	1.000	0.935	0.875	0.819	0.766	0.716	0.670	0.627	0.586	0.549	0.513
PV	–1000	93.5	87.5	81.9	76.6	71.6	67.0	62.7	58.6	54.9	564.4
NPV	**218.7**										

Table 4.5 NPV of a 10-year Brazilian government bond—law of one price

Time	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031
Cash flow	–1218.7	100	100	100	100	100	100	100	100	100	1100
Discount factor	1.000	0.935	0.875	0.819	0.766	0.716	0.670	0.627	0.586	0.549	0.513
PV	–1218.7	93.5	87.5	81.9	76.6	71.6	67.0	62.7	58.6	54.9	564.4
NPV	**0**										

Box 4.2: Principal Financial Markets

The principal financial markets are:

- The **money market**—this is the market for short-term funds up to 1 year. Banks and companies use the money market for the management of their short-term liquidity positions (see this chapter)
- The **bond markets**—these are the most important segment of the market for debt securities, with a maturity of more than 1 year. Governments and companies issue bonds to raise medium- and long-term funds against a fixed or flexible interest rate (see this chapter, and Chap. 8)
- The **equity markets**—companies may raise funds by issuing equity that grants the investor a residual claim on the company's income (see Chaps. 9 and 10)
- The **derivatives market**—derivatives are financial instruments whose value is derived from the value of the underlying financial instruments. Derivatives are important risk-management tools for companies (see Chap. 19)
- The **foreign exchange market**, where the relative values of currencies are determined. Companies can use the forex market to trade foreign currencies and hedge currency exposure

Changes in Interest Rates

When we looked up the value of the 10-year Brazilian government bond in June 2021, almost 6 months had passed since its issuance. Over this period, the price of the bond had fallen from \$1218.7 to \$1104.3 and its yield had risen from 6.9 to 9.05% (Table 4.6). Both are reflected in the calculations: the lower price means a less negative initial cash flow; and the yield raises the discount factor. Moreover, the discount factor changes, since we don't use full year but partial year discounting. For example, the 2022 discount factor now becomes $1/(1.0905)^{(194/365)} = 0.955$. Since 1-1-2022 is 194 days away from 21-6-2021, the 9.05% yield only applies to $194/365 = 0.53$ of a year.

The difference between Tables 4.5 and 4.6 illustrates the inverse relation between bond prices and bond yields. But it does not tell us why the price went down and the

Table 4.6 NPV of a 10-year Brazilian government bond—secondary market price

Time	6/21/21	1/1/22	1/1/23	1/1/24	1/1/25	1/1/26	1/1/27	1/1/28	1/1/29	1/1/30	1/1/31
Cash flow	–1104.3	100	100	100	100	100	100	100	100	100	1100
Discount factor	1.000	0.955	0.876	0.803	0.736	0.675	0.619	0.568	0.520	0.477	0.438
PV	–1104.3	95.5	87.6	80.3	73.6	67.5	61.9	56.8	52.0	47.7	481.5
NPV	**0**										

yield went up. Prices and yields can change for various reasons. We will discuss this in Sect. 4.2.

Compounding

The above example showed how the present value of a stream of cash flows can be calculated, and how that present value may change in relation to the discount rate used. Another matter is the development of value over time as a return is earned on it.

Let's suppose that you have €30,000 in a savings account and earn a 2% annual interest on it. What will be the value of your savings account in 50 years' time? The answer depends on what you do with the intermediate returns. 2% on €30,000 is €600. So, if you cash in on your interest each year, then you will earn €600 each year and the value of your account stays at €30,000. The €600 is the simple interest: interest without the effect of compounding. However, if you keep the interest in your savings account, then your annual interest receipts will rise over time since the interest is calculated over a growing amount of capital. You then receive interest not just on the original amount of €30,000 but also on the interest previously earned. This is called compounded interest. The difference in value grows exponentially over time, as Table 4.7 illustrates.

With compounded interest, the value after 50 years is €80,748 instead of €30,000. Of course, a fairer comparison is to add the received interest (50 × €600 = €30,000), in which case the value is €60,000. This is still €20,748 short, i.e. earned from interest on interest. People tend to underestimate this power of compounding. The effects are especially striking at higher returns and over longer periods of time. Figure 4.4 shows that interest on interest is insignificant at the beginning, but grows to 25% of total value (€20,748 out of €80,748).

The compounding effect is also visible when comparing rates of compounding. As seen in Fig. 4.4, 50 years of compounding at 2% results in a final value of €80,748 and a total return of 169%. But compounding at 4% gives a final value of €213,201 (2.6 times higher) and a total return of 611% (3.6 times higher). At 8% compounding, the final value is €1.4 million, over 17 times higher than at 2% (Table 4.8).

Table 4.7 Capital with and without compounding

	2% not compounded		2% compounded	
Year	Capital	Return	Capital	Return
1	30,000	600	30,600	600
2	30,000	600	31,212	612
3	30,000	600	31,836	624
4	30,000	600	32,473	637
5	30,000	600	33,122	649
...				
49	30,000	600	79,164	1552
50	30,000	600	80,748	1583

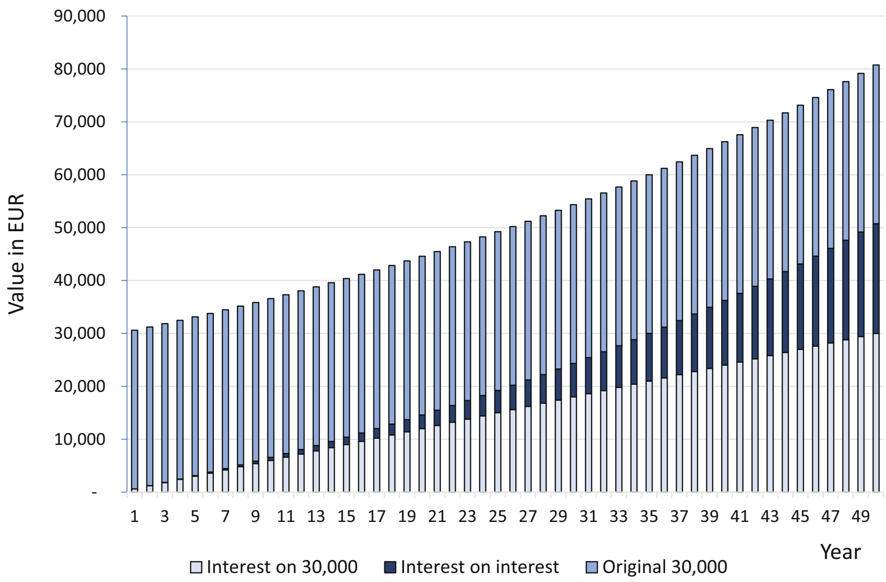


Fig. 4.4 Value composition with compounding returns

Table 4.8 Final values over different time periods and at different compounding rates

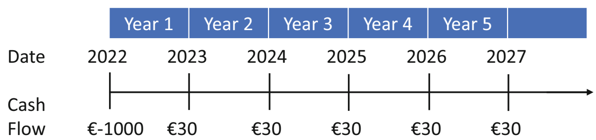
Annual return	Years				
	10	20	30	40	50
2%	36,570	44,578	54,341	66,241	80,748
4%	44,407	65,734	97,302	144,031	213,201
8%	64,768	139,829	301,880	651,736	1,407,048

Perpetuities

A *perpetuity* is a stream of regular and equal cash flows into infinity. For example, a 3% perpetual bond may pay a €30 coupon on an annual basis forever, as Fig. 4.5 illustrates.

The principal of €1000 is never repaid as such, but its value is earned back by means of the perpetual stream of €30 per year. The value of a perpetuity can be calculated as follows:

Fig. 4.5 Visualising a perpetual stream of cash flows



$$PV = \frac{CF_1}{(1+r)} + \frac{CF_2}{(1+r)^2} + \frac{CF_3}{(1+r)^3} + \ldots = \sum\nolimits_{n=1}^{\infty} \frac{CF_n}{(1+r)^n} \tag{4.5}$$

which can be reduced[1] to:

$$PV = \frac{CF}{r} \tag{4.6}$$

In the above example, the value of the perpetuity is €30/0.03 = €1000. This outcome satisfies the *law of one price*: the value of the perpetuity equals the cost to create it.

In practice, perpetual bonds do end at some point as their issuer ceases to exist. Nevertheless, some survive for centuries. For example, Yale owns a Dutch water bond from 1648 that still pays interest.[2]

Annuities

Like a perpetuity, an *annuity* is a stream of equal cash flows paid at regular intervals. Unlike a perpetuity, an annuity ends after a predetermined number of payments. So, an annuity is effectively a perpetuity with an end date ($n = N$) and its calculation reflects that: it is a perpetuity minus that same perpetuity with a later start date (and hence discounted). The value of an annuity can be calculated as follows:

$$PV = \frac{CF}{r} \cdot \left(1 - \frac{1}{(1+r)^N}\right) \tag{4.7}$$

Annuities are often used in mortgages to smooth out the interest payments that are higher at the beginning than later on (when the residual amount has fallen). The borrower pays then equal amounts (divided over interest payment and principal repayment) over the lifetime of the mortgage.

[1] The derivation is as follows (Brealey et al., 2023). We start with Eq. (4.5): $PV = \frac{CF_1}{(1+r)} + \frac{CF_2}{(1+r)^2} + \frac{CF_3}{(1+r)^3} + \ldots$. Now let $\frac{CF}{1+r} = a$ and $\frac{1}{1+r} = x$. Then we get (4.5a): $PV = a \cdot (1 + x + x^2 + \ldots)$. Multiplying both sides by x, we get (4.5b): $PV \cdot x = a \cdot (x + x^2 + \ldots)$. Subtracting (4.5b) from (4.5a), we get $PV \cdot (1 - x) = a$. Substituting back for a and x, we get $PV \cdot \left(1 - \frac{1}{1+r}\right) = \frac{CF}{1+r}$. Multiplying both sides by $(1 + r)$ and then dividing by r gives Eq. (4.6): $PV = \frac{CF}{r}$.

[2] A living artifact from the Dutch Golden Age: Yale's 367-year-old water bond still pays interest | YaleNews

4.2 Determinants of Discount Rates on Financial Capital

So far, we have taken discount rates as a given. But what discount rate should investors use when discounting their expected cash flows? One could of course consider market interest rates—but there are many different interest rates, and there is no single market interest rate. Moreover, the appropriate discount rate depends on a number of issues, some of them specific to the investor or the investment. It therefore makes sense to use a discount rate based on the investor's opportunity cost of capital, also known as the cost of capital. This is the best available return on an investment that has risk and conditions similar to the cash flows to be discounted—either in the market or in other projects available to the company. Box 4.3 illustrates the opportunity cost of capital.

Box 4.3: Opportunity Cost of Capital

If a project is expected to return 11% to the company, while similar investments in the market deliver 9%, then the opportunity cost of capital is 9% and the project promises an excess return of 200 basis points. However, the dynamics can change if the company has several competing projects and a scarcity of capital. For example, if the company has a competing project that is expected to return 14%, then the opportunity cost of capital of the first project is 14% and the excess return of the 11% project is –300 basis points. In that case, the 11% project should not be done, and the 14% project should be chosen. Of course, both should be done if there is sufficient capital to do both projects.

For risk-free projects, a benchmark for (minimal) market risk can be chosen, such as the highest-rated government bonds. However, most corporate projects are not risk-free but carry additional risks that raise the discount rate. Investors typically determine those risk markups (or risk premiums) over the risk-free rate and the resulting discount rate by means of formulas and/or rules of thumb. For example, a private equity investor might use a standard 20% cost of equity for early-stage investments and then apply discounts (deductions) or premia (further markups) on this standard cost for specific industries, more or less mature technologies, quality of management, etc.

There are many determinants of discount rates, such as the demand and supply of capital; expected inflation; investment horizon; tax deductibility of interest rates; seniority; credit risk; illiquidity; sustainability; and behavioural aspects. Analytically, these determinants are typically split in the components that drive government bond yields (benchmark rate); and those that drive the premia on top of them, such as the corporate bond premium and the equity premium (Fig. 4.6). A brief overview is provided here. Chapter 8 on bonds and Chap. 9 on public equities provide a more in-depth treatment of the bond premium (also called the yield spread) and the equity premium.

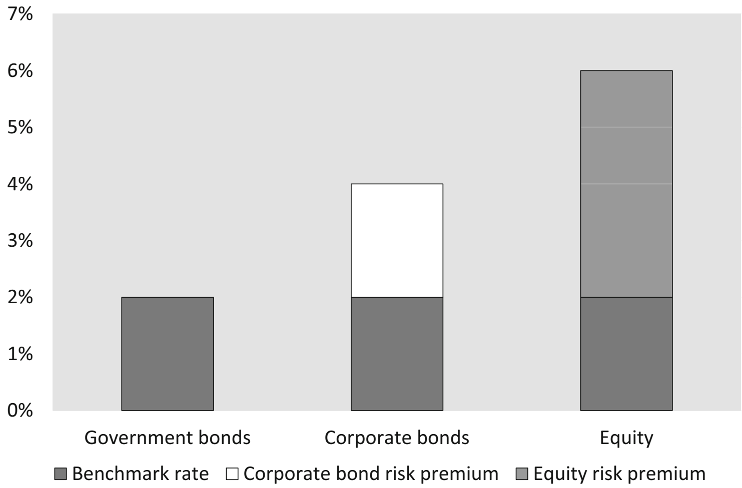


Fig. 4.6 Discount rates and risk premia (illustrative numbers)

Benchmark: Government Bonds

Market discount rates refer to the interest rates on government securities in specific markets. The highest quality government securities are considered 'risk-free'. Market discount rates are the benchmarks against which discount rates are determined. If they move, then all discount rates move. Such moves are effectively shifts in the scarcity of capital. When supply of capital is tight and demand is high, market discount rates (the price of capital) will be high. Conversely, when supply is ample, such as in the recent period of quantitative easing, market discount rates will be low and sometimes even negative. The scarcity is partly set by the central bank's supply of money. But the scarcity is also a function of the risk appetite in the market and the need for capital.

The investment horizon is another consideration. Short-term interest rates are strongly influenced by the monetary policy of central banks. Box 4.4 explains the different money market segments for funds up to 1 year. Yields of government bonds are influenced by expected short-term interest rates and the term premium. Risk-averse investors demand a *term premium* (or *risk premium*) for investments in long-term bonds to compensate them for the risk of losses due to (unexpected) interest rate hikes; those losses increase with a bond's *duration*, which is the sensitivity of a bond's price to changes in interest rates (see Chap. 8).

Box 4.4: Money Market Segments

Money markets are split into:

- Unsecured segment: money borrowed without collateral. This is subject to credit risk and will demand a credit risk premium.
- Secured segment: repurchase agreements (repos) whereby asset is sold against money, while the seller has right and obligation to repurchase the asset at specific price on future date. The underlying asset serves as collateral, eliminating credit risk.

The term premium leads to a positive *term spread*, i.e. the difference or spread between yields for bonds with longer maturity and yields for bonds with shorter maturity. The term spread can even be positive when markets expect increasing and decreasing interest rates to be equally likely.[3] A positive term spread reflects what is often called a 'normal' yield curve. Figure 4.7 shows such an upward sloping yield

Fig. 4.7 German government bond yield curve. Source: World Government Bonds

[3] The term premium can also be negative providing a downward sloping yield curve (inverted yield curve). This depends on the investment horizon of investors: long-term investors, for example, may have a preference for long-term bonds resulting in a lower (or negative) term premium.

curve for German government bonds. A *yield curve* is a visualisation of the term structure, which is the relation between yields and maturities of otherwise similar bonds.

Apart from interest rate expectations and the term premium, *credit risk* and *liquidity* also influence government bond yields. Credit risk is the risk of loss because of the failure of a counterparty to perform according to a contractual arrangement, for instance due to a default by a borrower. The spread between the yield of a particular bond and the yield of a bond with similar characteristics but without credit risk is the *credit risk premium*. Rating agencies—like Moody's, Standard & Poor's (S&P), and Fitch—indicate issuers' credit risk by assigning them a *credit rating*. These are assessments of the risk of default. For example, at the time of writing (2022), Germany, the Netherlands, and the USA had AAA ratings and China and Japan had A+ ratings, whereas Brazil had a BB– rating and India was at BBB–. Differences in those credit ratings are driven by per capita income, GDP growth, inflation, external debt, level of economic development, and default history of the respective governments (Cantor & Pecker, 1996).

Liquidity is the ease with which an investor can sell or buy a bond immediately at a price close to the market price (see Box 8.2 in Chap. 8). Investors prefer more liquid securities, all else equal. The spread between the yield of a bond with high liquidity and a similar bond with less liquidity is referred to as the *liquidity premium*.

In Europe, Germany is the most creditworthy country. German government bonds form the deepest market (most liquid) and serve as benchmark for the euro-yield curve. In the USA, the US Treasury is the benchmark for the dollar-yield curve: see Fig. 4.8. As you can see, the US yield curve is above the German yield curve (Fig. 4.7) at the time of writing.

Corporate Bonds: Yield Spread

Corporate bonds tend to carry more serious default risk and lower liquidity than government bonds. These are the main drivers of the corporate yield spread, which is the difference between yields on corporate bonds and government bonds with the same maturity and rating. For example, yields of AAA-rated corporate bonds are generally higher than AAA-rated government bond yields. The corporate yield spread can be calculated per rating class and per maturity (Table 4.9).

Default risk is the risk that a bond will not make its promised payments. This is higher for corporate bonds since, unlike governments, they do not have the option of raising taxes to meet their payment obligations. They have to meet their obligations from their own cash flow. Defaults of corporate bonds are related to the business cycle and clustered in recession times. Bonds with higher operational and sustainability risk, and higher sensitivity to the business cycle, tend to have lower ratings and higher yields. Operational and sustainability risks can stem from social and environmental issues such as labour unrest or environmental costs that put a burden on financial performance (see Chap. 8 for more detail on default risk).

The lower liquidity of corporate bonds stems from lower trading frequencies and higher transaction costs, which are due to the smaller sizes of individual corporate bond markets (i.e. per security) and less competition among bond traders.

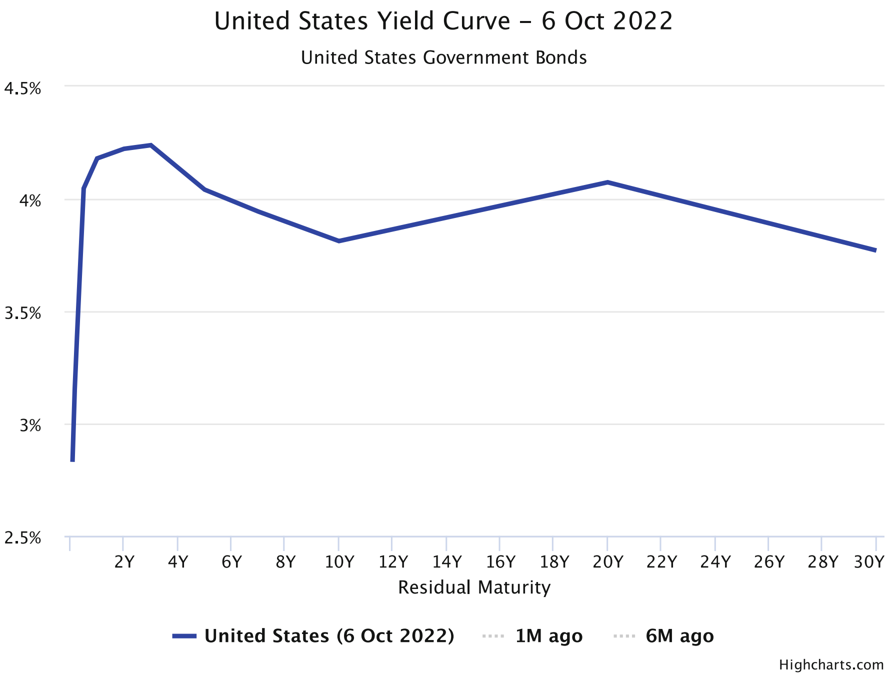


Fig. 4.8 US government bond yield curve. Source: World Government Bonds

Table 4.9 Illustrative corporate yield spread per maturity, November 2022

	1 year	5 years	10 years	20 years
AAA corporate bonds	4.39%	4.30%	4.39%	4.61%
AAA government bonds	4.07%	3.85%	3.65%	4.04%
AAA corporate yield spread	**0.31%**	**0.45%**	**0.75%**	**0.57%**

Source: Bloomberg

Equities: Market Risk Premium

Shareholders are the so-called residual claimants, in that they are paid out of the profits that remain after the other stakeholders and the providers of credit have been paid. As a result, equity typically carries a higher risk than corporate bonds. This higher risk is reflected in the equity risk premium, which is the expected excess return of equities over the risk-free rate. The equity risk premium is mostly related to market risk, but can also be related to social and environmental risk. The equity risk premium tends to be higher for smaller companies, more cyclical companies, and companies with weaker corporate governance. This is discussed more thoroughly in Chap. 12 on risk-return analysis.

Stock markets trade public equity, but equity can be private as well. In fact, most equity in most companies starts as private and remains private. That means there are high transaction costs involved in buying and selling it. As a result, private companies typically have a liquidity discount over public companies (i.e., the equity value of private companies is lower than that of similar public companies).

Behavioural Explanations

The above sections described the determinants of discount rates from the perspective of the securities and markets under consideration. But discount rates are also affected by the ones using them, i.e. the investors. Investors may have behavioural biases that induce them to use other, lower or higher, discount rates than expected. For example, people have the tendency to use the same discount rate for all investment projects within a company, even if they differ significantly in their risk profile. This is called the 'one discount rate fits all heuristic'.

4.3 Discounting Social and Environmental Capital

The previous section discussed the determinants of discount rates of financial capital, which come about in a setting of markets with supply and demand of financial funds. Figure 4.2 in Sect. 4.1 illustrates the flow of financial funds from investors to users through financial markets and intermediaries. A large supply of funds relative to demand lowers the price or discount rate of financial capital, ceteris paribus.

In a similar vein, social and environmental flows can be discounted as well. However, for social and environmental capital, the setting is different. The counterparty of companies' social and environmental capital is the wider society, representing current and future generations. This raises two fundamental and ethical questions:

1. Should current and future generations be treated equally?
2. What is the appropriate discount rate for society (the social discount rate)?

Why Social Discount Rates Are Low

Many moral philosophers (e.g., Krznaric, 2020; Rawls, 1971) and economists (e.g. Ramsey, 1928; Stern, 2006) argue for an equal treatment of current and future generations. In economic terms, this means that the well-being of future generations gets the same weight as the well-being of the present generation (Dasgupta, 2021). So, when evaluating investment proposals for combatting climate change or preserving biodiversity, the well-being or 'interest' of future generations is taken fully into account alongside the interest of the present generation. This implies a zero-time preference between current and future generations. A positive time preference would advantage the present generation at the expense of future generations (facing global warming or biodiversity loss). Krznaric (2020, p.142) describes lucidly the practice of discounting the future as follows 'Discounting is an iconic expression of the colonisation of the future, treating it as virtually empty of inhabitants'.

But there is more to social discounting than the time preference δ between current and future generations. Ramsey (1928) derives the social discount rate r^S for the appraisal of social projects:

$$r^s = \delta + \eta \cdot g \tag{4.8}$$

The growth rate g is driven by growth in consumption as well as by total factor productivity growth (i.e., innovations increase efficiency of production). The latter means that future generations have cheaper and more innovative solutions than those in the present. Given a diminishing marginal utility of consumption, the growth rate is multiplied by the elasticity of marginal utility of consumption η. The elasticity measures how utility changes with consumption. So, if future generations have better technology or if there is a greater elasticity, you should discount more. That is because the discount rate is set in such a way that consumers derive the same utility from current and future consumption. Higher future consumption thus increases the discount rate to equalise it with current consumption.

The social discount rate in Eq. (4.8) is a combination of time preference and (adjusted) consumption growth. The Ramsey rule measures the willingness to pay for a sure transfer of consumption through time. The risk premium for the social discount rate is introduced in Chap. 12.

Economists writing on global climate change (Cline, 1992; Nordhaus, 1994; Stern, 2006) have used Eq. (4.8) to identify optimum policies for correcting climate externalities (external impacts). Table 4.10 shows their different choice of parameters, assuming a growth rate of consumption of 1.3% (Stern, 2006). William Nordhaus is the outlier with a relatively large time preference of 3%. By contrast, William Cline and Nicholas Stern have a time preference close to zero, leading to discount rates of 1–2%. Dasgupta (2021) finds that the vast majority of economists find a social discount rate of 1–3% appropriate for long-run public projects. Low discount rates lead to high investment in combatting climate change, as the future benefits of restricting global warming are almost fully included because of limited discounting.

More broadly, low social discount rates imply that future environmental and social capital is almost as scarce as current environmental and social capital. Companies that add to these scarce capitals create integrated value and will be rewarded, while companies that draw these capitals down will face an increasing cost.

Table 4.10 Parameters for the social discount rate

	Social discount rate $r^s = \delta + \eta \cdot g$ with $g = 1.3\%$		
Author	Time preference δ	Elasticity η	Discount rate r^s
Cline (1992)	0%	1.5	1.95%
Nordhaus (1994)	3%	1	4.3%
Stern (2006)	0.1%	1	1.4%

Source: Dasgupta (2021)

4.4 Discounting Integrated Capital

Chapter 12 will more thoroughly address the issue of discounting on social and environmental capital (denoted by S capital or social value (SV) and E capital or environmental value (EV)) and add a risk parameter to the social discount rate. For now, let's assume 2% (the midpoint of Dasgupta's 1–3% range) for social and environmental capital for illustrative purposes. That makes calculations easier and means that discount rates on SV and EV are lower than on FV (financial value or capital). This in turn means that companies' discount rate on integrated capital rises with liabilities on SV and EV and falls with assets on SV and EV. Integrated capital is the combination of financial, social, and environmental capital. Let's see how this works.

If a company is investing in projects that contribute to scarce environmental or social capital, for example reducing carbon emissions or improving the health and safety of employees, it reduces its physical, transition or litigation risk (see Box 4.5). This lower risk reduces the integrated discount rate and thereby increases the value of the investment project. In Chap. 12, this is expressed as a low or negative beta on the environmental or social factor.[4] By providing solutions for the SDGs, the company meets societal expectations. In contrast, a company that creates environmental or social liabilities, for example adopting high carbon technology or selling cigarettes, faces transition risk of future tightened policies or litigation risk of negligence of societal care. This raises the integrated discount rate.

Box 4.5: Breaking Down Environmental and Social Risks

Environmental risks, such as climate risk or risk of water shortages, and social risks, such as health and safety risks, can be broken down in several components:

- **Physical risks** are environmental events like floods or storms due to climate change or workplace injuries due to unsafe factories. Physical risks can affect companies directly through damage/loss of assets and injuries/deaths of employees, and indirectly through its effects on value chains and customers (see Chap. 1)
- **Transition risks** arise from changes in policy and new technologies. A carbon tax can affect the profitability of a company's business model (see Chap. 2) and
- **Litigation risk** is the risk that a company faces legal action. Examples are big litigation cases against tobacco companies on the health effects of smoking, and oil companies on not adhering to the Paris climate agreement of 2015 (see Chap. 12)

[4]Chapter 12 distinguishes between idiosyncratic risk (which can be diversified) and systemwide risk. Social and environmental risks have both systemwide dimensions and idiosyncratic dimensions; only the systemwide dimension is priced.

Table 4.11 Financial balance sheet of a standard company (only FV)

	Value	Discounted at		Value	Discounted at
F net operating assets	100	8.0%	F debt	20	4.0%
			F equity	80	9.0%
F capital	**100**	**8.0%**	**F capital**	**100**	**8.0%**

Table 4.12 Integrated balance sheet, company A (FV and EV)

	Value	Discounted at		Value	Discounted at
F net operating assets	100	8.0%	F debt	20	4.0%
E net assets	20	2.0%	F equity	80	9.0%
			E equity	20	2.0%
Integrated capital	**120**	**7.0%**	**Integrated capital**	**120**	**7.0%**

Table 4.13 Integrated balance sheet, company B (FV and EV)

	Value	Discounted at		Value	Discounted at
F net operating assets	100	8.0%	F debt	20	4.0%
E net assets	–20	2.0%	F equity	80	9.0%
			E equity	–20	2.0%
Integrated capital	**80**	**9.5%**	**Integrated capital**	**80**	**9.5%**

The starting point of our analysis is the financial balance sheet of a standard company, which only represents financial value. Let's assume the standard company has 100 in financial assets, financed by debt of 20 at 4% and equity of 80 at 9%. Table 4.11 shows the financial balance sheet of this standard company. The cost of capital of 8% is a weighted average of the cost of debt (4%) and the cost of equity (9%): $8\ \% \ = (20 \cdot 4\ \% \ + 80 \cdot 9\%)/100$ (see Chap. 13 for the weighted average cost of capital).

We now add environmental capital to construct an integrated balance sheet and leave out social capital for simplicity (Chap. 5 shows how environmental and social value can be calculated). Table 4.12 provides the balance sheet of company A which has positive net assets on EV (the company operates within planetary boundaries and helps other companies to reduce carbon emissions). The cost of integrated capital is now reduced to $7\ \% \ = (20 \cdot 4\ \% \ + 80 \cdot 9\ \% \ + 20 \cdot 2\%)/120$. The cost of integrated capital is lower than the cost of financial capital of 8%.

Instead of creating positive net assets, the standard company can also create negative net assets or liabilities. Table 4.13 shows the integrated balance sheet of company B with negative net assets on EV (not operating within planetary boundaries). The integrated capital is reduced to 80. The cost of integrated capital increases to $9.5\ \% \ = (20 \cdot 4\ \% \ + 80 \cdot 9\ \% \ - 20 \cdot 2\%)/80$. Hence, the integrated cost of capital of 9.5% is higher than the cost of financial capital of 8%.

We can do the same exercise for social capital, leaving out environmental capital for simplicity. An example of positive net assets on SV is investment in workplace

Table 4.14 Integrated balance sheet, company C

	Value	Discounted at		Value	Discounted at
F net operating assets	100	8.0%	F debt	20	4.0%
S net assets	10	2.0%	F equity	80	9.0%
			S equity	10	2.0%
Integrated capital	**110**	**7.5%**	**Integrated capital**	**110**	**7.5%**

Table 4.15 Integrated balance sheet, company D

	Value	Discounted at		Value	Discounted at
F net operating assets	100	8.0%	F debt	20	4.0%
S net assets	–10	2.0%	F equity	80	9.0%
			S equity	–10	2.0%
Integrated capital	**90**	**8.7%**	**Integrated capital**	**90**	**8.7%**

safety procedures. A chemical company can be a frontrunner in workplace safety. The company can use its safety technology for its own factories and at the same time provide safety consultancy services for other industries. Table 4.14 provides the integrated balance sheet of company C that has positive net assets on SV. The cost of integrated capital is reduced to $7.5\,\% = (20 \cdot 4\,\% + 80 \cdot 9\,\% + 10 \cdot 2\%)/110$, which is lower than the cost of financial capital of 8%.

A company can also create social liabilities, for example selling cigarettes that cause health care problems. Table 4.15 depicts the integrated balance sheet of company D with negative net assets on SV (not operating within social boundaries). The cost of integrated capital increases to $8.7\,\% = (20 \cdot 4\,\% + 80 \cdot 9\,\% - 10 \cdot 2\%)/90$, which is higher than the cost of financial capital of 8%.

Internalisation

The financial balance sheets for all the above companies look the same now, but will be different after internalisation of social and environmental externalities (e.g. through regulation) or the anticipation of internalisation (e.g. taking provisions for future litigation), as discussed in Chap. 2. The social discount rate is developed to analyse public investment projects. We apply it in this section to show scenarios in which companies want to (or must) meet societal expectations. The empirical prediction is that companies with large social and environmental liabilities will have a higher cost of integrated capital, ceteris paribus. This risk premium will rise when the risk of internalisation—that is the likelihood of (future) regulation or change in technology or consumer preferences—rises. By contrast, companies with social and environmental assets will enjoy a lower cost of integrated capital. Chapters 12 and 13 provide an in-depth analysis of the cost of integrated capital and Chap. 15 introduces integrated balance sheets. The cost of integrated capital can be used to discount projects on an integrated basis, including the financial, social, and environmental value dimensions.

As suggested in Chap. 2, *scenario analysis* is a useful tool to get insight into the possible internalisation of external impacts (externalities). In the scenario analysis, a company can identify the most important societal trends for the industry in which it operates (including the likely internalisation of the main impacts) and assess its relative position (for example, degree of pollution or payment of living wages) within the industry.

4.5 Conclusions

When balancing capitals in investment decisions, one necessarily deals with the future. This raises the subject of this chapter: present values and discount rates. These are the basics of corporate finance. The first section of this chapter therefore discusses discount rates and the time value of money. Using the example of a Brazilian government bond, these concepts and the effects of changes in discount rates are shown in calculation examples. In addition, concepts such as compounding, perpetuities, and annuities are discussed.

Subsequently, the determinants of discount rates are discussed, starting from government bonds as a benchmark, and then adding the premia on corporate bonds and equity. This all applies to financial capital. Next, we introduce the social discount rate for social and environmental capital. The counterparty of companies' social and environmental capital is the wider society, representing current and future generations. Leading economists argue for an equal treatment of current and future generations, which implies a low social discount rate.

Finally, we show how the financial discount rate can be expanded to an integrated discount rate that can be applied to integrated value which also includes social and environmental value. It is shown that larger environmental and social liabilities raise the cost of integrated capital. Conversely, environmental and social assets lower the cost of integrated capital.

Key Concepts Used in This Chapter

Annuity is a stream of equal cash flows paid at regular intervals, which ends after a predetermined number of payments.

Arbitrage refers to the buying and selling of the same or similar goods in different markets to benefit from price differences between these markets (see also *law of one price*).

Bond market refers to the market segment for debt securities with a maturity of more than 1 year (bonds).

Compounding refers to the process whereby interest is credited to an existing principal amount as well as to interest already paid. Compounding is also referred to as interest on interest—the effect of which is to magnify returns to interest over time.

Credit rating refers to the assessment of the credit risk of prospective debtors by a rating agency, predicting their ability to pay back the debt.

Derivatives market refers to the place for trading derivatives, which are financial instruments whose value is derived from the value of the underlying financial instruments.

Discount factor is the factor by which a future cash flow must be multiplied in order to obtain the present value.

Discount rate refers to the interest rate used to determine the present value of future cash flows.

Equity market is the place where companies raise funds by issuing equity (that grants the investor a residual claim on the company's income) and investors trade equities.

Foreign exchange market is the place where traders buy and sell foreign currencies.

Future value refers to the value of a cash flow now, expressed in euros in the future.

Interest rate is the amount charged (interest) on top of the principal by a lender to a borrower for the use of financial funds.

Law of one price says that similar products should sell at the same price. And if they don't sell at similar prices, the arbitrage mechanism usually makes sure that such differences disappear quickly.

Liquidity is the ease with which an investor can sell or buy a bond immediately, at a price close to the market price

Money market is the market for short-term funds up to one year.

One discount rate fits all heuristic is the tendency to use the same discount rate for all investment projects within a company, even if they differ significantly in their risk profile.

Opportunity cost of capital refers to the best available return on an investment that has risk and conditions similar to the cash flows to be discounted—either in the market or in other projects available to the company.

Perpetuity is a stream of regular and equal cash flows into infinity.

Policy rate refers to the interest rate at which a central bank provides short-term money to the market.

Present value refers to present or current value of a discounted stream of future cash flows.

Social discount rate is the discount rate for social projects and can be used to discount social and environmental capital.

Term spread is the spread of yields for bonds with longer maturity over yields for bonds with shorter maturity.

Time value of money refers to people's preference for money today over money tomorrow.

Yield is the return on a bond.

Suggested Reading

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5 Calculating Social and Environmental Value

Overview
The previous chapters described the importance of balancing the various types of value; how that affects corporate governance; and how to discount future flows. With this chapter we take the necessary next step: how to calculate those types of value.

The core model in corporate finance is the discounted cash flow (DCF) model, used to determine the financial value (FV) of a project or a company. This chapter explains how social (S) and environmental (E) issues can be added to the standard DCF model. Recent advances in impact measurement enable companies to measure social and environmental quantities (such as life years saved by medical treatment or carbon emissions from using fossil fuels) and then to multiply these quantities by their respective shadow price, derived from welfare theory. The resulting value flows can be fed alongside the financial cash flows into the DCF model.

The practical challenge for calculating social value (SV) and environmental value (EV) is the availability of company information on S and E issues. Chapter 17 shows that companies are stepping up their sustainability reporting and that mandatory sustainability reporting standards are in the making. It is important to keep the big picture in mind by focusing on material S and E issues and not to get lost in unnecessary detail.

The reason for monetary valuation of (non-market priced) social and environmental impact is to make them visible, and part of the decision-making process, by integrating SV and EV in the accounting system and business language. A common unit ($, € or any other currency) for financial, social, and environmental aspects of business impacts enables managers (and stakeholders) to compare different value components and to analyse the interactions between these value components. It facilitates better understanding of integrated value creation and incorporation of social and environmental impacts in strategy-setting and decision-making. Monetary valuation of impacts also allows managers to assess the relevance and materiality of sustainability topics. The mental challenge for many managers is to start thinking, analysing, and acting in this way, in spite of data gaps and other hurdles.

D. Schoenmaker, W. Schramade, *Corporate Finance for Long-Term Value*, Springer Texts in Business and Economics, https://doi.org/10.1007/978-3-031-35009-2_5

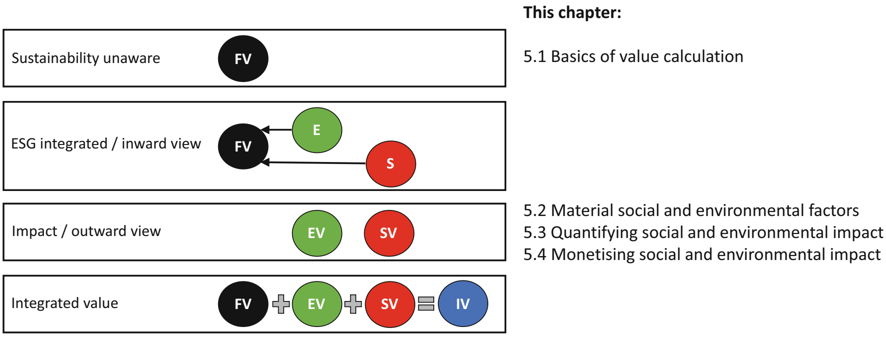


Fig. 5.1 Chapter overview

This chapter shows how to calculate FV (based on cash flows); SV (based on social value flows); and EV (based on environmental value flows) (Fig. 5.1). The next chapter analyses how the various value types can be used in investment decisions.

Learning Objectives
After you have studied this chapter, you should be able to:

- Use the discounted cash flow (DCF) model
- Calculate the social (S) and environmental (E) value of projects
- Assess the materiality of S and E factors
- Identify the advantages and shortcomings of the use of shadow prices

5.1 Basics of Value Calculation

The calculation of the value of a project or a company is at the heart of corporate finance. A commonly used model is the discounted cash flow (DCF) model, which derives the value V of a project or a company as follows:

$$V = \sum_{n=0}^{N} \frac{CF_n}{(1+r)^n} \tag{5.1}$$

whereby CF reflects the expected cash flows, r the discount rate (also called the cost of capital), and n the number of periods over which a cash flow is discounted.

The standard DCF model is used to calculate financial value FV. Chapter 6 shows how this is done for the value of projects, and Chap. 9 for the value of companies. This is the bedrock of corporate finance as found in current textbooks. This chapter shows how we can calculate social value SV and environmental value EV using the standard DCF model.

Social (S) and environmental (E) issues can be expressed in their own units Q (e.g. life years saved by medical treatment, or carbon emissions by using fossil fuels) and then multiplied by their respective shadow price SP derived from welfare

Table 5.1 Steel project

Year	2023	2024	2025	2026	2027	2028
Cash flows, in $ millions	–100	40	40	40	40	40
Carbon emissions, in thousands tons	0	30	30	30	30	30

theory. The shadow price for one life year, for example, can be estimated at $119,000 and the shadow price per 1 ton of CO_2 equivalent at $224 (see Sect. A.1 in Appendix). The value flows VF are calculated as follows:

$$VF = Q \cdot SP \tag{5.2}$$

The social value flows SVF and environmental value flows EVF can be discounted with the DCF model to obtain SV and EV.

$$SV = \sum_{n=0}^{N} \frac{SVF_n}{(1+r)^n} \tag{5.3}$$

$$EV = \sum_{n=0}^{N} \frac{EVF_n}{(1+r)^n} \tag{5.4}$$

So, we obtain clear formulas to calculate SV and EV. Chapter 4 indicated that SV and EV should be discounted at the social discount rate, which is typically very low. The counterparty of companies' SV and EV is the wider society, representing current and future generations. Low social discount rates imply that current and future generations are treated as more or less equal. Here is a company example to show how the DCF model works for the various value types.

Company Example

Let's take a steel company that is considering a project to produce a new type of steel. This project employs a carbon-intensive technology and has a productive lifetime of 5 years. The financial discount rate is 6% per year and the social discount rate is 2% per year. Table 5.1 sets out the cash flow profile, and the carbon emissions, from the project. The project requires an initial investment of $100 million and then yields $40 million for the next 5 years. The carbon emissions of the production installation amount to 30,000 tons of CO_2 equivalent per year.

The first step is to calculate the environmental value flows. We use the earlier shadow carbon price of $224 per 1 ton of CO_2 equivalent (that we assume to be constant over time) in Table 5.2. Applying Eq. (5.2), the resulting annual environmental value flow is –$6.7 million (= 30,000 * $224). Please note that this value is negative, because carbon emissions have a negative impact on the environment. Summing cash flows and environmental value flows provide us with the total value flows in the bottom line of Table 5.2.

The next step in Table 5.3 is to discount the cash flows and value flows at the discount factor $\frac{1}{(1+r)^n}$ (see Chap. 4). Let's start with the financial value. For year

Table 5.2 Value flows of steel project

Year	2023	2024	2025	2026	2027	2028
Cash flows, in $ millions	–100	40	40	40	40	40
Carbon emissions, in thousands tons	0	30	30	30	30	30
Shadow carbon price, in $	224	224	224	224	224	224
Environmental value flows, in $ millions	0.0	–6.7	–6.7	–6.7	–6.7	–6.7
Total value flows, in $ millions	**–100.0**	**33.3**	**33.3**	**33.3**	**33.3**	**33.3**

Table 5.3 Financial and environmental value components of steel project

Year	2023	2024	2025	2026	2027	2028
Cash flows, in $ millions	–100	40	40	40	40	40
Discount factor, 6%	1.00	0.94	0.89	0.84	0.79	0.75
PV (cash flows), in $ millions	–100.0	37.7	35.6	33.6	31.7	29.9
Financial value, in $ millions	**68.5**					
Environmental value flows, in $ millions	0.0	–6.7	–6.7	–6.7	–6.7	–6.7
Discount factor, 2%	1.00	0.98	0.96	0.94	0.92	0.91
PV (value flows), in $ millions	0.0	–6.6	–6.5	–6.3	–6.2	–6.1
Environmental value, in $ millions	**–31.7**					
Integrated value, in $ millions	**36.8**					

1 (2024), the discount factor is $\frac{1}{(1.06)^1} = 0.94$, based on the financial discount rate of 6%. The present value PV of the value flows is obtained by multiplying the value flow with the discount factor. For 2024, the $PV = \$40$ million $* \ 0.94 = \$37.7$ million. After adding up the present values PV for all years (2023–2028), you arrive at a financial value of $68.5 million, as shown in Table 5.3.

Next, for the environmental value we use the social discount rate of 2%. For year 1 (2024), the discount factor is $\frac{1}{(1.02)^1} = 0.98$ and the $PV = -\$6.7$ million $* \ 0.98 = -\$6.6$ million. Adding up for all years, the environmental value is –$31.7 million. The overall or integrated value is then $68.5 million − $31.7 million = $36.8 million in Table 5.3.

What do our value calculations show? The steel project is worth doing, with a positive integrated value. The calculations also demonstrate that the carbon-intensive technology reduces the integrated value of the project by a significant amount. Management may want to consider an alternative technology which produces less carbon emissions (and thus a smaller negative environmental value).

The remainder of this chapter shows the detailed steps to calculating social value and environmental value. Chapter 6 develops investment decision rules for projects and the interaction between the various value types.

5.2 Material Social and Environmental Factors

The calculation of social value (SV) and environmental value (EV) is a recent phenomenon. This new field of impact measurement and valuation has developed methods to value social and environmental impact (Harvard Business School et al., 2022; Impact Economy Foundation, 2022; Impact Institute, 2019; Serafeim et al., 2019).

The value calculation for SV and EV can be done in three steps:

1. **Materiality assessment**—determine important SV and EV factors
2. **Quantification**—express these factors in their own units Q and
3. **Monetisation**—express these factors in money with shadow prices SP

This section discusses the materiality assessment to determine relevant social and environmental factors. Sections 5.3 and 5.4 explain the quantification and monetisation steps.

Materiality Assessment

Materiality assessments aim to determine which S and E factors are sufficiently important for consideration in SV and EV. Material social and environmental topics are those that reflect a company's most significant impacts (positive or negative) on people and environment. This is the outward impact of Fig. 2.5 in Chap. 2. Given the impact on a company's stakeholders and wider society, stakeholder engagement is crucial for companies to understand and determine materiality. Ultimately, companies decide which social and environmental topics should be included in their investment valuation calculations (Chaps. 6 and 7). However, this does not give them carte blanche, because they are likely to be held accountable for omissions. Moreover, new sustainability reporting rules prescribe certain sustainability topics on which it is mandatory to report (see Chap. 17). Box 5.1 discusses whether stakeholders have rights and could thus be seen as rightsholders.

Materiality depends on the specific situation and can differ per industry and country. For example, health and safety at work is a material topic for factories and mining operations. By contrast, attracting and training human talent is material for knowledge institutions, such as universities and management consultancies. In addition, materiality can differ within industries. Mining in the Democratic Republic of Congo has bigger human rights challenges than mining in Australia, for example.

Box 5.1: Stakeholders or Rightsholders?

The term stakeholder was popularised by Freeman (1984) and refers to a party that has an interest in a company and can either affect or be affected by the business. However, the sustainability platform R3.0 (2017, 2018) argues that 'rightsholder' is sometimes a better term to use. A rightsholder is a person or

(continued)

Box 5.1 (continued)
organisation that owns the legal rights to something. A right gives a much stronger claim than a stake. It recognises that people don't just have a desire for clean water (or other basics), but a right to it, giving them a stronger legal basis against company actions.

Such rights are laid down in international treaties and are increasingly referred to in legal proceedings, such as in the 2021 lawsuit against Royal Dutch Shell. In the ruling, the judge ordered the company to reduce its CO2 emissions by much more than the company intended to. Shell tried to hide behind its organisation in many local legal entities outside of the Netherlands, but the judge argued that headquarters effectively set the policy and strategy for those legal entities. This suggests that rightsholders might become more relevant than stakeholders.

In their 'Blueprint 1: Reporting', R3.0 (2017) put it as follows:

> There is a need to strengthen and 'empower' rightsholders to remind organisations of their 'right to know' when it comes to duties and obligations, not allowing 'laissez-faire' as a widely used option of systemic malfunctioning. We argue for a pulling of the sustainability context and materiality principles together under the 'relevance' principle leading to the following steps, embedded in a plan-do-check-act approach for management.
>
> Step 1: Identify impacts on capitals vital to rightsholder well-being: The first step in context-based materiality is to identify positive and negative company impacts on capitals (ecological, social, and economic resources) that are vital to rightsholder well-being. Companies have duties and obligations to uphold the well-being of their direct rightsholders, by managing their impacts on resources these rightsholders rely on.
>
> Step 2: Determine if impacts compromise carrying capacities of capitals: The second step in context-based materiality is to determine if company impacts compromise the carrying capacity of capitals. If company impacts are far removed from this risk, then the impact can be deemed immaterial; if the impact is reasonably proximate to overshooting the carrying capacity of a capital, then it is by definition material.
>
> Step 3: Ascertain strategic innovation opportunities to enhance capitals: The final step in context-based materiality is to ascertain if the impact lends itself to innovation opportunities with the potential to enhance or even regenerate capitals to achieve net positive impact.

The Impact Economy Foundation (2022) also takes a rights-based approach in the calculation of shadow prices (see Sect. 5.4 below).

Material Social and Environmental Factors

There is a core set of social and environmental factors, which one always needs to include in SV and EV calculations (Kuh et al., 2020):

- **Greenhouse gas emissions**, including carbon emissions
- **Labour practices**, including discrimination and inclusion
- **Business ethics**, including corruption and fraud

Table 5.4 provides an expanded set of social and environmental indicators that can be material for a company. Companies can use this larger set as a useful checklist in their materiality assessment. It should be noted that the concept of materiality is dynamic. Box 5.2 provides some examples of issues that have become more important over time.

Table 5.4 Material social and environmental factors

Factor	Example
Social factors	
1. *Labour practices*	
(a) Training (b) Discrimination and inclusion (c) Health and safety (employees) (d) Child labour and other human rights breaches (e) Employment well-being	(a) New competences training (b) Gender discrimination (c) Workplace health and safety (d) Child labour in the value chain (e) Additional benefits of employment
2. *Combatting poverty*	
(a) Underpayment in the value chain (b) Products/services that enable low-income people	(a) Paying below living wage (b) Microcredit
3. *Interaction with (local) communities*	
(a) Regional economic activity (b) Taxes (c) Consumer well-being (d) Health and safety (local residents) (e) Social cohesion (f) Business ethics	(a) Local employment and suppliers (b) Corporate tax (c) Consumer surplus of products sold (d) Chemical plant safety (e) Contributing to local sports club (f) Bribing (local) government officials
Environmental factors	
1. *Pollution*	
(a) Emissions of greenhouse gases (b) Toxic emissions to air (c) Toxic emissions to water (d) Toxic disposition on land	(a) Carbon emissions (b) Emission of particulate matter (c) Chemical spill (d) Nitrogen disposition
2. *Use of scarce resources*	
(a) Scarce materials (b) Land (c) Water	(a) Cobalt for batteries (b) Deforestation for agriculture (c) Water usage in production
3. *Restoration*	
(a) Air (b) Land (c) Water	(a) Removal of carbon emissions (b) Land restoration (c) Water purification

Source: Adapted and shortened from Impact Economy Foundation (2022)

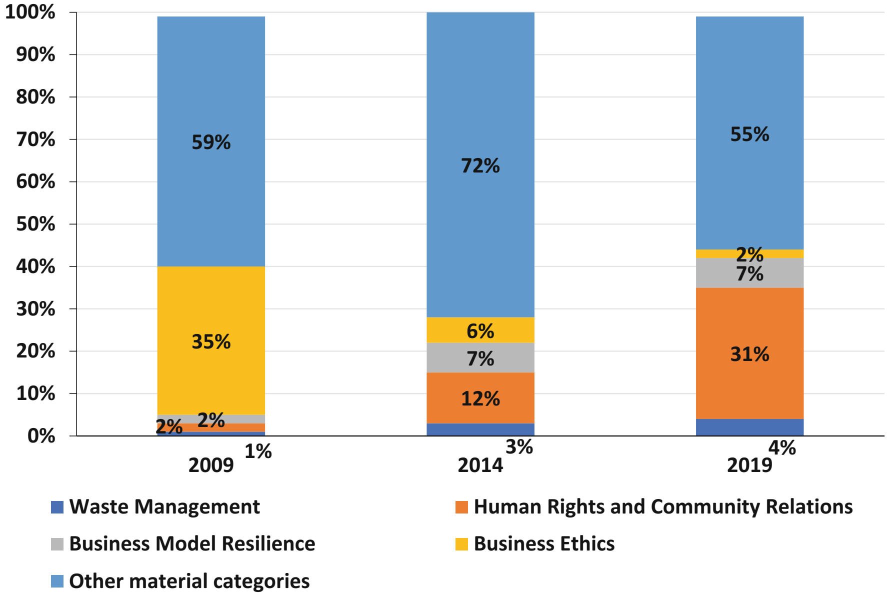


Fig. 5.2 Dynamic materiality in oil and gas industry. Source: Adapted from Kuh et al. (2020)

Box 5.2: Dynamic Materiality

Industry materiality is a dynamic concept. Certain topics that may not be considered material at one point may rise with respect to stakeholder focus over time. These shifts represent a change in the nature of what might be material to a company within a given industrial sector at a given time. An example is the topic of human rights and community relations in the oil and gas sector. That came to prominence in 2019, as witnessed by the legal case on Shell's treatment of indigenous people in Nigeria.[1] By contrast, business ethics has become less important over the same period, as illustrated in Fig. 5.2. The percentages in Fig. 5.2 represent the focus of stakeholder discussions in the oil and gas industry.

Examples 5.1 and 5.2 illustrate how the stakeholder impact map of Chap. 2 can be used to assess materiality in different industries. These examples confirm that material social and environmental factors are industry (and country) specific.

[1] See https://www.rechtspraak.nl/Organisatie-en-contact/Organisatie/Gerechtshoven/Gerechtshof-Den-Haag/Nieuws/Paginas/Shell-Nigeria-liable-for-oil-spills-in-Nigeria.aspx.

Example 5.1: Determining Materiality in the Garment Industry

Problem

What are the material social and environmental factors in the garment (clothing) industry? In the garment industry, clothes are typically sold in high-income countries and produced in low-income countries. In the process, people in high-income countries have the benefits of cheap clothing, while the negative externalities tend to be imposed on people in low-income countries

Solution

A way to obtain clarity on the matter is to map the interests of stakeholders in a stakeholder impact map (see Chap. 2). For a company like Inditex or H&M, this could look as follows:

	Employees	Workers in the chain	Suppliers	Customers	Society at large
Stakeholder's goals	Decent pay and working conditions	Decent pay and working conditions	Steady business	Cheap and fast fashion	Good S and E outcomes
Does the company help or hurt those goals?	Helps as it does provide the above	Hurts: poor conditions as costs are squeezed at suppliers	Hurts: unreliable partner that cancels orders after finishing	Helps: delivers that	Hurts: suffering in the chain (S) and large environmental damage (E)

Hence, there are serious frictions on both S and E between what customers want (cheap and fast fashion) and what matters to suppliers, workers in the chain and society at large. On S, material issues include labour conditions and supplier relations. After all, to keep prices low, fashion companies squeeze suppliers, who in turn squeeze their employees. On E, material issues include waste and GHG emissions. The high frequency of product replacement means that massive amounts of waste and GHG emissions are produced. Both S and E issues are at the heart of the business model of fast-fashion companies. However, not all companies are working sufficiently hard to address these challenges. ◄

Example 5.2: Determining Materiality in the Airline Industry

Problem

What are the material social and environmental factors in the traditional airline industry?

Solution

For a traditional airline like British Airways, Lufthansa, or American Airlines, the stakeholder impact map can look like this:

	Employees	Customers	Airports	Society at large
Stakeholder's goals	Decent pay and working conditions	Cheap tickets, good services, reliable, and safe transport	Fees, connections, traffic for retail operations	Jobs, tax income, access, environmental protection
Does the company help or hurt those goals?	Helps for pilots, hurts for other personnel: job cuts, long hours	Helps: delivers cheap tickets and safety; less so on reliability and service	Helps by running many flights	Hurts the environment (E) and health of residents near airports (S); delivers on most other aspects

This suggests serious friction between customers' desire for cheap tickets and employees' working conditions. Moreover, the negative externalities in health (S) and especially emissions (E) are substantial. For most airlines, negative value of the externalities probably outweighs their profitability by a wide margin. ◄

5.3 Quantifying Social and Environmental Impact

Let's recall the three steps to calculate SV and EV:

1. **Materiality assessment**—determine important SV and EV factors
2. **Quantification**—express these factors in their own units *Q* and
3. **Monetisation**—express these factors in money with shadow prices *SP*

In this section, we analyse Step 2, quantification. This second step towards calculating SV and EV involves expressing S and E in their own units, similar to the volume component in sales or costs. For example, GHG emissions can be expressed in tonnes of CO_2 or tonnes of CO_2 equivalent, which includes all greenhouse gases (GHG): carbon dioxide CO_2 (80% of GHG), methane CH_4 (10% of GHG), nitrous oxide N_2O (7% of GHG), and fluorinated gases (3% of GHG). Table 5.5 does that for an airline, whose aircraft emit various GHG (expressed in CO_2 eq) by burning jet fuel (kerosene).

It should be noted, however, that this is just one component of E. To fully cover E, all nine planetary boundaries (see Chap. 1) should be considered and quantified as far as they are material for the company at hand. Some, such as nitrogen or freshwater use, are as easily quantifiable as carbon, but others are not. For example, biodiversity is difficult to express in a single metric, although some very

Table 5.5 Airline (partly) expressing E in its own units

Year	2022	2023	2024	2025	2026	2027	2028	2029	2030
CO_2-eq. million tons	30	31	22	25	31	30	29	25	20

general metrics such as mean species abundance (MSA) or hectares of land affected are used. Box 1.4 in Chap. 1 gives the drivers of biodiversity loss. Land-use change and land pollution—measured in hectares of land affected—are major drivers. The lack of an easily quantifiable metric is problematic since biodiversity loss is a major threat, at similar scale as climate change.

To provide an overview of the basics of environmental metrics, Sect. A.2 in the Appendix contains a primer on natural capital accounting. Ideally, every company would be held accountable for its contribution to all nine planetary boundaries and would have a budget of maximum harm that it is allowed to cause. This is the idea of thresholds and allocations proposed by R3.0 (2017). Current reporting is far from that ideal, but initiatives such as the European Sustainability Reporting Standards and the IFRS Sustainability Standards are moving reporting in that direction (see Chap. 17). Bolton et al. (2021) make recommendations to accomplish this for carbon budgets (see Box 5.3 below).

Box 5.3: Carbon Budgets

To stay within the realm of manageable temperature rises (i.e. below 2 °C warming), our carbon use cannot exceed a specific amount until 2050, by which time we need to be and remain carbon neutral. This effectively sets a global carbon budget, which is to be allocated over countries, industries, and companies, all of which will all need to establish an individual timeline for going to zero emissions. So far, however, this is hardly happening. Therefore, Bolton et al. (2021) recommend making carbon disclosure mandatory in the following way:

- Publicly listed firms are to report their global greenhouse gas emissions for the past calendar year in their annual reports. Private firms beyond a certain minimum size are to report their global greenhouse gas emissions for the past calendar year to a national registry in the country in which the firm is headquartered
- Corporate GHG emissions are expressed in tonnes of CO_2 equivalent, where the aggregation weights for greenhouse gases other than CO_2 are determined according to current IPCC guidelines
- Corporate GHG emissions comprise direct (scope 1) emissions from all installations and operating assets that the company (or its subsidiaries) has a majority interest in
- In addition to the above measure of gross direct carbon emissions (GDE), Bolton et al. (2021) support the reporting of corporate net direct carbon emissions (NDE), provided that GDE and NDE are reported separately. The NDE metric should only allow the subtraction from GDE of those carbon offsets that the firm, or its subsidiaries, has removed and sequestered durably from the atmosphere in the past year. Durability requires a

(continued)

Box 5.3 (continued)

reasonably high degree of confidence that the captured CO_2 will not be released back into the atmosphere for at least 100 years. That means that most of the current offsetting schemes will not be allowed

It is also possible to express components of S in their own units, such as quality life years added by a medical technology company (see Table 5.6). The number of quality life years added is calculated as the change in utility value induced by the medical treatment, multiplied by the duration of the treatment effect. The aim of the quality life year concept is to combine the biological, individual, and societal perspectives of health in a coherent fashion (Prieto & Sacristán, 2003). Section 5.4 discusses how the social and environmental quantities and shadow prices are based on welfare theory.

As with E, many S components are quite challenging to compute, since they lack a clear unit. This applies, for example, to violations of human rights. However, organisations like Impact Institute have shown that such types of S can still be quantified, albeit less easily. This can, for example, be done by expressing the components in terms of health effects or underpayment.

Attribution of Impact

Another challenge is attributing (i.e. distributing) shares of the impact to each of the stakeholders (Impact Economy Foundation, 2022). For example, if a construction company builds a windmill park, it cannot claim all of the positive (nor the negative) impacts of that project, since a lot of the impact is generated by the machinery companies that deliver the windmills and their components. Another example are carbon emissions from the usage of combustion engine vehicles. The emissions can be attributed to the car manufacturer (e.g. based on annual depreciation) and to the oil company selling petrol (e.g. based on the annual costs of petrol). This allows for an attribution of the emissions in proportion to responsibility. In the garment industry, for example, fashion companies have a shared responsibility for GHG emissions in their supply chain. In calculations, one can use the assumption that half of the GHG emissions by suppliers in the garment manufacturing can be attributed to the fashion company, as primary company in the supply chain (see Chap. 11 for the Inditex case study).

CO_2 emissions are probably the most widely used metric on the environmental side (natural capital). Several companies nowadays report on their scope 1, 2, and 3 emissions. The Greenhouse Gas Protocol (WRI, 2015) distinguishes between direct emissions from sources that are owned or controlled by the reporting entity;

Table 5.6 Medtech company (partly) expressing S in its own units

Year	2022	2023	2024	2025	2026	2027	2028	2029	2030
Quality life years added, × 1000	62	64	67	70	73	75	78	82	99

and indirect emissions that are a consequence of the activities of the reporting entity, but occur at sources owned or controlled by another entity. The GHG Protocol further categorises these direct and indirect greenhouse gas (GHG) emissions into three scopes:

- **Scope 1**: All direct GHG emissions of an organisation
- **Scope 2**: Indirect GHG emissions from consumption of purchased electricity, heat, or steam
- **Scope 3**: Other indirect GHG emissions both upstream and downstream of the value chain of an organisation

Scope 3 emissions are indirect emissions in the upstream supply chain caused by input purchases of the company, and by the use of the products sold by the company downstream. It is a challenge to attribute these indirect emissions across the value chain, without double counting (overreporting) or omission (underreporting).

While the Greenhouse Gas Protocol has a very clear definition for scope 3 emissions, it does not contain rules for attributing these emissions across the value chain (i.e. the supply chain). The Impact Economy Foundation (2022) proposes, in the case of shared responsibility, to attribute 50% of scope 3 emissions to the company with the prime responsibility (e.g. the car or garment manufacturer) and to re-attribute the remaining 50% over the value chain, based on how influential they are.

Example 5.3 shows how the social and environmental impact of a paint manufacturer can be attributed. The example shows that this paint manufacturer causes not only negative social and environmental impact in its own production process, but also in its supply chain. Scope 3 emissions form a major part of GHG emissions. We find the same for the fast-fashion retailer Inditex in Chap. 11.

Example 5.3: Attributing Impact

Problem

Akzo, a paint and coating manufacturer, has a sizeable social and environmental impact. From Akzo's sustainability performance report 2021 (see Table 17.4 in Chap. 17), we take the following information:

People	Unit	2021
People, process, and product safety		
Fatalities employees	Number	1
Injury rate employees	/200k hours	0.21
Fatalities contractors	Number	0
Injury rate contractors	/200k hours	0.12

Planet	Unit	2021
Energy use and emissions		
GHG emissions—Scope 1	Kilotons	64.5
GHG emissions—Scope 2	Kilotons	172.1
Scope 3 upstream	Million tons	6.8
Scope 3 downstream	Million tons	7.7
Resource efficiency		
Freshwater use	Million m^3	9.6
Freshwater consumption	Million m^3	1.3

Please attribute the relevant social and environmental impact to Akzo.

Solution

On the social side, the fatalities and injury rate of Akzo's employees can be fully attributed to Akzo. Those of its contractors are a shared responsibility and are attributed for 50% to Akzo.

On the environmental side, scope 1 GHG emissions arise in Akzo's production process and are fully attributed to Akzo. These emissions amount to 64.5 kilotons, which is 0.0645 million tons. Scope 2 emissions occur at the electricity utility and Scope 3 emissions occur upstream and downstream in the supply chain. Scope 2 and 3 are attributed for 50% to Akzo, as explained in Sect. 5.3. The attributed scope 2 and 3 emissions amount to 7.3 million tons (= 50% * [0.172 + 6.8 + 7.7 million tons]). Interestingly, scope 1 emissions only form a minor part of overall GHG emissions: 0.9% (= 0.065 / [0.065 + 7.3]).

The freshwater usage of 10.9 million m^3 is fully attributable to Akzo. ◀

The question of comparability arises: how to compare, say, GHG emissions with quality life years added? This is where monetisation comes in: by putting a unit price on these issues, they become comparable in monetary terms.

5.4 Monetising Social and Environmental Impact

Again, the three steps to calculate SV and EV are:

1. **Materiality assessment**—determine important SV and EV factors
2. **Quantification**—express these factors in their own units Q and
3. **Monetisation**—express these factors in money with shadow prices SP

In this section, we analyse the monetisation step, which refers to expressing S and E in monetary terms. This involves putting a price on the units identified in the second step. For example, for the above-mentioned airline example, Table 5.7 puts a price on carbon to arrive at the carbon component of EV. What price to choose is subject of debate: while the price of carbon in a certain market may be $80 per tonne, estimates by scientists suggest that prices should be in the hundreds or even thousands to stay within our carbon budget (Boussemart et al., 2017). And the

Table 5.7 Airline (partly) monetising E

Year	2022	2023	2024	2025	2026	2027	2028	2029	2030
CO_2, million tons	30	31	22	25	31	30	29	25	20
Shadow carbon price, $	224	232	240	248	257	266	275	285	295
Environmental value flow, $ billions	**–6.7**	**–7.2**	**–5.3**	**–6.2**	**–8.0**	**–8.0**	**–8.0**	**–7.1**	**–5.9**

longer we wait, the higher the carbon price needs to be to reduce carbon emissions sharply to stay within our carbon budget. We reflect that in Table 15.7 by starting with a shadow carbon price of $224 per tonne in 2022 (see Sect. A.1 in Appendix), which then rises with 3.5% every year (CE Delft, 2018; IEF, 2022).

Table 5.7 shows that the airline's GHG emissions of 30 million tons in 2022 translate to a negative environmental value flow of –$6.7 billion. This is very substantial and can easily outweigh profit (i.e. the financial value flow), which is typically smaller for airlines of that size.

The Impact Economy Foundation (2022) defines impact as a change in capital (human, social, or natural capital), a change in experienced well-being (e.g. health effects) or a breach of a right (see Box 5.2 on rightsholders). Carbon emissions can be seen as a breach of the Paris Climate Agreement, which aims to limit global warming. The shadow carbon price for a tonne of CO_2 is then the price to restore the original situation, in this case taking one tonne of CO_2 out of the air. We explain below how shadow prices can be derived from welfare theory.

Similarly, Table 5.8 puts a price on the quality life years added by the aforementioned medical technology company. From a well-being perspective, the shadow price is $119,000 per quality life year in 2022 and is assumed to be constant over time (see Sect. A.1 in Appendix). Table 5.8 illustrates that the annual social value flows of the medtech company can be sizeable, moving from $7.4 billion in 2022 to $11.8 billion in 2030.

As stated, other components of E and S are harder to quantify in their own units, but can nevertheless be monetised. For example, human rights violations can be expressed in monetary damages (by assessing how they hurt people's ability to lead a decent life) without taking the intermediate step of expressing them in comparable units.

Welfare-Based Shadow Prices

The shadow prices (also called monetisation factors by the Impact Economy Foundation) should reflect the 'true scarcity' of resources to stay within planetary boundaries; or the 'true price' of human rights breaches to stay within social boundaries. Using shadow prices is thus a tool for companies to stay within social and planetary boundaries, as discussed in Chaps. 1 and 2. The term shadow prices illustrates that these prices don't reflect current market prices but 'shadow' true prices. The Impact Economy Foundation (2022) and True Price (2021) provide a regularly updated list of impacts and shadow prices for a whole range of social and environmental impacts. Section A.1 in the Appendix provides a shortened list of

Table 5.8 Medtech (partly) monetising S

Year	2022	2023	2024	2025	2026	2027	2028	2029	2030
Quality life years, × 1000	62	64	67	70	73	75	78	82	99
Shadow price, × $1000	119	119	119	119	119	119	119	119	119
Social value flows, $ billions	**7.4**	**7.6**	**8.0**	**8.3**	**8.7**	**8.9**	**9.3**	**9.8**	**11.8**

shadow prices for illustration purposes. Box 5.4 shows that there are limits to monetisation—not everything can be quantified and monetised.

Box 5.4: Limits to Monetisation

The Capitals Coalition stresses that there are limits to monetisation. It may, for example, be difficult to monetise certain S issues (Social and Human Capital Coalition, 2019). Stakeholders may find it difficult to accept the quantification of certain changes (e.g. in cultural identity or historical significance). An example of the latter is provided by Rio Tinto in March 2020. The mining giant Rio Tinto destroyed a 46,000-year-old Aboriginal site in the expansion of an iron ore mine. One year later, the Rio Tinto chairman quit over the Aboriginal site damage and an Australian Parliamentary Inquiry ordered Rio Tinto to rebuild the ancient Aboriginal caves.

A precautionary approach may be needed for certain E issues (Natural Capital Coalition, 2016), for example when a company is close to important ecological thresholds (planetary boundaries) or has the potential to cause irreversible changes (e.g. species extinction). In these cases, the company should (aim to) avoid the use of these natural resources.

Rights

You may wonder about the theoretical underpinning of shadow or true prices for social and environmental impact. They are based on welfare theory (e.g. Bosselmann, 2016), whereby welfare is defined as the current and future value enjoyed by a company's stakeholders. True prices are based on two welfare categories: respect of rights and well-being. The first category of rights include (Galgani et al., 2021):

- **Human rights**: these refer to the rights of any individual as stated in the International Bill of Human Rights of the United Nations, such as the rights to life, liberty, and personal security, to freedom from slavery or degrading treatment
- **Labour rights**: these are the rights in the Fundamental Conventions of the International Labour Organisation, such as the rights to freely chosen work, to

fair wages, to a safe and healthy workplace, to unionise, and to freedom of discrimination

- **Environmental rights**: these refer to the right to a healthy environment and to natural resources, as enshrined in international agreements of the United Nations, such as the Paris Climate Agreement

In the latter case, for example, air, land, and water pollution and depletion of natural resources can be seen as breaches of environmental rights. The shadow price reflects the cost to restore the original situation or the cost to compensate for the damage by the unsustainable impacts.

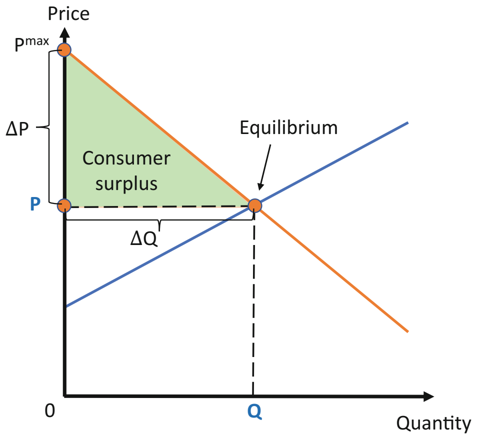
Well-Being

The second category is based on the well-being of stakeholders. Well-being, also known as quality of life, refers to what is intrinsically valuable for someone. This includes well-being of employees, customers, and communities (social cohesion). Employment well-being refers to additional well-being experienced by employees resulting from their employment and education at the company; this well-being is additional to the salary received. Employment well-being is measured by life satisfaction points on a scale of 0–100. The shadow price of one life satisfaction point is estimated at \$2647 (see Sect. A.1 in Appendix).

Consumer well-being is calculated as the consumer surplus, which is the difference between the price of a product and what consumers want to pay for it. Consumer surplus is a measure of consumer welfare. For completeness, we show how consumer surplus can be calculated. The shaded area below the downward sloping demand curve and above the equilibrium price in Fig. 5.3 is the consumer surplus:

$$\text{consumer surplus} = \Delta P \cdot Q \cdot \frac{1}{2} \tag{5.5}$$

Fig. 5.3 Consumer surplus



where the price differential ΔP is the maximum price P^{max} minus the price paid P; and Q is the number of goods sold. Because ΔP cannot directly be observed, we use the price elasticity of demand. The price elasticity measures how demand $\Delta Q/Q$ reacts to a change in price $\Delta P/P$:

$$\text{price elasticity} = \frac{\Delta Q/Q}{\Delta P/P} \tag{5.6}$$

We can rewrite Eq. (5.6) as follows: $\Delta P = \frac{\Delta Q \cdot P}{\text{price elasticity} \cdot Q}$ and fill this expression into Eq. (5.5):

$$\text{consumer surplus} = \frac{\Delta Q \cdot P}{\textit{price elasticity}} \cdot \frac{1}{2} = \frac{\textit{sales}}{\textit{price elasticity}} \cdot \frac{1}{2} \tag{5.7}$$

The numerator $\Delta Q \cdot P$ is equal to sales $Q \cdot P$, given that Fig. 5.3 shows that $\Delta Q = Q$. Equation (5.7) shows that a relatively high price elasticity yields a low consumer surplus (and vice versa).

We are now able to calculate the consumer surplus. The only input required is an estimate of the price elasticity. In the case of Inditex in Chap. 11, Khaled and Lattimore (2006) find an average price elasticity of men's and women's clothing of 3.45. Given Inditex sales of €20.4 billion, the estimate of the consumer surplus amounts to €3.0 billion (= €20.4 billion/3.45 * 0.5).

The purpose of these calculations is to show that employment and consumer well-being can be estimated. Standard microeconomic tools can be used to make the calculations. Of course, estimates of the degree of life satisfaction (measured in life satisfaction points) and the price elasticity of demand need to be made. In both cases, well-being is defined as the 'benefits' on top of the financial payments—salaries paid to employees and market prices paid by consumers for goods and services.

Calculating Social and Environmental Value

With the outputs from all three steps, we can calculate the value flows VF from Eq. (5.2):

$$VF = Q \cdot SP$$

The social value flows SVF and environmental value flows EVF in Tables 5.7 and 5.8 can subsequently be discounted with the standard DCF model to obtain the social value SV and environmental value EV of a project or a company. Equations (5.3) and (5.4) provide the DCF model for SV and EV:

$$SV = \sum_{n=0}^{N} \frac{SVF_n}{(1+r)^n}$$

$$EV = \sum_{n=0}^{N} \frac{EVF_n}{(1+r)^n}$$

Table 5.9 Environmental value (EV) of airline (in $ billions)

Year	2022	2023	2024	2025	2026	2027	2028	2029	2030
Environmental value flows (EVF)	–6.7	–7.2	–5.3	–6.2	–8.0	–8.0	–8.0	–7.1	–5.9
Discount factor, 2%	1	0.98	0.96	0.94	0.92	0.91	0.89	0.87	0.85
PV (EVF)	–6.7	–7.0	–5.1	–5.9	–7.4	–7.2	–7.1	–6.2	–5.0
Environmental value (EV)	**–57.6**								

Table 5.10 Social value (SV) of medtech (in $ billions)

Year	2022	2023	2024	2025	2026	2027	2028	2029	2030
Social value flows (SVF)	7.4	7.6	8.0	8.3	8.7	8.9	9.3	9.8	11.8
Discount factor, 2%	1	0.98	0.96	0.94	0.92	0.91	0.89	0.87	0.85
PV (SVF)	7.4	7.5	7.7	7.8	8.0	8.1	8.2	8.5	10.1
Social value (SV)	**73.3**								

We apply the social discount rate of 2% to discount social and environmental value flows, as discussed in Chap. 4. Table 5.9 shows the outcome. The environmental value flows *EVF* are multiplied with the discount factor to obtain the present value of *EVF*. When we sum the present values *PVs* of *EVF* we get the environmental value *EV*, which is –$57.6 billion for the airline. So, our airline has a large negative *EV*.

Table 5.10 follows the same procedure to calculate the social value *SV* of the medtech company. Our medtech appears to achieve a large positive *SV* of $73.3 billion.

Application in Case Studies

The best way to understand the working of shadow prices in the calculation of social and environmental value is to apply them in company case studies. Chapter 11 applies shadow prices to calculate the integrated value of Inditex and Chapter 18 uses shadow prices to assess the (dis)synergies from the aborted Kraft Heinz–Unilever takeover. These case studies illustrate the importance of valuing social and environmental impacts with shadow prices. The resulting social and environmental value can be larger than the company's financial value.

5.5 Conclusions

The core model in corporate finance is the discounted cash flow (DCF) model to determine the financial value (FV) of a project or a company. This chapter explained how social (S) and environmental (E) issues can be added to the standard DCF model. Recent advances in impact measurement enable companies to measure social and environmental quantities, such as life years saved or carbon emissions, and then to multiply these quantities by their respective shadow price, derived from welfare theory. The resulting value flows can be put, alongside the financial cash flows, into the DCF model.

The challenge for calculating social value (SV) and environmental value (EV) is the availability of company information on S and E issues. Chapter 17 shows that companies are stepping up their sustainability reporting and that mandatory sustainability reporting standards are in the making. It is important to keep the big picture by focusing on material S and E issues, and not to get lost in unnecessary detail.

This chapter showed how to calculate FV (based on cash flows), SV (based on social value flows), and EV (based on environmental value flows). The next chapter analyses how the various value types can be used in investment decisions.

Key Concepts Used in This Chapter

Attribution of impact refers to attributing or distributing shares of the impact to each of a company's stakeholders

Impact is defined as a change in capital (human, social, or natural capital), a change in experienced well-being or a breach of a right

Integrated value is obtained by combining the financial, social, and environmental values in an integrated way (with regard for the interconnections)

Materiality indicates relevant and significant information

Materiality assessment aims to determine which S (social) and E (environmental) factors are sufficiently important for consideration in SV and EV

Monetisation of social and environmental factors means to express them in monetary terms with shadow prices

Quantification of social and environmental factors means to express them in their own units

Rights refer to human, labour, and environmental rights of individuals as laid down in international treaties

Rightsholder is a person or organisation that owns the legal rights to something

Shadow prices or true prices reflect the 'true scarcity' of resources to stay within planetary boundaries or the 'true price' of human right breaches to stay within social boundaries; shadow prices are based on welfare theory

Stakeholder refers to a person or organisation that has an interest or 'stake' in the company: customers, employees, suppliers, shareholders, creditors, and the community

True prices, see shadow prices

Well-being or quality of life refers to what is intrinsically valuable for someone

Welfare is current and future value enjoyed by stakeholders

Appendix: Shadow Prices and Natural Capital Accounting

This Appendix provides a list of shadow prices and additional material on natural capital accounting, as discussed in Sect. 5.4.

A.1 List of Shadow Prices

The Impact Economy Foundation (2022) and True Price (2021) publish a regularly updated list of shadow prices (or monetisation factors) to monetise social and environmental impact. Section 5.4 discusses the theoretical underpinning of these shadow prices from welfare theory. In this Appendix, we show some commonly used shadow prices for the year 2022 for illustration purposes. In addition, there are, for example, several shadow prices for air, land, and water pollution (in the form of toxic emissions). See the guidance document for the full list:

https://impacteconomyfoundation.org/impactweightedaccountsframework/ and https://trueprice.org/monetisation-factors-for-true-pricing/

Impact	Indicator	Shadow price	Explanation
Environmental impacts			
Climate change	GHG emissions	\$224/ton CO_2 equivalent (eq)	A restoration cost that expresses the abatement cost for achieving the policy targets of reducing GHG emissions to meet the 2 °C target of the Paris Agreement
Air pollution	Toxic emissions to air	\$119,000/DALY (disability-adjusted life year)[a]	A compensation cost that expresses the Value of Statistical Life (VSL) based on a meta-analysis of willingness-to-pay studies
	Nitrogen deposition NH3 (animal husbandry)	\$18.10/kg NH3 eq	A marginal cost of the abatement measures needed to reach the regulatory target of nitrogen deposition in nature areas
	Nitrogen deposition NOx (use of machines and vehicles)	\$1.76/kg NOx eq	
	Particulate matter (PM) formation	\$75/kg PM2.5 eq	A compensation cost that expresses the social cost of pollution and indicates the occurring loss of economic welfare when pollutants are emitted into the environment, looking at human health damage and ecosystems damage
	Photochemical oxidant formation (POF)	\$1.18/kg NMVOC \$4.19/kg NOx eq	
	Ozone layer depleting emissions	\$65.40/kg CFC-11 eq	

(continued)

Impact	Indicator	Shadow price	Explanation
Water pollution	Toxic emissions to water	$119,000/DALY (disability-adjusted life year)	A compensation cost that expresses the Value of Statistical Life (VSL) based on a meta-analysis of willingness-to-pay studies
	Freshwater eutrophication[b]	$290/kg phosphorus eq to freshwater	A combination of restoration and compensation costs based on a literature review on the costs of eutrophication. Restoration costs express average abatement costs for bringing nutrient levels to a regulatory target, for the impacts that are reversible
Soil pollution	Toxic emissions to soil	$119,000/DALY (disability-adjusted life year)	A compensation cost that expresses the Value of Statistical Life (VSL) based on a meta-analysis of willingness-to-pay studies
	Terrestrial ecotoxicity	$0.4/ton 1,4 dichlorobenzene (DB) emitted to industrial soil eq	A compensation cost that expresses the social cost of pollution and indicates the occurring loss of economic welfare when pollutants are emitted into the environment, looking at ecosystems damage
	Freshwater ecotoxicity	$57.90/ton 1,4-DB emitted to freshwater eq	
Soil degradation	Soil organic carbon (SOC) loss	$43/ton SOC loss	A compensation cost that expresses the damage cost for the chemical, physical, biological, and ecologic decline of soil resulting from loss of soil organic carbon

(continued)

Impact	Indicator	Shadow price	Explanation
Land occupation	Tropical forest	$3030/(MSA * ha * year)	A compensation cost that expresses the opportunity cost of land occupation based on the value of ecosystem services for main biomes
	Other forest	$1450/(MSA * ha * year)	
Availability of non-renewable materials	Non-renewable material depletion	$261/ton copper eq	A compensation cost that expresses the future loss of economic welfare resulting from increased extraction costs of non-renewable materials in the future
Availability of water	Scarce blue water use	$1.49/m^3	A restoration cost that expresses the annualised cost of desalination, including the cost of operation and maintenance, electrical and thermal energy, as well as the cost of covering and repaying initial capital and operational costs of desalination
Social impacts			
Effects on human health	Effects on human health	$119,000/DALY (disability-adjusted life year)	A compensation cost that expresses the Value of Statistical Life (VSL) based on a meta-analysis of willingness-to-pay studies
Consumer well-being	Consumer surplus	$ based on price elasticity of demand	The value of well-being is based on the consumer surplus. See Sect. 5.4
Well-being of employment	Well-being effect per one additional point of life satisfaction	$2647/life satisfaction point (scale 0–100)	The value of well-being is based on a reduction of well-being resulting from unemployment and an increase of well-being resulting from education

(continued)

Impact	Indicator	Shadow price	Explanation
Occupational health and safety incidents	Non-fatal occupational incidents	$4170/incident	A combination of compensation, prevention, and retribution costs. The compensation cost represents the average cost of medical expenses for occupational injuries not covered by the employer. The prevention cost expresses the cost of generic auditing set-up to prevent future instances. Finally, the retribution costs represent a penalty for the cases in which workers perform their duties in conditions that violate health and safety regulations
	Fatal occupational incidents	$3,540,000/incident	
	Occupational injuries with breach of health and safety standards	$3840/incident	
Underpayment in the value chain	Wage gap of workers earning below minimum wage	$1.56/$	A combination of compensation, prevention, and retribution costs. The compensation cost expresses the gap to a decent living wage, as well as the interest rate. The prevention cost expresses the cost of generic auditing set-up to prevent future instances. The retribution cost represents a penalty for the wage gap that is below the legal minimum wage
	Wage gap of workers earning above minimum wage but below decent living wage	$1.06/$	

(continued)

Impact	Indicator	Shadow price	Explanation
Child labour	Workers below minimum age for light work involved in non-hazardous economic work	$21,600/child FTE	A combination of restoration, compensation, prevention, and retribution costs. The restoration cost expresses the costs of providing quality education for children not attending school and the costs of implementing additional components of reintegration programmes for children involved in hazardous child labour. The compensation cost expresses the loss of future earnings when a child is prevented from attending school during youth. The prevention cost expresses the cost of generic auditing set-up to prevent future instances. Finally, the retribution cost represents a penalty for instances of child labour
	Underage workers above minimum age for light work and below minimum age involved in non-hazardous light economic work	$7970/child FTE	
	Underage workers who are not attending school	$25,300/children	
Forced labour	Forced workers	$17,200/FTE	A combination of restoration, compensation, prevention, and retribution costs. The restoration cost expresses the restitution of past economic losses of forced workers in debt bondage, as well as other costs for reintegration. The compensation cost expresses the cost of lost health valued using DALY for forced workers as victims of abuse. The prevention cost expresses the cost of generic auditing set-up to prevent future instances

(continued)

Impact	Indicator	Shadow price	Explanation
Discrimination	Female workers without provision for maternity leave	$2450/FTE	A combination of restoration, prevention, and retribution costs. The restoration cost represents the restitution of wage lost due to denied maternity leave, gender discrimination, and unequal opportunities. The prevention cost expresses the cost of generic auditing set-up to prevent future instances of discrimination. The retribution cost represents a penalty for the violation of denied maternity leave and a penalty proportional to the size of the wage gap from discrimination
	Wage gap from gender discrimination	$1.06/$	
	Wage gap from unequal opportunities	$1.06/$	
Occurrence of harassment	Workers who experienced non-physical non-sexual harassment	$33,000/worker	A combination of restoration, compensation, prevention, and retribution costs. The restoration cost represents average medical costs for injuries, anxiety, depression, and post-traumatic stress disorder resulting from workplace harassment. The compensation cost represents the cost of loss of future well-being resulting from long-term mental health impact of victims of harassment. The prevention cost expresses the cost of generic auditing set-up, to prevent future instances. Finally, the retribution cost represents a penalty for instances of physical non-sexual and sexual harassment based on the weighted average of penalties from various countries to express a global penalty
	Workers who experienced non-physical sexual harassment	$35,700/worker	
	Workers who experienced physical non-sexual harassment	$64,300/worker	
	Workers who experienced non-severe physical sexual harassment	$74,500/worker	
	Workers who experienced severe physical sexual harassment	$85,800/worker	

(continued)

Impact	Indicator	Shadow price	Explanation
Lack of freedom of association	Instances of denied freedom of association	$527/violation	A combination of prevention and retribution costs. The prevention cost expresses the cost of generic auditing set-up to prevent future instances. The retribution cost expresses a penalty for denied freedom of association (e.g. to form a trade union)

Source: Adapted and shortened from Impact Economy Foundation (2022)
[a]Disability-adjusted life year (DALY) combines (1) years of life lost due to premature mortality; and (2) years of life lost due to time lived in states of less than full health, or years of healthy life lost due to disability. One DALY represents the loss of the equivalent of one year of full health
[b]Eutrophication is the process by which an entire body of water, or parts of it, becomes progressively enriched with minerals and nutrients, particularly nitrogen and phosphorus

A.2 Natural Capital Accounting

Natural capital accounting provides an accounting framework to measure stocks and flows of natural capital (Hoekstra, 2022). The underlying premise: because the environment is important to society and the economy, it should be recognised as an asset. It must, therefore, be maintained and managed, with its contributions (services) better integrated into commonly used frameworks like the System of National Accounts, which defines important economic variables such as GDP. The System of Environmental-Economic Accounting (SEEA) is the accepted international standard for environmental-economic accounting, providing a framework for organising and presenting statistics on the environment and its relationship with the economy. It brings together economic and environmental information in an internationally agreed set of standard definitions, classifications, and accounting rules to produce internationally comparable statistics.

The SEEA is developed and released under the auspices of the United Nations, International Monetary Fund and World Bank. It consists of two parts. The **SEEA Central Framework** was adopted as the international standard for environmental-economic accounting in 2012. The Central Framework looks at 'environmental assets', such as water resources, energy resources, forests, and fisheries. It considers their use in the economy and returns to the environment in the form of waste, air, and water emissions. In addition, there are methodological documents that take a sectoral approach, such as SEEA-Energy; SEEA-Water and the SEEA Agriculture, Forests and Fisheries. The **SEEA Ecosystem Accounting** complements the Central

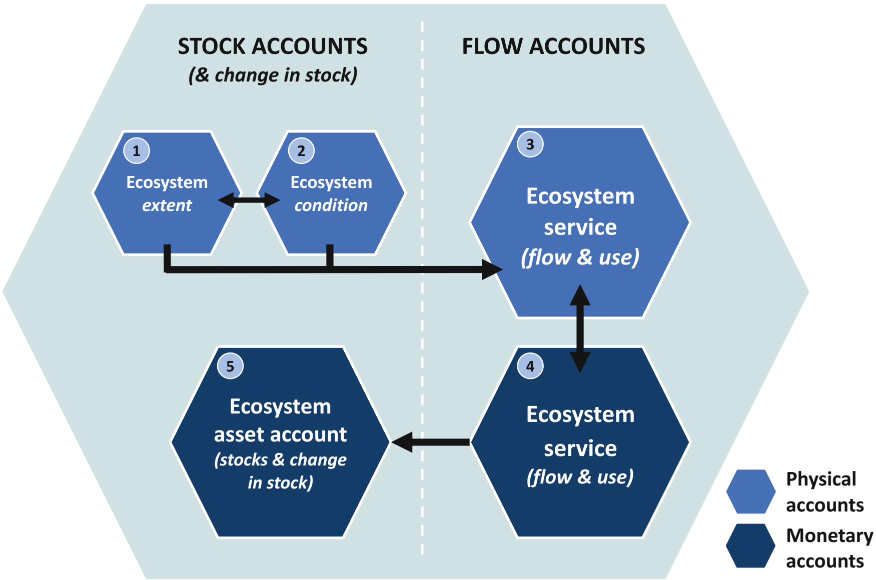


Fig. 5.4 SEEA—sequence of ecosystem accounts. Source: Adapted from SEEA, UN

Framework and was adopted in 2021. It takes the perspective of ecosystems and considers how individual environmental assets interact as part of natural processes within a given spatial area. Ecosystem accounts enable the presentation of indicators of the level and value of 'ecosystem services' in a given spatial area. The SEEA Ecosystem Accounts consist of five different types of accounts, depicted in Fig. 5.4:

1. **Ecosystem Extent** accounts record the total area of each ecosystem, classified by type within a specified area (ecosystem accounting area). Ecosystem extent accounts are measured over time in ecosystem accounting areas (e.g., nation, province, river basin, protected area, etc.) by ecosystem type, thus illustrating the changes in extent from one ecosystem type to another over the accounting period.
2. **Ecosystem Condition** accounts record the condition of ecosystem assets in terms of selected characteristics at specific points in time. Over time, they record the changes to their condition and provide valuable information on the health of ecosystems.
3. & 4. **Ecosystem Services** flow accounts (physical and monetary) record the supply of ecosystem services by ecosystem assets and the use of those services by economic units, including companies and households.
5. **Monetary Ecosystem Asset** accounts record information on stocks and changes in stocks (additions and reductions) of ecosystem assets. This includes accounting for ecosystem degradation and enhancement.

For more on natural capital accounting: https://seea.un.org/content/seea-e-learning-resources.

Suggested Reading

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Investment Decision Rules

6

Overview

When making investment decisions, companies need to be able to compare various investment opportunities. Which ones offer the best value? The first sections of this chapter describe how companies can make such comparisons on a purely financial basis. We start out with the basic investment decision rules of payback period and internal rate of return (IRR). Next, we discuss the technique of net present value (NPV) to calculate financial value (FV).

Chapter 5 showed the steps we need to take for calculating social value (SV) and environmental value (EV). Even with these values known, the big question remains: how to balance them? What decision rules should be followed? The NPV approach can be combined with S and E in three ways: (1) the constrained PV (with S & E as a budget); (2) the expanded PV (with SV & EV in monetary values); and (3) the integrated PV (with SV & EV explicitly balanced). In all three approaches F, S, and E all weigh in and can be prioritised—ideally informed by the company's purpose and value creation profile.

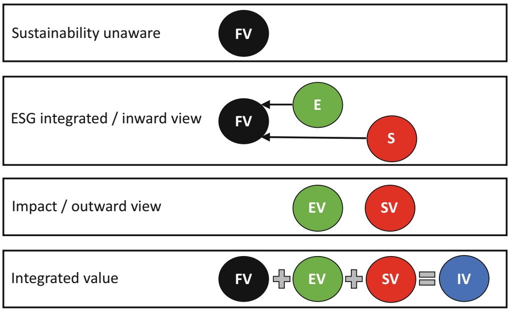
Many companies are keen to integrate SV and EV in their decision making, but struggle to do so in a formalised way. They know that SV and EV are crucial for their purpose, mission, and licence to operate. But their decision-making tools and systems are still geared towards FV only. This chapter provides companies with the basic tools to change this (Fig. 6.1).

Learning Objectives

After you have studied this chapter, you should be able to:

- Calculate the net present value (F) of projects
- Apply the payback period and internal rate of return methods
- Analyse the interactions between F, S, and E in projects
- Apply a balanced approach in integrated present value calculations
- Assess the advantages and shortcomings of the different investment decision rules

D. Schoenmaker, W. Schramade, *Corporate Finance for Long-Term Value*, Springer Texts in Business and Economics, https://doi.org/10.1007/978-3-031-35009-2_6



This chapter:

6.1 Calculating financial value by means of NPV
6.2 Other investment decision rules
6.3 Behavioural effects on investment decisions

6.4 Integrated investment decision rules
6.5 Internalisation

Fig. 6.1 Chapter overview

6.1 Calculating Financial Value by Means of NPV

Managers need an investment decision rule to evaluate projects. Which projects add value to the company and which do not? And if more profitable projects are available, which one should be chosen if capital is scarce? The technique of discounted cash flow (DCF), also known as net present value (NPV), was introduced in Chap. 4. In this chapter, we discuss NPV as a decision-making tool: how to compare the attractiveness of investment opportunities? In Sect. 6.2, we contrast the NPV method with alternatives such as the internal rate of return (IRR) and the payback period criterion. As argued in Chap. 4, future cash flows need to be discounted to take into account the time value of money.

The basic idea is that cash flows are discounted at their opportunity cost of capital (the best available return on an investment of similar risk—see Chap. 4). Suppose that a company is buying new equipment X that requires an initial investment of 100 now and will produce incremental (extra) cash flows of 25 per year for the next 7 years; the opportunity cost of capital r is assumed to be 10%. Table 6.1 provides the cash flow profile, the discount factors $\frac{1}{(1+r)^n}$, the present value of the cash flows $PV = \frac{CF_n}{(1+r)^n}$, and the NPV calculation—as sum of the present values—of the purchase of equipment X.

Since the present value of future cash flows is higher than the initial investment outlay, the NPV is positive. That means that the purchase of the new equipment is financially attractive. The NPV rule states that investment projects with a positive net present value should be undertaken:

$$NPV = \sum_{t=0}^{n} \frac{CF_n}{(1+r)^n} > 0 \tag{6.1}$$

However, it might still not be undertaken if alternatives are better. So, let's consider buying a rival equipment version Y, which requires an investment of 50, then produces three incremental cash flows of 20 per year and subsequently

Table 6.1 NPV calculation of equipment project X

Year	2022	2023	2024	2025	2026	2027	2028	2029
Cash flow	–100	25	25	25	25	25	25	25
Discount factor	1.00	0.91	0.83	0.75	0.68	0.62	0.56	0.51
PV(Cash flow)	–100.0	22.7	20.7	18.8	17.1	15.5	14.1	12.8
NPV	**21.7**							

Table 6.2 NPV calculation of equipment project Y

Year	2022	2023	2024	2025	2026	2027	2028	2029
Cash flow	–50	20	20	20	5	5	5	5
Discount factor	1.00	0.91	0.83	0.75	0.68	0.62	0.56	0.51
PV(Cash flow)	–50.0	18.2	16.5	15.0	3.4	3.1	2.8	2.6
NPV	**11.65**							

Table 6.3 Doing equipment project Y twice

Year	2022	2023	2024	2025	2026	2027	2028	2029
Cash flow	–100	40	40	40	10	10	10	10
Discount factor	1.00	0.91	0.83	0.75	0.68	0.62	0.56	0.51
PV(Cash flow)	–100.0	36.4	33.1	30.1	6.8	6.2	5.6	5.1
NPV	**23.3**							

four cash flows of 5 per year. Like the original equipment project X, this project has a discount rate of 10%. The NPV calculation is shown in Table 6.2.

Like the first project X, equipment project Y has a positive NPV. Which one is better? Project X has the higher NPV, so if the choice is either project X or project Y, the choice will be to do project X. However, in terms of capital intensity, project Y is more attractive; it offers a slightly better NPV per euro invested: 23.3 cents (=11.65/50) versus 21.7 cents (21.7/100). So, if project Y can be duplicated (and this is a big 'if'), then doing it twice is superior to doing project X once, since its NPV is 23.3 (see Table 6.3). If capital is readily available, both projects can be done. Example 6.1 gives you an opportunity to calculate the NPV of a hypothetical data centre project for Microsoft.

Investments can also be valued in different ways, by looking at the security's market price (if available) or by means of relative valuation. This involves deriving a project's or a security's value from the value of similar investments—see Chap. 9.

Example 6.1: Calculating the NPV of a Data Centre Project

Problem

Consider: Microsoft wants to open a new data centre that has an initial investment outlay of €1.2 billion now; positive cash flows of €50 million in years 1 and 2; and positive cash flows of €500 million in years 3, 4, and 5 when the data centre is fully exploited. The cost of capital of the project is 12%; this is the minimum amount for the data centre to be acceptable to Microsoft and is also referred to as the 'required rate of return' or 'hurdle rate'. The cost of capital reflects the 'cost' that Microsoft needs to pay for its capital.

Given the above information, what is the NPV of the data centre project? How much higher/lower would the initial investment outlay have to be (keeping everything else the same) to arrive at an NPV of 0?

Solution

In € millions, the project's cash flows (CFs) are as follows:

Year	0	1	2	3	4	5
Cash flow	–1200	50	50	500	500	500

With a cost of capital of 12%, the discount factors are as follows:

Year	0	1	2	3	4	5
Discount factor	1.00	0.89	0.80	0.71	0.64	0.57

Multiplying the CFs by the discount factors of the same year results in the following present values (PVs) of CFs:

Year	0	1	2	3	4	5
PV(Cash flow)	–1200	45	40	356	318	284

Summing those PVs of CFs gives an NPV of –€158.1 million. So, the data centre project should not be accepted.

The initial investment outlay would have to be €158.1 lower to arrive at an NPV of 0. After all, since the investment outlay happens now, its discount factor is 1 and every euro reduction in investment outlay translates to an increase in NPV of equal size.

The data centre project will only be accepted with a positive NPV ($NPV > 0$) according to Eq. (5.1). So, the initial investment should be at least €158.1 lower to be accepted. ◄

6.2 Other Investment Decision Rules

Projects can also be prioritised in ways other than by means of NPV. Two frequently used methods are (1) the payback rule and (2) the IRR (internal rate of return) rule.

6.2.1 Payback Rule

The payback rule has been in use for a long time. It is quite simple: only do an investment if its cash flows pay back its initial investment within a pre-specified period (which is set by company management). The payback period is the number of years needed to earn back the initial investment. In the example of Table 6.1, the payback time of the equipment project is 4 years, since the cash flows of 2023, 2024, 2025, and 2026 are 25 each and add up to 100, which cancels out the investment of 100. Whether that meets the payback rule depends on the payback period pre-specified by management: yes, if the threshold is 4 or more years, and no, if the threshold is set at 2 or 3 years.

The obvious advantage of the payback rule is its ease of use. However, it has serious flaws:

- The pre-specified payback period is usually arbitrary
- The payback period does not account for the time value of money
- It makes cash flows beyond the cut-off point irrelevant, which does not stimulate long-term investment

6.2.2 IRR Rule

The IRR rule is more sophisticated than the payback rule. It says that one should take an investment opportunity if the IRR exceeds the opportunity cost of capital. IRR is the abbreviation of internal rate of return, and it is the discount rate at which a project's NPV equals zero. This calculation is done with the same information as in an NPV calculation, but without the discount rate, which is left as the variable to be solved for setting the NPV to 0. Table 6.4 illustrates the calculation problem for the earlier equipment project X (from Table 6.1).

With a bit of trial and error (or using the IRR formula in Excel), it is found that $r = 0.163$, i.e. the IRR is 16.3% in this case. The attraction of the IRR is that it gives an indication of safety: the more the IRR exceeds the cost of capital, the clearer it seems to be value for money. But that may be misleading, since it does not mean much for capital light projects (i.e. projects that do not need much capital). Moreover, the IRR implicitly assumes that interim cash flows can be reinvested at the same return until the end period.

Table 6.4 Applying the IRR to equipment project X

Year	2022	2023	2024	2025	2026	2027	2028	2029
Cash flow	–100	25	25	25	25	25	25	25
Discount factor	1	$\frac{1}{(1+r)^1}$	$\frac{1}{(1+r)^2}$	$\frac{1}{(1+r)^3}$	$\frac{1}{(1+r)^4}$	$\frac{1}{(1+r)^5}$	$\frac{1}{(1+r)^6}$	$\frac{1}{(1+r)^7}$
PV(Cash flow)	–100	?	?	?	?	?	?	?
NPV	**0**							

Table 6.5 Cash flows for projects A and B

Year	2022	2023	2024	2025	2026	2027	2028	2029
CF project A	–200	110	110	110	–60	110	110	–300
CF project B	–150	30	30	30	30	30	30	30

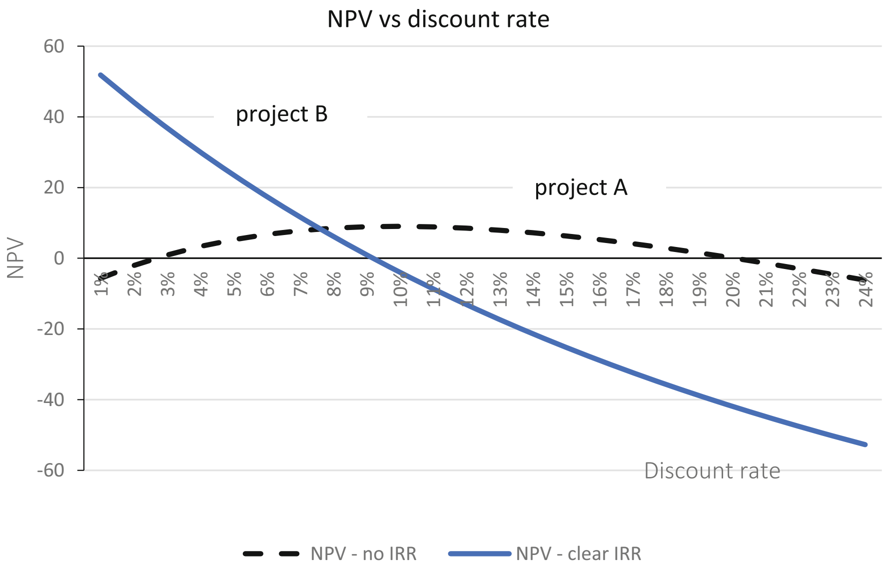


Fig. 6.2 IRR for projects A and B

In effect, the IRR is not useful in comparing projects of different sizes. If a small and a large project both have an IRR above the cost of capital, then which one is best? It is not clear. Moreover, the IRR does not give uniform outcomes if cash flows flip signs (i.e. cash flows after the initial investment are alternately positive and negative, like for project A in Table 6.5). Table 6.5 contrasts the cash flows of projects A and B. Figure 6.2 shows the NPVs of these two projects at various discount rates. The IRR is supposed to be found at the unique discount rate for which the NPV is 0. However, for project A, there are actually two points at which the NPV line crosses the x-axis because of the alternating positive and negative cash flows during the project. Hence, there is no unique solution.

Example 6.2 asks you to calculate the payback period and IRR for Microsoft's data centre project.

Example 6.2: Calculating Payback Period and IRR of a Data Centre Project

Problem

Consider the Microsoft data centre project described in Example 6.1. With a cost of capital of 12%, its NPV was found to be negative. What does that imply for the data centre's IRR: should it be higher or lower than 12%? Please calculate the data centre's IRR and payback period.

Solution

The IRR of a project is the discount rate at which the project has an NPV of 0. Most often (barring exceptions such as shown in Table 6.5), a project's NPV falls as its discount rate rises. So, if a project's NPV is negative at a 12% cost of capital, then its IRR will typically be below 12%. This can be checked by inserting alternative discount rates and seeing how the NPV changes. The table below illustrates that and shows that the NPV of the data centre project falls if the discount rate rises from 12 to 13% and rises if the discount rate is lowered:

Discount rate (%)	NPV
13	–192
12	–158
11	–123
10	–86
9	–47
8	–6
7	36

At a discount rate somewhere between 8 and 7%, the NPV turns positive. In fact, with a bit of trial and error it is found that the IRR is just over 7.85%. Because the project IRR is lower than the cost of capital of 12%, the IRR rule suggests that the data centre project should be rejected.

The payback period is found by taking the cumulative positive CFs in each year (i.e. the sum of the positive CFs up until and including that year), and comparing them with the initial investment outlay, as done below:

Year	0	1	2	3	4	5
Cash flow	–1200	50	50	500	500	500
Positive CFs		50	50	500	500	500
Cumulative positive CFs		50	100	600	1100	1600
Investment outlay paid back?		No	No	No	No	Yes

Since the cumulative CFs only exceed (or at least equal) the investment outlay in the 5th year, the payback period of the data centre project is 5 years. To be precise, we can calculate the fraction of the year: the exact payback period is then 4 years and 2.4 months (=100/500 * 12 months). ◀

6.2.3 NPV Versus IRR and Payback

Let's consider the three methods for the same investment opportunities. Table 6.6 compares the results of the three investment options from Sect. 6.1. As seen previously, equipment project X beats equipment project Y on NPV, but doing project Y twice is best. On IRR and payback, project Y is actually preferred over project X. And doing project Y once or twice delivers the same IRR. This comparison highlights yet another advantage of NPV over IRR or payback period: NPVs can be added up.

The key argument behind the preference for NPV is that it is a direct measure of value created for shareholders (in monetary terms), and that we assume that the objective of the financial manager is to maximise shareholder value (see Chap. 3). We thus want to have the highest NPV, as opposed to the highest IRR (whereby we may end up with a lower NPV).

However, such comparisons only tell us something about the financial value of projects and their ranking. They do not tell us anything about their desirability in social and environmental terms. Moreover, there may be problems with the way people apply them.

6.3 Behavioural Effects on Investment Decisions

In the above discussion of decision rules, it was implicitly assumed that people behave rationally, making unbiased estimates of cash flows and using the correct discount rate. In practice, however, that may not be the case. There is plenty of academic evidence that people often behave irrationally, including in corporate investment decisions. For example, corporate managers are found to sacrifice long-term value in earnings management (Graham et al., 2005). Misvaluation due to such irrational behaviour by corporate managers is called 'internal errors', as opposed to 'external errors', which is misvaluation due to irrational behaviour by participants in financial markets. There are two main categories of internal errors that can be distinguished: overconfidence and excessive optimism.

Overconfidence means that managers underestimate the risk involved in their investments, resulting in a lower discount rate or hurdle rate for the project. This is a widespread problem. Ben-David et al. (2013) find evidence that most executives underestimate risk, both in the stock market and in their own company's prospects. This is reflected in narrow confidence intervals: realised market returns are within the executives' 80% confidence intervals only 36% of the time. The authors find that

Table 6.6 Comparing investment opportunities by method

Method	Project X	Project Y	Project Y twice	Preferred project
NPV	21.7	11.6	23.3	Project Y twice
IRR	16.3%	19.6%	19.6%	Project Y or Project Y twice
Payback rule	4	3	3	Project Y or Project Y twice

underestimation of risk results in more aggressive corporate policies: companies with more overconfident managers invest more and use more debt finance. In addition, Malmendier and Tate (2005) find that overconfident managers overestimate their company's ROIC (Return on Invested Capital) and find external finance too costly.

Excessive optimism involves the overestimation of cash flows. This too is a widespread problem. For a US sample, Graham et al. (2013) find that 80% of CEOs and 66% of CFOs are much more optimistic than average people. Overoptimistic managers invest more when cash is ample since they overestimate the perceived NPVs of projects. But they invest less when external equity is required since the perceived financing costs are too negative (see Chap. 15 on capital structure). In other words, they think they are giving away shares too cheaply (for example, selling shares for €60 while they think their value is €90) and that the losses on the shares are larger than the gains (i.e. the NPV) of the investments to be made.

Example 6.3 illustrates the difference between overconfidence and excessive optimism with a calculation example.

Example 6.3: Calculating Changes in Value Due to Managerial Overconfidence and Excessive Optimism

Problem

Suppose three managers have to assess the same project. Table 6.7 gives their individual estimates of project risk and expected cash flows (CFs), as well as an unbiased assessment of project risk and CFs.

Let's consider the following questions:

1. What is the unbiased project value?
2. How much do managers A, B, and C think the project is worth?

Solutions

Question 1. From Eq. (4.6) (see Chap. 4), we get the unbiased project value for a perpetual stream of cash flows: $PV = CF/r = 200/0.080 = 2500$.

Question 2. The estimated value for each manager:

Manager A: $200/0.075 = 2666.7$
Manager B: $220/0.080 = 2750.0$
Manager C: $220/0.075 = 2933.3$

Table 6.7 Project assessment with managerial overconfidence and excessive optimism

	Unbiased assessment	Manager A assessment	Manager B assessment	Manager C assessment
Project risk	8%	7.5%	8%	7.5%
Perpetual CF	200	200	220	220

Table 6.8 Value effects of managerial overconfidence and excessive optimism

	Unbiased assessment	Manager A assessment	Manager B assessment	Manager C assessment
Unbiased project value	2500	2500	2500	2500
Estimated project value (with bias)	2500	2667	2750	2933

Table 6.8 gives an overview of the value effects. It is clear that manager A's overconfidence (resulting in a lower risk assessment) and manager B's excessive optimism (resulting in higher CF projection) both lead to a higher estimated project value. Manager C's combination of the two biases leads to the highest overvaluation. ◄

Overconfidence and excessive optimism often go hand in hand, making them hard to distinguish from each other. So, the source and type of such aggressive corporate policies is not always clear. But there are ways to spot overconfident and excessively optimistic CEOs who conduct aggressive corporate policies: premature liquidation of options, i.e. managers that liquidate options prematurely to finance private transactions (e.g. a new mansion; Malmendier & Tate, 2009); earnings misses and earnings management, which are visible in abnormal accruals (Hribar & Yang, 2016); and excessive press coverage (Malmendier & Tate, 2009). Box 6.1 provides the example of overconfident managers at Enron.

It is also found that CEOs with private pilot licenses (Cain & McKeon, 2016) and those with military experience (Malmendier et al., 2011) tend to be more aggressive. Conversely, female CEOs tend to be less aggressive (Faccio et al., 2016; Huang & Kisgen, 2013), as are CEOs with large cash holdings (Dittmar & Duchin, 2016) and those with deep recession experience (Malmendier et al., 2011).

Box 6.1: Signs of Overconfident Managers at Enron

Energy company Enron went bankrupt in 2001, the largest corporate bankruptcy in US history up until that point. The company went bankrupt after a massive accounting scandal was exposed. Several signs of overconfident managers could be spotted at Enron:

- The arrogance of its CEO, Jeff Skilling, was hard to miss: he boasted about his smartness; posted large pictures of himself in the Enron annual report; made wild claims (e.g., 'perception is reality'). And he was known to be a compulsive gambler
- The company had a self-deceiving accounting system: Skilling introduced mark-to-market accounting, which was approved by the auditors and allowed Enron to basically make up its profits ('hypothetical future value')

(continued)

Box 6.1 (continued)

- Group processes: employees evaluated each other on a scale of 1–5, where the 1s got huge bonuses and the 5s (15%) were fired—which gave unhealthy incentives in voting
- The company had a macho culture with wild motorcycle expeditions and parties with strippers at the office at night and
- There was no decent capital budgeting process. For example, the company built a power plant in India without seriously assessing local electricity demand

In addition to excessive optimism and overconfidence, managers may suffer from other behavioural biases. For example, availability bias means that people overweigh available and intuitive information. In confirmation bias, people are looking for support of their opinion, while the more useful thing to do is to look for falsification, i.e. evidence that you might be wrong. Variants on this are wishful thinking, self-attribution, and escalation of commitment. The latter involves people hanging on to projects that should be stopped.

Managers also make behavioural errors in the shape of heuristics. These are rules of thumb that help them to take short-cuts, which may or may not be helpful. An example is the 'one discount rate fits all' heuristic: instead of adjusting the discount rate to reflect the risk of the project at hand, managers tend to use one single company discount rate.

6.4 Integrated Investment Decision Rules

Chapter 5 showed how to calculate SV and EV. The next question is how to integrate them in investment decision rules. Chapters 2 and 3 described how a company's purpose and value creation profile can inform its prioritisation among the types of value. That is the top-down company view. But how to prioritise at the investment project level? The same priorities should hold, but they need to be applied in investment decision rules.

This section therefore develops three ways to prioritise at the investment project level, by combining the PV (present value) approach with S and E:

1. **The constrained PV** includes S and E in their own units as a budget constraint to the NPV on purely financial value (FV)
2. **The expanded PV** expresses S and E in monetary values (SV and EV) and shows these in addition to the NPV on FV
3. **The Integrated PV** goes further by explicitly balancing FV, SV, and EV in a formula

Table 6.9 Comparing types of present value (PV) approaches

Method	Analysis	Example
Standard NPV	NPV on F gives FV	Projects from Sect. 6.1
Constrained PV	Add: S and/or E in their own units as a budget	E: Net zero CO_2 emissions S: Positive health effects
Expanded PV	Add: SV and/or EV in monetary terms	EV: CO_2 emissions x price
		SV: Positive health effects x price
Integrated PV	Add: FV + SV + EV all in monetary terms	$IPV = FV + b * SV + c * EV$, with $b, c > 0$

Table 6.9 provides an overview of the PV approaches. In all three approaches, F, S, and E all weigh in and can be balanced. Ideally the balancing is informed by the company's purpose and value creation profile (see Chap. 2). So if a company is, say, value destructive on E, it should put extra weight on improving E; and if E is central to its purpose, it will also weight E more heavily. The next sub-sections explain the approaches. Box 6.2 discusses how investment decisions are made in practice.

Box 6.2: Investment Decisions in Practice

It is important to note that investment decisions (as part of the capital budgeting process that makes a list of investment projects to be done) do not start with an NPV analysis. Instead, several steps are typically taken before an NPV analysis is conducted. See Fig. 7.2 in Chap. 7. S and E issues are increasingly identified before any financial evaluation takes place. Advanced companies adopt high standards and targets for S and E issues, which can effectively exclude certain projects due to insufficient performance on the social and environmental fronts. For example, these companies might have a target of eliminating child labour in their supply chain or a target of being net zero on carbon by 2030.

6.4.1 Constrained PV

In the constrained PV method, S and/or E function as a budget constraint to the standard NPV on F. Typically, such budgets are informed by the company's purpose, strategy, and context. Suppose a medical technology company has the goal of being carbon neutral and wants all of its investment projects to contribute to that goal. The company can choose from three projects, which are listed in Table 6.10 along with their characteristics.

Project A with a negative NPV is an investment in carbon capture and storage. Project B with a large upfront investment has a positive NPV, but uses a carbon-intensive technology. Finally, project C has a smaller upfront investment and a higher NPV and uses a similar carbon-intensive technology.

Table 6.10 Comparing projects on constrained PVs

Project	Investment, € millions	NPV F, € millions	CO_2 emitted, millions	CO_2 stored, millions	NPV ≥ 0?	Contribution to CO_2 emissions ≤0?
A	70	–50	0	1	No	Yes
B	100	200	0.2	0	Yes	No
C	20	250	0.2	0	Yes	No

Table 6.11 Comparing combinations of projects on constrained PVs

Project	Investment, € millions	NPV F, € millions	CO_2 emitted, millions	CO_2 stored, millions	NPV≥0?	Contribution to CO_2 emissions ≤0?
A + B	170	150	0.2	1	Yes	Yes
A + C	90	200	0.2	1	Yes	Yes

Project A is valuable in terms of meeting the company's target of becoming carbon neutral. However, it has a negative standard NPV and hence fails on the constrained PV—which wants both a positive NPV and to have S and E within budget. Projects B and C also fail on the constrained PV criterion, but for the opposite reason of project A: whereas B and C have positive standard NPVs, they fail on reducing the company's emissions. Hence, all three projects should not be done on a stand-alone basis.

But what about combining projects? Given that project A has opposite strengths to projects B and C, they might be value creative in combination. Table 6.11 shows the characteristics of such combinations.

Both combinations meet the constrained PV criterion: projects A+B and projects A+C make a net positive contribution to reducing the carbon footprint and have a positive standard NPV. However, they are not the same: the combination of projects A+C is better on standard NPV than the combination of projects A+B. The combined projects are equal on E (the carbon footprint). We can also compare the combination of projects A+C to project B. The combined projects A+C are equal to project B on NPV, but they outperform project B on E.

Another issue is that these combinations are effectively netting the pros and cons of individual projects: project C is harmful to E; and project A has a negative standard NPV. To what extent netting should be allowed is debatable, both in investment decision-making and in reporting. Some netting can be a good thing in that it justifies doing projects that are individually problematic but net positive on aggregate. This enables decision-makers to avoid decision paralysis. However, netting should not be used to make half-hearted decisions. In our example, project A's carbon capture and storage (with negative NPV) is meant to offset the effects of carbon-intensive projects.

The comparison is further complicated by including S. Since the example concerns a medical technology company, it makes sense to consider the quality life years added by projects A, B, and C. Table 6.12 shows the projects' profiles.

Table 6.12 Quality life years added per project and combination of projects

Project	Quality life years added	Contribution to health effects ≥0?
A	–	Yes
B	2500	Yes
C	4000	Yes
A + C	4000	Yes

The good news is that two out of three projects add quality life years. For projects B and C, the numbers are quite high, since they relate to the medical technology company's core business of improving health. Project A, which is essentially an environmental project, brings no health effects. But how to compare these? If the budget constraint is to be positive (or more precisely non-negative), then all three projects meet the criterion. Then again, more quality life years saved is better. So how to account for that? We get one step closer to doing so by means of the expanded PV.

6.4.2 Expanded PV

The expanded PV expresses S and E in monetary values to arrive at SV and EV (as explained in Chap. 5) and then shows these in addition to the standard NPV. For the above-mentioned projects A, B, and C, this can be done by applying a shadow price to both CO_2 (at €200 per ton) and quality life years added (at €110,000 per quality life year added). The shadow prices are taken from Sect. A.1 of Chap. 5. Tables 6.13 gives the results.

Table 6.13 shows that, while project A has a zero SV and a negative FV, it has a high EV. In contrast, it is now clearer that projects B and C have negative EV, but

Table 6.13 Comparing projects on expanded PVs

Project	Investment, € millions	NPV F, € millions	E in own units net CO_2 reduction, millions of tons	EV (€ millions) net CO_2 reduction at 200 Euro/ton	S in own units quality life years added	SV (€ millions) quality life years added at 110k euro/life
A	70	–50	1.0	200	–	0
B	100	200	–0.2	–40	2500	275
C	20	250	–0.2	–40	4000	440
A + C	90	200	0.8	160	4000	440

Note: The table shows the present value (PV) of financial flows in the third column (NPV F = FV), environmental flows in the fifth column (EV), and social flows in the seventh column (SV). To keep the exposition simple, a zero discount rate is used for calculating the PV of EV and SV high FV and even higher SV. Moreover, the combination of projects A and C now looks much better than that of the individual projects: the combination is strongly positive on all three value dimensions.

So by going from S and E to SV and EV, the comparability of projects and project combinations has gone up. However, it did require adding a shadow price which may be hard in other cases (such as biodiversity). And which shadow price to use? On the one hand, one could argue that the €200/ton shadow price of CO_2 is high. versus the current market price (of about €100/ton in early 2023). On the other hand, it is very low versus estimates by scientists on what is needed to reach net zero. And the €110,000 shadow price on a quality life year effectively gives SV a high weight vs. EV. The above example is also quite simplistic, as other types of SV and EV (such as health and safety; and biodiversity) are not included. It also ignores potential loss of life from environmental degradation.

Moreover, while we did consider SV and EV at the same level as FV, we did not explicitly prioritise among the three types of value. That is what we do in an Integrated PV, abbreviated as IPV.

6.4.3 Integrated PV (IPV)

In the integrated PV (IPV), SV and EV are not only separately calculated (as in the expanded PV), but also added and weighted, along with the NPV, to arrive at an integrated value creation number. In its simplest form, we sum all types of value at equal weights. The simple integrated present value decision model then becomes:

$$IPV = FV + SV + EV > 0 \tag{6.2}$$

The application of the integrated present value decision model is similar to the net present value rule in Eq. (6.1). Companies should only undertake projects that have positive integrated value. Among projects with positive integrated value, the company should first undertake the project with the highest integrated value. But as explained below, a company should avoid conducting projects whereby a positive FV outweighs negative SV and EV. Table 6.14 gives this simple IPV for the above-mentioned projects.

Table 6.14 calculates integrated value by simply summing FV, SV, and EV. But integrated value can also be calculated not just by adding values, but also by balancing them (Schramade et al., 2021). For example, SV might get a higher weight if the company has a mission focused on S or if its SV value creation profile is negative. We can apply different regimes, with b denoting the weighting of SV; and c denoting the weighting of EV. We only need two parameters to design relative weights for all three value dimensions, because the effective weight for FV is 1. The equation for calculating the IPV is as follows:

$$IPV = FV + b \cdot SV + c \cdot EV > 0 \qquad with\ b, c > 0 \tag{6.3}$$

Table 6.14 Integrated PVs when equally weighting FV, SV, and EV

Project	FV	SV	EV	IPV = FV + SV + EV
A	–50	0	200	150
B	200	275	–40	435
C	250	440	–40	650
A + C	200	440	160	800

Note: The table shows the present value (PV) of financial flows in the second column (FV), social flows in the third column (SV), environmental flows in the fourth column (SV), and the integrated present value in the fifth column (IPV)

Table 6.15 Integrated PVs with intermediate and full weighting of SV and EV

Project	FV	SV	EV	IPV = FV + 0.5 * SV + 0.5 * EV	IPV = FV + SV + EV
K	50	–50	–20	15	–20
L	30	30	–40	25	20
M	10	60	–40	20	30

The IPV model acknowledges the interrelationships between the different types of value and allows a structured balancing of stakeholder interests. Chapter 3 argues that the current corporate governance regime is characterised by very small weighting of social and environmental value: $b = c = 0.1$. This is quite close to the shareholder model, whereby FV is prioritised over SV and EV. The weights should be set by the company's board (see Chap. 3). The board's choice of weights depends not only on a company's purpose and mission, but also on the speed of internalisation of negative impacts. Companies may want to improve their competitive position by including social and environmental value in their business model ahead of expected internalisation of negative impacts (see Chap. 5). The IPV model allows companies to choose their degree of sustainability. Here, we explore the intermediate case ($b = c = 0.5$) and the full case ($b = c = 1$) of including SV and EV.

Table 6.15 lists several projects. Project K is profitable and has negative social and environmental impact. Project L is less profitable, with positive social impact and negative environmental impact. Project M is again less profitable with improved social impact, but still negative environmental impact.

From a financial perspective using the NPV rule ($b = c = 0$), the company chooses project K with the highest FV. Using the IPV rule, the company selects project L in the intermediate case ($b = c = 0.5$) and project M in the full case ($b = c = 1$) as the project with the highest IPV. This hypothetical list of projects shows that the weighting of SV and EV matters. Project M has the highest combined SV and EV (+20 = 60 – 40) in comparison with project K (–70) and project L (–10). Box 6.3 illustrates the operation of the IPV decision model with a real-world example of Shell, a major oil company.[1] By applying the NPV model, Shell

[1] See https://royaldutchshellplc.com/2020/01/07/fd-why-did-shell-miss-out-on-the-sale-of-eneco/

continued its current oil and gas activities. Using the IPV model, by contrast, would stimulate Shell to invest in green activities, making its business model more future-proof.

Box 6.3: Shell Lost in Transition

Oil company Shell has a negative environmental value because of the carbon emissions of its main products, oil and gas. This negative environmental value outweighs its positive financial value (profits). Investment in green energy companies, with simultaneous divestment of the exploration of new oil and gas, can reduce this negative value. An opportunity to do that was provided by the possible acquisition of Eneco, an energy utility company with a green strategy, in 2019.

With the IPV model, Shell would have arrived at a relatively high valuation of Eneco, because Eneco would reduce Shell's negative environmental value (which outweighs its positive financial value). However, Shell applied the traditional NPV model, resulting in a low valuation of Eneco. As a result, Japan's Mitsubishi was able to acquire Eneco with a higher bid, and Shell continued to focus its investments on oil and gas exploration.

Upgrading Legacy Investments

The IPV rule optimises all new investments based on the company's preferences b and c for SV and EV, respectively. But what about past projects with negative SV and EV? Are there legacy investments that locked the company into carbon-intensive production processes and products or negative social practices? They need to be upgraded with new investments, even if it means that the standard NPV of these investments is negative (De Adelhart Toorop et al., 2023).

In the Appendix, we develop an extended IPV model, in which negative values should 'hurt' more than positive values of the same size. This gives companies an incentive to phase out negative (social and environmental) impacts, thus creating positive value on all three dimensions in the long term. **The Appendix provides some company case studies on the working of the extended IPV model.**

Limits

There are also limits to the use of the IPV decision model. An important limit is the availability of company data on social and environmental impacts. Mandatory reporting of sustainability data, as envisaged by the International Sustainability Standards Board and the European Union's Corporate Sustainability Reporting Directive, will advance data availability (see Chap. 17). Another (and related) limit is the advance of impact valuation. Further progress is needed in the valuation practices of social and environmental impact in order to include the quantified impacts in investment decision-making.

6.5 Internalisation

In the previous section FV, SV and EV were calculated independently, which gives the impression that they are also created independently from each other. In practice, the three dimensions are created jointly and with similar drivers. The same processes that allow an airline to make money selling flights also result in GHG emissions, poor (or good) working conditions, and other S and E effects. The effects are related and can affect each other. Improving one of them may have a cost or benefit for the other—now or later, or now *and* later. This makes that taking a dynamic perspective is very important: do not assume that current conditions will last forever, but acknowledge that they can change in various ways.

Industries, companies, and products that are currently loss-making because they do not get paid for the positive externalities they generate, may become profitable as those externalities get priced (internalised). Conversely industries, companies, and products with large negative externalities face the risk of those externalities being (partly) internalised by means of regulation, technology, or customer behaviour. The example of the car industry was mentioned in Chap. 2: emission limits (regulation) and the arrival of Tesla (technology & customer behaviour) forced automobile makers to start switching from cars with internal combustion engines to electric vehicles and incur the high costs required to adapt.

Let us illustrate internalisation with the IPV examples presented in Table 6.16. The company applies an intermediate regime (with $b = c = 0.5$) for its IPV calculations. Project X has a positive IPV of +45, while projects Y and Z have negative IPVs of –15 and –35, respectively. Only project X would be undertaken.

There is a possibility that the government imposes a carbon tax of €150, which amounts to 75% of the environmental value (based on the shadow carbon price of €200 per ton). In this internalisation scenario, FV absorbs 75% of EV due to carbon taxation (assuming that all EV is related to carbon emissions). Table 6.17 shows how FV changes. The (partial) internalisation of EV makes project X financially less attractive, but still value creative. More importantly, the internalisation means that projects Y and Z become financially viable on a stand-alone basis. This happens regardless of the regime at the company, as shown in Table 6.17, which gives the new FVs and the IPVs for the intermediate regime (with $b = c = 0.5$) from Table 6.16.

Carbon taxes or prices enter the valuation twice—for calculating FV and EV. The taxation incentivises the company to change behaviour and switch to low-carbon or carbon-neutral technologies reducing the negative EV. In the case of the company reducing carbon emissions, FV improves (by avoiding costly carbon taxes) and EV

Table 6.16 IPV of various projects

Project	FV	SV	EV	IPV = FV + 0.5 * SV + 0.5 * EV
X	80	–20	–50	45
Y	–20	–30	40	–15
Z	–40	–50	60	–35

Table 6.17 Internalisation scenario: FV absorbs 75% of EV

Project	FV (old)	SV	EV	FV (new) = FV (old) + 0.75 * EV	IPV with internalisation	IPV without internalisation
X	80	–20	–50	42.5	7.5	45
Y	–20	–30	40	10	15	–15
Z	–40	–50	60	5	10	–35

Note: This table is based on Table 6.16 and shows the internationalisation scenario for IPV with intermediate weighting: IPV = FV + 0.5 ∗ SV + 0.5 ∗ EV

Table 6.18 Expected IPV of project Y under varying probabilities of internalisation

IPV with internalisation	Probability of internalisation (%)	IPV without internalisation	Probability of no internalisation (%)	Expected IPV
15	0	–15	100	–15
15	10	–15	90	–12
15	20	–15	80	–9
15	30	–15	70	–6
15	40	–15	60	–3
15	50	–15	50	0
15	60	–15	40	3
15	70	–15	30	6
15	80	–15	20	9
15	90	–15	10	12
15	100	–15	0	15

improves (by reducing carbon emissions). This then should not be seen as double counting. Table 6.17 shows that projects Y and Z become more attractive due to their improved FV and positive EV, and project X becomes less attractive due to its reduced FV and negative EV.

So, even the manager who gives EV an intermediate weighting (with $c = 0.5$) is now interested in doing projects Y and Z, in which FV derives from its high EV. However, the manager's interest will depend on the probability of this happening. Table 6.18 shows how the expected IPV of project Y increases with the probability of internalisation. This is not to be confused with the probability of transition (Chap. 2). The probability of internalisation is a narrower concept that estimates to what extent externalities are likely to be translated into FV effects, driven by transition processes.

Table 6.18 can be read as follows: In our example, the probability of internalisation means the probability of the government imposing a carbon tax of €150. Looking at the top rows, this probability of internalisation in column 2 is quite low (0%, 10%, etc.). The counterpart is the probability of no internalisation in column 4. Note the two probabilities add up to 100% by definition. The expected IPV is the weighted average of the IPV with internalisation and the IPV without internalisation, with the respective probabilities as weights. For example, in the case of a probability of internalisation of 20%, the expected IPV is $-9 = 15 * 20\ \% - 15 * 80\%$.

At a probability of 50% or higher, the expected IPV of project Y turns positive in Table 6.18. Of course, this is a stylistic example. In the real world, internalisation can happen in many different ways (e.g. over different time horizons), making the calculation much more difficult. However, a rough calculation like this one can be very helpful in assessing the attractiveness of projects and in helping to make better decisions. In Chap. 7, we provide some real-life examples and calculations with the IPV decision model.

6.6 Conclusions

The previous chapters described the importance of balancing the various types of value; how that affects corporate governance; and how to discount future flows. This chapter takes the necessary next step: how to calculate those types of value.

When making investment decisions, companies need to be able to compare various investment opportunities. Which ones offer the best value? The first sections of this chapter describe how companies can make such comparisons on a purely financial basis. We start out with the traditional technique of net present value (NPV) to calculate financial value (FV). Next, we discuss the contrast with other investment decision rules such as payback period and internal rate of return (IRR).

Chapter 5 showed the steps to be taken for calculating the social and environmental value in monetary terms, i.e. SV and EV. Even with these types of value known, the big question remains how to balance them. What decision rules should be followed? The NPV approach can be combined with S and E in three ways: the constrained PV (with S & E as a budget); the expanded PV (with SV & EV in monetary values); and the Integrated PV (with SV & EV explicitly balanced).

In all three approaches, F, S, and E all weigh in and can be prioritised—ideally informed by the company's purpose and value creation profile. It is important to take a dynamic perspective to these types of value: internalisation can happen, thereby shifting EV or SV to FV in positive or negative ways. This chapter showed how this can be done when quantities are given. But to make it more practical, the next chapter goes further by discussing the fundamentals of getting the right data and line items to estimate value flows per year.

Key Concepts Used in This Chapter

Constrained PV (present value) includes S (social) and E (environmental) factors in their own units as a budget constraint to the NPV on financial value

Excessive optimism involves the overestimation of cash flows

Expanded PV (present value) expresses S (social) and E (environmental) factors in monetary values (SV and EV) and shows these in addition to the NPV on financial value

Integrated PV (IPV) calculates and explicitly balances FV, SV, and EV in a formula

Internal rate of return (IRR) says that one should take any investment opportunity in which the IRR exceeds the opportunity cost of capital

Investment decision rules are decision rules for investment projects; examples of such rules are NPV, IPV, payback rule, and IRR

Materiality indicates relevant and significant information

Materiality assessment aims to determine which S (social) and E (environmental) factors are sufficiently important for consideration in SV and EV

Monetisation of social value (SV) and environmental value (EV) means to express them in monetary terms

Net present value (NPV) is the present value of cash inflows and cash outflows

Payback rule states that one should only do an investment if its cash flows pay back its initial investment within a pre-specified period

Payback period is the number of years needed to earn back the initial investment

Overconfidence means that managers underestimate the risk involved in their investments

Shadow prices reflect the 'true scarcity' of resources to stay within planetary boundaries or the 'true price' of human rights breaches to stay within social boundaries; shadow prices are based on welfare theory

Quantification of social and environmental factors means to express them in their own units

Appendix: Extended IPV Model with Company Case Studies

This Appendix introduces an extended version of the IPV model of Sect. 6.4 and provides company case studies on applying this model.

A.1 Extended IPV Model

In Sect. 6.4, the IPV model was introduced as follows:

$$IPV = FV + b \cdot SV + c \cdot EV > 0 \tag{6.4}$$

The IPV rule optimises all new investments based on the company's preferences b and c for SV and EV, respectively. But what about past projects with negative SV and EV? Old investments, that locked the company into carbon-intensive production processes and products or negative social practices, need to be upgraded with new investments (De Adelhart Toorop et al., 2023).

This implies that negative values should 'hurt' more than positive values of the same size. Discouraging, but not banning, negative effects on one of the value dimensions is possible with parameter $d > 1$ for negative values. Companies then have an incentive to phase out negative (social and environmental) impacts and thus create positive value on all three dimensions in the long term. The extended IPV decision model then becomes:

$$IPV = \{FV^{+} + b \cdot SV^{+} + c \cdot EV^{+}\} + d * \{FV^{-} + b \cdot SV^{-} + c \cdot EV^{-}\} > 0 \tag{6.5}$$

The superscript +/– stands for a positive/negative value, respectively. For FV, we get either an overall positive value FV^{+} or an overall negative value FV^{-}, since cash flows are fungible (i.e. they can be netted). For SV and EV, we can get both positive and negative values at the same time. Clothes, for example, can contribute to consumer well-being SV^{+}, while being produced under poor labour conditions SV^{-} (see calculations for Inditex in Chap. 11). It is important to account for positive and negative social and environmental values separately. This prevents netting of positive values, such as customer well-being, and negative values, such as poor labour conditions.

We propose to start with a parameter for negative value of one and a half: $d = 1.5$. Companies that aim to phase out a negative value faster will set the weight of d higher. In the long run, the weight of d may go to infinity, which is de facto a ban on negative social and environmental externalities.

A.2 Company Case Studies

We provide some company case studies on the working of the extended IPV model, which may lead to different decisions on corporate investments. To analyse potential differences, the extended IPV model in Eq. (6.5) is applied to two hypothetical companies: an oil company and a medical technology company. The simple IPV model with adding up of the three value dimensions (with a weight of 1 for all three value dimensions) is also presented as benchmark.

Table 6.19 shows the valuation creation profile of the companies. The value profile of the oil company is typical for the sector: moderately profitable ($FV = 3$), but with major environmental externalities due to carbon emissions ($EV = -15$) and some social externalities in the supply chain ($SV = -2$). The company has no explicit purpose and thus applies equal weights across the value dimensions ($b = c = 1$), which already goes well beyond how the typical oil company is currently managed (with values for b and c close to zero). A simple adding up delivers a negative value profile ($IV = -14$). Using the extended IPV model, however, delivers a larger negative annual value creation profile ($IV = -22.5$), as the negative impact of the polluting oil company counts 1.5 times ($d = 1.5$).

The medtech company is strong on its mission of health care ($SV = 15$) and profitable ($FV = 8$), but does generate negative environmental externalities ($EV = -2$), albeit much smaller than those of the oil company. The medtech's purpose is reflected in the higher weight for SV ($b = 1.6$) than for EV ($c = 1$) and FV (1 by definition). The medtech company wants to phase out its negative values as fast as possible ($d = 2$). The extended IPV model shows a large positive value creation profile ($IV = 28$), due to the higher parameter for its social mission. A simple adding up gives a smaller positive value profile ($IV = 21$).

Table 6.19 Value creation profile of an oil and a medtech company

Value dimensions and parameters	Company 1: Oil	Company 2: Medtech
FV	3	8
SV	–2	15
EV	–15	–2
Annual value creation by simple adding up	**–14**	**21**
b	1	1.6
c	1	1
d	1.5	2
FV^{+}	3	8
$b \cdot SV^{+}$	0	24
$c \cdot EV^{+}$	0	0
$d \cdot FV^{-}$	0	0
$d \cdot b \cdot SV^{-}$	–3	0
$d \cdot c \cdot EV^{-}$	–22.5	–4
Annual integrated value creation	**–22.5**	**28**

Note: This table shows the value creation profile of two companies based on three value dimensions (FV, SV, EV). The oil company has equal weights for the value dimensions ($b = c = 1$), while the medtech company has higher weights for SV ($b = 1.6$) than for EV ($c = 1$) and FV (1). In the extended IPV model (rows 7–12), negative values count 1.5 times ($d = 1.5$) for the oil company and double for the medtech company ($d = 2$) in the value creation. The top rows show annual value creation by a simple adding up of the three values (rows 1–3)

Table 6.20 summarises the investment projects available for the oil company. Projects 1 and 2 have positive impact on the social side (+2) and the environmental side (+2), respectively, but make financial losses (–1). Project 3 generates a profit (+1) with no externalities. We first analyse the choice of projects on a stand-alone project base, i.e. irrespective of the company's current value creation profile. The NPV rule would select project 3 with the highest financial value, which is positive (+1). Punishing negative values in the extended IPV model leads also to project 3, which has no negatives. The simple adding up sees no difference among the projects, they all create a value of +1.

The second step is to analyse the projects with regard to the company's value profile. The last three columns in Table 6.20 illustrate that the extended IPV model would favour selection of project 1 and/or 2, as these projects (partly) repair the value destruction on the social and environmental side. In terms of the value matrix of Chap. 2, the oil company is a quadrant 1 type, value destructive company, which can improve its value profile by doing financially loss-making projects that generate positive impact. The oil company can, for example, select a project from a set of renewables investments to improve its EV and SV profile by varying degrees. Box 6.3 in Sect. 6.4 illustrates the operation of the IPV decision model with a real-world example of Shell, a major oil company.

Table 6.21 provides the details of the investment projects available for the medtech company. The set-up of the projects is identical to those of the oil company. Again, projects 1 and 2 have positive impact on the social side (+2) and the

Table 6.20 Change in value creation by an oil company

Value dimensions and parameters	Oil company profile	Project 1	Project 2	Project 3	Company after project 1	Company after project 2	Company after project 3
FV	3	–1	–1	1	2	2	4
SV	–2	2	0	0	0	–2	–2
EV	–15	0	2	0	–15	–13	–15
Annual value creation by simple adding up	**–14**	**1**	**1**	**1**	**–13**	**–13**	**–13**
Improvement					**1**	**1**	**1**
b	1	1	1	1	1	1	1
c	1	1	1	1	1	1	1
d	1.5	1.5	1.5	1.5	1.5	1.5	1.5
FV^{+}	3	0	0	1	2	2	4
$b \cdot SV^{+}$	0	2	0	0	0	0	0
$c \cdot EV^{+}$	0	0	2	0	0	0	0
$d \cdot FV^{-}$	0	–1.5	–1.5	0	0	0	0
$d \cdot b \cdot SV^{-}$	–3	0	0	0	0	–3	–3
$d \cdot c \cdot EV^{-}$	–22.5	0	0	0	–22.5	–19.5	–22.5
Annual integrated value creation	**–22.5**	**0.5**	**0.5**	**1**	**–20.5**	**–20.5**	**–21.5**
Improvement					**2**	**2**	**1**

Note: This table shows the value profile of an oil company which has the choice of three projects. The last three columns show the value profile of the oil company after the project (1, 2, or 3). The oil company has equal weights for the value dimensions ($b = c = 1$), while negative values count 1.5 times ($d = 1.5$). The annual integrated value creation is obtained by adding the adjusted values in rows 7–12. The improvement is relative to the original company profile in the first column. The top rows show annual value creation by simple adding up of the three values in rows 1–3

Table 6.21 Value creation by a medtech company

Value dimensions/parameters	Medtech company profile	Project 1	Project 2	Project 3	Company after project 1	Company after project 2	Company after project 3
FV	8	–1	–1	1	7	7	9
SV	15	2	0	0	17	15	15
EV	–2	0	2	0	–2	0	–2
Annual value creation by simple adding up	**21**	**1**	**1**	**1**	**22**	**22**	**22**
Improvement					**1**	**1**	**1**
b	1.6	1.6	1.6	1.6	1.6	1.6	1.6
c	1	1	1	1	1	1	1
d	2	2	2	2	2	2	2
FV^+	8	0	0	1	7	7	9
$b \cdot SV^+$	24	3.2	0	0	27.2	24	24
$c \cdot EV^+$	0	0	2	0	0	0	0
$d \cdot FV^-$	0	–2	–2	0	0	0	0
$d \cdot b \cdot SV^-$	0	0	0	0	0	0	0
$d \cdot c \cdot EV^-$	–4	0	0	0	–4	0	–4
Annual integrated value creation	**28**	**1.2**	**0**	**1**	**30.2**	**31**	**29**
Improvement					**2.2**	**3**	**1**

Note: This table shows the value profile of a medtech company which has the choice of three projects. The last three columns show the value profile of the medtech company after the project (1, 2, or 3). The medtech company has a higher weight for SV ($b = 1.6$) than for EV ($c = 1$) and FV (1), while negative values count double ($d = 2$). The annual integrated value creation is obtained by adding the adjusted values in rows 7–12. The improvement is relative to the original company profile in the first column. The top rows show annual value creation by simple adding up of the three values in rows 1–3 environmental side (+2), respectively, but make financial losses (–1). Project 3 generates a profit (+1) with no externalities. The extended IPV model leads to the selection of project 1, due to the medtech's healthcare mission with a higher weight for SV ($b = 1.6$). In this way, the company makes use of the comparative advantage of its purpose (Edmans, 2020).

Analysing the projects from perspective of the company's value creation profile produces a different outcome. Table 6.21 shows that project 2 is selected, as this project repairs the value destruction on the environmental side (integrated value improvement of 3). The second choice is project 1 with the added value coming from the company's mission (integrated value improvement of 2.2). In terms of the value matrix of Chap. 2, the medtech company is a quadrant 1 company (albeit quite close to quadrant 2), which can improve its value creation profile by doing financially loss-making projects that generate positive impact. With project 2, the company is able to erase its negative environmental value and thus move to quadrant 2.

In contrast, the simple IPV model with adding up sees no difference between the projects, while the net present value rule would select project 3 which has the highest financial value (both on a stand-alone and a company basis).

These case studies show that similar projects can have a different value for different companies and situations. The value depends on a company's purpose (b, c) and its starting position, where a potential negative value dimension is weighted heavier (d). The extended IPV decision model leads to different investment decisions than both the standard NPV rule (always project 3) and the simple IPV model with a simple adding up of the three value dimensions (indifferent between projects).

Suggested Reading

Malmendier, U., & Tate, G. (2005). CEO overconfidence and corporate investment. *Journal of Finance, 60*(6), 2661–2700.

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Schramade, W., Schoenmaker, D., & de Adelhart Toorop, R. (2021). *Decision rules for long-term value creation* CEPR (Discussion Paper DP16074).

Capital Budgeting

7

Overview

In Chap. 6 we explained decision rules for investment decisions. We discussed financial investment evaluation methods such as NPV (net present value), IRR (internal rate of return), and payback period. The chapter subsequently showed that S (social) and E (environmental) factors can be valued in their own right and can be included in constrained, expanded, or integrated PVs (present values). However, in Chap. 6 the cash flows were presented as given. In this chapter, we dive deeper into the capital budgeting process, which is the process of making a list of investment projects to be done. We make these investment decisions more tangible by presenting more detailed calculation examples—including the calculation and forecasting of cash flows and their drivers.

We start by showing the steps in the capital budgeting process and then show how cash flows and incremental cash flows are calculated and forecasted. Subsequently, we identify behavioural challenges in the capital budgeting process, such as the tendency to continue poor projects for too long, to underestimate risk, and to overestimate cash flows. Even more challenging, people tend to extrapolate business as usual into the future, which is highly unrealistic in dealing with non-linear processes such as climate change.

Next, we integrate S and E in the capital budgeting process—integrated capital budgeting. The constrained, expanded, and integrated PVs (introduced in Chap. 6) are now shown with cash flow projections. It is shown that FV, SV, and EV can have shared, reinforcing, or conflicting underlying value drivers—and that the way and extent to which they are taken into account affect decisions.

The value dimensions FV, SV, and EV can affect each other. We discuss the process of internalisation, by which SV or EV might spill over into FV. Those investment decisions are put in the context of corporate objectives, as put forward in Chap. 3 on corporate governance. See Fig. 7.1 for an overview of the chapter.

D. Schoenmaker, W. Schramade, *Corporate Finance for Long-Term Value*, Springer Texts in Business and Economics, https://doi.org/10.1007/978-3-031-35009-2_7

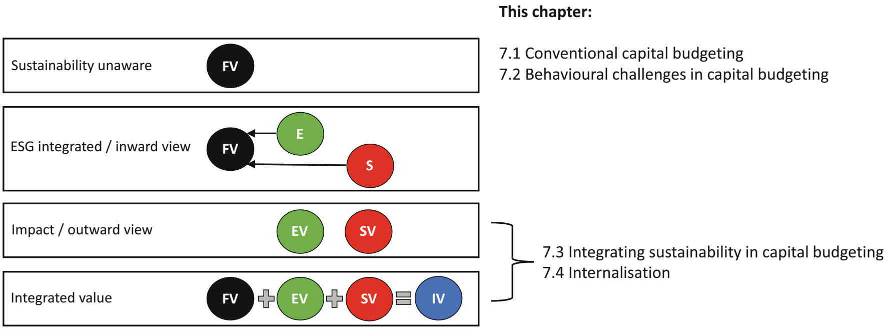


Fig. 7.1 Chapter overview

Learning Objectives
After you have studied this chapter, you should be able to:

- Calculate and compare the value of projects
- Identify behavioural biases in capital budgeting
- Explain how to integrate SV and EV into project evaluation
- Balance the financial, social, and environmental dimensions of projects
- Critically evaluate projects in terms of company valuation profile

7.1 Conventional Capital Budgeting

7.1.1 The Capital Budgeting Process

A *capital budget* is the list of projects the company plans to invest in. The process of determining the list of investment projects to be undertaken is called *capital budgeting*. Capital budgeting happens in several steps, as illustrated in Fig. 7.2.

First, managers and workers from all over the company identify investment opportunities. They can typically choose and execute small investment opportunities on their own authority, but where investment needs are beyond pre-specified and company-specific thresholds (e.g. for every outlay above €500k), they will need to ask for permission. This leads to the second step, where they submit investment proposals, which are collected centrally by a corporate financial planning department.

In the third step, that department will do an initial assessment of the proposed projects: do they meet financial and nonfinancial criteria, such as strategic fit? These nonfinancial criteria might include S and E criteria on, for example, CO_2 emissions, safety, and labour conditions across the value chain. Such criteria will typically inform the behaviour of the proposers as well, meaning that there is a bias towards meeting those criteria. The financial planning department will typically test the

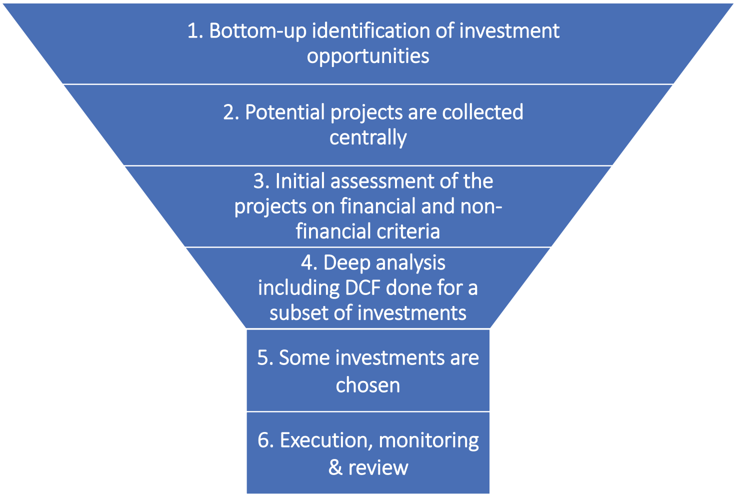


Fig. 7.2 Stages of a typical capital budgeting process

assumptions made in the proposal. See Box 7.1 for an example of the role of strategic objectives in capital budgeting.

A subset of projects makes it to the fourth stage, where their consequences for the company and its value creation are calculated in terms of their DCF (discounted cash flow) value. This gives a list of projects that are ranked on NPV and matched with the available investment budget to decide which projects are finally chosen (Step 5). The final step (#6) is the execution of the chosen projects, which happens over the course of years, and during which they are monitored and reviewed. This chapter will focus on the calculation side of Steps 4 and 5.

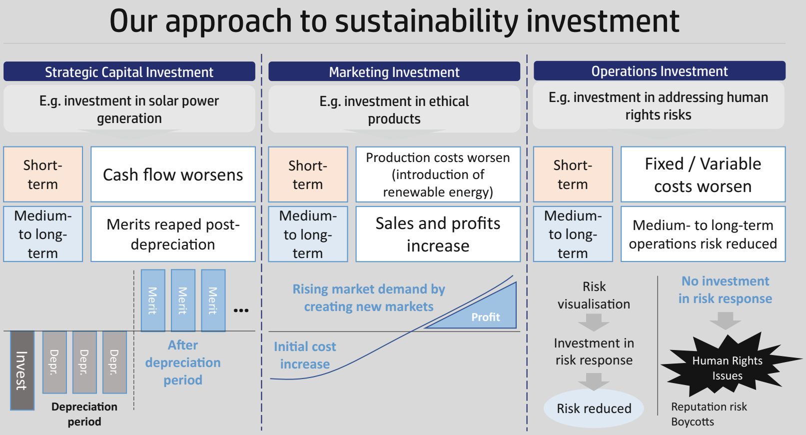
Box 7.1: Asahi Group: Strategic Objectives for the Capital Budgeting Process

Asahi Group Holdings is a Japanese company that produces alcoholic drinks, soft drinks, and other beverages in the food business. Sustainability concerns are part of Asahi's strategy and the subject of a separate sustainability strategy, which has five components: responsible drinking; health; environment; people; and communities. The goal of promoting responsible drinking indicates that the company is aware of the negative health effects of its alcoholic drinks. Asahi has set several quantified targets on E, such as reducing its waste and carbon emissions. On the S side, the company takes measures to reduce 'inappropriate drinking' and it wants low-alcohol and non-alcohol beverages to account for 20% of its sales by 2025.

To achieve those targets, the company sets management incentives accordingly. In its investor presentations, the company talks about integrating

(continued)

Box 7.1 (continued)
sustainability into management strategy through such initiatives as 'Asahi Group Environmental Vision 2050' and 'Sustainable Communities'. Such strategic choices are set by top management, and they give direction to the goals and actions of middle managers. So, if a strategy includes having more sales from non-alcoholic beverages, or lowering the company's carbon footprint, then managers will be actively looking for projects that further those goals.



Source: Adapted from page 7 of 2021 Investor Relations presentation, Asahi Group

In talking about its sustainability investments, Asahi distinguishes strategic capital investment (e.g. investment in solar power generation); marketing investment (e.g. investment in ethical products); and operations and management investment (e.g. investment in addressing human rights risks). In all three areas, the company expects lower cash flows and/or higher costs in the short term, but better cash flows and lower risk in the medium to long term. As Asahi puts it: 'Sustainability is not about cost—it is investment in the future. By addressing sustainability not from a short-term but rather a medium- to long-term perspective, we aim to secure investment returns, reduce risk, and boost corporate value'.

7.1.2 Calculating Cash Flows

Step 4 of the capital budgeting process involves a DCF analysis, which requires the calculation of expected cash flows. Table 7.1 shows a simplified DCF with a cost of capital of 10%, similar to the ones shown in Chaps. 4 and 6. The PV (present value)

Table 7.1 Simple NPV calculation

Year	2022	2023	2024	2025	2026	2027	2028	2029
Cash flow	–100	25	25	25	25	25	25	25
Discount factor	1.00	0.91	0.83	0.75	0.68	0.62	0.56	0.51
PV(Cash flow)	–100.0	22.7	20.7	18.8	17.1	15.5	14.1	12.8
NPV	**21.7**							

Table 7.2 Calculating cash flows

	2018	2019	2020	2021
Sales	0	320	633	1196
Costs (including depreciation)	–472	–501	–512	–855
EBIT = sales – total costs	**–472**	**–181**	**121**	**341**
Interest paid	–10	–12	–10	–8
× applicable corporate tax rate	25%	25%	25%	25%
Corporate tax	121	48	–28	–83
Net income = EBIT – interest – corporate tax	**–362**	**–145**	**83**	**250**
+ depreciation	48	48	48	48
– CAPEX	–516	–37	–37	–37
– increase in NWC	–12	–14	–24	–37
Project cash flows	**–842**	**–148**	**70**	**224**

for each year is the cash flow multiplied by the discount factor. The NPV (net present value) is the sum of the PVs over the project life.

But how are the cash flows themselves calculated? Where do they come from? How are they generated? Table 7.2 gives a breakdown of cash flows in their components, which can be estimated separately. The following accounting terms are used in the cash flow calculation:

- **EBIT**: earnings before interest and taxes
- **CAPEX**: capital expenditures (i.e. company investments)
- **NWC**: net working capital, which is the difference between the company's current assets (such as cash, inventories, and accounts receivable) and its current liabilities (such as taxes payable, accounts payable, short-term funding). Current assets and liabilities are short term (typically less than 1 year)

Table 7.2 shows the standard set-up. EBIT is sales minus costs. To arrive at net income, interest and corporate taxes are deducted. Please note that corporate tax is positive (i.e. a cash inflow) in 2018 and 2019. This means that the company receives a tax refund, as the negative income (EBIT minus interest paid) can be deducted from corporate taxes. Up till now, we work with accounting terms as represented in a company's management and financial accounts. To get from net income to cash flows, we need to make a few corrections. First, depreciation is a component of costs (as presented in the second line item of Table 7.2) and hence deducted from sales.

However, since depreciation is a non-cash item (i.e. does not affect cash flows), it should be added back. Second, the investment outlays in machinery and buildings are incorporated as capital expenditures (CAPEX) in the cash flow analysis; and investment in inventory is included as an increase in net working capital (NWC). The final result is the project cash flows in Table 7.2. These project cash flows are also labelled 'free cash flows' available to the company's shareholders.

7.1.3 Estimated Cash Flows

However, Table 7.2 shows historical cash flows. For capital budgeting purposes, we need forward-looking cash flows, i.e. estimated cash flows. This requires estimates on individual line items, and importantly, on their underlying value drivers. What's driving sales and costs? To what extent will the company be successful in beating its competitors, in selling its products, and in handling its operating issues to keep costs in check? There is obviously no certainty on any of the above, hence the estimates are no more than expected values, with a large margin of error.

It is important to note that choices can be made as to what line items to estimate, with what detail, and which line items simply follow from others. For example, if one estimates sales and costs, then EBIT and the EBIT margin will result from them. Alternatively, one could estimate sales and the EBIT margin (i.e. EBIT as a percentage of sales), and then EBIT and costs will follow from them. One can also go deeper, for example estimating the volume and price components separately to arrive at sales and cost estimates. We can illustrate this with an example.

Let's suppose a mining company plans to develop an extension to one of its copper mines in Latin America. To obtain a cash flow forecast, the business unit (BU) will forecast the amount of time and money spent on building the extension; the volumes of product to be sold, and at what price; and the costs involved in producing the product. Table 7.3 shows the BU's assumptions for the first 10 years, and how they add up to cash flows. In the first 2 years, there is no production and capital expenditures are high, resulting in negative cash flows of over $500 million. Production starts in year 3 and is expected to reach maximum capacity by year 6. Production costs fall from $7000/tonne (1000 kg) in year 3 to $4200/tonne in year 5. Since the copper price is forecast to be $8000/tonne, this results in an EBIT margin of 48%. Please note that for simplicity, we assume constant prices in our examples. In reality, inflation will lead to increased prices and costs. Moreover, commodity prices are volatile due to fluctuations in demand and supply.

When reading tables with detailed numbers (e.g. Tables 7.3 and 7.4), you will notice that the numbers don't add up exactly, due to rounding. This is the case for internal company overviews and calculations (like in this chapter) as well as external reports (see Chap. 17).

If we suppose that those cash flows run until year 30 (as in year 10) and apply an 11% cost of capital to the cash flows, we can calculate the value of the 20-year annuity from year 11 to year 30. So, the terminal value at year 10 is calculated as a 20-year annuity.

Table 7.3 Copper mine extension FCF calculation (in millions of USD)

	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	...	Year 10
Volume (thousands of tonnes)	n/a	n/a	50	120	130	140		140
Price (USD/tonne)	n/a	n/a	8000	8000	8000	8000		8000
Sales (USD million)	**0**	**0**	**400**	**960**	**1040**	**1120**		**1120**
Costs per tonne	n/a	n/a	–7000	–5000	–4200	–4200		–4200
Costs (USD million)	–100	–100	–350	–600	–546	–588		–588
EBIT = sales – total costs	**–100**	**–100**	**50**	**360**	**494**	**532**		**532**
EBIT margin	n/a	n/a	13%	38%	48%	48%		48%
× applicable corporate tax rate	25%	25%	25%	25%	25%	25%		25%
Corporate tax	25	25	–13	–90	–124	–133		–133
Net income = EBIT – corporate tax	**–75**	**–75**	**38**	**270**	**371**	**399**		**399**
+ depreciation	100	100	100	100	100	100		100
– CAPEX	–600	–700	–400	–60	–60	–60		–60
– increase in NWC	–20	–20	–20	–20	–20	–20		–20
Project Cash Flows	**–595**	**–695**	**–283**	**290**	**391**	**419**		**419**

Table 7.4 Copper mine extension DCF (in millions of USD)

	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Year 7	Year 8	Year 9	Year 10
Project cash flows	–595	–695	–283	290	391	419	419	419	419	419
Terminal value										3337
Total cash flows	–595	–695	–283	290	391	419	419	419	419	3756
Discount factor	0.901	0.812	0.731	0.659	0.593	0.535	0.482	0.434	0.391	0.352
Present value	–536	–564	–207	191	232	224	202	182	164	1323
NPV	**1210**									

Using Eq. (4.7) from Chap. 4, we get the following value of the 20-year annuity: $PV = \frac{CF}{r} \cdot \left(1 - \frac{1}{(1+r)^N}\right) = \frac{419}{0.11} \cdot \left(1 - \frac{1}{(1+0.11)^{20}}\right) = 3{,}809.1 \cdot (1 - 0.124) = 3{,}336.8$ (which is rounded to 3337 in Table 7.4). Please note that the annuity from year 11 to year 30 is discounted at the discount factor of the preceding year (year 10) in Table 7.4. Discounting total cash flows (which include project cash flows and the terminal value), one obtains an NPV or DCF value of \$1.2 billion (\$1210 million in Table 7.4).

In the above mining example prices and volumes need to be split, since prices can fluctuate so much. However in many instances, it makes sense to take a shortcut and estimate sales directly, based on estimates of growth rates. For example, a project may be expected to ramp up from 0 to $80 million annual sales in 2 years, with the assumptions in Table 7.5 resulting in the cash flow forecasts of Table 7.6.

In Table 7.5, the white cells in years 0–2 are calculated on given data (as also shown in Table 7.6), whereas the grey cells are assumptions that are inspired by, and extrapolated from, the white cells. Those assumptions in turn drive the results in Table 7.6. It often makes sense to have detailed assumptions (e.g. on the absolute cost level) for the first few years, followed by more high-level assumptions (e.g. on growth rates and percentage margins) in later years.

When discounting the cash flows from Table 7.6 at 9% from the end of year 0, we obtain an NPV of 15.

Table 7.5 Forecasting assumptions

	Year 0	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Year 7
Sales growth	n/a	n/a	167%	5%	5%	5%	5%	5%
EBIT margin	n/a	-50%	31%	31%	31%	31%	31%	31%
Corporate tax rate	25%	25%	25%	25%	25%	25%	25%	25%
Depreciation/sales	n/a	33%	13%	12%	11%	10%	9%	8%
CAPEX/sales	n/a	17%	6%	8%	8%	8%	8%	8%
Increase in NWC/sales	n/a	3%	1%	1%	1%	1%	1%	1%

Table 7.6 Resulting cash flows (in millions of USD)

	Year 0	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Year 7
Sales	**0**	**30**	**80**	**84**	**88**	**93**	**97**	**102**
Costs	–10	–45	–55	–58	–61	–64	–67	–70
EBIT	**–10**	**–15**	**25**	**26**	**27**	**29**	**30**	**32**
× applicable tax rate	25%	25%	25%	25%	25%	25%	25%	25%
Corporate tax	3	4	–6	–7	–7	–7	–8	–8
Net income	**–8**	**–11**	**19**	**20**	**21**	**22**	**23**	**24**
+ depreciation	10	10	10	10	9	9	8	8
– CAPEX	–70	–5	–5	–7	–7	–7	–8	–8
– increase in NWC	–1	–1	–1	–1	–1	–1	–1	–1
Project cash flows	**–69**	**–7**	**23**	**21**	**22**	**22**	**22**	**22**
Discount factor	1.000	0.917	0.842	0.772	0.708	0.650	0.596	0.547
Present value	–69	–7	19	17	15	14	13	12
NPV	**15**							

7.1.4 Incremental Cash Flows

It is important to realise that investment assessment is about changes to the current situation. So if a project creates new cash flows—but at the same time reduces the cash flows on on-going projects—the net effect should be calculated, i.e. the *incremental cash flows* of projects. These incremental cash flows reflect the difference in the company's overall cash flows with and without the project under evaluation. It requires estimating incremental sales and incremental costs. One therefore needs to take into account the indirect effects of the project which may increase or decrease the cash flows of other activities of the company.[1] For example, a new product may come at the expense of an existing product's sales. If the new product has superior characteristics compared to the existing product, then clients will switch and buy the new product instead of the existing one. This process is called *cannibalisation*. If the cannibalisation potential relates to a very profitable product, it may hold the company back from introducing the new product.

Table 7.7 shows an example in which the introduction of a new product, B, is expected to result in 15% lower sales of the existing product, A. The change in cash

Table 7.7 Calculating incremental cash flow

	Product A before introduction product B	Product A after introduction product B	Change in product A	Product B	Incremental cash flows of product B
Sales	1000	850	–150	1200	**1050**
Costs	–700	–620	80	–800	**–720**
EBIT	300	230	–70	400	**330**
EBIT margin	30%	27%	–3%	33%	**31%**
× applicable tax rate	25%	25%	0%	25%	**25%**
Corporate tax	–75	–58	18	–100	**–83**
Net income	225	173	–53	300	**248**
+ depreciation	50	50	0	100	**100**
– CAPEX	–50	–40	10	–100	**–90**
– increase in NWC	–20	–20	0	–30	**–30**
Total Cash Flows	205	163	–43	270	**228**

[1] These are also called project externalities. However, we find the name of that concept confusing as it is quite distinct from externalities (or external impacts) as defined in Chaps. 1 and 2, i.e. costs and benefits that fall outside the boundaries of the company.

flow on product A is –43. Since product B gives a cash flow of 270, the incremental cash flow is 270 – 42.5 = 227.5. So, cannibalisation does happen. But since the new product has higher sales and higher profit margins than the existing product, its introduction is still quite value creative for the company.

Another effect that is often missed in calculating incremental cash flows is the *opportunity cost* of the project: the missed value of what could have been done instead. For example, in the above calculation one might have forgotten to include the cost of an idle machine that is used for project B but could have been sold or rented out, with a cash flow of, say, 100. That would have reduced incremental cash flow to 228–100 = 128.

7.1.5 Include the Opportunity Costs of the Desalination Plant in Incremental Cash Flows

Let's return to the copper mine project described in Tables 7.3 and 7.4. Additional information comes in: the water stress of the project is so severe that it puts drinking water quality and availability for the local population at risk. As a result, the company runs the risk of losing the project, and all cash flows associated with it, at the end of year 3—just when cash flows are expected to turn positive. The chance of this happening is estimated at 50%. This means that expected cash flows from year 4 onwards are halved, and the NPV is reduced by $1258 million (see Table 7.8). To address this risk, and reduce the probability of losing the asset to 0%, the company could build a desalination plant, which makes seawater suitable for human consumption.

On a stand-alone basis, i.e. forgetting about the opportunity cost of reducing the risk of losing the asset, the marginal CF from the desalination plant is negative across all years (see Table 7.9). Applying the mining company's 11% discount rate, the marginal cash flows turn into a negative DCF value of $538 million. Note that years 7–9 have marginal project cash flows which are similar to year 6. The respective present value (PV) for these years is –5, –5, and –4, due to the decreasing discount factor over time.

Table 7.8 NPV of 50% chance of losing the asset in year 4 (in millions of USD)

	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Year 7	Year 8	Year 9	Year 10
Total cash flows	0	0	0	–145	–195	–210	–210	–210	–210	–1878
Discount factor	0.901	0.812	0.731	0.659	0.593	0.535	0.482	0.434	0.391	0.352
Present value	0	0	0	–96	–116	–112	–101	–91	–82	–661
NPV	**–1258**									

Note: This table is based on Table 7.4, whereby half of cash flows are lost from year 4 onwards

Table 7.9 The desalination plant's marginal cash flows excluding opportunity costs

	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	...	Year 10
Marginal operating costs	0	–10	–10	–10	–10	–10		–10
Marginal depreciation	0	–25	–25	–25	–25	–25		–25
Marginal costs	0	–35	–35	–35	–35	–35		–35
Marginal EBIT	0	–35	–35	–35	–35	–35		–35
Marginal corporate tax	0	9	9	9	9	9		9
Marginal Net Income	0	–26	–26	–26	–26	–26		–26
Marginal depreciation	0	25	25	25	25	25		25
Marginal CAPEX	–500	–10	–10	–10	–10	–10		–10
Marginal project cash flow	**–500**	**–11**	**–11**	**–11**	**–11**	**–11**		**–11**
Terminal value								**–90**
Total marginal project cash flow	**–500**	**–11**	**–11**	**–11**	**–11**	**–11**		**–101**
Discount factor	0.901	0.812	0.731	0.659	0.593	0.535		0.352
Present value	–450	–9	–8	–7	–7	–6		–36
NPV	**–538**							

Table 7.10 The desalination plant's incremental cash flows

	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	...	Year 10
Marginal CF of the desalination plant, stand-alone	–500	–11	–11	–11	–11	–11		–11
Opportunity cost: eliminating the expected loss in CF	0	0	0	145	195	210		210
Incremental cash flow	**–500**	**–11**	**–11**	**134**	**184**	**198**		**198**
Terminal value								**1579**
Total incremental cash flow	**–500**	**–11**	**–11**	**134**	**184**	**198**		**1777**
Discount factor	0.901	0.812	0.731	0.659	0.593	0.535		0.352
Present value	–450	–9	–8	88	109	106		626
NPV	**720**							

Based on the calculations in Table 7.9, the desalination plant seems like a poor investment. **However, the analysis should include the benefits of eliminating the probability of losing the asset.** Table 7.10 does exactly that to arrive at the real incremental cash flows of the desalination plant. It does so by calculating the expected cash flows to be missed from the original project (50% of the positive cash flows from year 4 onward—see the bottom line of Table 7.3 for the original cash flows) and adding them to the stand-alone marginal cash flows calculated in Table 7.9.

The cash flows from Table 7.10 result in a $720 million DCF value of building the desalination plant. And the new NPV of the project, including the desalination plant is $672 million. Table 7.11 summarises the DCF results.

To check if the new project value of $672 million is correct, let's calculate the adjusted cash flows of the project and the individual line items. This is done by summing the relevant lines in Tables 7.3 and 7.9, of which the results are shown in Table 7.12.

Table 7.11 DCF value including the desalination plant

Type of value	Value in USD millions
1. Original NPV before the risk of losing the asset (Table 7.4)	1210
2. Loss due to risk of losing the asset (Table 7.8)	–1258
3. New NPV before the desalination plant (3) = (1) + (2)	–48
4. NPV of the desalination plant (Table 7.10)	720
5. New NPV including the desalination plant (5) = (3) + (4)	672

Table 7.12 Project CFs including the desalination plant

	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	. . .	Year 10
Volume (thousands of tonnes)	n/a	n/a	50	120	130	140		140
Price (USD/tonne)	n/a	n/a	8000	8000	8000	8000		8000
Sales (USD million)	**0**	**0**	**400**	**960**	**1040**	**1120**		**1120**
Costs per tonne	n/a	n/a	–7000	–5000	–4200	–4200		–4200
Costs (USD million)	–100	–135	–385	–635	–581	–623		–623
EBIT (USD million)	**–100**	**–135**	**15**	**325**	**459**	**497**		**497**
EBIT margin	n/a	n/a	4%	34%	44%	44%		44%
× applicable corporate tax rate	25%	25%	25%	25%	25%	25%		25%
Corporate tax (USD million)	25	34	–4	–81	–115	–124		–124
Net income (USD million)	**–75**	**–101**	**11**	**244**	**344**	**373**		**373**
+ depreciation (USD million)	100	125	125	125	125	125		125
– CAPEX (USD million)[a]	–1100	–710	–410	–70	–70	–70		–70
– increase in NWC (USD million)	–20	–20	–20	–20	–20	–20		–20
Project Cash Flows (USD million)	**–1095**	**–706**	**–294**	**279**	**379**	**408**		**408**

Note: [a]CAPEX is including desalination investment

Table 7.13 Adjusted copper mine extension DCF (in millions of USD)

	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Year 7	Year 8	Year 9	Year 10
Project cash flow	–1095	–706	–294	279	379	408	408	408	408	408
Terminal value										3247
Total cash flow	–1095	–706	–294	279	379	408	408	408	408	3655
Discount factor	0.901	0.812	0.731	0.659	0.593	0.535	0.482	0.434	0.391	0.352
PV	–986	–573	–215	184	225	218	196	177	159	1287
NPV	**672**									

Table 7.13 calculates the present value in the same way as in Table 7.4. We use again a 20-year annuity to calculate the terminal value at year 10. The result is the same as the result in Table 7.11: $672 million.

7.1.6 Sanity Checks in Analysing Projects

When analysing a project, it makes sense to do sanity checks on what is driving the outcomes. A sanity check (or test) is a basic test to quickly evaluate whether a claim, or the result of a calculation, can possibly be true. For example, one could do a sensitivity analysis on (some of) the value drivers of the project: that is an effective way to answer the question of what happens to the NPV when changing key assumptions. Table 7.14 shows what happens when changing the assumptions about sales growth and EBIT margin (from year 3 onward) for the project shown in Tables 7.5 and 7.6. The NPV of $15 million, shown in the middle, is the original outcome with the best estimate of the value drivers, namely 5% sales growth and 31% EBIT margins. When raising the EBIT margin assumption to 33% while holding sales growth constant, the NPV becomes $20 million (one cell to the right of the 15 in the box), i.e. a 2% percentage point higher margin gives a $5 million (=33%) higher value. The sensitivity to sales growth is a bit lower though, since a 7% sales growth assumption (combined with the original 31% EBIT margin) results in an NPV of $19 million (one cell below the 15 in the box). Of course, one could also vary the cost of capital instead of margins or sales growth.

Another sanity check is the break-even analysis, which asks which levels of sales growth and margins (or cost of capital) are needed to have an NPV of 0. In the above example, while holding sales growth at 5% and cost of capital at 9% constant, the 0 NPV is obtained by lowering the EBIT margin assumption to 24%. Similarly, while holding the others constant, a zero NPV is reached by raising the cost of capital to 14%. The project IRR in the base scenario of 5% sales growth and 31% EBIT margin is thus 14%.

Table 7.14 Sensitivity analysis on value drivers: NPV in millions of USD

Sales growth	EBIT margins 27%	29%	31%	33%	35%
1%	0	4	8	12	16
3%	3	7	11	16	20
5%	6	11	**15**	20	24
7%	9	14	19	24	29
9%	13	18	23	28	33

Table 7.15 Simple scenario analysis on value drivers

Value driver	Base case	Bear case	Bull case
Product volume growth	3%	0%	5%
Sales price	€40	€30	€50
Cost per unit	€25	€30	€20
Capex needed	€100 million	€200 million	€80 million

One could also do a simple scenario analysis, in which one makes a rough estimate of what a 'bull' or 'bear' case would look like in terms of value drivers (Table 7.15), which can then be inserted into the more detailed forecasting model. A bull market occurs when prices (and demand) are on the rise, while a bear market occurs when prices fall for a sustained period of time. Of course, analysing a bull or bear case falls well short of a real scenario analysis, in which the qualitative drivers are thoroughly assessed.

7.2 Behavioural Challenges in Capital Budgeting

Chapter 6 described behavioural effects on investment decisions, such as overconfidence (underestimation of risk) and excessive optimism (overestimation of cash flows). In this section, we will focus on forms of the latter. We discuss how such behavioural challenges can affect cash flow projections and how to deal with them.

Excessive optimism at the abovementioned copper mining project might show up in the tendency to overestimate copper demand and copper prices and to underestimate costs. In addition, the project could suffer other behavioural biases, such as the sunk cost fallacy, extrapolation bias, and escalation of commitment.

7.2.1 Sunk Cost Fallacy

The opposite of opportunity costs applies to sunk costs, which are costs that have been made and that are unrecoverable in any case, regardless of the project. Sunk costs have zero incremental impact, are irrelevant for the project, and should not be included in incremental cash flows. For example, if the desalination plant in the above example had already been in place, it should not have been included in the calculations, and the NPV of the copper mining project would simply have been the original $1.2 billion. Still, people are quite often inclined to include sunk costs in their analysis. This is called the 'sunk cost fallacy'. When sunk costs are wrongly included, it can lead to rejecting good projects because of the extra cost burden.

Overhead costs are a typical example of costs that are often, but not always, 'sunk' from a project perspective. The rule here is to include only additional overhead costs, i.e. those incurred specifically for the project, in the calculation of incremental cash flows.

7.2.2 Extrapolation Bias

When forecasting future cash flows, there is a tendency to extrapolate business as usual into the future, a phenomenon called extrapolation bias. This can be highly unrealistic when dealing with non-linear processes such as climate change and transitions, as explained in Chap. 2. For example, ignoring future policy changes such as higher carbon taxes may lock companies into high-emitting projects.

In the copper mining project, projections of copper prices and costs might be based too much on historical copper prices and costs at current operations.

7.2.3 Escalation of Commitment

Once projects are in process, or their preparations are well advanced, the team involved in them might suffer from escalation of commitment: they feel so committed to the project that they ignore signals that it might not be as good as they thought. Instead of seriously evaluating the project, they move forward in its execution. That means that they may continue with projects that should be stopped or start with projects that should not be started.

In the case of the abovementioned copper mining project, escalation of commitment might happen to the managers who propose it, in that they refuse to see (and act on) red flags. The red flags include issues such as rising prices of inputs, poor exploration results at the prospective mine, or difficulties with local stakeholders.

7.2.4 Impact on Discount Rates

In assessing projects, people tend to underestimate the risk of business as usual, while overestimating the risk of new models. Yes, new business models tend to be riskier simply because they are new. But if such new models benefit from internalisation processes, then their risk should fall; the risk of many old business models meanwhile rises with internalisation of social and environmental factors (see Sects. 6.5 and 7.4 on internalisation).

Discount rates should also be adapted over time. For example, a private equity firm might apply a 20% discount rate to an early-stage company, but will let it drop over time as milestones are reached (see Chap. 10).

7.2.5 Dealing with Behavioural Biases

Overcoming behavioural biases starts with awareness of them. In the case of the copper mine, the finance department at HQ (headquarters) might be concerned that the business unit's plan might be too optimistic. To deal with that, HQ might challenge the business unit and ask it to better argue the validity of its assumptions. Alternatively, HQ can do its own calculations and adjust the copper mine forecasts downwards, by using lower copper prices, lower volumes, and/or higher costs, resulting in lower sales, lower margins, and lower valuations. HQ might also choose to reflect overconfidence in a higher discount rate, which also lowers valuation.

However, there is the risk that both sides start to see budgeting as a game: business units submit optimistic plans and/or more projects on purpose, as they know that HQ will downsize the submitted plans and projects. Realistic grounding and testing of the validity of assumptions is therefore important.

7.3 Integrating Sustainability in Capital Budgeting

The preceding sections described the basics of conventional capital budgeting and the behavioural challenges associated with them. However, conventional capital budgeting calculates FV (financial value) only, with S (social) and E (environmental) taking at best a secondary role. Since SV and EV are not calculated, the company effectively remains blind to its integrated value creation. SV and EV need to be incorporated into capital budgeting—and it is possible. Chapter 5 described how to value S and E separately and in present values (PVs). Chapter 6 developed three ways to integrate E and S in investment decision rules, by combining the PV approach with S and E:

1. The **constrained PV** includes S and E in their own units as a budget constraint to the standard NPV on financial value (FV)
2. The **expanded PV** expresses S and E in monetary values (SV and EV) and shows these in addition to the standard NPV on FV
3. The **integrated PV** goes further by explicitly calculating and balancing FV, SV, and EV in a formula

In this section, we show these three types of PVs in more detail for the abovementioned copper mine. A copper mine typically faces several S and E issues. On the E side, these include GHG emissions, water use, and biodiversity effects as negative impacts. However, a copper mine also has a positive impact since it enables the production of renewable energy. This means that the copper mine produces 'avoided emissions' elsewhere. Of course, since these are less certain than the mine's own emissions and can only be partially attributed to the copper mine, they cannot simply be deducted from its emissions. Chapter 5 explained that an attribution factor should be applied for environmental or social externalities in the value chain. On the S side, the copper mine deals with local stakeholders, who might benefit from jobs and schooling due to the mine, but who also suffer from pollution and limited access to water due to the mining activities.

As discussed in Sect. 7.1, capital budgeting should be part of the strategic objectives of the company: new investment projects should be part of implementing the company's strategy. However, some companies still just 'do sustainable projects' to improve their profile (see Box 7.2). That is a missed opportunity to create integrated value.

Box 7.2: Capital Budgeting and Sustainability in Practice

A few years ago, we met a board member from a consumer goods corporation known for its advanced integration of sustainability issues. We asked him how they integrate sustainability into their investment decisions and his answer was sobering: they simply split the list of proposals into sustainability projects and all other projects. For the sustainability projects, they even take projects with a negative Net Present Value (NPV), since not doing them is not an option.

The good thing about that approach is that sustainability is at least prioritised. But this is very imperfect integration, as company management still does not know how valuable these sustainability efforts are, and whether they really should happen. It also means that top management fails in making middle management really change their approach towards taking decisions on the basis of integrated value. And that is what sustainability leadership is about: a multiyear change process throughout the company.

7.3.1 Constrained NPV

In the constrained NPV method, S and E function as a budget constraint to the standard NPV on F. Table 7.16 shows S and E in their own units for the copper mining project that we analysed in Sect. 7.1. Please note that S and E impacts only start to materialise in year 3, when production starts. In Sect. 7.1, we found that the project had a positive NPV of $672 million after inclusion of the desalination project (Tables 7.11 and 7.13). However, it remains to be seen if the project is still value creative when including SV and EV. The constrained PV does not answer that question yet, but takes the first step towards including SV and EV by showing S and E in their own units, as far as that is possible with the current information.

Although the company did not set explicit budgets on S and E items, Table 7.16 does reveal some interesting items. It shows that the mine has significant GHG emissions of about 750 kg per tonne of copper mined. On the other hand, its avoided emissions are much higher than its own emissions (4000 kg per tonne of copper),

Table 7.16 Constrained DCF value calculation including the desalination plant

	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	. . .	Year 10
Project cash flows	–1095	–706	–294	279	379	408		408
Volume of copper (thousands of tonnes)			50	120	130	140		140
Emissions 750 kg per tonne copper (thousands of tonnes CO_2e)			38	90	98	105		105
Emissions avoided 4,000 kg per tonne copper (thousands of tonnes CO_2e)			200	480	520	560		560
of which attributable to the copper mining project			20%	20%	20%	20%		20%
Avoided emissions attributable (thousands of tonnes CO_2e)			40	96	104	112		112
Net emissions (thousands of tonnes CO_2e)			–3	–6	–7	–7		–7
Water stress: number of people at risk, thousands			120	120	120	120		120
Probability of risk materialising			1%	1%	1%	1%		1%
Expected number of people affected, thousands			1.2	1.2	1.2	1.2		1.2
Biodiversity damage: fall in MSA (mean species abundance)			?	?	?	?		?
Positive health effects for the local community (quality life years added) due to employment			25	25	25	25		25
Negative health effects for the local community (quality life years lost) due to accidents and pollution			–15	–15	–15	–15		–15
Net health effects (quality life years added)			10	10	10	10		10
Increase in years of schooling of the local population			200	200	200	200		200

since much of the copper is used to build electric vehicles and power lines. However, since those avoided emissions are uncertain and can only be partly attributed to the copper miner, they cannot simply be deducted from the mine's emissions. Rather, we attribute 20% to the copper mine to reflect the aforementioned considerations. As a result, the copper mine turns out to be marginally better than net zero on GHG emissions, i.e. a positive value effect on EV.

Water stress offers an unpleasant surprise: in spite of the desalination plant, there is still an annual 1% risk of 120,000 people being hit by water stress, leading to a negative impact on SV. The planning department at HQ therefore asks the project team to investigate what can be done to eliminate, or at least significantly reduce that risk, and at what cost. They can then determine the trade-off.

In addition, it turns out that the project team did not determine the biodiversity risk of the project. Hence, this is a question mark in Table 7.16. On this item too, HQ demands that the team to get back with further information on biodiversity risk.

The project team did deliver on measuring the health effects (net 10 quality life years) and schooling effects (increase of 200 years of schooling), which are both net positive, i.e. a positive contribution to SV. To determine how much the project contributes to SV, prices are needed, which are added in the expanded PV.

7.3.2 Expanded PV

The expanded PV expresses S and E in monetary values to arrive at SV and EV and shows these in addition to the standard NPV. Table 7.17 does this on the basis of the quantities given in Table 7.16, and then multiplying them by the relevant shadow prices or damages (see Chap. 5).

The company uses a shadow carbon price of \$224 per tonne, which rises with 3.5% per year. So, year 3 is \$240 ($=224*[1.035]^2$). Given the low net emissions (which are negative due to saved emissions), the value of emissions will be around \$2 million, i.e. about 0.5% of annual cash flows in year 10. Similarly, using \$119,000 per quality life year added and \$25,300 in annual schooling value per person (see Sect. A.1 in Chap. 5 based on IEF (2022)), the net health effects and schooling effects are positive, but quite low compared to cash flow (combined, they are about 1.5% of cash flow in year 10). And the biodiversity damage cannot be assessed due to problems in measurement. The expected water stress damages are most significant, with expected water stress damages of 20,000 m^3 per person. Using \$1.49 per m^3 (see Sect. A.1 in Chap. 5), expected water stress damages amount to about \$36 million per year.

In sum, this gives positive annual environmental value flows (EVF) and negative annual social value flows (SVF), as presented in Table 7.18. To discount the EV and SV flows, the company uses a social discount rate of 2%, as suggested in Chap. 4. This means that the value flows during the 10 years of the desalination project's life can be discounted to arrive at the present value (PV). The sum of the PVs provides the EV and SV, respectively. EV amounts to \$12.0 million, and SV to –\$207.8 million in Table 7.18. These amounts also appear in the first line of Table 7.19.

Table 7.17 Expanded DCF calculation including the desalination plant

	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	...	Year 10
Project Cash Flows	–1095	–706	–294	279	379	408		408
Net emissions (thousands of tonnes CO_2e)			–3	–6	–7	–7		–7
Shadow price of emissions, USD/t			240	248	257	266		305
Net value of emissions (USD millions)			0.6	1.5	1.7	1.9		2.1
Expected number of people affected (thousands)			1.2	1.2	1.2	1.2		1.2
Damage per person when affected (USD thousands)			29.8	29.8	29.8	29.8		29.8
Expected water stress damages (USD millions)			–35.8	–35.8	–35.8	–35.8		–35.8
Biodiversity damage			n/a	n/a	n/a	n/a		n/a
Net health effects (quality life years added)			10	10	10	10		10
Value per quality life year added (USD thousands)			119	119	119	119		119
Value of health effects (USD millions)			1.2	1.2	1.2	1.2		1.2
Increase in years of schooling of the local population			200	200	200	200		200
Value per year of schooling added (USD thousands)			25.3	25.3	25.3	25.3		25.3
Value of schooling effects (USD millions)			5.1	5.1	5.1	5.1		5.1

The good news, however, is that the water stress damages can be eliminated by means of an enhancement of the desalination plant, with a financial cost of $64 million (second line of Table 7.19). Combining the two projects, SV then turns positive, amounting to $6 million, an improvement of $214 million (third line of Table 7.19).

7.3.3 Integrated PV (IPV)

In the integrated PV (IPV), SV and EV are not only separately calculated (as in the expanded PV), but also added and weighted, along with the NPV of FV, to arrive at an integrated value creation number. Table 7.19 gives these values for the mining project with the original desalination plant; the desalination plant enhancement; and

Table 7.18 From annual SV and EV flows to SV and EV

	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Year 7	Year 8	Year 9	Year 10
Net external reduction in emissions (USD MM)			0.6	1.5	1.7	1.9	1.9	2.0	2.1	2.1
Value of biodiversity damage			n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Annual environmental value flows (EVF)			**0.6**	**1.5**	**1.7**	**1.9**	**1.9**	**2.0**	**2.1**	**2.1**
Discount factor, 2%			0.942	0.924	0.906	0.888	0.871	0.853	0.837	0.820
PV (EVF)			0.6	1.4	1.5	1.7	1.7	1.7	1.7	1.8
Environmental value (EV) (USD MM)	**12.0**									
Expected water benefits or damages (USD MM)			–35.8	–35.8	–35.8	–35.8	–35.8	–35.8	–35.8	–35.8
Value of health effects (USD MM)			1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2
Value of schooling effects (USD MM)			5.1	5.1	5.1	5.1	5.1	5.1	5.1	5.1
Annual social value flows (SVF)			**–29.5**	**–29.5**	**–29.5**	**–29.5**	**–29.5**	**–29.5**	**–29.5**	**–29.5**
Discount factor, 2%			0.942	0.924	0.906	0.888	0.871	0.853	0.837	0.820
PV (SVF)			–27.8	–27.3	–26.7	–26.2	–25.7	–25.2	–24.7	–24.2
Social value (SV) (USD MM)	**–207.8**									

Table 7.19 Integrated PV

Project	FV	SV	EV	IPV = SV + EV + FV
Mining project with original desalination plant	672	–208	12	476
Desalination plant enhancement	–64	214	0	150
Mining project with enhanced desalination plant	608	6	12	626

Table 7.20 Integrated PVs under two regimes (in USD millions)

Intermediate regime – $b = 0$, $c = 0.5$	FV	$b \cdot SV$	$c \cdot EV$	$IPV = FV + b \cdot SV + c \cdot EV$
Mining project with original desalination plant	672	0	6	678
Desalination plant enhancement	–64	0	0	–64
Mining project with enhanced desalination plant	608	0	6	614
Responsible regime – $b = 1$, $c = 1$	FV	$b \cdot SV$	$c \cdot EV$	$IPV = FV + b \cdot SV + c \cdot EV$
Mining project with original desalination plant	672	–208	12	476
Desalination plant enhancement	–64	214	0	150
Mining project with enhanced desalination plant	608	6	12	626

the combination of these projects, i.e. the mining project with an enhanced desalination plant.

Table 7.19 calculates integrated value by simply summing FV, SV, and EV. But, as shown in Chap. 6, integrated value can also be calculated by not just adding values, but also balancing them. For example, SV might get a higher weight if the company has a mission focused on S or if its SV value creation profile is negative. As in Chap. 6, we apply different regimes, with b denoting the weighting of SV; and c denoting the weighting of EV. Equation (7.1) for calculating the simple IPV is as follows:

$$IPV = FV + b \cdot SV + c \cdot EV > 0 \qquad with\ b, c > 0 \tag{7.1}$$

In contrast to Chap. 6, the intermediate regime (weights of half) now weights EV at 0.5 ($c = 0.5$) and SV at 0 ($b = 0$) instead of 0.5. Chapters 3 and 6 explained that companies choose the weights in line with their purpose; companies can thus choose to pay more or less attention to social and environmental objectives. The responsible regime (weights of one) applies equal weights: $b = c = 1$. Table 7.20 shows the results.

Under the intermediate regime, the desalination enhancement is seen as a negative value project, since only its FV of –\$64 million is taken into account and the SV improvement of \$214 million is ignored. In contrast, the responsible regime does value the $214 million in SV and arrives at an integrated value of $150 million for the enhancement. The outcome: under the intermediate regime, the mining company would not do the investment for enhancing the desalination plant; but under the responsible regime, it would. In terms of integrated value creation, the mining company is balancing its value dimensions in the long term, optimising value creation and avoiding long-term risks.

In an alternative intermediate regime with $b = 0.5$ and $c = 0$, $b \cdot SV$ would amount to 0.5*$214 million, i.e. $107 million; and integrated value would be positive at $43 million ($107 million – $64 million).

Oil Companies (Not) in Transition

Facing the energy transition, Chap. 2 argued that carbon-intensive companies should consider how to make their company future-proof. A case in point are the oil majors, such as Saudi Aramco, Exxon, Shell, BP, and TotalEnergies. These oil companies have to choose between continuing their investments in fossil fuels (both upstream and downstream) and switching investments to renewables. Example 7.1 allows you to make the calculations. The example illustrates how the outcome can differ when applying the IPV rule instead of the NPV rule.

Example 7.1: Big Oil: Choosing Between Fossil and Renewable Projects

Problem

Consider that the company Big Oil wants to undertake new investment projects to serve society's energy needs. Big Oil can choose between a fossil project and a renewable project. Both projects need an initial investment of $100 million. The fossil project has annual net cash flows of $40 million, while the renewable project has annual net cash flows of $30 million over the next 5 years.

Emissions from the fossil project are 120,000 tonnes per year, of which half are attributed to Big Oil. The renewable project has no emissions. The shadow carbon price is $224 per tonne of carbon emissions and increases with 3.5% per year.

The financial discount rate for Big Oil is 10% and the environmental discount rate is 2%.

Year	2023	2024	2025	2026	2027	2028
Fossil project						
Cash flows, in $ millions	–100	40	40	40	40	40
GHG emissions, in thousands tonnes	0	60	60	60	60	60
Renewable project						
Cash flows, in $ millions	–100	30	30	30	30	30
GHG emissions, in thousands tonnes	0	0	0	0	0	0

Which project should Big Oil choose using the NPV rule? And which project using the IPV rule?

Solution

We can calculate the financial and environmental value of the project by discounting the cash and value flows at their respective discount rates.

Year	2023	2024	2025	2026	2027	2028
Fossil project						
Cash flows, in $ millions	–100	40	40	40	40	40
Discount factor, 10%	1.00	0.91	0.83	0.75	0.68	0.62
PV (Cash flows)	–100.0	36.4	33.1	30.1	27.3	24.8
Financial value, in $ millions	**51.6**					
GHG emissions, in thousands tonnes	0	60	60	60	60	60
Shadow carbon price, in $ per tonne	224	232	240	248	257	266
Environmental value flows, in $ mln	0.0	–13.9	–14.4	–14.9	–15.4	–16.0
Discount factor, 2%	1.00	0.98	0.96	0.94	0.92	0.91
PV (Value flows)	0.0	–13.6	–13.8	–14.0	–14.2	–14.5
Environmental value, in $ millions	**–70.2**					
Integrated value, in $ millions	**–18.6**					
Renewable project						
Cash flows, in $ millions	–100	30	30	30	30	30
Discount factor, 10%	1.00	0.91	0.83	0.75	0.68	0.62
PV (Cash flows)	–100.0	27.3	24.8	22.5	20.5	18.6
Financial value, in $ millions	**13.7**					
GHG emissions, in thousands tonnes	0	0	0	0	0	0
Environmental value, in $ millions	**0**					
Integrated value, in $ millions	**13.7**					

The NPV rule only considers financial value. The fossil project has higher net cash flows leading to an NPV of $51.6 million. The renewable project has an NPV of $13.7 million. Applying the NPV rule, Big Oil chooses the fossil project.

The IPV rule also includes environmental value. We can translate the attributed GHG emissions in environmental value flows using the shadow carbon price, which is $224 in 2023 and increases with 3.5% per year (see Chap. 5). The environmental value is –$70.2 million for the fossil project and $0 million for the renewable project. The IPV of the fossil project is –$18.6 million (= $51.6 –

$70.2 million). The IPV of the renewable project is $13.7 million. Applying the IPV rule, Big Oil chooses the renewable project.

Among the major oil companies mentioned (Saudi Aramco, Exxon, Shell, BP and TotalEnergies), all but one invested about 80–90% of their annual capex in fossil projects and the remaining 10–20% in renewable projects (at the time of writing in early 2023). TotalEnergies was the exception, allocating about 50% of their capex to fossil and 50% to renewables in 2023. While investments in renewables may lead to lower financial profits in the short term, this investment strategy makes TotalEnergies more future-proof. ◄

7.4 Internalisation

The preceding analyses did not assume internalisation. This is the (partial) elimination of external impacts due to changing market conditions, higher taxes, and/or tougher regulations, as discussed in Chap. 2. Such internalisation often involves spillovers from SV or EV to FV. A higher carbon tax on carbon emissions (EV), for example, leads to reduced profits (FV) for carbon-intensive companies.

As explained in Sect. 6.5, the three types of value are created jointly, and in part with the same drivers. The same processes that allow a chemicals company to make money selling plastics also result in GHG emissions, poor (or good) working conditions, and other S and E effects. They are related and have an effect on each other. Improving one of them may have a cost or benefit in the other, now or later, or both now and later, and possibly with different signs. This makes the dynamic perspective very important: do not assume the current conditions are going to last forever, but acknowledge that they can change in various ways. That is the rationale behind integrated value creation, instead of short-term financial value maximisation. The challenge with this is that future outcomes are clouded in uncertainty.

To illustrate the capital budgeting implications of internalisation processes, let's consider a bioplastics project by a commodity chemicals producer. While the company's current business lines have a negative value creation profile on E, the bioplastics project actually produces positive flows on E. At first sight, however, the project looks unattractive from an FV perspective—but that is taking a static view, without internalisation. With internalisation, this changes completely, an illustration of how EV can spill over into FV once shadow prices change (partly or fully) into real prices.

Since the company has already operated a bioplastics pilot plant, its management knows how to do it and at approximately what cost, but the big question is about the price, and hence margins. With an asset life of several decades, this is a big issue. Table 7.21 shows the expanded NPV of the bioplastics project if internalisation does not occur. The absence of internalisation means that fossil fuel-based plastics are not taxed for their negative externalities and continue to be offered at an artificially cheap price. As a result, bioplastics have a competitive disadvantage from their higher costs, and the project's EBIT margin is only 7%. At such margins, the project

Table 7.21 Bioplastics project value without internalisation (in EUR millions)

	Year 0	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Year 7
Sales	**0**	**0**	**900**	**3200**	**3264**	**3329**	**3396**	**3464**
Sales growth				*256%*	*2%*	*2%*	*2%*	*2%*
Costs	–200	–200	–1100	–2976	–3036	–3096	–3158	–3221
EBIT	**–200**	**–200**	**–200**	**224**	**228**	**233**	**238**	**242**
EBIT margin			*–22%*	*7%*	*7%*	*7%*	*7%*	*7%*
Corporate tax	50	50	50	–56	–57	–58	–59	–61
Net income	**–150**	**–150**	**–150**	**168**	**171**	**175**	**178**	**182**
+ depreciation	200	200	200	200	200	200	200	200
– CAPEX	–2000	–2000	–1000	–10	–10	–10	–10	–10
– increase in NWC	–100	–100	–100	0	0	0	0	0
Project cash flows	**–2050**	**–2050**	**–1050**	**358**	**361**	**365**	**368**	**372**
Terminal value								2778
Total cash flows	**–2050**	**–2050**	**–1050**	**358**	**361**	**365**	**368**	**3149**
Discount factor	1.000	0.893	0.797	0.712	0.636	0.567	0.507	0.452
PV	–2050	–1830	–837	255	230	207	187	1425
NPV FV	**–2415**							
E flows (millions of tonnes CO_2 emissions avoided)			**0.90**	**3.20**	**3.23**	**3.26**	**3.30**	**3.33**
CO_2 price	224	232	240	248	257	266	275	285
EV flows (in EUR millions)			**216**	**795**	**831**	**868**	**908**	**949**
Discount factor	1.000	0.980	0.961	0.942	0.924	0.906	0.888	0.871
PV	0	0	208	749	768	787	806	826
EV	**4143**							

has an FV of –€2.4 billion, based on a standard NPV calculation (with a financial discount rate of 12%). However, the project has positive EV flows that are expected to exceed competitive products for 7 years, after which the alternatives are expected to be of the same quality. Discounting them at 2% gives an EV of €4.1 billion.

Now let's assume internalisation: competing fossil fuel-based products are heavily punished by a carbon tax from year 3 onward. This pushes up plastics prices by 20%, since the tax makes all producers' costs go up. An exception are bioplastics producers, whose costs rise by less than 1%. Table 7.22 shows the higher sales (+20% from 3200 to 3840) in year 3 and higher sales growth from 2 to 5% in later years, as bioplastics gain market share as a more attractive product. As a result, its EBIT margins go from 7 to 22%.

The FV flips from negative (–€2.4 billion) to positive (€1.1 billion). EV increases slightly to €4.3 billion in line with the quantity (Q) component of sales growth, as it is related to production volumes. Note also that the internalisation effect on FV (€1.1 billion + €2.4 billion = €3.5 billion) is large, but smaller than the value of EV which ranges between €4.1 and €4.3 billion.

In the case of internalisation, both FV and EV are positive. But internalisation is not certain, and FV is negative in its absence. So, will the company make the investment? To better understand the decision, it should be put in the context of the company's total value. Table 7.23 shows the company's initial values of FV and EV (these are given) without, and then with, the project (in the top panels for FV and EV). Next, Table 7.23 contrasts the company's $IPV = FV + b \cdot SV + c \cdot EV$ (equal weighted, i.e. $c = 1$) without and with the project, and without and with internalisation (in the bottom panel for IPV).

In terms of EV, the project is a clear improvement for the company, regardless of whether internalisation happens. The same applies to an equal weighted IPV (with $c = 1$), which rises due to the project. The company would therefore undertake the project, when applying the IPV decision model.

For FV though, it is a different story: the project results in a drop in FV in case of no internalisation and a rise in case of internalisation. Hence, for shareholder-driven companies where FV is the main decision criterion with $b = c = 0$, the investment decision depends on the probability of internalisation. Table 7.24 shows that at a 70% probability of internalisation, the expected FV of the company with the project equals the expected value without the project at €13.8 billion.

At lower than 70% probability of internalisation, the project is not expected to be value creative on FV. This is not atypical for such projects and has serious implications for government policy: transitions are very much helped by clarity on transition paths, or at least clear signals that internalisation is highly likely.

7.4.1 Asymmetric and Non-linear Internalisation

In the above example, the shift in FV due to internalisation is similar to the size of EV. But that certainly does not need to be the case in practice. In fact, even the internalisation of small EVs can disrupt business models in such a way that they

Table 7.22 Bioplastics project value with internalisation (in EUR millions)

	Year 0	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Year 7
Sales	**0**	**0**	**900**	**3840**	**4032**	**4234**	**4445**	**4668**
Sales growth				*327%*	*5%*	*5%*	*5%*	*5%*
Costs	–200	–200	–1100	–2995	–3145	–3302	–3467	–3641
EBIT	**–200**	**–200**	**–200**	**845**	**887**	**931**	**978**	**1027**
EBIT margin			*–22%*	*22%*	*22%*	*22%*	*22%*	*22%*
Corporate tax	50	50	50	–211	–222	–233	–244	–257
Net income	**–150**	**–150**	**–150**	**634**	**665**	**699**	**733**	**770**
+ depreciation	200	200	200	200	200	200	200	200
– CAPEX	–2000	–2000	–1000	–10	–10	–10	–10	–10
– increase in NWC	–100	–100	–100	0	0	0	0	0
Project Cash Flow	**–2050**	**–2050**	**–1050**	**824**	**855**	**889**	**923**	**960**
Annuity value								7172
Total cash flow	**–2050**	**–2050**	**–1050**	**824**	**855**	**889**	**923**	**8132**
Discount factor	1.000	0.893	0.797	0.712	0.636	0.567	0.507	0.452
PV	–2050	–1830	–837	586	544	504	468	3678
NPV FV	**1063**							
E flows (millions of tonnes CO_2 emissions avoided)			**0.90**	**3.20**	**3.28**	**3.36**	**3.45**	**3.53**
CO_2 price	224	232	240	248	257	266	275	285
EV flows (in EUR millions)			**216.0**	**794.7**	**843.1**	**894.4**	**948.9**	**1006.6**
Discount factor	1.000	0.980	0.961	0.942	0.924	0.906	0.888	0.871
PV	0	0	208	749	779	810	843	876
EV	**4264**							

Table 7.23 Value of the company with and without the bioplastics project & with and without internalisation (in EUR billions)

FV	Company value excluding the project	Project value	Company value including the project
Without internalisation	15.4	–2.4	13.0
With internalisation	13.1	1.1	14.2
EV	Company value excluding the project	Project value	Company value including the project
Without internalisation	–13.3	4.1	–9.1
With internalisation	–10.7	4.3	–6.4
$IPV = FV + SV + EV$	Company value excluding the project	Project value	Company value including the project
Without internalisation	2.1	1.7	3.9
With internalisation	2.4	5.3	7.8

Table 7.24 FV of the company with and without the bioplastics project, while accounting for the probability of internalisation (in EUR billions)

FV	Probability	Company value excluding the project	Company value including the project
Without internalisation	30%	15.4	13.0
With internalisation	70%	13.1	14.2
Expected value		**13.8**	**13.8**

cause shifts in FV that are many times larger. Conversely, internalisation of a large EV can also have small effects on FV if they do not change competitive positions. It is even possible that internalisation of negative impacts actually boosts the FV of negative EV companies, because they have a strong competitive position. In some cases, the entire industry even benefits on FV. A prominent example of an industry that has so far benefited from the internalisation of its SV is the tobacco industry. Because of heavy taxation, its volumes fell. But it also allowed that (heavily concentrated) industry to raise prices continuously and raise its profits. In sum, internalisation is often not linear and not symmetric.

7.4.2 IPV Versus Internalisation

What is the difference between calculating the integrated present value (IPV) and the effects of potential internalisation of negative impacts? The SV and EV calculations show and quantify the company's negative (and positive) impacts. The shadow prices, as derived from welfare theory (see Chap. 5), provide useful discipline in calculating the social and environmental value resulting from negative social and environmental impacts. These calculations are then no longer guesses by management, but can be derived from science-based shadow prices. Using the IPV rule, the company can take the monetised impacts into account when making investment decisions. Using the IPV rule instead of the NPV rule, companies will avoid projects with (large) negative impacts.

Internalisation brings a dynamic aspect to the calculations. When impacts are internalised, shareholder-driven companies using the NPV rule are also forced to move. But there is also a competitive element. Companies that have already reduced impacts because of the application of the IPV rule have a competitive advantage. Laggards in the sector with more negative impacts will be hit harder if and when internalisation happens.

As Chap. 2 explained, a key assumption in this book is that impacts will be internalised during sustainability transitions. But the timing of these transitions (early vs late) is difficult to predict. Companies that are prepared are ahead in these transitions, whereas the laggards may be phased out like Kodak.

7.5 Conclusions

Chapter 6 explained decision rules for investment decisions. It discussed purely financial criteria for investment evaluation such as NPV (net present value), IRR (internal rate of return), and payback period. It subsequently showed that S (social) and E (environmental) factors can be valued in their own right and can be included in constrained, expanded, or integrated PVs (present values). However, in Chap. 6 the cash flows were presented as given. In this chapter, we dived deeper into the capital budgeting process, which is the process used to make a list of investment projects to be done. We made these investment decisions more tangible by presenting more detailed calculation examples—including the calculation and forecasting of cash flows and their drivers.

The chapter started by showing the steps in the capital budgeting process and then how cash flows and incremental cash flows are calculated and forecasted. Subsequently, we identified behavioural challenges in the capital budgeting process, such as the tendency to continue poor projects for too long, to underestimate risk, and to overestimate cash flows. More importantly, people have a tendency to extrapolate business as usual into the future, which is highly unrealistic in dealing with non-linear processes such as climate change or biodiversity loss.

Next, we explained how to integrate S and E in the capital budgeting process—integrated capital budgeting. The constrained, expanded, and integrated PVs (introduced in Chap. 6) were now shown with cash flow projections. It was illustrated that FV, SV, and EV can have shared, reinforcing, or conflicting underlying value drivers. And the way and extent to which they are taken into account affect decisions.

Moreover, the value dimensions FV, SV, and EV can affect each other. We discussed the process of internalisation, by which SV or EV might spill over into FV. These investment decisions were put in the context of corporate objectives, as put forward in Chap. 3 on corporate governance. Interestingly, the IPV (integrated present value) rule leads to different investment decisions, resulting in the creation of integrated value. In the next chapters we will apply the same methods to valuing stocks and bonds.

Key Concepts Used in This Chapter

Break-even analysis is an analysis in which the value drivers are set in such a way that the NPV gives an outcome of zero

Cannibalisation is process whereby new products (partly) replace existing sales

CAPEX (capital expenditures) are investment outlays

Capital budget is the list of projects the company plans to invest in

Capital budgeting is the process to determine the list of investment projects to be undertaken

Incremental cash flows is the net change in cash flows due to the project

Integrated capital budgeting is the process of capital budgeting based on the integrated value of projects; this incorporates the social and environmental value dimensions, alongside the financial dimension

Internalisation is the process by which externalities are borne by the organisation that creates them

Net working capital (*NWC*) is the difference between the company's current assets (such as cash, inventories, and accounts receivable) and its current liabilities (such as taxes payable, accounts payable, short-term funding)

Opportunity costs is the value missed due to not doing alternative projects

Sensitivity analysis is an analysis that involves changing the value driver assumptions to see to what extent that affect the outcome of the NPV

Sunk costs are costs that have been made already and cannot be recouped

Suggested Reading

Impact Economy Foundation (IEF). (2022). *Impact-weighted accounts framework*.

Schramade, W., Schoenmaker, D., & de Adelhart Toorop, R. (2021). *Decision rules for long-term value creation* (CEPR Discussion Paper DP16074).

Serafeim, G., Zochowski, R., & Downing, J. (2019). *Impact-weighted financial accounts: The missing piece for an impact economy* (White Paper). Harvard Business School.

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Part III

Valuation of Companies

Valuing Bonds

8

Overview

This chapter introduces the basic types of bonds and considers their valuation. The pricing of bonds is relevant for corporate finance for several reasons. First, the yield on government bonds serves as the risk-free rate discussed in Chap. 4. Second, companies issue bonds to finance their operations. In particular, long-term investments are financed by bonds and equity (see Chaps. 9 and 10 on equity). A key element of this chapter is the analysis of credit risk on corporate bonds. Bond markets are bigger than stock markets, with institutional investors typically holding more bonds than equity. In the case of insurers and pension funds, the main reason for these large bond holdings is to hedge the interest rate risk on their long-term liabilities.

Social and environmental factors are increasingly being integrated in the valuation of corporate bonds. Studying the company's business model is important for sustainability integration in the credit risk analysis of bonds. This chapter shows how to include a company's adaptability to sustainability transitions into the credit risk analysis. Companies that can better adapt their business model face a lower credit risk and hence a lower cost of debt. By contrast, companies with limited capability to adapt encounter increased credit risk and a higher cost of debt.

There is innovation in the form of green bonds and social bonds to cater for sustainable investment projects. The challenge is to 'certify' the use of the proceeds for green or social projects and to overcome bureaucratic procedures. Yet another type are sustainability-linked bonds, where the interest rate on the bond is directly 'linked' to the overall sustainability performance of a company. See Fig. 8.1 for a chapter overview.

Learning Objectives

After you have studied this chapter, you should be able to:

- Explain the basics of bond pricing and valuation
- Differentiate between government and corporate bonds
- Demonstrate how social and environmental factors can be integrated into bond valuation

D. Schoenmaker, W. Schramade, *Corporate Finance for Long-Term Value*, Springer Texts in Business and Economics, https://doi.org/10.1007/978-3-031-35009-2_8

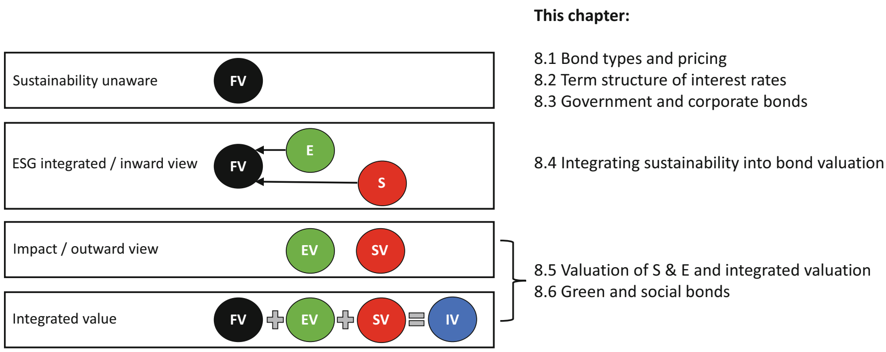


Fig. 8.1 Chapter overview

- Explain that bond investors are more focused on downside protection
- Identify the green bond market as an interesting and fast-growing innovation

8.1 Bond Types and Pricing

While equity markets may get more attention, bond markets are actually bigger. At the end of 2020, the value of outstanding government and corporate bonds globally was estimated at $123 trillion (i.e. about 145 per cent of global GDP) versus $112 trillion for outstanding equity (SIFMA, 2021). Bonds come in many forms. They can be complex and varied, but they have a lot in common as well. **Bonds are certificates of debt issued by a government, a company, or a financial institution that promise payment of the borrowed amount plus interest by a specified future date.**

The biggest bond issuer is the US government. Outstanding US Treasuries amounted to $21 trillion at the end of 2020. Corporate bonds are more dispersed. The largest single corporate bond issuance is a $49 billion corporate bond issued by Verizon Communications to finance its $130 billion acquisition of Vodafone's 45% stake in Verizon Wireless in 2013.

Bond Payments

A bond certificate indicates the amounts and dates of all payments to be made. Payments are made until the final repayment date, known as the maturity date of the bond. The time until the maturity date is known as the term. Bond maturities or terms range from very short term (months) to decades or even perpetuity. There are still some bonds outstanding that were issued centuries ago. Two types of payments are made on a bond:

1. The **promised interest payments**, which are called **coupons**. The bond certificate specifies that the coupons are paid periodically, for example once or twice per year.

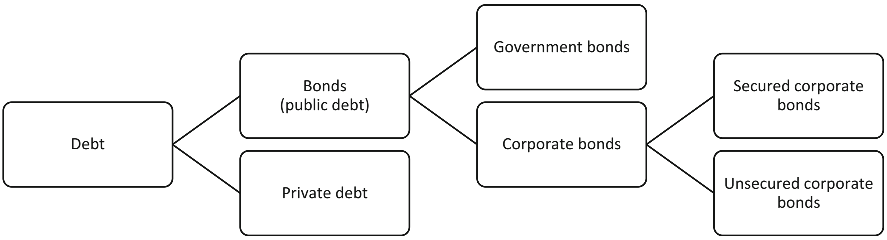


Fig. 8.2 Classification of bonds

Table 8.1 Size of equity and bond markets (end 2020)

Type of securities	Outstanding (in trillions of USD)		
Equity markets	**112.1**		
• Public equity		105.8	
• Private equity		6.3	
Bond markets	**123.4**		
• Government bonds		62.8	
• Corporate bonds		60.6	
– Issued by companies			17.0
– Issued by financial institutions			43.6

Sources: SIFMA (2021); McKinsey (2022); BIS debt securities statistics

2. The **principal or face value** of the bond. This is the amount to be paid at maturity. The face value is typically denominated in standard increments such as €1000.

For example, a bond with a face value of €1000 and a 3% coupon (payable annually) will make coupon payments of €30 every 12 months: €1000 * 0.03 = €30. Some bonds do not pay coupon payments. Such bonds are known as zero-coupon bonds and can still offer the same return as coupon paying bonds, by offering the same principal at a lower price.

Types of Bonds

Whereas bonds are public debt, bank loans and private debt placements are types of private debt. Figure 8.2 classifies bonds by the identity of the issuer, with the main distinction being between government and corporate bonds as the latter carry more serious default risk.

Government or *sovereign bonds* are issued by national governments (i.e. countries). The main distinctions within *corporate bonds* are those between company issuers and financial sector issuers and between secured and unsecured bonds. The financial sector accounts for a very large part of the corporate bond market (see Table 8.1). In the remainder of this chapter, we focus on government bonds and corporate bonds issued by companies.

Secured bonds entail specific assets that are pledged as collateral and to which bondholders have a direct claim in the event of bankruptcy. An example is *mortgage bonds*, which are bonds secured by a pool of mortgages on real estate. *Unsecured bonds* have lower seniority or priority. In the event of bankruptcy, holders of unsecured bonds have a claim only to the assets of the company that are not already pledged as collateral on other (secured) debt.

Bond Valuation and Its Drivers

In principle, bond prices result from discounting a clear pattern of promised cash flows. The price or value of a coupon bond P equals the present value of all its coupons plus the present value of the face value of the bond with maturity N. The formula is as follows:

$$P = \frac{CPN}{(1 + YTM_1)} + \frac{CPN}{(1 + YTM_2)^2} + \ldots + \frac{CPN + FV}{(1 + YTM_N)^N} \tag{8.1}$$

where YTM_n is the yield to maturity of a zero-coupon bond (a bond without coupons) that matures at the same time as the n-th coupon payment; CPN is the coupon payment; and FV is the bond's face value, which is typically denominated in standard increments of €1000 or $1000. Bond prices and yields are inversely related. It follows from Eq. (8.1) that a lower yield produces a higher bond price and vice versa. Given that one knows the coupon and face value of a bond, one needs only the price (the yield) to calculate the yield (the price). Below we give examples of both: calculating the yield to maturity (Example 8.1) and calculating the price (Example 8.2). These examples show that once you know one (the yield or the price), you can calculate the other one (the price or the yield).

The coupon payment is determined by the annual coupon rate ACR and the number of coupon payments per year Nr:

$$CPN = \frac{ACR * FV}{Nr} \tag{8.2}$$

A €1000 bond with a 5% coupon rate and annual payments pays a coupon of €50 = 5% * €1000/1 every year. A €1000 bond with a 6% coupon rate and semi-annual payments pays a coupon of €30 = 6% * €1000/2 every 6 months.

The coupon payments form a stream of equal cash flows paid at regular intervals. In Chap. 4, we call this an annuity (see Eq. 4.7). The present value of the bond then becomes the sum of the 'coupon annuity' and the face value. The rates (yields) at which the cash flows need to be discounted do vary, as interest rates fluctuate over time. The *yield to maturity* (*YTM*) or just the *yield* (y) on a bond is the discount rate that sets the present value of its payments equal to its current market price. More formally, the price of a bond P is:

$$P = CPN * \frac{1}{y}\left(1 - \frac{1}{(1+y)^N}\right) + \frac{FV}{(1+y)^N} \tag{8.3}$$

where y is the yield of this particular bond and reflects the yield received if all coupons received are reinvested at a constant interest rate. Put another way, the yield is the *IRR* (internal rate of return) of a bond. Market forces keep this relation intact: as interest rates and bond yields rise, bond prices fall, and vice versa. This means that bonds trade at times at a premium (at a price greater than face value), at times at a discount (at a price lower than face value), and very occasionally at par (at a price equal to face value).

Example 8.1: Calculating the Yield to Maturity of a Bond

Problem

Consider a 6-year €1000 bond with a 5% coupon rate and annual coupons. If this bond is currently trading for a price of €950.83, what is the bond's yield to maturity?

Solution

Using Eq. (8.3), we can calculate the yield to maturity:

$$950.83 = 50 * \frac{1}{y}\left(1 - \frac{1}{(1+y)^6}\right) + \frac{1{,}000}{(1+y)^6}$$

We can solve it by trial and error. As the price is lower than the face value, the yield to maturity is higher than the annual coupon rate. The yield to maturity appears to be 6%. ◀

Example 8.2: Calculating a Bond Price from Its Yield to Maturity

Problem

Consider a 6-year €1000 bond with a 5% coupon rate and annual coupons. If the yield to maturity is 6%, what is the bond price?

Solution

Using Eq. (8.3), we can calculate the bond price:

$$P = 50 * \frac{1}{0.05}\left(1 - \frac{1}{(1+0.05)^6}\right) + \frac{1{,}000}{(1+0.05)^6} = 950.83$$

Calculating the price is easier: filling in the formula produces a bond price of €950.83. Of course, this is the same bond price as in Example 8.1. We used the same bond for both calculations. ◀

The price of a zero-coupon bond can be calculated more easily: it is just the present value of the face value:

$$P = \frac{FV}{(1 + YTM_n)^n} \tag{8.4}$$

The yield to maturity YTM_n on a zero-coupon government bond is the per-period rate of return for holding the bond from today until maturity n. The zero-coupon yield can be used to calculate the risk-free rate with maturity n. By taking different maturities $n = 1, 2, 3, \ldots, N$, we can build the yield curve of N years (see Sect. 8.2 below).

Interest Rate Changes

As stated, interest rates fluctuate and bond prices move along with them. Equation (8.3) shows that if the yield y increases by 1% the effect is larger for a long-term bond than for a short-term bond. This can easily be seen by comparing Eq. (8.3) with $N = 1$ to that with $N = 2$. So longer-term bonds are more exposed to interest rate fluctuations. It is possible to derive an exposure measure to interest rate/yield fluctuations, which is called duration. The *duration* of a bond is the sensitivity of a bond's price to changes in interest rates. Duration is the weighted average of the time-length of the cash payments. The time-length is the number of future years $n = 1, 2, 3, \ldots$, extending to the final maturity date N. The weight for each year is the present value of the cash flow in that year $PV(CF_n)$ divided by the total present value PV of the bond.

$$\text{Duration} = 1 * \frac{PV(CF_1)}{PV} + 2 * \frac{PV(CF_2)}{PV} + \ldots + N * \frac{PV(CF_N)}{PV} \tag{8.5}$$

The duration is higher for bonds of longer maturity, since more of their cash flows are further in the future, and thus more affected by discount rates. Table 8.2 calculates the duration of 6-year bonds with an annual coupon of 5% and a yield of 4%. The present value PV of the cash flows of each year add up to the total present value PV of €1057.7. Then we calculate the PV of each year's cash flow as a fraction of total value and multiply each fraction by the year in which that cash flow takes place. The outcomes (see bottom line of Table 8.2) add up to a duration of 5.3 years. As the final payment is relatively large (coupon + face value) and counts heavily (multiplied by year in which discounted), a bond's duration is close to the bond's maturity. In Table 8.2, the duration of 5.3 years is close to the bond's maturity of 6 years. The duration is a good measure of the interest rate risk of a bond. A higher duration ('weighted maturity') reflects higher interest rate risk.

8.2 Term Structure of Interest Rates

Interest rates differ not only over time, they also differ across maturities. This variation is referred to as the term structure of interest rates (also called yield curve): the array of yields on bonds with different terms to maturity. Let's start with deriving the yield curve from bond prices. To derive a 10-year yield curve, we

Table 8.2 Calculating the duration of 5% 6-year bonds, with a yield to maturity of 4%

Time	2022	2023	2024	2025	2026	2027		
Year	1	2	3	4	5	6		
Cash flow	€50	€50	€50	€50	€50	€1050		
Discount factor	0.962	0.925	0.889	0.855	0.822	0.790		
PV(CF_n) at 4%	€48.1	€46.2	€44.4	€42.7	€41.1	€829.8	Total PV =	€1057.7
Fraction of total value	**0.045**	**0.044**	**0.042**	**0.040**	**0.039**	**0.785**	**Total=**	**1.0**
Year * fraction of total value	**0.045**	**0.087**	**0.126**	**0.162**	**0.194**	**4.708**	**Total duration=**	**5.3**

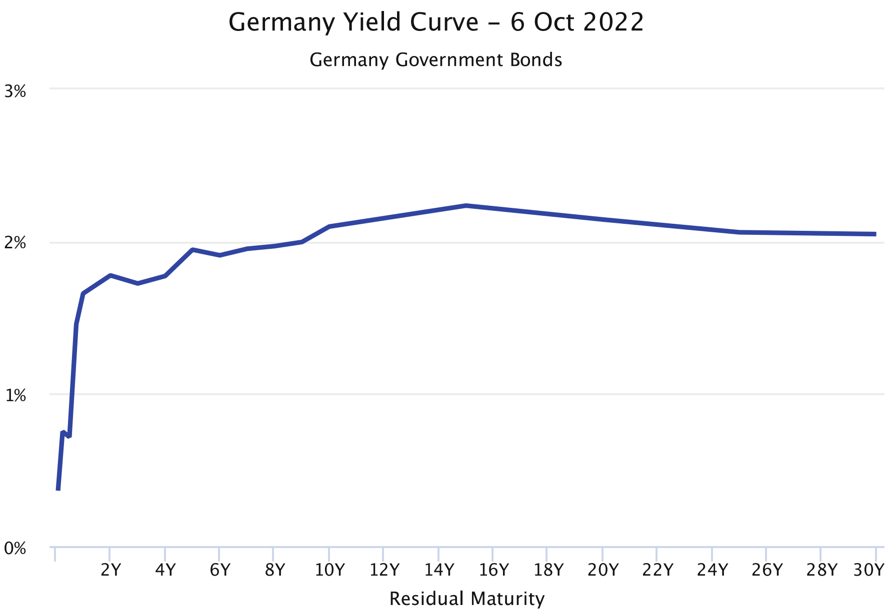


Fig. 8.3 German government bond yield curve. Source: World Government Bonds

need to obtain the 1, 2, . . ., 10-year yield to maturity YTM_n. Zero-coupon bonds can be used to find these yields. As Eq. (8.4) demonstrates:

$$P = \frac{FV}{(1 + YTM_n)^n}$$

The price of a 1-year zero-coupon bond P gives the 1-year zero-coupon yield YTM_1 and so on. Figure 8.3 provides the German yield curve.

The *law of one price* can be used to calculate the yields on coupon bonds (with the same liquidity and credit risk). This 'law' says that similar products should sell at the same price (see Box 4.1 in Chap. 4). And if they don't sell at similar prices, the arbitrage mechanism usually makes sure that such differences disappear quickly. Example 8.3 shows how we can calculate the yields on bonds with the same maturity, once we have the yield curve (modelled on the zero-coupon yields). The yield on a coupon bond is basically some sort of weighted average of the cash flows in each period. As the final cash flow (repayment of the face value) dominates, the yield of the 4-year coupon bonds at 4.85% for the 6% coupon bond, and 4.90% for the 4% coupon bond is quite close to the 4-year zero-coupon yield of 5.0% in Example 8.3.

Example 8.3: Law of One Price: Yields on Bonds with the Same Maturity

Problem

Given the following zero-coupon yields, compare the yield to maturity and price of a 4-year bond with 4%, 6%, and zero annual coupons. We use risk-free government bonds.

Maturity	1 year	2 years	3 years	4 years
Zero-coupon yield	2.0%	3.0%	4.0%	5.0%

Solution

We can calculate the bond prices using Eq. (8.1):

$$P = \frac{CPN}{(1 + YTM_1)} + \frac{CPN}{(1 + YTM_2)^2} + \ldots + \frac{CPN + FV}{(1 + YTM_N)^N}$$

And the yields using Eq. (8.3):

$$P = CPN * \frac{1}{y}\left(1 - \frac{1}{(1+y)^N}\right) + \frac{FV}{(1+y)^N}$$

The payoff scheme is provided in the table.

	Year (n)				Bond price (P)	Yield (y)
Maturity	1	2	3	4		
Zero-coupon yield	2%	3%	4%	5%		
Discount factor	$\frac{1}{(1.02)^1} = 0.98$	$\frac{1}{(1.03)^2} = 0.94$	$\frac{1}{(1.04)^3} = 0.89$	$\frac{1}{(1.05)^4} = 0.82$		
Bond A (4% coupon)						
Payment	€40	€40	€40	€1040		
PV(CF$_n$)	**€39.22**	**€37.70**	**€35.56**	**€855.61**	**€968.09**	**4.90%**
Bond B (6% coupon)						
Payment	€60	€60	€60	€1060		
PV(CF$_n$)	**€58.82**	**€56.56**	**€53.34**	**€872.06**	**€1040.78**	**4.85%**
Bond C (0% coupon)						
Payment	€0	€0	€0	€1000		
PV(CF$_n$)	**€0**	**€0**	**€0**	**€822.70**	**€822.70**	**5.00%**

The bond price calculation is straight-forward. For the yield, we use trial and error. It is interesting to see that the yields on the coupon bonds are just below the yields on zero-coupon bond at 5%. The higher the coupons, the larger the deviation (0.15% for the 6% coupon bond and 0.10% for the 4% coupon bond), since the coupons get a higher weight in the calculation of the yield as weighted average. ◀

Example 8.4: Law of One Price: Yields on Bonds with Different Maturity

Problem

Given the following zero-coupon yields, compare the yield to maturity and price of a 2-year, 3-year, and 4-year bond with a 6% annual coupon. We use risk-free government bonds.

Maturity	1 year	2 years	3 years	4 years
Zero-coupon yield	2.0%	3.0%	4.0%	5.0%

Solution

We can again calculate the bond prices using Eq. (8.1) and the yields using Eq. (8.3). The payoff scheme is provided in the table.

	Year (n)				Bond price (P)	Yield (y)
Maturity	1	2	3	4		
Zero-coupon yield	2%	3%	4%	5%		
Discount factor	0.98	0.94	0.89	0.82		
Bond D (6% coupon)						
Payment	€60	€1060				
PV(CF$_n$)	**€58.82**	**€999.15**			**€1057.98**	**2.97%**
Bond E (6% coupon)						
Payment	€60	€60	€1060			
PV(CF$_n$)	**€58.82**	**€56.56**	**€942.34**		**€1057.72**	**3.92%**
Bond F (6% coupon)						
Payment	€60	€60	€60	€1060		
PV(CF$_n$)	**€58.82**	**€56.56**	**€53.34**	**€872.06**	**€1040.78**	**4.85%**

Again, the yields on the coupon bonds are close to the zero-coupon-yield with the same maturity. The 2-year bond yield is 2.97% (compared to the 3% zero-coupon yield), the 3-year bond yield is 3.92% (compared to the 4% zero-coupon yield), and the 4-year bond yield is 4.85% (compared to the 5% zero-coupon yield). ◀

In a similar way as in Example 8.3, we can calculate the yields on bonds with different maturities. Example 8.4 shows again that the yield on coupon bonds is quite close to the respective zero-coupon yield with the same maturity. The attentive reader has spotted that Bond B in Example 8.3 is the same as Bond F in Example

8.4. That is an interesting feature of the law of one price. You can make different calculations of bond prices and yields, and you end up with identical prices and yields for 'similar' bonds.

Explaining the Term Structure

As bonds with a higher duration are more exposed to interest rate risk, they carry a higher risk premium (or term premium). The yield curve is therefore typically upward sloping. The term premium leads to a positive *term spread*, i.e. the spread of yields for bonds with longer maturity over yields for bonds with shorter maturity, even when markets expect increasing and decreasing interest rates to be equally likely.

There are several explanations for a positive term premium:

1. Belief that short-term rates will be higher in the future
2. Higher exposure of longer-term bonds to changes in interest rates
3. Risk of higher inflation in the future

So, the first two reasons for a positive term spread concern (the risk of) higher future interest rates. The third reason is about risk-averse investors demanding a premium for inflation risk. Inflation $i_{i,t} = \frac{(CPI_{i,t} - CPI_{i,t-1})}{CPI_{i,t-1}}$ is the realised consumer price index (CPI) inflation rate in a given country i and year t. Inflation can and does differ across time and across countries. It is therefore helpful to compare yields or more generally returns in real terms r_r. The real rate of return can be calculated as:

$$1 + r_r = \frac{1 + r}{1 + i} \tag{8.6}$$

By re-arranging, we can express the Inflation-adjusted real returns r_r for an asset class as:

$$r_r = \frac{(1 + r) - (1 + i)}{1 + i} = \frac{r - i}{1 + i} \approx r - i \tag{8.7}$$

We can use the approximation for real interest rates in the form of nominal return minus inflation $r - i$ in low inflation countries. If the nominal rate is 4% and inflation is 1%, the real rate of return is approximately $3\ \% \ \approx 4\ \% \ - 1\%$. The exact real interest rate is 2.97%. For high inflation countries, we'd better use the full formula, since larger numbers result in larger deviations.

Notwithstanding these forces for a positive term premium, a downward sloping yield curve (called inverse yield curve) is also possible. A major reason for an inverse yield curve is increased expectations of a recession, where central banks are likely to reduce interest rates to foster economic growth.

8.3 Government Bonds and Corporate Bonds

This section reviews the main drivers of yields on government and corporate bonds. Next, we calculate the credit risk (also called the risk of default) and the liquidity risk on bonds.

Drivers of Yields on Government Bonds

National government bonds, also known as sovereign bonds, have been issued for centuries and their prices have tended to be driven by (expectations regarding) the fortunes of the states involved and their reliability in paying back their debt. In fact, Ferguson (2001) argues that Britain beat France in the struggle for colonial empire in the 1700s, as the British managed to finance their wars at low interest rates, thanks to reliability in repaying debt and an efficient bureaucracy. France's cost of funding was consistently higher due to its poor reputation in repaying debt.

Nowadays, countries have formal credit ratings, set by credit rating agencies (as explained in Sect. 8.3 below). In an empirical study of the determinants of sovereign credit ratings, Cantor and Pecker (1996) find that credit ratings and sovereign borrowing costs can be explained by per capita income, GDP growth, inflation, external debt, the level of economic development, and default history. Government bonds are typically bought by institutional investors, who seek a relatively safe investment. Insurance companies and pension funds have large holdings of government bonds to hedge the interest rate risk of their liabilities with safe assets. Government bonds by the same issuer (or by an issuer with the same rating) may still have different prices, driven by differences in maturity and liquidity.

Different dynamics may occur during economic crises, with a prominent role for financial contagion (Beirne & Fratzscher, 2013). *Financial contagion* is the spread of market disturbances from one market or country to other markets or countries. A salient example is the European Sovereign Debt Crisis, which started in Greece at the end of 2009. After several revisions of previously announced deficit figures (even going back to the time of admission of Greece into the Euro area) had been published it became clear that public finances in Greece were unsustainable. On 10 May 2010, the 10-year yield spread between Greek and German government bonds reached about 10% (outside the range of Fig. 8.4). Similar concerns arose in Ireland, Portugal, and, later, Spain and Italy. Figure 8.4 shows that the Italian 10-yield spread went up to 5% in late 2011 (7% for Italy minus 2% for Germany). Again, the Italian yield spread reached 3% in 2018/2019, due to concerns about political stability in Italy.

The European Sovereign Debt Crisis reconfirmed the status of the German bond as benchmark bond. The German bond yield can thus be used as the risk-free rate for the Euro (see Chap. 13). The yield curves of two other very creditworthy countries, France and the Netherlands, are just above the German yield curve in Fig. 8.4. Similarly, the US Treasury yield serves as the risk-free rate for the US dollar. US government bonds are called Treasuries. These German and US government bonds are the most creditworthy and liquid bonds in their respective currencies.

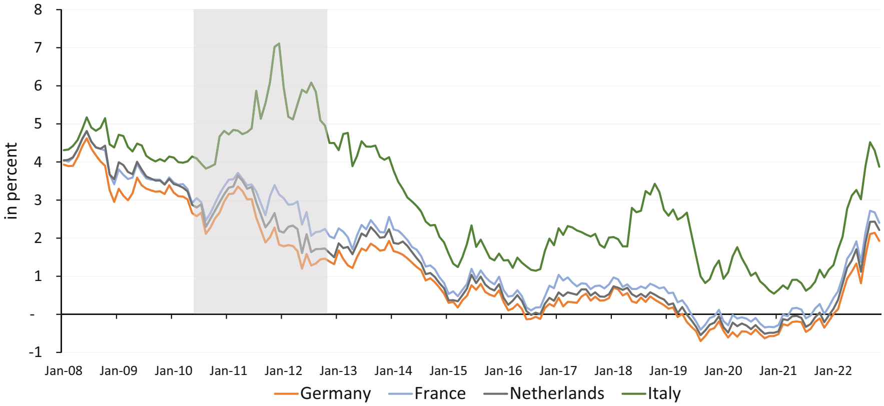
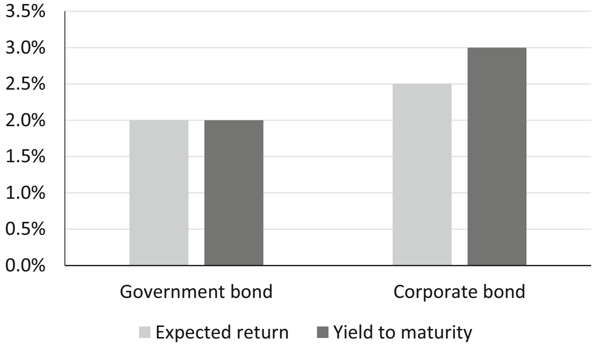


Fig. 8.4 Ten-year government bond spreads against German government bonds, 2008–2022 (in percent). Source: Bloomberg

Fig. 8.5 Expected return versus yield to maturity on bonds



Drivers of Yields on Corporate Bonds

Corporate bonds differ from sovereign bonds in some important respects. The most important differences are that corporate bonds tend to carry more serious default and liquidity risks. Liquidity risk refers to the lower trading frequencies, higher transaction costs due to lower competition among bond traders, and smaller sizes of corporate bonds, which make it harder to trade such bonds. Given that corporates are (much) smaller entities than governments and cannot tax people, they are also much more likely to default (i.e. be unable to meet their payment obligation).

Such default risk, or credit risk, means that the bond's expected return, which is equal to the firm's cost of capital, is less than the yield to maturity *YTM* on the promised payments. Equation (8.8) below gives the mathematical relationship between the yield to maturity (i.e. the promised rate) and the expected rate. Figure 8.5 illustrates the difference between these two rates.

The reason for the difference is that the expected payments are lower than the promised payments, if there is a risk of default. So a higher *YTM* on bond X than on bond *Z* does not necessarily imply that the expected return on X is higher than on *Z*.

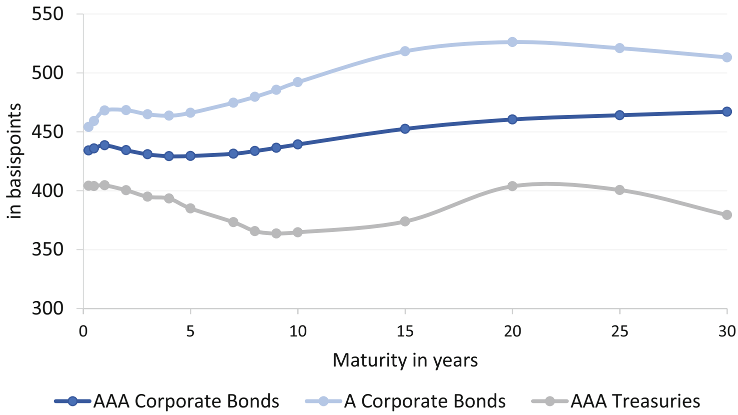


Fig. 8.6 Ten-year yield curves for various ratings, November 2022. Source: Bloomberg

Table 8.3 Corporate yield spread per maturity, November 2022

Maturity	1 year	5 years	10 years	20 years
AAA corporate bonds	4.39%	4.30%	4.39%	4.61%
A corporate bonds	4.68%	4.66%	4.92%	5.26%
AAA Treasuries	4.07%	3.85%	3.65%	4.04%
AAA corporate yield spread	**0.31%**	**0.45%**	**0.75%**	**0.57%**
A corporate yield spread	**0.61%**	**0.81%**	**1.28%**	**1.22%**

Source: Bloomberg

The yield spread is the difference between yields of corporate bonds and yields of government bonds and reflects the default and liquidity risks. The higher the default (and liquidity) risk, the larger the spread will be. This spread can be calculated for all maturities and be expressed in the so-called corporate yield curve. Figure 8.6 shows the 10-year yield curves (in basis points) and Table 8.3 the yield spread (in percent). Note that 100 basis points is equal to 1%.

Several drivers of yields have been identified, some of them a long time ago. Fisher (1959) finds that default risk is the prime determinant of yield spreads on corporate bonds and that liquidity or marketability is the second most important determinant. Cohan (1962) finds the following additional (and related) drivers: rating (essentially an assessment of default risk), type of bond, and maturity. Of course, these factors are related to each other to some extent. For example, larger firms tend to have more stable cash flows, lower default risk, larger issues, and higher ratings. Section 8.4 shows that there is also evidence that yields are affected by sustainability factors.

Credit Risk and Ratings

Now it's time to formally introduce the concepts of credit and liquidity risk. *Credit risk* refers to the risk of default of the government or company issuing a bond. The expected return on a bond is different from the promised return or yield y on bonds, as some issuers default on their bond. The expected return on debt r_D can be calculated as follows:

$$E[y] = (1 - PD) \cdot y + PD \cdot (y - LGD) = y - PD \cdot LGD = r_D \tag{8.8}$$

where PD is the probability of default and LGD the loss given default (the fraction of the principal and interest lost in case of default). Historically, the loss given default rate is about 60% for unsecured bonds (S&P Global Ratings, 2020b). Equation (8.8) can be illustrated with a simple example. Assume a promised yield of 6%, a probability of default of 4%, and a loss given default of 60% (which means that 40% is recovered). The expected return is 3.6%, calculated as $6\ \% - 4\ \% \ * 0.60 = 3.6\%$.

We can formulate the expected credit losses ECL:

$$\text{Expected credit losses}: ECL = EAD \cdot PD \cdot LGD \tag{8.9}$$

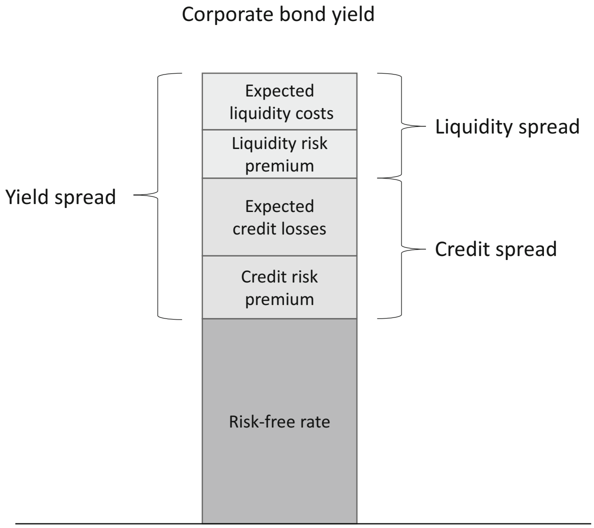
where EAD is exposure at default. Equation (8.9) gives the formula for expected credit losses. In the case of bonds, the exposure at default is the principal and interest payment. The expected credit losses in our bond example are 2.4%, calculated as: $1 \cdot PD \cdot LGD = 1 * .04 * .60 = 0.024$. This 2.4% expected loss is the difference between the promised yield at 6% and the expected return at 3.6%.

The next step is to calculate the reward for risk taking: the credit risk premium or CRP. Just like the market risk premium (Eq. 12.13) introduced later in Chap. 12, the CRP is the difference between the expected return on a bond $E[y]$ and the risk-free rate r_f:

$$\begin{aligned}\text{Credit risk premium}: \quad CRP &= E[y] - r_f \\ &= \text{expected return–risk-free rate}\end{aligned} \tag{8.10}$$

As discussed, the risk-free rate can be derived from the government bond yield curve. Assuming a risk-free rate of 2%, the credit risk premium is 1.6%, calculated as $3.6\ \% - 2\ \% = 1.6\%$. Now that we have derived the separate items in Eqs. (8.8) and (8.9), we can introduce the overall concept. The *credit spread* is the difference between the promised yield y and the (risk-free) government yield r_f. In our example, the credit spread is 4%, calculated as $6\ \% - 2\ \% = 4\%$. The credit spread covers the expected credit losses at 2.4% (that are a function of the probability of default PD and the loss given default LGD in Eq. 8.9) and the reward for risk taking on the bonds at 1.6% (that is the credit risk premium from Eq. 8.10). Figure 8.7 summarises the components of corporate bond yields: the risk-free rate, the credit spread, and the liquidity spread (see Sect. 8.3 below). Example 8.5 shows how to compute the expected return and credit risk premium.

Fig. 8.7 Components of corporate bond yields



Example 8.5: Bond Yield and Expected Return

Problem

Given the following 1-year zero-coupon bond prices and yields, calculate the expected return, the expected credit losses, the credit risk premium, and the credit spread. The risk of default on the corporate bond is 4% and the loss given default is 60%.

Bond (1-year, zero coupon)	Bond price	Yield to maturity
Government bond	€970.87	3.0%
Corporate bond	€930.23	7.5%

Solution

We can calculate the expected return using Eq. (8.8):

$$E[y] = r_D = 7.5\% - 4\% * 0.60 = 5.1\%$$

The expected credit losses using Eq. (8.9):

$$ECL = 4\% * 0.60 = 2.4\%$$

And the credit risk premium using Eq. (8.10):

$$CRP = 5.1\% - 3\% = 2.1\%$$

The credit spread is the difference between the government and corporate bond yield, which amounts to 4.5%. The numbers are included in the table. Please note there is no credit risk premium or credit spread on the risk-free government bond.

Bond (1-year, zero coupon)	Bond price	Yield to maturity	Expected return	Expected credit losses	Credit risk premium	Credit spread
Government bond	€970.87	3.0%	3.0%	0%	0%	0%
Corporate bond	€930.23	7.5%	5.1%	2.4%	2.1%	4.5%

◀

During times of crises, credit spreads on corporate bonds (also called yield spreads) can jump up. A jump in yield spreads comes typically from two sides:

1. The (perceived) risk of corporate bonds goes up as the risk of default increases, resulting in higher corporate yields and
2. A flight to safety, whereby investors move from risky assets, such as equities and corporate bonds, to safe assets, such as government bonds (or even gold); the increased demand leads to higher government bond prices and thus lower government yields

Figure 8.8 shows the increase in 10-year yield spreads versus the US Treasuries during the global financial crisis of 2009. The increase was the biggest for the BAA corporate and then the A corporate. The AAA corporate was seen as the safest among the corporate bonds, with a smaller increase.

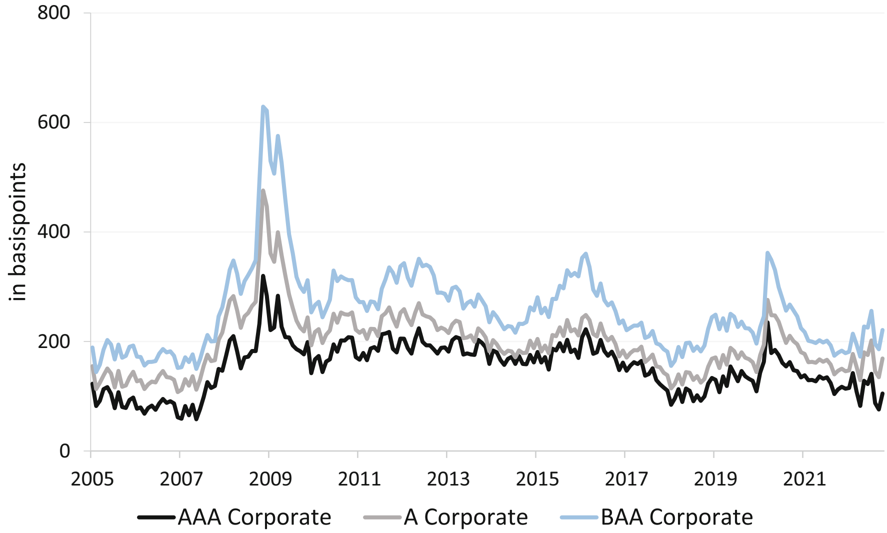


Fig. 8.8 Ten-year yield spreads of corporate bonds versus US Treasuries during crisis. Note: The curves show the yield spreads versus US Treasuries. The AAA Corporate curve, for example, shows the 10-year AAA Corporate yield minus the 10-year Treasury yield. Source: Bloomberg

Credit Ratings

Bond ratings are assessments of the possible risk of default, prepared by independent private companies that specialise in such ratings. Credit ratings are there for efficiency reasons: it is inefficient for every investor to privately investigate the default risk of every bond. Instead, a limited number of credit ratings agencies assess the creditworthiness of bonds and certify the issuers. They make this information available to investors, who can decide whether to do additional work on assessment. The best-known credit rating agencies are Moody's, Standard & Poor's (S&P), and Fitch. A major governance issue is that credit ratings are paid by the issuer and not by the investor, which creates a conflict of interest.

Credit ratings are typically classified as investment-grade (the top four ratings categories, with low default risk) or junk/high-yield/speculative (the bottom five categories, with high likelihood of default). Box 8.1 provides an overview of bond ratings, with long-term average default rates (*PD* from Eq. 8.8). The mandate of institutional investors often allows them only to invest in investment-grade bonds. This increases the demand for these bonds, resulting in higher bond prices and lower yields.

Box 8.1: Bond Ratings

The rating agencies use different keys to classify bond ratings. The table provides the ratings for investment-grade bonds and junk or high-yield bonds. The final column contains the long-term average default rate, which is the 1981–2019 average.

Rating agency	Moody's	Standard & Poor's and Fitch	Long-term average default rate
Type of bonds	**Investment-grade bonds**		
	Aaa	AAA	0.00%
	Aa	AA	0.02%
	A	A	0.05%
	Baa	BBB	0.16%
Type of bonds	**Junk or high-yield bonds**		
	Ba	BB	0.61%
	B	B	3.33%
	Caa	CCC	27.08%
	Ca	CC	
	C	C	

Source: S&P Global Ratings (2020a)

Corporate Bonds and Agency Costs

A company that has bonds outstanding also has equity. In fact, owning the equity of a company is like having the right to buy the company (an option) paying the face value of debt to the bondholders. And the more debt there is, the riskier that right becomes (Merton, 1974). Equity holders have much more upside risk than bondholders. A benefit for bondholders is that they get paid back first in case of default. While both parties benefit from higher profits and growth, equity holders benefit from volatility (risk), while bondholders suffer from volatility or uncertainty. This may give rise to a conflict of interest between equity holders and bondholders.

The presence of debt may, for example, cause an underinvestment problem. In this situation equity holders have no incentive to invest new capital, not even in positive NPV projects: as the company is highly levered, equity holders know the payoffs go to bondholders anyway. Myers (1977) has shown the 'debt overhang' problem formally: if management is aligned with equity holders (for example, via variable compensation in stocks), it will only attract new capital for projects that have returns that are high enough to pay back not just bondholders, but to leave a residual return for shareholders as well.

The situation is different if there is already capital in the company (e.g. through retained earnings), and an overinvestment problem might occur. Equity holders might prefer risky investments in negative NPV all-or-nothing projects in which their expected payoff is higher (equity holders get the full upside, and only part of the downside), but the expected payoff of the bondholders is lower (bondholders get most of the downside). These risk-shifting situations increase the value of equity at the expense of bondholders.

There are ways of limiting agency conflicts. An example is including *covenants* that protect the interest of bondholders and limit the decisions of management, say when a certain threshold profitability or threshold debt-to-equity ratio is crossed. But there are also costs, called monitoring costs, related to such arrangements. Shareholders will want to limit those monitoring costs, as they ultimately bear most of them as residual claimants. In case of default, bondholders bear them. Shareholders can disclose information (for example, on the financial expectations of large operations in the annual report) to facilitate the work of control. For that information to be credible, its accuracy has to be verified by independent outside auditors. This results in bonding costs: the costs of providing information, contracting auditors, and self-imposed restrictions such as covenants. Smith and Warner (1979) list a number of bond covenants: restrictions on investment policies, restrictions on dividend payments, restrictions on subsequent financing, and the modification of patterns of payoff to the bondholders, for example convertibles or callability provisions.

Bondholders rely on delegated monitoring and have little control over the issuer. Debt holders typically have no voting power, except when the company goes bankrupt. As the original equity is then wiped out, the debt holders become the 'owners' of the company. In bankruptcy, debt is turned into equity. Such control transfers do not happen very frequently, and they may not be very swift.

Liquidity Risk

Bonds also face liquidity risk, which is the risk that bonds cannot be sold swiftly. **Liquidity is the ease with which an investor can sell or buy a bond immediately at a price close to the mid-quote** (i.e. the average of the bid-ask spread, see Box 8.2). The spread between the yield of a bond with high liquidity and a similar bond with less liquidity is referred to as the *liquidity premium*. The higher liquidity risk of corporate bonds stems from lower trading frequencies and higher transaction costs. That is due to the smaller sizes of individual corporate bond markets (i.e. per security) and less competition among bond traders.

In Europe, Germany is one of the most creditworthy countries. Germany has one major advantage over other creditworthy countries like Finland and the Netherlands: the German government bonds form the deepest market (the most liquid) and serve as benchmark for the Euro-yield curve. In the USA, the US Treasury is the benchmark for the US-dollar-yield curve.

Box 8.2: Market Makers and Bid-Ask Spread

Market makers provide liquidity to markets. Here is how it happens: when a security is traded, the buyer pays the ask price p_a to the market maker, and the seller receives the bid price p_b of the market maker. The difference is the *bid-ask spread*: $s = p_a - p_b$ received by the market maker. The market maker typically holds an inventory of securities during the day to be able to sell (and buy) immediately. From their return (i.e. the bid-ask spread), the market maker has to cover the costs of holding their inventory (e.g. interest costs of financing the securities inventory) and the risks (e.g. prices may move while the securities are in the inventory).

Governments bond issuances are very large and typically very liquid, with very tight bid-ask spreads. Corporate bond issuances are smaller in size and far less traded. This low liquidity results in high bid-ask spreads.

8.4 Integrating Sustainability into Bond Valuation

Why Does Sustainability Matter to Bonds?

Sustainability matters for bond valuation, as sustainability issues include value relevant issues that are not yet properly priced (inefficiencies). As in equities (Chap. 9), sustainability analysis is a natural extension of fundamental bond analysis, providing the link between valuation and material environmental and social factors. Bond analysis is also called fixed-income analysis, given that the income of bonds is 'fixed' (just the contractual interest payments). Compared to equity, the focus in fixed-income valuation is much more on risk than opportunities, except perhaps in high yield. The reason is that bondholders are mainly exposed to downside risk and benefit much less from upside potential than shareholders do.

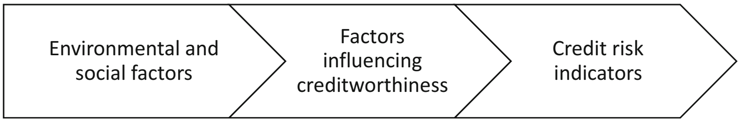


Fig. 8.9 From sustainability to credit risk. Source: Adapted from Schoenmaker and Schramade (2019)

Some fixed-income investors are equally, if not more concerned than equity investors about environmental and social exposures. These exposures can have pronounced effects on performance by generating risks that may materialise in both going concern and default scenarios. For example, as the Dieselgate scandal hit Volkswagen in September 2015, its CDS spread rose from 75.5 basis points (bp) on 17 September to 299.5 bp on 28 September (the CDS spread is the credit default swap spread, which measures the credit spread on a bond). This can also happen with governments. After Russia seized the Crimea from Ukraine in 2014, the Russian 5- and 10-year CDS spread rose from a 200–300 bp range to spike over 600 bp. Ukraine's CDS spread spiked at over 5000 bp. Figure 8.9 visualises the materiality of environmental and social factors to bonds. The underlying factors differ slightly when comparing governments to corporates (Table 8.4).

All of the issues mentioned in Table 8.4 merit a paragraph by themselves, but that is beyond the scope of this chapter. It is striking that many issues are relevant for both corporate and government bonds, especially on the environmental side. The environmental side is also better developed than the social side, in terms of both data and impact investing. The green bond market has, for example, taken off while the social bond market is very small (see Sect. 8.6). Because of the data and nature of the issues, it is much more difficult to decide which companies are part of the solution and which are part of the problem when dealing with social issues compared to environmental issues. The remainder of this section focuses on integration of sustainability into corporate bond analysis, as this book is focused on corporate finance. For the integration of sustainability into government bonds, see Schoenmaker and Schramade (2019).

Sustainability Integration into Corporate Bonds

Advanced credit risk assessment models estimate the probability of default *PD* and the loss given default *LGD* on the basis of historical data at industry and company level. Equation (8.9) in Sect. 8.3 provides the formula:

$$\text{Expected credit losses :} \quad ECL = EAD \cdot PD \cdot LGD$$

It is a challenge to integrate sustainability due to its forward-looking nature (see Chap. 12). The prospect of forced internalisation of social and environmental externalities affects credit risk. Companies that internalise social and environmental factors (and are thus well prepared for the sustainability transitions) can reduce their credit risk. Chapter 2 discusses how companies can adapt their business model to transitions. A high adaptability *a* (from Eq. 2.1) reduces the probability of default

Table 8.4 Underlying factors of government and corporate bonds

Factor	Corporate and government	Mostly government	Mostly corporate
Traditional factors			
Factors influencing creditworthiness	Cash reserves	Economic strength Economic growth prospects Balance of trade Fiscal performance External (and domestic) debt Budget deficit Monetary flexibility Implicit liabilities from social security*	Profitability Employee productivity Competitive advantage Cost of capital Leverage Intangibles*
Credit risk indicators	Credit ratings CDS spreads Bond yields and prices Volatility		Default probability Breach of covenants
Environmental and social factors			
Environmental	Climate change Biodiversity Energy resources and management Biocapacity and ecosystem quality Air/water/land pollution Renewable and non-renewable natural resources	Natural disasters Land system change*	Product stewardship* Redemption of used products*
Social	Human rights Education and human capital Health and safety Innovation management*	Political freedoms Demographic change Employment levels Social exclusion and poverty Trust in society/ institutions Food security	Product responsibility Diversity Employee relations and access to skilled labour Community/ stakeholder relations Consumer relations

Source: Adapted by the authors based on PRI Fixed-Income working groups (2013a, 2013b). Issues with an * are added by the authors

PD and the loss given default *LGD*. By contrast, a low adaptability increases credit risk, as the company has less chance of survival in our changing world. It is therefore important to integrate into credit risk analysis:

1. The **prospect of internalisation** of social and environmental factors and
2. The **company's capability to adapt** to this new sustainable world

Example 8.6 illustrates the increased credit risk of an oil company that fails to adapt.

Example 8.6: Credit Risk of Oil Companies

Problem

The energy transition from fossil fuels to renewables will have consequences for oil and gas companies like Exxon, Shell, and Total. The energy transition is unfolding with carbon reduction targets of about 50% for 2030 and net zero carbon targets for 2050. Assume that the current probability of default of oil companies A and B with similar operations is 2% in 2022.

Oil company A is preparing for the energy transition by investing in renewables operations and stopping the exploration of new fossil fuel sources. It has a high adaptability $a = 0.9$. Oil company B is continuing its fossil fuel operations as usual and has a low adaptability $a = 0.1$.

What is the likely probability of default of these companies by 2025 (assuming no other relevant developments)?

Solution

While the precise policy path for achieving the carbon reduction targets is unknown, the dominant policy strategy for the energy transition is to favour renewables (e.g. through R&D subsidies) and to make fossil fuels less popular (e.g. through increasing carbon taxes).

As the relative costs of fossil fuels and renewables move in favour of renewables, company A will become more profitable and company B less profitable. So, company A's probability of default will decrease to below its current 2%, while company B's probability of default will increase to well above 2% (with the ultimate possibility of failure). ◄

A simple method to incorporate sustainability into credit risk assessment is the Altman *Z*-score. This is a multivariate credit score system. The updated Altman *Z*-score is based on four factors (Altman, 2018):

1. Working capital: $x_1 = \frac{\text{current assets–current liabilities}}{\text{total assets}}$
2. Retained earnings: $x_2 = \frac{\text{retained earnings}}{\text{total assets}}$
3. EBIT: $x_3 = \frac{\text{earnings before interest and taxes}}{\text{total assets}}$
4. Equity: $x_4 = \frac{\text{book value of equity}}{\text{total liabilities}}$

The *Z*-score is constructed as follows:

$$Z = 3.25 + 6.56 \cdot x_1 + 3.26 \cdot x_2 + 6.72 \cdot x_3 + 1.05 \cdot x_4 \tag{8.11}$$

The *Z*-score can be used to predict bankruptcy of both public and private firms, because it employs accounting data. Based on empirical testing of industrials (both manufacturing and non-manufacturing) across multiple countries, Altman (2018) finds the following zones of discrimination:

- **Safe zone**: $Z > 5.85$
- **Grey zone**: $4.35 < Z < 5.85$
- **Distress zone**: $Z < 4.35$

The zones are selected on the basis of empirical testing: companies in the distress zone were bankrupt (or did go bankrupt within 1 year); companies in the safe zone did not go bankrupt. The grey zone comprised the companies that were at risk of bankruptcy. While the Altman *Z*-score has the drawback of being based on historical accounting data, its simple set-up allows the integration of sustainability. The credit analyst can estimate the impact of sustainability on the four factors for a company. A more adaptable company may have a more favourable development of the factors than a less adaptable company, yielding a higher *Z*-score. Here is an example of a chemicals company (Example 8.7).

Example 8.7: *Z*-Score for a Chemicals Company

Problem

Evonik is a speciality chemicals company, based in Germany. It produces and supplies smart materials for environmentally-friendly and energy-efficient systems to industry (business-to-business). It also has a consumer-based nutrition and care division aimed at health and quality of life. Sustainability is at the core of Evonik's strategy. Evonik's current profile is as follows:

Factor	2020
Working capital	0.10
Retained earnings	0.33
EBIT	0.04
Equity	0.39

Working capital is expected to increase by 10% (from 0.10 to 0.11) over the next 2 years, while the book value of equity remains flat. Due to its sustainability strategy, Evonik can tap into the growing market for sustainable products, realising higher EBIT margins. EBIT is expected to increase by 75% (from 0.04 to 0.07) for both years and retained earnings increases from 0.33 to 0.40 in 2021 and 0.43 in 2022.

What is the impact of Evonik's sustainability strategy on its default risk?

Solution

Using Eq. (8.11), we can calculate the *Z*-score

Factor	Weight	2020	2021	2022
Constant	1.00	3.25	3.25	3.25
Working capital	6.56	0.10	0.11	0.11
Retained earnings	3.26	0.33	0.40	0.43
EBIT	6.72	0.04	0.07	0.07
Equity	1.05	0.39	0.39	0.39
***Z*-score**		**5.66**	**6.16**	**6.25**

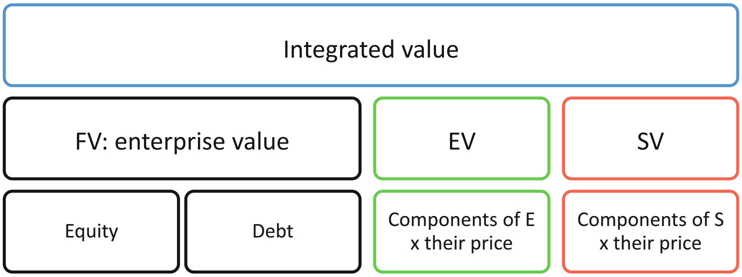


Fig. 8.10 The components of integrated value

The *Z*-score of 5.66 indicates that Evonik is in the grey zone in 2020. The improvement in EBIT and retained earnings increases Evonik's *Z*-score to 6.16 in 2021 and 6.25 in 2022. Evonik is thus moving to the safe zone. Evonik's sustainability strategy reduces its default risk. ◄

Sustainability Integration into Credit Ratings

There is academic evidence that sustainability measures improve credit rating predictability (Dorfleitner et al., 2020). Companies with higher sustainability scores have better credit ratings, which supports the risk-mitigation view. Sustainability or ESG integration into credit ratings has grown over the last years. Yet, such integration is still limited, as it typically just reflects an adjustment for ESG factors. Such efforts do not fully account for social and environmental externalities, and staying within planetary and social boundaries, as in Example 8.6 above.

Credit rating agencies are stepping up their sustainability integration by acquiring sustainability data providers. S&P, for example, bought Trucost, a provider of carbon and environmental data and risk analysis, in 2016.

8.5 Valuation of S & E and Integrated Value

The valuation of S and E is similar to the valuation of F at enterprise level. In this set-up, FV is enterprise value, which is the sum of equity and debt.[1] S and E are valued separately and are a result of the company's operations. Integrated value is simply the sum of FV, EV, and SV—see Fig. 8.10.

For both SV and EV, the value calculation can be done in three steps:

[1] An alternative is to define FV as equity value, which is assets (enterprise value) minus debt. But we define integrated value here from a stakeholder perspective: social, environmental, and financial stakeholders. Financial stakeholders comprise both equity and debt holders.

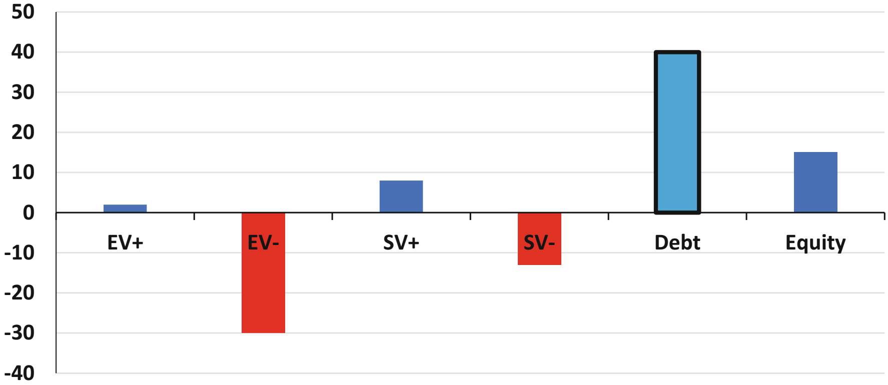


Fig. 8.11 The components of a company's integrated value and share of debt

1. Determine material S and E issues
2. Quantify the S and E issues in their own units *Q* and
3. Put a monetary value on those S and E units with shadow prices *SP*

See Chap. 5 for an elaboration of these three steps. The valuation is done in the discounted cash flow (DCF) way as described in Chap. 9.

Figure 8.11 shows what the composition of integrated value, and in it the role of debt, might look like for a company. In this hypothetical case, debt looks vulnerable due to large negative values for S and especially E, as well as high financial leverage (i.e. the size of the debt itself relative to equity). The high leverage means that the risk of both debt and equity rises. And the large negative values of S and E have a similar effect in that they raise the risk of the company and its equity. These effects of leverage, both financial and from E and S, will be discussed further in Chap. 15 on capital structure.

In addition, one should be aware that these types of value can spill over into each other. The social and environmental value can be internalised (i.e. spillover) in the financial value as part of transitions. For an example of determining a company's integrated value, see Chap. 11 with an in-depth case study of Inditex.

8.6 Green and Social Bonds

Green and social bonds are bonds with a special label. By issuing such bonds, companies and countries signal that they undertake environmental or social projects. These bonds also meet a demand from responsible investors.

Green Bonds

Green bonds are a recent and fast-growing phenomenon. Similar to green loans, their purpose is to finance green projects, such as those that reduce greenhouse gas

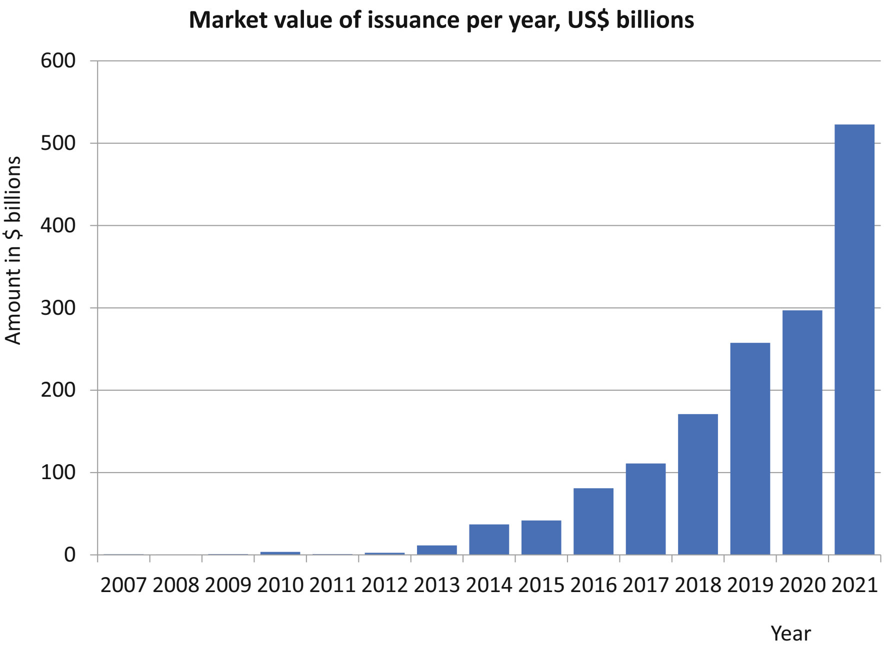


Fig. 8.12 Green bond issues, 2007–2021. Source: Climate Bonds Initiative

emissions or increase recycling. The first green bond was issued by the European Investment Bank in July 2007, and it took 6 years for the green bond market to pass $10 billion in cumulative issues. The market has grown exponentially in recent years, reaching global annual issuance of $520 billion in 2021 (Fig. 8.12). At first, the market was dominated by supranationals, which are supranational or multilateral government agencies, such as the World Bank, the International Monetary Fund, the Inter-American Development Bank, the Asian Development Bank, or the European Investment Bank. Since 2012 other types of issuers, including agencies, sovereigns, corporates, municipalities and financial institutions, have been involved. Related products were also launched, including green bond funds and green bond indices. Market-based standards followed suit, including the Climate Bond Standards in November 2010 and the Green Bond Principles in January 2014. The European Commission produced a draft EU Green Bond Standard in 2021.

In principle, green bonds provide environmental or climate change benefits, but are otherwise the same as other bonds. The vast majority (90%) of the green bonds issued are investment-grade bonds (Zerbib, 2019). Institutional investors that pursue sustainable investing policies can buy these investment-grade bonds. Box 8.3 describes the criteria for a green bond.

Box 8.3: Criteria for Green Bonds

ICMA (2021a) set out four criteria for determining whether a bond is green:

1. **Use of proceeds**: proceeds are exclusively for green projects, which should be appropriately described in the legal documentation accompanying the security;
2. **Process of project evaluation and selection**: the issuer should clearly communicate to investors what the environmental objectives are, the process by which the issuer determines how the project fits within eligible green project categories, and the related eligibility criteria;
3. **Management of proceeds**: the net proceeds of the green bond should be credited to a sub-account, and subsequently tracked and verified;
4. **Reporting**: mandatory reporting on the use of the proceeds.

But what is green? The draft EU Green Bond Standard specifies that green projects should contribute substantially to at least one of the six environmental objectives as set out in the EU taxonomy for sustainable activities:

1. Climate change mitigation
2. Climate change adaptation
3. Sustainable use and protection of water and marine resources
4. Transition to a circular economy
5. Pollution prevention and control
6. Protection and restoration of biodiversity and ecosystems

In addition, a green project aimed at contributing to one of these objectives should not undermine or harm any of the others. The EU thus provides a clear standard for 'green projects'. The draft EU Green Bond Standard also requires verification by an external party of the allocation of the proceeds to green projects. That sounds great, but does not mean that the project or the issuer operates within planetary boundaries.

Moreover, green bonds are meant for financing green projects, but they are not ring-fenced. That is, the bond's payments are not necessarily tied to the green project (unless the project constitutes all of the issuer's assets). So the bond carries the same credit risk as other bonds from the same issuer with the same conditions. The main difference is the commitment to use the proceeds for green projects.

Sustainable investors are prepared to pay a green bond premium (resulting in a lower yield) for holding these bonds, a factor known as the 'clientele effect'. The green bond premium is defined as the difference in the yield from green bonds compared to perfectly matched reference bonds. The green bond premium ranges from 0 to 20 basis points and clusters around 5 basis points (Flammer, 2021; Gianfrate & Peri, 2019; Zerbib, 2019). These benefits, in the form of lower financing costs, are at least partially offset by higher issuing and reporting costs (ICMA criteria

2–4 in Box 8.3), which Gianfrate and Peri (2019) estimate at 5 basis points per annum.

Flammer (2021) shows that investors respond positively to the issuance announcement of green bonds and that issuers improve their environmental performance (i.e., higher environmental ratings and lower carbon emissions) after issuance. They also experience an increase in ownership by long-term and green investors. This is in line with the signalling argument—by issuing green bonds, companies credibly signal their commitment to the environment.

Challenges

The green bond market is growing fast but it faces some serious challenges. For example, there is no clear agreement on what constitutes a green bond. There are several standards and numerous interpretations of those standards. As discussed, there are plans for developing official European sustainability standards for green bonds. Green bonds also require better investor communication. Many investors do not know how green bonds work, what the costs are, and whether they stay within planetary boundaries. Demystifying those issues could help to broaden the investor base.

Green bonds are not suitable for complex transactions. Waste management company Renewi used bank finance for its merger with Van Gansewinkel rather than coming back to the green bond market. Companies also face reputational risk by issuing a green bond, as it may not be recognised as such. In 2015, Unilever issued a £250 million green bond that was excluded from the Bloomberg Barclays MSCI Green Bond Index.

Social Bonds

Social bonds are bonds that are meant to provide clear social benefits. They are a payment by results contract, with which an organisation, typically one with a social purpose, agrees to deliver a certain outcome on a social project. If the objectives are not achieved, investors receive neither a return nor repayment of the principal. In that respect, social bonds are different from regular or green bonds, where the principal needs to be repaid.

So far, the market for social bonds is less developed than the green bonds market. The UK is leading the way in this regard. The Peterborough social bond is the world's first, established in 2012. It intends to invest £5 million in reducing the reoffending rate in prisoners leaving Peterborough prison. Another early social bond is the £10 million charity bond by Triodos, Golden Lane Housing and Mencap, which is meant to buy homes for people with learning disabilities.

The Social Bond Principles (ICMA, 2021b) define a social bond as 'any type of bond instrument where the proceeds will be exclusively applied to finance or re-finance in part or in full new and/or existing eligible social projects and which are aligned with the four core components of the Social Bond Principles'. That means that, as with green bonds, the bonds are earmarked but not ring-fenced, for social projects. Hence, they bear the same risk as otherwise similar bonds of the same

Table 8.5 Sustainable bond market

Label	Format
Green bonds	Use of proceeds
Social bonds	Use of proceeds
Sustainability bonds	Use of proceeds
Sustainability-linked bonds	Entity KPI-linked

issuer. The Social Bond Principles have the same four core components as the Green Bond Principles, described in Box 8.3.

Just as with green bonds, there is no clear agreement on what exactly constitutes a social bond. However, the Social Bond Principles do give an indication of what eligible social projects look like. Social project categories include, but are not limited to: affordable basic infrastructure; access to essential services; affordable housing; employment generation; food security; socioeconomic advancement, and empowerment. But of course, one could argue just what fits in these categories.

For further guidance, the Social Bond Principles also state that examples of target populations include those living below the poverty line; excluded/marginalised communities; vulnerable groups; migrants or displaced persons; the undereducated, underserved, and unemployed. Whatever the project may be, the principle is very clear: it should provide clear social benefits. Social bonds have been criticised for being complex, expensive, and bureaucratic. It has been hard to create accurate measures of social results.

In addition to green and social bonds, several types of 'sustainable' bonds are emerging at the time of writing. Sustainability Bonds are bonds where the proceeds are exclusively applied to finance or re-finance a combination of green and social projects.

Sustainability-Linked Bonds

Sustainability-linked bonds can be used for the issuer's general purposes. These bonds incorporate measurable forward-looking sustainability key performance indicators (KPIs) and sustainable performance targets. Improvement in the sustainability KPIs leads to lower interest rate payments (i.e. a lower yield), and vice versa. The price of these sustainability-linked bonds thus includes the market's assessment of the expected sustainability performance of a company. Remember that higher bond prices reflect lower yields and lower bond prices higher yields (see Sect. 8.1). Table 8.5 provides an overview of the sustainable bond market.

While the different types of green, social and sustainability bonds can play a useful role in the build-up of a company's sustainability credentials (Flammer's (2021) signalling argument), it is expected that, just like credit analysis, sustainability analysis will be fully integrated into investment analysis. The overall sustainability performance of a company is then relevant for determining the yield on that company's bonds. In that way, sustainability-linked bonds are the way forward, because they link a company's cost of debt to its overall sustainability performance.

8.7 Conclusions

This chapter discusses the basic types of bonds and considers their valuation. The pricing of bonds is relevant for corporate finance for two reasons. First, the yield on government bonds serves as the risk-free rate. Second, companies issue bonds to finance their operations. The credit risk on corporate bonds is analysed in detail. It is shown how to calculate the yields on bonds with different risk profiles and different maturities. The yield curve, which shows bond yields at different maturities, is introduced. Bond markets are bigger than stock markets, with institutional investors typically holding more bonds than equity.

Social and environmental factors are being integrated in the valuation of corporate bonds. There is still a lot of underestimated social and environmental risk in bonds. This chapter shows how to include a company's adaptability to sustainability transitions into the credit risk analysis. Companies that can better adapt their business model face a lower credit risk. By contrast, companies with limited capability to adapt encounter increased credit risk. Their lack of transition preparedness puts their survival at risk.

There is innovation in the form of green bonds and social bonds to cater for sustainable investment projects of governments and companies. The challenge is to 'certify' the use of the proceeds for green or social projects and to overcome bureaucratic procedures.

Key Concepts Used in This Chapter

Agency costs reflect the difference between the value of the firm in an ideal contracting situation and its value in the real (and suboptimal) contracting situation

Bid-ask spread is the difference between the ask price paid by the buyer and the bid price received by the seller. The size of the bid–ask spread in a security is a measure of the liquidity of the market.

Bond is a form of public debt

CDS spread is the credit default swap spread, which measures the default risk on a bond

Coupon is the interest paid on a bond

Covenants are promises by management of the borrowing company to adhere to certain limits in the company's operations

Credit rating is a rating of the creditworthiness of a company or country given by a credit rating agency; a high rating reflects a low *default risk* (and vice versa)

Default risk or credit risk is the risk of an issuer not making a coupon payment or principal repayment; see also *credit rating*

Duration is the sensitivity of a bond's price to changes in interest rates

Face value, also known as the *principal*, is the amount that needs to be repaid at the end of the bond's life

Green bonds are bonds that finance green projects (i.e. provide environmental or climate change benefits), but are otherwise the same as other bonds

High-yield bonds, also known as *junk bonds*, are high coupon paying bonds with a lower credit rating than investment-grade corporate bonds
Investment-grade bonds are bonds with a high rating and relatively low risk of default
Junk bonds, also known as *high-yield bonds*, are high coupon paying bonds with a lower credit rating than investment-grade corporate bonds
Liquidity is the ease with which an investor can sell or buy a bond immediately at a price close to the mid-quote (i.e. the average of the bid-ask spread)
Maturity is the time until the final repayment date of the bond
Principal, also known as the *face value*, is the amount that needs to be repaid at the end of the bond's life
Seniority is the order of repayment in the event of a sale or bankruptcy of the issuer
Social bonds are bonds that finance social projects (i.e. provide clear social benefits), but are otherwise the same as other bonds
Sustainability-linked bonds are bonds whereby interest payments are linked to a company's sustainability key performance indicators (KPIs)
Term spread is the spread of yields for bonds with longer maturity over yields for bonds with shorter maturity.
Term structure is the array of prices or yields on bonds at different terms or maturities
Yield is the return on a bond
Yield spread is the difference between yields on differing bonds of varying maturities, credit ratings, issuer, or risk level, calculated by deducting the yield of one bond from the other. For example, the difference between the 10-year government bond (Treasury) yield curve and the 10-year AAA corporate bond yield curve. This difference is expressed in basis points (bps) or percentage points.
Yield to maturity (YTM) is the discount rate that sets the present value of the bond's payments equal to the bond's current market price.

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Valuing Public Equity

9

Overview

A core element of corporate finance is the valuation of a company. A company's enterprise value refers to the value of its business activities, which are financed by equity and debt. Chapter 8 already covered the methods to value and price bonds (debt). This chapter examines methods to derive the equity value of publicly listed companies and the accompanying Chap. 10 looks at the equity value of private companies. These equity valuation methods either look at a company's 'fundamentals' or just compare a company to a similar company in order to obtain a company's value.

Looking at those two methods, let's start with the first: absolute valuation models are fundamental methods to calculate value by discounting cash flows from business activities or discounting dividends which are paid from realised profits. The discounted cash flow model is also most suited to integrate sustainability into valuation. By contrast, relative valuation models determine the value of one company in comparison with another company with similar characteristics. With a few market metrics, a company's value can be derived. There are also limits to valuation models. Most valuations assume constant growth, which just extrapolate growing cash flows or dividends into eternity—not realistic given the digital and sustainability transitions.

Sustainability matters more to equity valuation than most equity investors realise. As Chap. 2 shows, material sustainability issues can make or break companies and their business models. As residual claimholders, equity investors are more heavily exposed than other investors. They bear most of the risk when companies fail and they also reap most benefits when companies succeed. Therefore, they have strong incentives to help companies achieve the conditions for integrated value creation described in Chap. 2.

Fundamental valuation methods—through a deeper understanding of companies and their value drivers—are most suited to sustainability integration. This chapter shows how these methods can incorporate social and environmental factors, alongside financial factors, into equity valuation. Moreover, fundamental valuation

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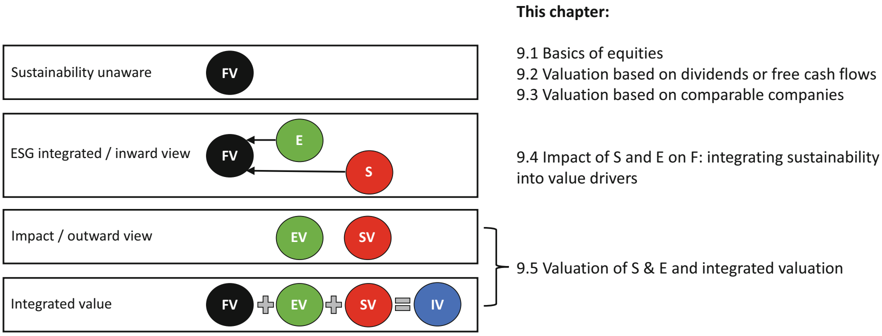

Fig. 9.1 Chapter overview

methods are at the core of valuing S and E in their own right, as discussed in Chap. 5. See Fig. 9.1 for a chapter overview.

Learning Objectives
After reading this chapter, you should be able to:

- Differentiate between absolute and relative equity valuation methods
- Perform an equity valuation using various methods
- Analyse how fundamental equity valuation brings a deeper understanding of companies and their value drivers
- Integrate social and environmental factors into equity valuation
- Critically assess alternative valuation methods

9.1 Basics of Equities

Stock markets have captured the imagination of the masses since the spectacular rise and fall of the South Sea Company in the 1720s and perhaps before. Global stock markets reached a market capitalisation of $106 trillion in 2021 (SIFMA, 2021), which is about 125% of global GDP. They perform the important societal function of steering equity finance to productive means. The emergence of the joint stock company has been a great innovation for spreading risk over a large number of shareholders with residual claims and limited liability. Until their emergence, investors could lose more capital than they had put in. The joint stock company lowered financial hurdles (such as liquidity) and helped in steering capital to productive means.

9.1.1 Types of Equity

Stock markets trade public equity, but equity can be private as well. In fact, most equity in most companies starts as private and remains private (see Chap. 10). Only larger companies scale up to become public, because only then the benefits of listing (in terms of risk sharing) start to outweigh the relatively high costs of listing (due to information disclosure requirements). In some ways, private equity investing is instructive for public equity investing. Precisely because private equity lacks standardised data, ratings, and daily pricing, it has not become the victim of benchmark thinking, and reducing companies and portfolios to a few market metrics. Private equity needs to do fundamental analysis of investee companies, which is a good starting point for integrating sustainability into equity valuation.

The way one invests in public equity can be classified as active versus passive investing. Passive investing refers to investments in indices or ETFs (Exchange-Traded Funds, which mimics an index), whereas active approaches tend to be either fundamental (i.e. based on analysis of financial statements, business models, etc.) or quant (i.e. based on factors in a model or algorithm). The attraction of passive investing is that it limits the costs of both trading and analysis. However, it also means there is a very limited scope for the societal allocation role of finance (French, 2008). In fact, as passive investing relies on efficient markets, it is dependent on the presence of sufficient fundamental and quant investors to keep markets efficient. Figure 9.2 provides a classification of public and private equities investing approaches.

Fundamental equity strategies are rooted in absolute valuation methods from corporate finance and are best suited for sustainability integration. Fundamental investors assess a company, which enables them to identify material sustainability issues and to estimate the impact on the company's valuation. Fundamental equity strategies are thus the ones with the most potential to integrate sustainability into company valuation. Traditional asset pricing theory has paid limited attention to fundamental equity investing, as it does not align with efficient markets and portfolio theory very well (see Chaps. 12 and 14) and is hard to capture in econometric analysis. That is unfortunate, since fundamental analysis of a

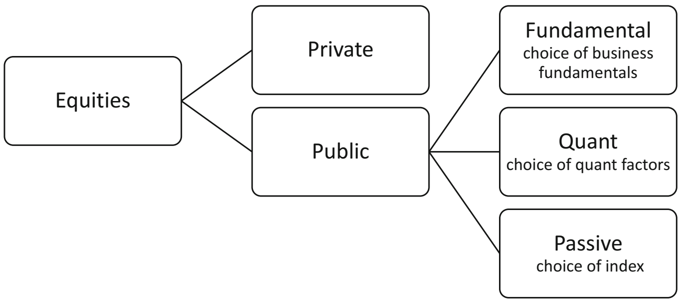

Fig. 9.2 Classification of equities investing

company (and its value drivers) is needed to assess the preparedness of companies for the transition to a more sustainable economy. The rise of machine learning can complement fundamental analysis, allowing for the upscaling of fundamental analysis.

9.1.2 Types of Stock Markets

A distinction can be made between primary and secondary stock markets. In the *primary market*, new issues of a stock are sold to investors. In a *secondary market*, equities that have been previously issued are traded. When issuing public equity, a firm may obtain a listing on a stock exchange for the first time, the *initial public offering* (IPO). If a firm is already listed and issues additional shares, this is called *seasoned equity offering* (SEO) or *secondary public offering* (SPO).

There are various motives for IPOs. One of the main reasons, of course, is to obtain funds to finance investment. Moreover, the listing of a firm's shares on a stock exchange increases its financial autonomy, as the firm becomes less dependent on a single financial provider (like a bank). Further, by issuing equity the firm's owners can diversify their investment risk by selling stakes in the company in a liquid market. Another advantage of public issuance is increased recognition of the company name. In addition, from the moment of the IPO, investors receive better information due to improved transparency and the disclosure requirements that are part of the listing conditions. At the same time, the price of a company's stock acts as a measure of the company's value and as a disciplining mechanism for managers.

However, there are a number of inherent disadvantages for a company in listing its shares on a stock exchange. To start with, equity issuance is an expensive procedure, incurring costs such as underwriters' commission, legal fees, and other charges resulting primarily from the need to satisfy the additional disclosure requirements. From the perspective of investors, going public implies that the ownership of the company is likely to be shared more widely, resulting in a larger gap between external investors and managers. This separation of ownership and control could cause agency problems, where company insiders hold more accurate information on the prospects of the firm than external equity investors, resulting in a divergence of interests between managers and outside investors (see Chap. 3). Lastly, by going public, a company exposes itself to the scrutiny of shareholders, who may be focused too much on short-term results.

9.1.3 Equity Valuation and Its Drivers

There are several methods for determining (or better, estimating) the value of equity. One can distinguish two types of valuation methods:

- Absolute valuation methods and
- Relative valuation methods

Absolute valuation methods are based on the company's cash flows. These cash flows are forecasted and then discounted at the company's discount rate. The dividend-discount model is a basic model that discounts future dividends. An important factor is the expected growth rate of dividends. The discounted cash flow model is more elaborate. It estimates the free cash flows available to equity and bondholders. The equity valuation can be split into three value drivers:

- **Sales**, which can be composed into volumes and price;
- **Margins**, which can be analysed by type of costs and before or after depreciation, taxes, and interest paid; and
- **Capital**, which can be split into the cost of capital (discount rate) and the uses of capital (capex, working capital).

Relative valuation methods derive a company's value from the value of comparable companies. The idea is to find 'identical' companies, which in practice is very difficult, so more or less comparable companies are used. A frequently applied metric is the price-earnings (P/E) ratio, which is the stock prices divided by the earnings. You then multiply your company's earnings with the P/E ratio of comparable companies. Relative valuation methods are typically used for market transactions (e.g. M&A), as the value is derived from prevailing market prices.

9.1.4 Connecting Equity and Debt Valuation

We can link debt valuation in Chap. 8 and equity valuation in this chapter. To do so, we introduce the concept of enterprise value V_0, which is the total value of the company:

$$\text{Enterprise value}: \quad V_0 = Equity_0 + Debt_0 - Cash_0 \tag{9.1}$$

The enterprise value is the market value of the company's underlying business before financing by equity and debt, and separate from any cash. It provides a comprehensive overview of the company's business activities, which helps to focus on a company's long-term value, as discussed in Chap. 2. Which activities contribute to the company's future value and which activities may have a negative impact on the company's future value? This holistic approach can aid the company in its strategy-setting.

9.2 Valuation Based on Dividends or Free Cash Flows

This section discusses two absolute equity valuation methods: the dividend-discount model and the discounted cash flow model. The second method is at the heart of fundamental equity valuation.

9.2.1 The Dividend-Discount Model

The dividend-discount model looks at cash flows to equity investors. A first cash flow is the dividend that an investor receives. A second cash flow is the cash received when selling the stock at some future date. Taking the perspective of a 1-year investor, we get the following equation for today stock price P_0:

$$\text{Stock price}: \quad P_0 = \frac{Div_1 + P_1}{1 + r_E} \tag{9.2}$$

Today, stock price P_0 is the net present value of the dividends received during the year Div_1 and the stock price at the end of the year P_1. These cash flows are discounted at the cost of equity r_E, which is the expected return of other investments available in the market with similar risks. We can rewrite Eq. (9.2) as follows:

$$\begin{aligned} \text{Total return}: \quad r_E = \frac{Div_1 + P_1}{P_0} - 1 \quad &= \frac{Div_1}{P_0} + \frac{P_1 - P_0}{P_0} \\ &= \text{dividend yield} + \text{capital gain} \end{aligned} \tag{9.3}$$

The total return of the stock for the equity investor can thus be split in the stock's dividend yield and the stock's capital gain. Example 9.1 shows how the stock price and return of a company can be calculated.

Example 9.1: Calculating Stock Price and Return

Problem

We assume that Unilever, a global consumer goods company, will pay dividends of €1.40 per share and trade at €46 per share at the end of the year. If the cost of equity is 7%, what would you be prepared to pay for Unilever today? What dividend yield and capital gain are expected?

Solution

Using Eq. (9.2), we can calculate today's stock price:

$$P_0 = \frac{Div_1 + P_1}{1 + r_E} = \frac{1.40 + 46.00}{1.07} = €44.30$$

So, today's stock price would be €44.30. The dividend yield is $\frac{Div_1}{P_0} = \frac{1.40}{44.30} = 3.2\%$ and the capital gain is $\frac{P_1 - P_0}{P_0} = \frac{46.00 - 44.30}{44.30} = 3.8\%$. The dividend yield and the capital gain add up to the total return: 3.2% + 3.8% = 7.0%, which is equal to the cost of equity. ◄

Up till now we use 1 year's dividend and the stock price at the end of the year (at which you can sell the stock in the market) to calculate today's stock price. Instead of referring to future stock prices, we can expand the dividend-discount model to a multiyear perspective:

$$P_0 = \frac{Div_1}{(1 + r_E)} + \frac{Div_2}{(1 + r_E)^2} + \frac{Div_3}{(1 + r_E)^3} + \ldots = \sum\nolimits_{n=1}^{\infty} \frac{Div_n}{(1 + r_E)^n} \tag{9.4}$$

So, the stock price is equal to the present value of the expected dividends. As the company develops, its earnings and dividends are expected to grow. Assuming a constant dividend growth g, we get the following:

$$\begin{aligned} P_0 &= \frac{Div_1}{(1 + r_E)} + \frac{Div_1 \cdot (1 + g)}{(1 + r_E)^2} + \frac{Div_1 \cdot (1 + g)^2}{(1 + r_E)^3} + \ldots \\ &= \sum\nolimits_{n=1}^{\infty} \frac{Div_1 \cdot (1 + g)^{n-1}}{(1 + r_E)^n} \end{aligned} \tag{9.5}$$

We can now use Eq. (4.6) from Chap. 4 for valuing a perpetuity. This is the present value of a continuous stream of constant cash flows: $PV = \frac{CF}{r}$. In this case, we have growing dividends (instead of constant dividends). The equation is then as follows:

$$P_0 = \frac{Div_1}{r_E - g} \tag{9.6}$$

This is the famous constant dividend growth model. Dividends cannot keep on growing beyond the discount rate forever, as this would imply an infinite stock price (i.e. value) of the company. So, this formula requires that the constant growth rate of dividend is below the discount rate. Example 9.2 shows how we can value a company with constant dividend growth.

Example 9.2: Valuing a Company with Constant Dividend Growth

Problem

E.ON is a European electric utility provider based in Essen, Germany. E.ON pays 40 euro cents (€.40) in dividend. The cost of equity is 6% and dividends are expected to grow with 2%. What is E.ON's stock price?

Solution

Using Eq. (9.6), we can calculate today's stock price:

$$P_0 = \frac{Div_1}{r_E - g} = \frac{0.40}{0.06 - 0.02} = €10.00$$

So, today's stock price would be estimated at €10.00. ◄

Dividend has to come out of a company's earnings. The actual dividend depends on the payout ratio:

$$\begin{aligned} Div_t &= \frac{\text{Earnings}_t}{\text{Shares outstanding}_t} \times \text{dividend payout ratio}_t \\ &= EPS_t \times \text{dividend payout ratio}_t \end{aligned} \tag{9.7}$$

The earnings per share *EPS* is the company's earnings divided by the number of outstanding shares. The dividend is thus the *EPS* multiplied by the payout ratio, which is defined as payouts divided by earnings or net income (see Chap. 16). Equation (9.7) shows that dividends are ultimately based on a company's earnings. So, there is natural limit to dividend growth, as the underlying earnings matter. Next, there are dangers in constant growth formulas. As circumstances change, the growth of dividends (and underlying earnings) will change. High-growth companies, for example, are not likely to keep these growth rates forever. This is the fallacy of extrapolating current numbers, without thinking about whether these numbers can be sustained in the future.

An update of the original dividend growth model includes share repurchases. Companies complement dividend payouts with share repurchases, because share repurchases are exempt from dividend tax. Share repurchases are therefore a more tax-efficient way of rewarding shareholders. The economic effect is the same. This is because shareholders are still entitled to future earnings, which are now assigned to the remaining shares (the originally outstanding shares minus the repurchased shares), so that each shareholder's claim on future earnings remains the same. The total payout model includes both dividends and share repurchases:

$$P_0 = \frac{PV\ (\text{total dividends and share repurchases})}{\text{Shares outstanding}_0} \tag{9.8}$$

Multiplying both sides by the number of shares outstanding provides the company's equity value:

$$Equity_0 = PV\ (\text{total dividends and share repurchases}) \tag{9.9}$$

So, the equity value is the present value of total dividends and share repurchases.

9.2.2 The Discounted Cash Flow Model

Another absolute valuation method is the Discounted Cash Flow (DCF) model. It goes several steps further than the Dividend-Discount Model, which only estimates the resulting cash flows from the business operations paid as dividends to shareholders. The Dividend-Discount model thus measures the company's equity value. The DCF model values a company's assets on the basis of their discounted future cash flows. It covers the enterprise value, which is the sum of a company's equity and debt (see Eq. 9.1).

To value the enterprise, we start with estimating the free cash flows that the company has available for all investors: equity and debt holders. Company cash flows can be estimated in the same way as project cash flows in Chap. 7. The starting point is the earnings before interest and taxes *EBIT*. The company has to pay corporate tax τ on these earnings. These items are based on accounting. The next step to arrive at cash flows is to deduct net investment and increases in net working capital *NWC* (see Chap. 7 for a definition of *NWC*). Net investment and increases in *NWC* support the company's future operations and growth. A company's net investment is defined as the company's capital expenditures *CAPEX* minus depreciation:

$$\text{Net investment} = CAPEX\text{–depreciation} \tag{9.10}$$

The free cash flow *FCF* of the company is then calculated as follows:

$$\begin{aligned} FCF \quad &= EBIT \times (1 - \text{tax rate}) - \text{net investment} - \text{increases in } NWC \\ &= EBIT \times (1 - \tau) - CAPEX + \text{depreciation} - \text{increases in } NWC \end{aligned} \tag{9.11}$$

FCF is the cash flow left to be distributed to financiers after all positive *NPV* investments have been done. It is calculated as cash from operations minus cash into investments. It is important to use *FCF* rather than earnings which is much more easily manipulated, as is visible in accruals. Accruals are differences between net earnings and operational cash flow, driven, for example, by revenues or expenses that have been earned or incurred (in other words 'accrued' to the accounts), but cash related to the transactions has not yet changed hands. Another factor which can be manipulated is depreciation. A company can increase depreciation to reduce (taxable) profits or decrease depreciation to show higher book profits to investors. In that way, companies can smooth profits over time, which is also referred to as 'cooking the books'. Cash flow statements can overcome these accounting gimmicks. Deprecation is, for example, deducted as a cost item in *EBIT*, but subsequently added to *CAPEX* to derive net investment. Depreciation is thus eliminated from the cash flow analysis.

The free cash flow *FCF* can be discounted to obtain the enterprise or company value V_0 at $t = 0$:

$$V_0 = \frac{FCF_1}{(1 + WACC)} + \frac{FCF_2}{(1 + WACC)^2} + \ldots + \frac{FCF_N + TV_N}{(1 + WACC)^N} \tag{9.12}$$

where *WACC* represents the weighted average cost of capital and TV_N the terminal value at $t = N$, which may in turn be valued with a *DCF* (see below Eq. 9.14). Note that V_0 in the *DCF* formula is the enterprise value of the company to all financiers, i.e. the value of debt and equity together. Equity holders are residual claimholders, who receive income only after the debt holders have been paid. In effect, equity is a call option on the company (Merton, 1974; see Chap. 19 on options).

WACC is the weighted average cost of capital, which is the rate of return demanded by the company's financiers (of both equity and debt) and is derived from the expected return on an asset with similar risk (see Chap. 13 on *WACC*).

In the case of a constant growth g of the company's FCF from $t = 0$, we can simplify Eq. (9.12). Just like in the dividend-discount model (Eq. 9.6), the value V_0 of the constant stream of growing free cash flows can be summarised as follows:

$$V_0 = \frac{FCF_1}{WACC - g} \tag{9.13}$$

In a similar way, we can calculate the terminal value TV_N in Eq. (9.12) as follows:

$$TV_N = \frac{FCF_{N+1}}{WACC - g} \tag{9.14}$$

A constant growth rate of the company's cash flows FCF is a simplifying assumption. A DCF valuation crucially relies on assumptions to be made on future FCF and on the cost of capital $WACC$, as well as on their elements. This opens the door to a behavioural problem, because analysts often simply extrapolate recent historical numbers or short-term forecasts into infinity (while the company is exposed to internal and external changes which impact it).

The DCF example in Table 9.1 illustrates how that works. The top part lists the inputs (e.g. a sales growth of 6 per cent until 2030, a long-term sales growth of 2%, and an $EBIT$ margin of 11–12%) and the components (sales, $EBIT$, and taxes) to calculate the FCF. The note at Table 9.1 explains the abbreviations. First, taxes are deducted from $EBIT$ to obtain the net operation profit less adjusted taxes ($NOPLAT$). Next, depreciation is added (no cash outflow) and investment in the form of $CAPEX$ and NWC is deducted (cash outflow) to obtain the FCF. The rows represent the years: the shaded area from 2023 to 2031 are the assumptions made by the analyst to arrive at the forecasted cash flows (all other data in Table 9.1 is given or calculated). The middle part contains the discount factor (based on a $WACC$ of 8%) to discount the FCF to the present value.

The enterprise value V_0 is the sum of the present values of the free cash flows from 2023 to 2030 and the terminal value. Next, net debt is deducted and cash added to obtain the equity value (Eq. 9.1). Dividing the equity value by the number of shares outstanding provides the stock price:

$$P_0 = \frac{V_0 - Debt_0 + Cash_0}{\text{Shares outstanding}_0} = \frac{Equity_0}{\text{Shares outstanding}_0} \tag{9.15}$$

Finally, the bottom part outlines the capital side: net working capital NWC, invested capital, and return on invested capital ($ROIC$). The invested capital is net investment (from Eq. 9.10) and NWC. The return on invested capital is the net operation profit less taxes divided by invested capital:

$$ROIC = \frac{\text{Return}}{\text{Invested capital}} = \frac{NOPLAT}{CAPEX - \text{depreciation} + NWC} \tag{9.16}$$

Some argue that short-termism is not an issue, as stocks incorporate more than a decade of cash flows in their pricing. That is true, but cash flow forecasts can be a mere extrapolation of the short term—not reflecting change or the relevance of

Table 9.1 DCF valuation with the value drivers—analyst extrapolation

	WACC	8%		TV growth	2%								
	FY2019	**FY 2020**	**FY 2021**	**FY 2022**	**2023e**	**2024e**	**2025e**	**2026e**	**2027e**	**2028e**	**2029e**	**2030e**	**2031e**
Sales growth	6%	11%	6%	7%	6%	6%	6%	6%	6%	6%	6%	6%	2
EBIT margin	11%	12%	12%	12%	12%	12%	12%	12%	12%	12%	12%	12%	12%
Tax rate	20%	21%	30%	29%	28%	28%	28%	28%	28%	28%	28%	28%	28%
Depreciation/sales	6%	5%	5%	5%	5%	5%	5%	5%	5%	5%	5%	5%	5%
CAPEX/sales	6%	6%	6%	6%	6%	6%	6%	6%	6%	6%	6%	6%	5%
NWC/sales	9%	9%	9%	8%	8%	8%	8%	8%	8%	8%	8%	8%	8%
Sales	6233	6910	7348	7856	8327	8827	9357	9918	10513	11144	11813	12521	12772
EBIT	691	807	906	937	993	1053	1116	1183	1254	1329	1409	1493	1523
Taxes on EBIT	138	172	276	269	278	295	312	331	351	372	394	418	427
NOPLAT	553	635	630	668	715	758	804	852	903	957	1014	1075	1097
Depreciation	361	377	352	405	416	441	468	496	526	557	591	626	639
Gross CF	914	1012	982	1073	1131	1199	1271	1348	1428	1514	1605	1701	1735
CAPEX	399	430	458	472	500	530	561	595	631	669	709	751	639
increase in NWC	37	33	32	28	40	42	44	47	50	53	56	59	21
Gross investment	436	463	490	500	539	572	606	642	681	722	765	811	660
FCF	478	549	492	573	592	628	666	705	748	793	840	891	1076
				Terminal Value (TV)									17930
				period, in years	1	2	3	4	5	6	7	8	
				Discount Factor	0.926	0.858	0.794	0.735	0.681	0.630	0.583	0.540	0.540
				Present Value	549	538	528	519	509	499	490	481	9685
				Sum of Present Values: Enterprise Value (V)	13798							TV/V	70%
				Net debt	1328								
				Equity value	**12470**								
				Number of shares outstanding	213								
				Stock price	58.5								
				Current stock price	60.2								
				Implied upside	-3%								
Net Working Capital (NWC)	566	599	631	659	699	740	785	832	882	935	991	1050	1071
Invested Capital	3982	4068	4206	4301	4424	4554	4692	4838	4993	5158	5332	5517	5538
ROIC	14%	16%	15%	16%	17%	17%	18%	18%	19%	19%	20%	20%	20%

Notes: FY2019–FY2022 relate to the historical financial performance of the company. 2023e–2031e are projections of future financial performance, made by the analyst. WACC is the weighted average cost of capital, the rate at which the company's cash flows are discounted. TV growth is the assumed growth rate after the explicit forecast period, where TV is the terminal or continuing value. EBIT is earnings before interest and taxes, also known as operating profit. CAPEX is the capital expenditure made by the company. NWC is net working capital, i.e. short-term liquid assets minus short-term finance. NOPLAT is net operating profit less adjusted taxes. Gross CF is the cash flow before investment. FCF is the free cash flow to the company. ROIC is return on invested capital sustainability. Multiples (relative) valuation in Sect. 9.3 faces this problem as well, and to an even larger extent, as it implicitly makes the same assumptions while giving the analyst a false sense of being objective.

In a *DCF* valuation, one can make explicit assumptions and choose to be very clear on which point one disagrees with the market. In a *DCF* valuation of the same company as in Table 9.1, an analyst uses, for example, exactly the same assumptions with one crucial difference: since they have a stronger belief in the company's competitive position, their margin assumptions are 4% higher (an *EBIT* margin of 16 instead of 12%), resulting in a 35% higher fair value of the stock.

The full DCF valuation model in Table 9.1 is the bread and butter of a seasoned equity analyst, but it is also quite elaborate. To provide more practice and the ability to develop a more intuitive understanding, we give a simpler valuation example. Example 9.3 calculates the value of Adidas' stock price at €301.2. Since the calculation of the value depends on several assumptions on sales, EBIT margins, investment needs, and cost of capital, Example 9.4 provides a sensitivity analysis of Adidas' stock valuation. The sensitivity analysis shows that 'under reasonable assumptions' the stock price can fluctuate from –24% (€227.6) to +28% (€385.5) in comparison with the midpoint estimate of €301.2.

Example 9.3: Valuing Adidas Using Free Cash Flow

Problem

Adidas, a German sportswear manufacturer, has sales of €19,844 million in 2020. We make the following assumptions. First, a sales growth of 9% until 2025 and a long-term sales growth of 3% (industry average). Next, the *EBIT* margin is expected to be 13% based on past margins and the effective tax rate is assumed to remain 26% in Germany. Finally, net investments and increases in *NWC* are, respectively, expected to be 4 and 8% of any increases in sales based on past investment needs. Adidas has €3597 million in excess cash, €2295 million in debt and 195 million shares outstanding. If the *WACC* is 7%, what is your estimate of the value of Adidas' stock price in early 2021?

Solution

Using Eq. (9.11), we can calculate Adidas' free cash flows based on the assumptions (in italics) as follows:

Year	2020	2021	2022	2023	2024	2025
Free cash flow forecast (€ millions)						
Sales	19,844.0	21,630.0	23,576.7	25,698.6	28,011.4	30,532.5
Growth versus previous year		*9%*	*9%*	*9%*	*9%*	*9%*
EBIT *(13% of sales)*		2811.9	3065.0	3340.8	3641.5	3969.2
Less: Income tax *(26% EBIT)*		–731.1	–796.9	–868.6	–946.8	–1032.0
NOPLAT		2080.8	2268.1	2472.2	2694.7	2937.2

(continued)

Year	2020	2021	2022	2023	2024	2025
Less: Net investment *(4% of increase in sales)*		71.4	77.9	84.9	92.5	100.8
Less: Increase in NWC *(8% of increase in sales)*		142.9	155.7	169.8	185.0	201.7
Free cash flow		1866.5	2034.5	2217.6	2417.2	2634.7

As we expect Adidas' free cash flow to grow at a constant rate of 3% after 2025, we use Eq. (9.14):

$$TV_N = \frac{FCF_{N+1}}{WACC - g} = \frac{FCF_N * (1+g)}{WACC - g} = \frac{2634.7 * 1.03}{0.07 - 0.03} = €67{,}843.5 \text{ million}$$

Next, the enterprise value can be calculated as the present value of the free cash flows and the terminal value using Eq. (9.12):

$$V_0 = \frac{1866.5}{1.07} + \frac{2034.5}{1.07^2} + \frac{2217.6}{1.07^3} + \frac{2417.2}{1.07^4} + \frac{2634.7 + 67843.5}{1.07^5}$$
$$= €57{,}425.6 \text{ million}$$

Using Eq. (9.15), we can calculate the fair value of Adidas's stock:

$$P_0 = \frac{V_0 - Debt_0 + Cash_0}{\text{Shares outstanding}_0} = \frac{57{,}425.6 - 2{,}295 + 3{,}597}{195} = €301.2$$

◀

Example 9.4: Sensitivity Analysis for Adidas' Stock Valuation

Problem

In Example 9.3, Adidas's sales growth rate was assumed to be 9% and the EBIT margin 13%. The valuation very much depends on these assumptions. What would Adidas' stock price be with sales growth of 8% until 2025? And what would the stock price be if, in addition, the EBIT margin is 12%?

Solution

The basis answer is that we can redo the calculation of Adidas' stock price with the new assumptions. The set-up of the calculation remains the same as in Example 9.3, only the inputs change. Luckily, that can quite easily be done in an Excel spreadsheet by changing the parameters for sales growth and EBIT margins.

Depending on the inputs, the stock valuation is as follows:

				Sales growth		
		7%	8%	9%	10%	11%
	11%	227.6	238.9	250.7	262.8	275.4
	12%	250.7	263.1	275.9	289.2	302.9
EBIT	13%	273.9	278.3	**301.2**	315.5	330.4
Margin	14%	297.1	311.5	326.4	341.9	357.9
	15%	320.2	335.7	351.7	368.3	385.5

At the time of analysis (Autumn 2021), Adidas' stock price was valued close to €301.2 based on 9% sales growth and 13% EBIT margin. A decrease of sales growth to 8% would give a stock price of €278.3. A reduction in EBIT margin to 12% in addition would yield a stock price of €263.1. This is a reduction in stock price of 13% compared to the previous assumptions of 9% sales growth and 13% EBIT margin. The table confirms that the stock valuation is very sensitive to the inputs—ranging from €227.6 (–24% based on 7% sales growth and 11% EBIT margin) to €385.5 (+28% based on 11% sales growth and 15% EBIT margin). ◀

9.2.3 Comparing Absolute Valuation Methods

We can compare the different absolute stock valuation methods. Table 9.2 summarises the various discounting methods with increasing information needs. The dividend-discount model estimates the dividend payments per share to derive a company's stock price. As share repurchases are becoming more important, the total payout model includes total dividends and share repurchases to calculate a company's equity value. These are relatively easy to establish.

The most cumbersome, but insightful method is applying the full discounted cash flow model to establish a company's enterprise value. One needs to estimate a company's free cash flows and then its weighted average cost of capital. As Table 9.1 shows, this is quite an exercise. The benefit is a fundamental valuation of the company. The discounted cash flow model is also the basis for calculating a company's integrated value in Sect. 9.5.

Table 9.2 Comparison of discounting models

Present value of . . .	Determines the . . .	Value
Dividend payments per share	Stock price	P_0
Total payouts (total dividends and share repurchases)	Equity value	$Equity_0$
Free cash flow (cash available to equity and debt holders)	Enterprise value	V_0

Source: Berk and DeMarzo (2020)

9.3 Valuation Based on Comparable Companies

Absolute or fundamental valuation methods are based on discounting a company's cash flows. By contrast, relative valuation methods derive a company's value from comparable companies, often in the same industry.

9.3.1 Equity Value Multiples

In the case of relative valuation, often called multiples valuation, a stock value P_0 (or more generally, an asset's value) is derived from the given (market) value of another comparable stock. For example, a fast moving consumer goods company like Unilever might be valued by taking its earnings per share EPS_0 and multiplying that number with the average price-earnings P/E ratio of its peer group:

$$P_0 = EPS_0 * \frac{P}{E} \tag{9.17}$$

So, in this method, when Unilever's EPS is €2.2 and its peers trade at a P/E of 24.0 at year-end 2021, then Unilever's fair stock value P is 24.0 × €2.2 = €52.8. Table 9.3 shows the average P/E of Unilever's direct peers from the consumer goods industry. Unilever's stock price is €46.8 at year-end 2021. So, Unilever's P/E ratio is slightly lower at 21.3 than the industry average at 24.0. Example 9.5 shows how Apple's stock price can be derived using the technology's industry's P/E ratio.

The P/E ratio can be used to derive a company's equity value by multiplying the stock value from Eq. (9.17) with the number of outstanding shares. The P/E ratio is thus an equity value multiple.

Forward P/E Ratio

A disadvantage of using the P/E ratio is that a company's current earnings can be distorted, because of exceptional circumstances related to the company (e.g. a reorganisation) or the economy (e.g. the covid-19 pandemic). A way to address that is by using forward earnings, which are the expected earnings over the next 12 months. Forward P/E ratios are more suitable for valuation purposes.

Table 9.3 Stock price, price-earnings (P/E), and market price-book (P/B) at year-end 2021

Company	Stock price	P/E	P/B	Comparable companies	P/E	P/B
Unilever	€46.8	21.3	6.8	Danone	16.9	2.1
				Kraft Heinz	20.0	0.9
				Procter & Gamble	29.7	8.7
				Nestlé	29.2	7.5
				Average	**24.0**	**4.8**

Price to Book Ratio

Another method using the stock price is the market price to book value ratio *P*/*B*. This ratio divides the market value by the book value of equity. Table 9.3 indicates that the *P*/*B* ratio of the consumers goods industry fluctuates from 0.9 for Kraft Heinz to 8.7 for Procter & Gamble. This wide fluctuation makes the price-book ratio very imprecise and thus less reliable for comparing company values. In practice, the price-earnings ratio is the most commonly used method for multiples valuation.

The problem with relative valuation is that it relies on fair valuation of the comparable assets, which in practice are not necessarily priced correctly. Another disadvantage is that it can be quite hard to find companies that are comparable, meaning that there are no perfect substitutes for a company. Each of its competitors is, for instance, active in different geographies, different segments and serves different customers, which may impact the *P*/*E* ratio. Moreover, companies may have different growth rates and EBIT margins.

Another problem is that industries can be overvalued. An example is the boom in Internet stocks in the late 1990s and early 2000s, before the Internet bubble burst. While multiples could justify the value of these companies in relation to each other, it was more difficult to justify the stock prices of these companies jointly (Berk & DeMarzo, 2020).

Example 9.5: Valuation Using the P/E Ratio

Problem

Suppose big tech company Apple has earnings per share of $5.8 at year-end 2021. The technology industry's price-earnings ratio is 27.7. What is Apple's stock price using multiples valuation? How does that compare to Apple's current stock price of $177.6 at year-end 2021?

Solution

Using Eq. (9.17) provides Apple's estimated stock price:

$$P_0 = EPS_0 * \frac{P}{E} = \$5.8 * 27.7 = \$160.8$$

So, the multiples valuation of $160.8 gives a lower stock price than the actual stock price of $177.6. Apple's *P*/*E* ratio is higher than the industry's average. This highlights that multiples valuation is an approximation. ◄

9.3.2 Enterprise Value Multiples

Companies differ also in leverage, making more leveraged companies riskier. That makes a precise comparison between companies difficult. To correct for leverage, multiples can be based on a company's enterprise value *V*. As enterprise value is the company's value before financing, the earnings should also be adapted to an earnings number before payment to financiers. A common earnings indicator is earnings before interest and taxes *EBIT*. In case one wants to correct for investments as well, earnings before interest, taxes, depreciation, and amortisation *EBITDA* can be used. The multiples formula for enterprise value V_0 is as follows:

$$V_0 = EBITDA_0 * \frac{V}{EBITDA} \tag{9.18}$$

Whereby V/EBITDA is the enterprise value multiple.

To get a company's stock price P_0, we need to deduct net debt from enterprise value to get a company's equity value and subsequently divide that by the number of shares outstanding (see Eq. 9.15).

9.4 Impact of S and E on F: Integrating Sustainability into Value Drivers

A high-level and pragmatic way to integrate sustainability into enterprise valuation is to adjust the value drivers on material sustainability issues. This gives a first-order approximation of the financial value (FV) consequences of sustainability. The value driver adjustment approach provides the inward perspective on sustainability and is financially driven (see Fig. 9.3, which is a reproduction of Fig. 2.6 from Chap. 2).

Section 9.5 takes the outward perspective on sustainability, estimating a company's social and environmental impact (SV and EV). Estimating the social and environmental value components is more elaborate and data-intensive. The calculation of the value components allows us to establish the company's integrated value in Sect. 9.5, which is a combination of financial value (FV), social value (SV), and environmental value (EV).

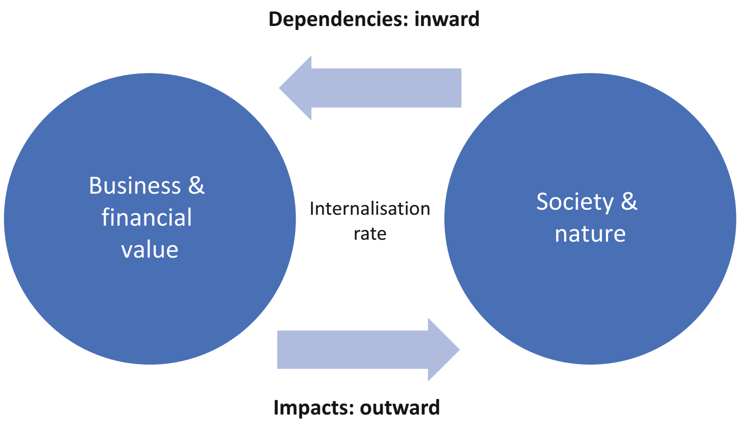

Fig. 9.3 The inward and outward perspective on company valuation

9.4.1 Value Driver Adjustment Approach

While academic corporate finance is very much concerned with risk and discount rates (see Chaps. 4 and 12), it tends to take a company's free cash flow as a given and it does not analyse where that free cash flow comes from. Fundamental equity valuation methods, like the DCF model in Sect. 9.2, analyse both cash flows and discount rates. Schramade (2016) introduces the Value Driver Adjustment (VDA) approach to integrate sustainability into the DCF model. The starting point is to split the enterprise valuation into value drivers (Koller et al., 2020):

- **Sales**, which can be composed into volumes and price
- **Margins**, which can be analysed by type of costs and before or after depreciation, taxes, and interest paid, and
- **Capital**, which can be split into the cost of capital (discount rate) and the uses of capital (capex, working capital)

While the first two value drivers (sales and margins) affect cash flows, only the third value driver (capital) affects the discount rate. Making these splits in value drivers can yield useful insights into how efficiently and successfully a company is run. Moreover, one can also analyse what is driving the value drivers. That is, what are the sources of competitive advantage that determine how fast a company grows and how profitable it can sell its goods and services (see Chap. 2). This is also where the link to sustainability comes in, as intangible assets on material social and environmental issues (such as intellectual capital, social capital, or environmental capital) tend to be the underlying value drivers.

Think of a mining company that has much lower costs than its peers because it is much better at managing local stakeholders (and hence experiences less delays and production losses) and has a better safety record (and more efficient production). Then consider a mining company that currently enjoys lower costs than its peers because it is ignoring lots of safety regulations and is paying its employees poorly, without pension or social security arrangements. That cost advantage is likely to be temporary and entails a high risk of costly disruptions, which should be factored into its cost of capital.

Applying the VDA approach, Schramade (2016) proposes a three-step approach to integrating sustainability into fundamental enterprise valuation:

1. Identify and focus on the most material issues
2. Analyse the impact of these material factors on the individual company
3. Quantify competitive advantages to adjust for value driver assumptions

Step 1: Identify and Focus on the Most Material Issues

Since material social and environmental factors, by definition, can have a substantial impact on business models and value drivers, analysts should take them into account in their valuation models. One needs a disciplined approach to identify material sustainability factors in the first place (see Chap. 5). Ideally, one does a materiality analysis of the industry (or has such analyses at one's disposal for all industries), plotting the likelihood of impact of a social or environmental issue against its likely size.

For a mining company for example, one could identify management of local stakeholders, environmental management, and operational health and safety as material issues. For a pharmaceutical company, the likely material issues are innovation management, human capital management, and product quality and safety. Then for a particular mining or pharmaceutical company, the importance of an issue can be more or less important than for the industry overall. For example, operational health and safety tends to be even more important for more manual types of mining (such as gold or platinum) than for more mechanised types of mining such as are typically found in iron ore mining.

Step 2: Analyse the Impact of These Material Factors on the Individual Company

After establishing the material social and environmental factors, the analyst draws up an assessment of the company's performance on these factors. Such analysis is not only done on an absolute basis, but also relative to peers, which is critical when establishing whether a company enjoys a competitive advantage (or disadvantage) in managing a given sustainability issue. For example, Novozymes' competitive edge in human capital and innovation management means that it is able to attract the best talent in enzymes (see Box 9.1). At the other side of the spectrum, Anglo American's weak management of local stakeholder relations results in serious local opposition to projects, operational mistakes, and long delays in project ramp-ups (see Box 9.2).

Step 3: Quantify Competitive Advantages to Adjust for Value Driver Assumptions

In the next step, the equity analyst makes deliberate, and often significant, adjustments to value drivers that are based on the sustainability-driven competitive advantages or disadvantages. These changes in value driver assumptions result in changes to the target price of the company's stock. To give a sense of magnitudes, if the analyst raises profit margins for all periods from 20 to 23% (that is, a 15% increase) to reflect the company's proficiency in managing a sustainability issue, the target stock price will likely also go up by 15%. In the case of Novozymes, the impact was much bigger, as its competitive edge in innovation and talent result in superior products that replace traditional chemicals—at double the margins and double the growth rate of the traditional chemicals industry (see Box 9.1).

Box 9.1: Novozymes: Competitive Advantage from Innovation

Novozymes is a Danish enzyme maker that replaces traditional chemicals with enzymes (proteins that act as catalysts) in, for example, washing powders, baking and agricultural products. Its enzymes provide better performance at

(continued)

Box 9.1 (continued)
lower temperatures and hence lower energy costs and lower emissions. As a result, the company is growing twice as fast and at double the profit margin compared to ordinary chemicals companies. Novozymes's growth and margins are driven by innovation, which depends in turn on human capital. Figure 9.4 illustrates the value drivers of Novozymes.

Box 9.2: Anglo American's Failure to Manage Local Stakeholders
Mining companies use a lot of capital to build and maintain mines that tend to be in operation for decades. All of that is wasted if the company loses its licence to operate due to environmental problems or unresolved local stakeholder conflict. Figure 9.5 shows the value drivers of a mining company.

South African mining company Anglo American has a long history of technical expertise and strong project execution. However, because the associated intangible human resources were neglected, many people left the firm, and much of its corporate memory was lost. The result was weak execution on projects. The Minas Rio iron ore project in Brazil turned out to be especially disastrous: originally planned to be built for around $2.5 billion, the project was delivered years over deadline and about $10 billion over budget. Local conditions were not sufficiently analysed and necessary environmental permits were not applied for. While Anglo had high scores with sustainability ratings agencies, and scored well on many immaterial issues, it failed spectacularly on its most material sustainability issues: local stakeholder management and environmental management.

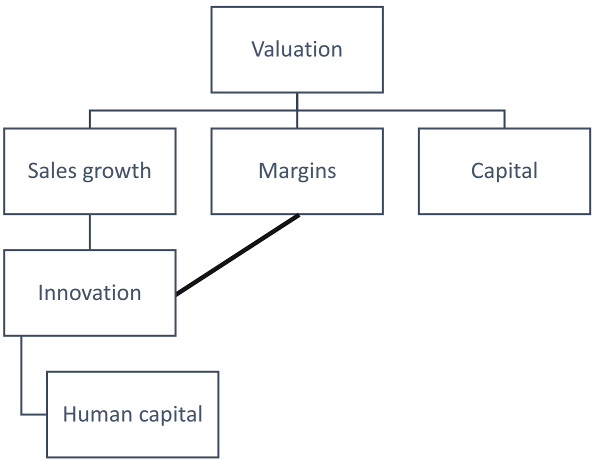

Fig. 9.4 Value drivers of Novozymes. Note: The scheme shows the value drivers in a bottom-up way

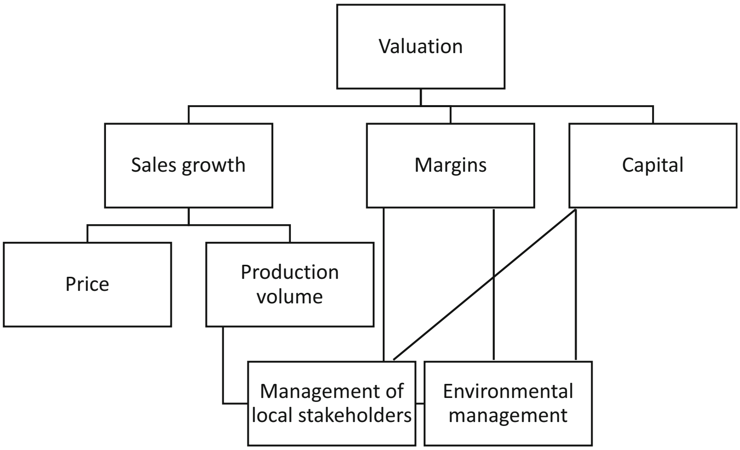

Fig. 9.5 Value drivers of a mining company. Note: The scheme shows the value drivers in a bottom-up way

The VDA approach is very practical. Box 9.3 provides a case study of a medtech company (based on a list of questions summarised in the Appendix to this chapter). The combined insights from sustainability analysis and traditional fundamental analysis allow one to make better financial valuations. Schramade (2017) argues that the impact can be substantial and reports valuation impacts ranging from –23% to +71% for a sample of 127 investment cases. Value driver adjustments can be made on any sustainability issue, but some are more frequent than others. Innovation, corporate governance, environmental management, and supply chain management are frequently used. The way value driver adjustments are made also differs: while value driver adjustments on innovation tend to be made to sales growth and margins (reflecting competitive position), the value driver adjustments on corporate governance are mostly about adjusting the cost of capital (reflecting risk).

Box 9.3: VDA Example

For a medical technology company, the three steps of the VDA approach are as follows (see the Appendix for the underlying questions):

1. **Identification of material issues** For the industry, the analyst identified the following issues as material: innovation management; human capital management; and energy efficiency & circular economy.
2. **Performance on material issues** The analyst assessed the medtech's key strengths to be in innovation management, human capital and capital management, while the others are too close to call.
3. **Make value driver adjustments** The analyst estimated that the medtech's strong focus on digital innovation puts the company ahead of the

(continued)

Box 9.3 (continued)

competition and could boost sales growth by 1% and that the medtech's innovation and circularity/energy savings could help drive the company's margins by as much as 2%. The net result of these effects is an increase in target price of 22% from 39.3 to €48.1.

Value driver	Sales growth	Margins	Cost of capital	Target price
Benchmark (performance excluding sustainability advantage)	4%	13%	8%	€39.3
Impact from sustainability factors	Innovation: +100 bps	Innovation and circularity/energy savings: +200 bps	No impact: 0 bps	€8.8 (22% higher value)
Total	5%	15%	8%	€48.1

The above illustrations of the VDA approach do not include a transition perspective. But the transition perspective can be included by building transition scenarios with distinctive value driver assumptions. Please see the Inditex case study in Chap. 11 (Sect. 11.3) for an illustration of how that works.

9.5 Valuation of S & E and Integrated Value

As stated in Chap. 8, the valuation of S and E is similar to the valuation of F at enterprise level. In this set-up, FV is enterprise value, which is the sum of equity and debt. S and E are valued separately and are a result of the company's operations. Integrated value is simply the sum of FV, EV, and SV—see Fig. 9.6.

For both SV and EV, the value calculation can be done in the three steps presented in Chap. 5:

1. Determine material S and E issues
2. Quantify the S and E issues in their own units *Q* and
3. Put a monetary value on those S and E units with shadow prices *SP*

See Chap. 5 for an elaboration of these three steps. The valuation is done in the DCF way as described in Sect. 9.2.3.

Figure 9.7 shows what the composition of integrated value, and in it the role of equity (assets minus debt), might look like for a company. In this hypothetical case, equity looks fine (35), because of limited leverage: debt (25) is not very high compared to assets (60). But the company looks vulnerable due to large negative

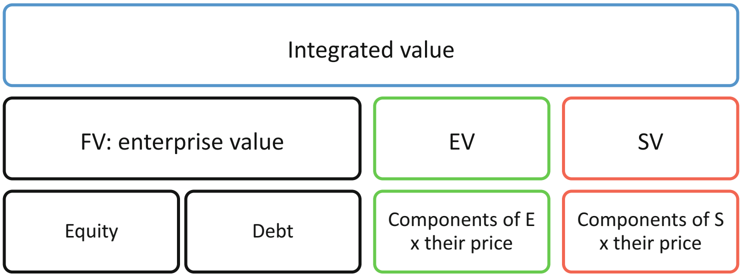

Fig. 9.6 The components of integrated value

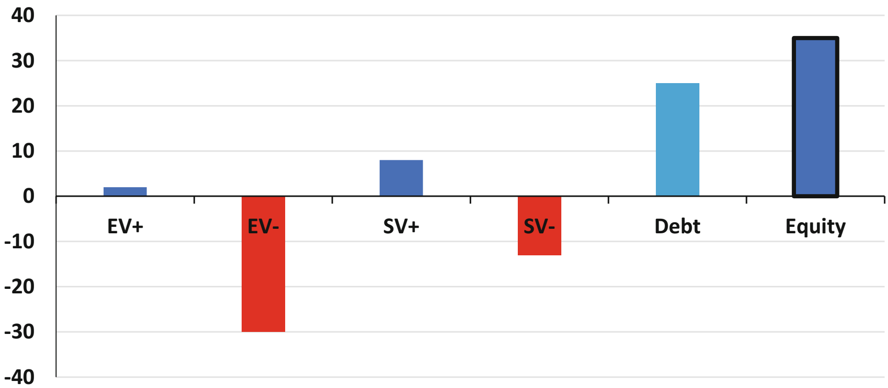

Fig. 9.7 The components of integrated value & share of equity for company X

values for S and especially E, which raise the risk of the company and its equity. These effects of leverage from E and S will be discussed further in Chap. 15 on capital structure.

In addition, you should be aware that these types of value can spill over into each other. The social and environmental value can be internalised (i.e. spillover) in the financial value, as shown in Chaps. 6 and 7. Chapter 11 provides an in-depth case study to show how the integrated value of a company can be calculated.

9.6 Conclusions

A company's enterprise value refers to the value of its business activities, which are financed by equity and debt. Chapter 8 already covered the methods to value and price bonds (debt). This chapter examines methods to derive the value of public equity (these are listed stocks; see Chap. 10 for private equity). These equity valuation methods either look at a company's 'fundamentals' or compare a company to a similar company, in order to obtain a company's value.

In the first case, absolute valuation models are fundamental methods to calculate value by discounting cash flows from business activities or discounting dividends which are paid from realised profits. The discounted cash flow model is well placed to integrate sustainability into valuation. By contrast, relative valuation models determine the value of one company in comparison with another company with similar characteristics. With a few market metrics, a company's value can then be derived.

Sustainability matters more to equity valuation than most equity investors realise. Material sustainability issues can make or break companies. As residual claimholders, equity investors bear most of the risk when companies fail and they also reap most benefits when companies succeed. Therefore, equity investors have strong incentives to help companies achieve the conditions for integrated value creation described in Chap. 2.

Fundamental valuation methods—through a deeper understanding of a company's value drivers—are most suited to sustainability integration. This chapter shows how these methods can incorporate social and environmental factors, alongside financial factors, into equity valuation.

Key Concepts Used in This Chapter

Absolute valuation is a valuation of an asset without reference to the valuation of other assets; absolute valuation methods are based on a company's cash flows

Accruals are adjustments for revenues earned and expenses incurred that are not yet recorded in the accounts

Discounted Cash Flow (DCF), also known as *Net Present Value* (NPV), is a method that values an asset or project by calculating cash flows and discounting them at a risk-adjusted discount rate

Enterprise value is the market value of the company's underlying business before financing by equity and debt and separate from any cash

ESG refers to environmental, social, and governance

ESG integration is the explicit integration of E, S, and G issues into the valuation and selection of securities

Exchange-Traded Funds (ETFs) are vehicles for passive investing

Fair value is an assessment of the value of an asset according to a (relative or absolute) valuation method, which may deviate from the asset's current price

Fundamental analysis is an approach to investing based on obtaining a good understanding of a company's business model and valuation

Materiality is the relevance of a certain issue to value creation

Multiples valuation is a type of relative valuation in which an asset's value is determined as a multiple of a financial statement metric such as profitability or book value

Net Present Value (NPV), also known as *Discounted Cash Flow* (DCF), is a method that values an asset or project by calculating cash flows and discounting them at a risk-adjusted discount rate

Passive investing is an approach to investing that buys widely diversified portfolios, often made up of entire market indices, and limits the amount of buying and selling, so as to steadily build wealth over time

Payout ratio is payouts (in the form of dividends and/or share buybacks) divided by earnings or net income

Private equity is the equity of privately held companies

Public equity is the equity of companies listed at a stock exchange, also called publicly listed companies

Quant investing is an investment approach that selects securities using advanced quantitative analysis

Relative valuation is a valuation of an asset with reference to the valuation of other assets; relative valuation methods derive a company's value from the value of comparable companies

Valuation is the process of arriving at a value estimate

Value drivers are the main components of valuation and its formula, namely sales growth, profit margins, cost of capital, and investment

Value Driver Adjustments (VDA) are the adjustments made to value driver assumptions in a valuation model, based on an assessment of the company's material ESG issues

Weighted Average Cost of Capital (WACC) is the minimum required return on a company's investments given its risk profile

Appendix: Case Study Template—How to Integrate Sustainability into Financial Valuation

This case study template allows you to do your own sustainability integration analysis for estimating a company's enterprise value using the Value Driver Adjustment (VDA) approach of Sect. 9.4. The list of questions in this case study has been made over the course of several years of doing sustainability integrated investment analysis. The questions have been structured as an assignment for the Sustainable Finance course taught at Rotterdam School of Management, Erasmus University, and can be found in *Principles of Sustainable Finance* (Schoenmaker and Schramade, Oxford University Press, 2019, Chapter 8).

The questions will deepen students' and practitioners' understanding of sustainability integration by having them apply sustainable finance insights to a real-life example—and ideally discuss with fellow students, teachers, or colleagues. The list contains a set of questions in six sections. Although the six sections address different issues, it should become evident during the analysis that they are related. To answer the questions, students have to rely on a company's reports (among other documents). Please make sure you read these documents with a critical mind; do not take all the company's messages at face value and look for independent sources. For the valuation questions, please include your Discounted Cash Flow calculation (see Sect. 9.2).

A.1 Business Model and Competitive Position

See Chap. 2 for a description of the business model and competitive position.

- How would you describe the company's business model?
- How strong do you rate the company's competitive position?
- What trends affect the company's business model and competitive position?

A.2 Value Drivers: Part 1

See Sect. 9.4 for the value drivers—sales growth, margins, and capital.

On sales growth:

- What seems to be a typical sales growth for the company? Please explain. Furthermore, what are the drivers of sales growth?

On margins:

- What seems to be a profit margin (EBIT or EBITDA) for the company? Please explain. In addition, what are the drivers of that margin?

On capital:

- How capital intense is the company? Please explain
- What do you think is the firm's cost of capital? Please explain

Valuation of company (based on enterprise value):

- What is the fair value (based on your DCF calculation) of the company?

Value driver	Assessment for next decade
Sales growth	
Margins	
Capital (WACC)	
DCF value	

A.3 Sustainability

See Chaps. 2 and 5 for the key sustainability concepts.

Purpose:

- What is the company's purpose/reason for being? In what way does the company create value for society? How does it get paid for that value creation?

Stakeholders:

- What are the company's main stakeholders? Please fill out the stakeholder impact tool below:

Material issue	Stakeholder 1	Stakeholder 2	Stakeholder n
Short-term goals			
Long-term goals			
How the company helps those goals			
How the company hurts those goals			

Externalities and impact:

- Does the company generate serious externalities? Are they positive or negative? How do you assess the chances of these externalities to be internalised?
- Which of the SDGs (if any) does the company help achieve? Which negative SDG exposures (if any) does the company have?
- To what extent can the company's impact be measured? Does the company report on its impact? How can its reporting be improved?

Material issues:

- What are the most material sustainability (S and E) factors? I.e. what issues are most critical to the success of the company's business model? Please fill out the below matrix, discussing for each of these most material S and E factors (1) how the company performs on it; (2) whether the company derives a competitive (dis)advantage from it; (3) how they might affect the value drivers

Material issue	Performance	Competitive edge?	Impact on value drivers?
Issue 1			
Issue 2			
Issue 3			
Issue 4			

A.4 Strategy and Reporting

See Chap. 2 for company strategy and Chap. 17 for sustainability reporting.

- How would you describe the strategy of the company?
- To what extent does that strategy take into account the company's most material sustainability issues? Please link to your answer in Sect. A.3.
- Is the strategy consistent with the company's purpose? Please explain.
- How do you assess the company's sustainability reporting?

A.5 Value Drivers: Part 2

Section 9.4 shows how the below VDA tables can be filled in for a company (e.g. Box 9.3).

- Given all of the above questions and your answers, how do you rate the effect of material sustainability issues on the value drivers going forward?
- For each value driver, please indicate whether you see a positive, negative, or neutral effect—and please explain why.

Value driver	Positive/negative/neutral	Explanation
Sales growth		
Margins		
Capital (WACC)		

- How would this affect your valuation of the company? Please provide the details of your DCF calculation excluding and including sustainability (S and E) (dis)advantages.

Value driver	Company excl. S and E (dis)advantages (in %)	Company incl. S and E (dis)advantages (in %)	Company (dis)advantage (in basis points)
Sales growth			
Margins			
Capital (WACC)			
DCF value			

A.6 Investment Conclusions

- In sum, how attractive do you find the company as an investment? Please explain and refer to your answers above.
- How would you compare the sum of your facts/findings with the overall impression you get of the company's transition preparedness?
- Suppose you were in the role of advisor to this company. Which strategies might the firm take to improve its transition preparedness? Which obstacles would you foresee in taking those steps?
- Would you say the company is part of the problem or part of the solution in the transition to a sustainable economy? Substantiate your answer.

Suggested Reading

Berk, J., & DeMarzo, P. (2020). *Corporate finance* (5th ed.). Pearson.

French, K. R. (2008). Presidential address: The cost of active investing. *Journal of Finance, 63*(4), 1537–1573.

Schramade, W. (2016). Bridging sustainability and finance: The value driver adjustment approach. *Journal of Applied Corporate Finance, 28*(2), 17–28.

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Koller, T., Goedhart, M., & Wessels, D. (2020). *Valuation: Measuring and managing the value of companies* (7th ed.). Wiley.

Merton, R. (1974). On the pricing of corporate debt: the risk structure of interest rates. *Journal of Finance, 29*(2), 449–470.

Schramade, W. (2016). Bridging sustainability and finance: The value driver adjustment approach. *Journal of Applied Corporate Finance, 28*(2), 17–28.

Schramade, W. (2017). Investing in the UN sustainable development goals: Opportunities for companies and investors. *Journal of Applied Corporate Finance, 29*(2), 87–99.

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Valuing Private Equity

10

Overview

Private equity funds are set up to invest in private companies for a predefined multiyear period. They aim to make a return by improving their investee companies' performance and exiting them at a profit. Private equity companies, i.e. the companies that run private equity funds, come in several types, with different goals and methods. Private equity performs an important role in funding and fostering companies that are as yet too small for the stock market and/or too risky for bank loans. Private equity as an asset class receives a growing allocation of pension fund money.

As in public equity, the relevance of environmental (E) and social (S) factors for financial value is growing in private equity. This is because of investor interest and as a result of E and S driving fundamentals. However, in the application of sustainability considerations, private equity falls behind the public equity space. The main difficulty lies in getting the right information for the investors in private equity funds, as many of these funds are still reluctant to systematically report on E and S—although this is improving. By nature, private equity is very well suited to sustainable investing since it is a fundamental form of investing with active ownership, multiyear investment horizons, and close consideration of the company's business model and circumstances.

Given the active ownership role that private equity takes, value creation by active investors on E and S is potentially greater in private equity than in public equity. This especially applies to early stage investments, such as venture capital. However, value creation on E and S is more likely if the private equity fund actually steers on impact, which only a small subset of private equity funds seems to do. In addition, private equity tends to shy away from activities that require fundamental research—that is left to governments, foundations, and large corporations.

The integrated view on private equity is again similar to the one on public equity, but with the added challenge of data and comparability. Ideally, pension funds can allocate to private equity not just on the basis of financial risk and return, but also on integrated risk and return. See Figure 10.1 for a chapter overview.

D. Schoenmaker, W. Schramade, *Corporate Finance for Long-Term Value*, Springer Texts in Business and Economics, https://doi.org/10.1007/978-3-031-35009-2_10

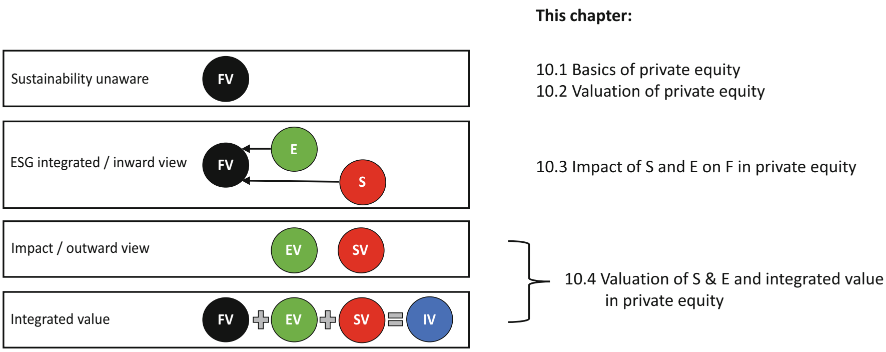

Fig. 10.1 Chapter overview

Learning Objectives

After reading this chapter, you should be able to:

- Explain the basics of private equity and how it differs from public equity
- Identify the challenges of data and comparability in private equity valuation
- Analyse the ways in which private equity may create and destroy value on E, F, and S

10.1 Basics of Private Equity

Private equity (henceforth: PE) funds invest in private companies by means of a non-traded equity stake for a multiyear period, with the aim to make a return by improving the investee companies' performance and exiting them at a profit.

Private equity comes in several forms. Most are of the formal type, which means that they have a fund structure that raises capital from other investors. Some are informal private equity, such as angel investors and families, who mainly invest their own money. The focus of this chapter is on formal private equity, rather than informal private equity. The formal types of PE are shown in Fig. 10.2.

Venture capital (VC) invests in early stage (start-up) companies. These typically have a great but unproven idea, carry high risk, and often have negative cash flows,

Fig. 10.2 Types of private equity

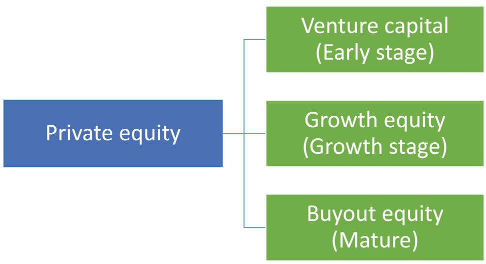

Table 10.1 Size of private equity market (end-2020).

Type of private equity	Outstanding (in billions of $)
Venture capital	1829
Growth equity	988
Buyout equity	2994
Other	484
Total private equity	**6295**

Source: McKinsey (2022)

i.e. high burn rate (which refers to the speed at which they run out of ('burn') their cash). Within VC, three substages are discerned: early-stage; mid-stage; and late-stage. VC companies can invest in all three stages or specialise in one or two of them.

VC involves high expected returns and high risks: about two-thirds of investments by VCs lose money, and half of those fail (Zeisberger et al., 2017). The high returns come from a limited number of 'home runs' that generate percentage returns in the hundreds or even thousands. To deal with such high levels of risk, VCs tend to demand internal rates of return (IRRs) of at least 20%, and sometimes over 100% in very early stage investments. Demanded IRRs fall as companies mature and their risk levels fall. Funding is done in stages: successful VC-backed companies are funded in several rounds of equity raisings, at typically higher subsequent valuations (and lower cost of capital), in which incumbent shareholders might be diluted.

Growth equity comes in at a more mature stage, sometimes just after the VC phase, where a company's business model works well, but has not yet succeeded in growing quickly. Growth equity aims to assist such a company in achieving that high growth and to reap the concomitant returns. Although the investment contract makes them influential, a minority stake does imply a lack of full control. That makes it important to maintain strong working relations and high levels of trust between the PE fund, existing owners, and company management.

Both venture capital and growth equity companies tend to take minority interests. That is different in the third type, buyouts. In buyouts, the PE company takes a majority stake, funded with equity and loans, to take control of the company and change its strategy and operations for higher performance. They typically use debt in leveraged buyouts (LBOs). The role of management differs per type of buyout deal. In MBOs (management buyouts) the incumbent management team takes over, helped by the PE company. In MBIs (management buy-ins), the PE company brings in an external management team.

Table 10.1 shows the size of the private equity market. Buyout equity is the largest segment with $2994 billion followed by venture capital with $1829 billion. The overall size of the private equity market of $6.3 trillion is far smaller than that of the public equity market of $105.8 trillion (see Table 8.1 in Chap. 8).

Fund Structure

The structure of PE funds is illustrated in Fig. 10.3. A PE company raises and advises a PE fund through two entities: (1) the General Partner (GP) and (2) the investment

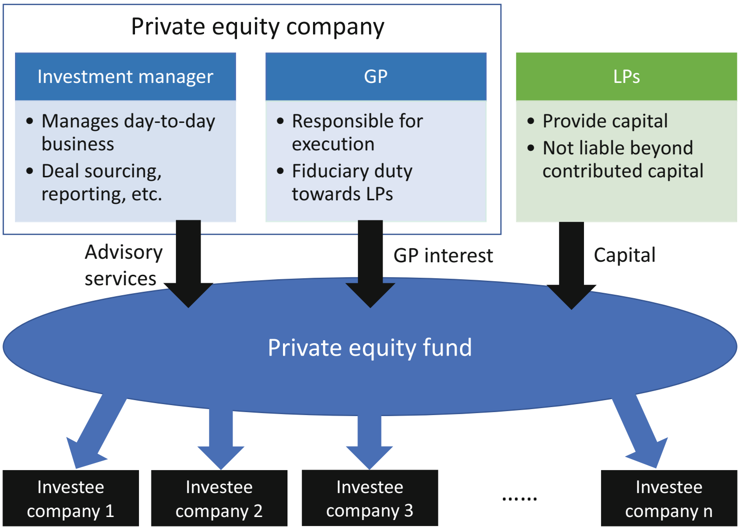

Fig. 10.3 Private equity fund structure. Source: Adapted from Zeisberger et al. (2017)

manager. The General Partner is responsible for managing the PE fund and has a fiduciary duty to act in the sole interest of the fund's investors. It issues capital and makes investments while respecting the Limited Partnership Agreement (LPA). The LPA sets out the mandate of the fund; and it may delegate some management functions to the investment manager of the PE company's investment committee. GPs have skin in the game with an equity stake of 1–10% of the fund.

The typical PE company is organised as a partnership or limited liability corporation (Kaplan & Strömberg, 2009). The larger PE companies, such as Blackstone, Carlyle and KKR, are mainly active in buyouts.

The investment manager executes the fund's daily operations: evaluating potential investments; doing the fund's reporting and auditing; and providing advisory services to investee companies. The limited partners (LPs) only take a financial role: they provide capital and pay fees to the PE company. Fees are typically paid in a '2 and 20' structure: a 1.5–2% management fee and 20% carried interest ('carry'), which is the percentage of profits paid to the GP, provided that the returns exceed the hurdle rate, which is typically 8%.

PE companies typically invest in 10–15 investee companies (to achieve a minimal degree of diversification) for 10 + 2 years. That is, the goal is to invest in and divest from all companies within 10 years, and pay back all capital, including returns, to the investors. The +2 means that there is allowance for two extra years to ensure exit from all portfolio companies.

From the LPs' perspective, the cash flows to and from a PE fund look like the J-curve in Fig. 10.4. The cash flow stream starts with cash outflows, and later on—if successful—cash inflows.

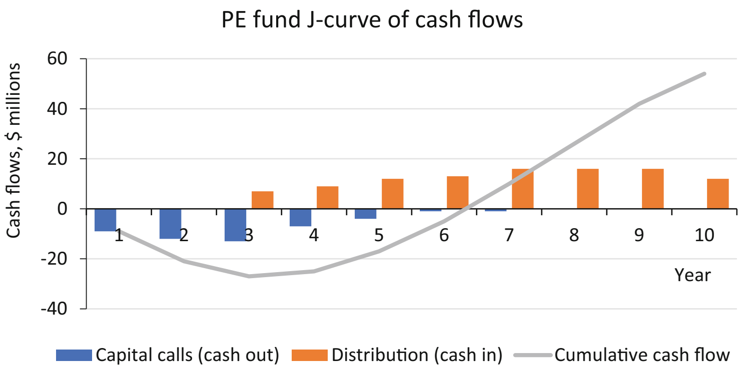

Fig. 10.4 Private equity J-curve. Source: Adapted from Zeisberger et al. (2017)

Such a cash flow stream is problematic for institutional investors acting as LPs, since they need to commit to capital calls that are hard to estimate in size and timing in advance, and which may result in liquidity problems.

The PE Investment Process

The PE investment process is summarised in Fig. 10.5. In the pre-deal phase, the PE company spends a lot of time and effort in finding and selecting prospective companies to invest in.

The pre-deal funnel is shown in Fig. 10.6. It starts with a large number of companies that are initially considered for investing, and which are filtered on several criteria (such as industrial sector, nature of the business model, competitive position, technology, size, etc.) to arrive at a small number of potential companies for which preliminary due diligence (DD) is done. Due diligence means that deeper research into the company's books is conducted. The PE company also engages external consultants for certain tasks in the DD process (e.g. Financial and Accounting DD, Tax DD, Commercial DD, ESG DD). The results of the preliminary DD are typically discussed in an investment committee review, in which a further selection is made. This subset is subjected to formal DD, which is an even more rigorous type of DD, after which the investment may or may not be made.

In their choice of targets, PE companies are guided by the need to achieve a minimum internal rate of return (IRR; see Chap. 6), unlike strategic buyers such as companies. Fidrmuc et al. (2012) find that in public to private deals, private equity

Fig. 10.5 Stages of the PE investment process

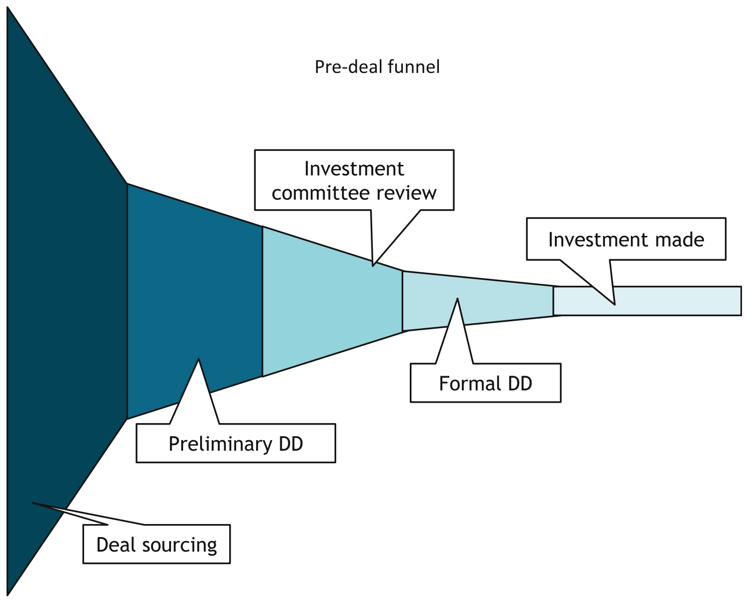

Fig. 10.6 PE pre-deal funnel

buyers pursue targets that have more tangible assets, lower market-to-book ratios, and lower research and development expenses relative to targets bought by strategic buyers. This is very different for VC though, where targets are selected based on very different criteria: mostly, on the skills of the entrepreneurial team. Practitioners stress that PE is a people's business: you need to trust the people you work with.

PE and Financial Performance

PE has a reputation for making companies more profitable, but to what extent is that reputation merited? Manigart et al. (2022) give an overview of the evidence and find that, after buyout, PE-backed companies experience higher growth than similar non-PE-backed companies, especially in the twenty-first century. More surprisingly, leveraged buyout (LBO) PE portfolio companies are found to enhance innovation (Amess et al., 2016). And LBO PE investors in the USA are associated with higher-quality patents that become more concentrated in important strategic domains (Lerner et al., 2011). Looking at LBOs, Kaplan and Strömberg (2009) distinguish three sources of value creation:

- **Financial engineering**: LBOs are often debt-financed, which increases leverage and thereby disciplines managers
- **Governance engineering**: PE companies control the boards of their investee companies; management at investee companies gets a larger stake in the company when it goes private, to align their interests with the company (see Chap. 3)
- **Operational engineering**: the ratio of operating income to sales increases, but the ratio of capital expenditures (investments) to sales declines at LBOs

Table 10.2 Exit of LBOs (1970–2007)

Type of exit	Percentage (1970–2007 period)
Sold to strategic buyer	38%
Secondary buyout	24%
IPO	14%
Other	24%
Total exits	**100%**

Source: Kaplan and Strömberg (2009)

For VC in Europe, Popov and Roosenboom (2012) also find a positive relation between PE activity and innovation. So, contrary to popular opinion, PE-backed companies grow faster and do more R&D.

Exits

There are several exit routes in PE LBOs. Table 10.2 provides an overview. The most common exit is the sale to a strategic (nonfinancial) buyer, which is typically another company. This occurs in 38% of the exits. The second most common exit is a trade sale to another PE fund in a secondary leveraged buyout (24%). IPOs, where the company is listed on the stock market and thus 'goes public', count for 14% of exits.

10.2 Valuation of Private Equity

Valuation of PE is similar to valuation of public equity (see Chap. 9). In both cases, the discounted cash flow (DCF) method is theoretically best, while multiples are a useful shortcut. However, valuing PE is harder for two reasons. First, especially in VC, it often concerns small companies that are not even profitable yet, which makes normalised projections harder. Second, there is no market price or beta for the target, and target prices and betas for comparable companies may be lacking as well.

Consider this fictitious example of a cultured meat producer, which develops a procedure for harvesting meat without animals. Initially, the company is focused on getting processes right: to make cultured meat not just as tasty as regular meat but also to get costs down sufficiently to make cultured meat competitive in terms of sales prices. Hence, the first few years see hardly any sales, significant costs, and hence a negative cash flow (see Table 10.3). From year 4 onwards, positive cash flows are projected, but they are much more uncertain than those of the typical public equity company. In such early stage companies, it can be all or nothing: if the producer does not succeed in getting its costs down, then sales won't take off, cash flows will never turn positive, and the company will shut down.

By now, you should be familiar with calculating the NPV (i.e. DCF) of a company (see Chaps. 4, 6, and 9). In addition to a WACC of 25%, we assume a growth of cash flows g of 2% after year 10. The terminal value TV of cash flows after year 10 can be calculated with Eq. (9.14) from Chap. 9: $TV_N = \frac{FCF_{N+1}}{WACC - g} = \frac{151}{25\% - 2\%} = 658$.

Table 10.3 VC NPV valuation, part 1

Perspective in year 1											
Year	1	2	3	4	5	6	7	8	9	10	TV
Sales	0	2	50	200	400	520	624	749	824	890	890
Costs	–15	–28	–53	–183	–340	–432	–505	–607	–667	–738	–738
Cash flow	–15	–26	–3	17	60	88	119	142	156	151	151
CF margin		–1300%	–6%	9%	15%	17%	19%	19%	19%	17%	17%
WACC	**25%**									TV	658
Discount factor	0.80	0.64	0.51	0.41	0.33	0.26	0.21	0.17	0.13	0.11	0.11
PV of cash flow	–12	–17	–2	7	20	23	25	24	21	16	71
NPV	**176**										

Often, in these very early stage fundings, convertible notes (i.e. bonds with a call option on the equity—see Chap. 19 for an explanation of how options work and are valued) are used to avoid having to rigorously value the companies at this stage. VC also tends not to invest in common stock, but in preferred stock with liquidation preference.

After this initial valuation, the numbers are updated as milestones are met (or not) and expectations change. The milestones are important for assessing and managing risk. For the abovementioned cultured meat producer, milestones may include reaching production cost levels; obtaining regulatory approval; and the launch of a production line at scale. The development of a reliable discounted cash flow model requires addressing many difficult questions (i.e. assumptions about if/when milestones can be reached) that have uncertain answers. Some of these questions may include: how much investment must be expended to complete technology development? Are any governmental approvals required? Will the technology be successfully scaled for manufacturing? How many units of the relevant products will be sold? How much revenue and profit will be earned? Will competitors be able to design around the technology, or are non-infringing alternatives available?

These milestones typically have date/time windows and (value driver) consequences attached to them. These too need to be defined. For example, reaching break-even level can trigger a lower cost of capital; and proof of concept can raise sales expectations.

In our example, two years after the initial valuation, expectations have been met exactly (not realistic, but easier to keep the numbers the same), and as a result, the NPV has tripled (from 176 to 456), basically for two reasons: (1) the time value of money; (2) due to the milestones being met, the WACC was lowered from 25 to 20% (see Table 10.4).

In reality, actual numbers will be lower or higher than the expected numbers for year 2 and 3, and the expectations for the following years will be updated accordingly. There are likely to be funding rounds in the meantime, moreover, which means that the shareholders' positions are diluted. For example, instead of owning 30% of the company, that might now be 20%, which means that the value of the stake hasn't tripled, but doubled. PE analysts will typically anticipate this dilution by modelling

Table 10.4 VC NPV valuation, part 2

Perspective in year 3											
Year	1	2	3	4	5	6	7	8	9	10	TV
Sales	0	2	50	200	400	520	624	749	824	890	890
Costs	–15	–28	–53	–183	–340	–432	–505	–607	–667	–738	–738
Cash flow	–15	–26	–3	17	60	88	119	142	156	151	151
CF margin		–1300%	–6%	9%	15%	17%	19%	19%	19%	17%	17%
WACC			**20%**							TV	840
Discount factor			0.83	0.69	0.58	0.48	0.40	0.33	0.28	0.23	0.23
PV of cash flow			–3	12	35	43	48	48	44	35	195
NPV			**456**								

the dilutive effect of funding rounds in their models. We will not show these here. To get familiar with PE valuation, we provide an exercise in Example 10.1.

Example 10.1: PE Valuation with Changing WACC in DCF

Problem

A start-up app developing company is expecting heavy investments and little revenue in its early years, as well as facing significant uncertainty leading to a high cost of capital. The company's expected sales and costs are shown in the table below. Assuming a WACC of 30% and cash flow growth rate of 2.5% after year 10, what is the company's NPV using the DCF method? And assuming the early milestones of the company are met, what is the NPV if the WACC changes to 20% in year 3?

Year	1	2	3	4	5	6	7	8	9	10
Sales	0	25	50	150	240	324	373	410	434	447
Costs	–60	–45	–58	–141	–209	–275	–309	–344	–369	–385

Solution

The calculation of the NPV of the company in year 1 with a 30% WACC is shown in the table below. The terminal value (TV) is calculated using Eq. (9.14): $TV_N = \frac{FCF_{N+1}}{WACC - g} = \frac{62}{30\% - 2.5\%} = 225$. The company value is only narrowly positive with an NPV of 5.3.

Perspective in year 1											
Year	1	2	3	4	5	6	7	8	9	10	TV
Sales	0	25	50	150	240	324	373	410	434	447	447
Costs	–60	–45	–58	–141	–209	–275	–309	–344	–369	–385	–60
Cash flow	–60	–20	–8	9	31	49	64	66	65	62	62
CF margin		–80%	–16%	6%	13%	15%	17%	16%	15%	14%	14%
WACC	**30%**									TV	225

(continued)

Perspective in year 1											
Discount factor	0.77	0.59	0.46	0.35	0.27	0.21	0.16	0.12	0.09	0.07	0.07
PV of cash flow	–46	–12	–4	3	8	10	10	8	6	4	16
NPV	**5.3**										

The calculation of the NPV of the company in year 3 with a 20% WACC is shown in the table below. The terminal value (TV) is again calculated using Eq. (9.14), but with the change in WACC: $TV = \frac{62}{20\% - 2.5\%} = 354$. Compared to year 1, the company value increased by nearly 200 in year 3, with an NPV of 203.9.

Perspective in year 3											
Year	1	2	3	4	5	6	7	8	9	10	TV
Sales	0	25	50	150	240	324	373	410	434	447	447
Costs	–60	–45	–58	–141	–209	–275	–309	–344	–369	–385	–60
Cash flow	–60	–20	–8	9	31	49	64	66	65	62	62
CF margin		–80%	–16%	6%	13%	15%	17%	16%	15%	14%	14%
WACC			**20%**							TV	354
Discount factor			0.83	0.69	0.58	0.48	0.40	0.33	0.28	0.23	0.23
PV of cash flow			–7	6	18	24	26	22	18	14	82
NPV			**203.9**								

◀

Valuation Using Multiples

An alternative to DCF is valuation by means of multiples. In the case of a multiples valuation, a company's value is determined as a multiple of a financial statement metric such as profitability or book value. The multiple is then based on the average multiple of its peer group (i.e. comparable companies in the same industry). In the example below, the enterprise value (EPV) is calculated as a multiple of earnings before interest, taxes, depreciation, and amortisation (EBITDA).

Table 10.5 illustrates how that works for a buyout situation. In this case, the PE company buys the investee company in 2023 for 600 in equity, with a net debt load of 730. It expects a rise in EPV from 1330 to 1980 by means of improvements in both profitability (EBITDA going from 160 to 210) and the valuation of that profitability (i.e. the EPV/EBITDA multiple to rise from 8.3 to 9.4). Meanwhile, 350 of the 730 in Net Debt is paid back, leaving 380 in 2028. As a result, the equity value rises from 600 to 1600. See Table 10.5 for the calculations and the forecasted numbers for 2028—labelled 2028E (E from estimate).

The financial value creation leads to an increase in equity of 1000. We check that in Table 10.6. The changes in EBITDA and in the EPV/EBITDA multiple give an increase of 650, which is equal to the increase in Enterprise Value in Table 10.5. The

Table 10.5 Buyout valuation using multiples

	2023	2028E	Change
Net debt	730	380	–350
Equity	600	1600	1000
Enterprise Value (EPV)	1330	1980	650
EBITDA	160	210	50
EPV/EBITDA multiple	8.3	9.4	1.1
Net debt/EBITDA	4.6	1.8	–2.8

Source: Adapted from Zeisberger et al. (2017)

Table 10.6 Financial value creation in a buyout using multiples

Value drivers	Change	Calculation	Explanation
Net debt impact	350		Net debt reduction
EBITDA impact	416	50*8.3	Change in EBITDA * original multiple
Multiple impact	234	1.1*210	Multiple expansion * new EBITDA
Value creation	**1000**		
Check: rise in equity	**1000**		

Source: Adapted from Zeisberger et al. (2017)

repayment of debt leads to an extra increase of equity of 350. Example 10.2 provides an exercise on PE valuation with multiples.

Example 10.2: PE Valuation with Multiples

Problem

An app developing company is expecting changes in its capital structure and profitability. Currently, the company's enterprise value (EPV) is 350, with a net debt load of 100, 250 in equity, and EBITDA of 50. In the coming year, debt is going to be increased by 25, EBITDA is expected to increase by 15, and the EPV/EBITDA multiple is expected to decrease by 0.5. What is the effect of these changes on the company's enterprise value and equity? What is the impact on this change in terms of EBITDA and multiples?

Solution

The current values, changes, and new values are illustrated in the table below.

	Current	Change	New	Calculation
EBITDA	50	+15	65	
EPV/EBITDA multiple	7.0	–0.5	6.5	
Enterprise Value (EPV)	350	+72.5	422.5	65*6.5 = 422.5
Net debt	100	+25	125	
Equity	250	+47.5	297.5	422.5 – 125 = 297.5

The table shows that the changes result in an increase in enterprise value of 72.5 and an increase in equity of 47.5. This is checked in the table below by measuring the impact from EBITDA and the EPV/EBITDA multiple. All of the positive impact on equity is derived from the increase in EBITDA, whereas the increase in debt and decrease in EPV/EBITDA multiple result in a negative impact on equity.

Value drivers	Change	Calculation	Explanation
Net debt impact	–25		Net debt increase
EBITDA impact	105	15*7.0	Change in EBITDA * original multiple
Multiple impact	–32.5	–0.5*65	Multiple expansion * new EBITDA
Value creation	**47.5**		
Check: rise in equity	**47.5**		

◀

PE companies also use other multiples for PE valuations. Examples are revenue multiples (EPV/revenue) and earnings multiples, like the price-earnings (P/E) ratio. PE companies typically employ several valuation methods. They use 'football field' graphs, like Fig. 10.7, to visualise the outcome of the different valuation methods.

Cost of Capital

Standard cost of capital practices derive a company's beta from its past stock performance; and then fill in that beta, along with assumptions on the risk-free rate and the market risk premium, to arrive at a company's cost of capital (see Chap. 13). However, non-listed companies do not have past stock returns, and hence no observable beta. At best then, betas of comparable companies or industry betas can be used. Moreover, the extra risk of early stage companies is not reflected in betas. Hence, one could take a different approach by taking a high default cost of capital of 20–60% and make adjustments to that rate—typically discounts as risk falls, but sometimes premiums as well. The 20% discount rate is in line with findings by Heaton (1998).

While the cost of capital reflects the required return from an investor perspective before the PE investment is made, realised returns measure the actual performance

Fig. 10.7 Football field graph of valuation methods

of PE investments. Phalippou (2020) shows that PE has not been as financially successful for its investors, as often claimed. He finds that PE funds have generated returns that are about the same as those of public equity indexes since at least 2006, while the risk is higher. A major reason is that the high management fees (the earlier explained '2 and 20') have to be deducted from the gross returns; investors only receive net returns. So, the gross returns may be higher for PE than for public equity; the net returns are about the same. Phalippou (2020) concludes that PE is in particular financially attractive for the PE managers.

10.3 Impact of S and E on F in Private Equity

In principle, the financial value of private equity is affected by S and E in the same way that public equity is affected by S and E. Chapter 9 discussed how S and E affect the valuation of F through the value drivers—sales growth, EBIT margin, and cost of capital—and how to model that.

ESG Integration Lagging in Comparison with Public Equity
However, the practice of ESG integration in PE seems to be lagging compared to ESG integration in public equity investing. Zaccone and Pedrini (2020) contend that 'PE companies' integration of ESG aspects is still in its infancy and that the literature lacks a clear understanding of their activities relative to ESG factors, what assessment tools they prefer, what criteria they rely on when deciding whether to perform an ESG due diligence, and the dominant barriers they face when considering ESG issues in their investment strategies'. Furthermore, their survey finds that ESG integration in PE is mostly driven by the desire to comply with regulations and standards; that ESG due diligence is typically performed by external advisors; and that most PE companies do not have standardised ESG procedures. The interviewees revealed that they 'do not do the ESG business assessment for value creation'. Of course, there are more advanced PE companies. For example, Indahl and Jacobsen (2019) describe how their PE company, Summa Equity, 'has turned its ESG principles and practices into a core competence, a source of competitive advantage that has enabled the company to distinguish itself from its competitors and, in so doing, to bring about significant increases in efficiency and long-run value'. Abraham et al. (2022) find that ESG disclosures by PE companies have been steadily increasing over the past two decades. Moreover, they find that PE companies with high ESG disclosures achieve better financial returns.

ESG Integrated Due Diligence
Ideally, PE companies do not only apply the methods described in Chap. 9 to make E and S related value driver adjustments, but also fully integrate the analysis of E and S in their due diligence (DD). That is, data on E and S issues should be part of the data provided by the company and collected during the DD process. Figure 10.8 gives an overview of the types of data collected during DD.

Financials	Management	Business model	Impact	Competitive position	Operations
• historical financials • forecast / management projections • risk-return assessment • future financing rounds • responsible exit scenarios	• organisation chart • management team CVs & track record • company culture	• customer value proposition • profit model • key resources & processes • scalability	• historical impact value creation data • theory of change	• SWOT analysis • intellectual property • markets • client base (existing, pipeline, target, future opportunities), • competition	• supply chain • products / services

Fig. 10.8 Elements of an ESG integrated due diligence process

Most of these elements are not very different from the typical PE DD process. However, explicitly taking impact into account, as done in column 4 of Fig. 10.8, is different. Moreover, and more importantly, all of these elements are ideally considered with E and S issues in mind. That requires additional data and methods, such as questionnaires, but most of all the mindset to do this.

In addition to the integration of E and S issues in their analysis of companies, PE companies can also see E and S issues as forces that affect their own company in terms of risk and opportunities, such as in Box 10.1.

Box 10.1: Apollo Launches Platform in Energy Transition and Decarbonisation Investments[1]

Apollo is a large and stock-listed PE company. In a February 2022 press release, Apollo announced 'the launch of a comprehensive sustainable investing platform focused on financing and investing in the energy transition and decarbonization of industry. Across asset classes, Apollo targets deploying $50 billion in clean energy and climate capital over the next five years and sees the opportunity to deploy more than $100 billion by 2030. With approximately $4.5 trillion annually in investments needed to achieve global net zero by 2050, Apollo aims to be a leading capital partner to companies and communities globally'.

In addition to the company's investment targets, Apollo has committed to:

- Reduce median carbon intensity by 15% over the projected hold period for new control investments in the company's flagship strategy;
- Align its public reporting with the Task Force on Climate-Related Financial Disclosures (TCFD) recommendations;
- Enhance due diligence with a deeper focus on sustainability improvements and targets; and
- Continue to identify and invest in innovative companies that accelerate the energy transition and more sustainable business models.

[1] See Apollo press release, February 2022

10.4 Valuation of S & E and Integrated Valuation in Private Equity

Just like in public equity, the valuation of S and E in their own right is possible in PE. For calculations and examples, please see Chap. 9. There are also differences. Especially early stage private equity tends to invest in newly emerging companies that are on the bottom left of the x-curve of transition (see Fig. 2.12 in Chap. 2). As a result, their integrated value tends to be better than those of established companies (top left of the x-curve) in public equity and public debt markets.

Here, we will focus on impact PE. This is a type of PE that explicitly aims to create value for society—and how it differs from venture philanthropy. This is still a very small part of the PE market, but it is growing fast, driven by the desire of affluent people to invest their money with the purpose of achieving better societal outcomes.

Impact PE

A small part of the PE universe is aimed at providing not just financial returns, but social and environmental ones as well. This is known as impact PE. Impact PE fits into the wider spectrum of impact investments. In the definition of Global Impact Investing Network: 'Impact investments are investments made with the intention to generate positive, measurable social and environmental impact alongside a financial return' (see definitions in Chap. 14). For impact investments, financial returns are not the main objective, but just one of the objectives. And to varying degrees, financial returns are just a budget constraint: a condition to achieving the main objective of impact. That impact can take various forms, and be of a social or environmental nature.

Moreover, the definition of impact investing requires that the impact be measured. In practice, measurement tends to be harder in impact PE than in impact public equities, since the data are often harder to get, or relatively more costly to produce. At the same time, the impact potential (i.e. the impact that can be generated per euro or dollar invested) is likely to be higher in impact PE than in listed equity, for the reasons previously mentioned: it can be more targeted, more local, and it can fund much earlier-stage ventures.

To deal with the data challenge, impact PE companies can develop their own frameworks. For example, global impact investment manager, BlueOrchard, developed an impact framework based on the principles of the former Impact Management Project (IMP):

1. **Intentionality**: there need to be clear impact goals; and these goals are set out in a theory of change
2. **Contribution**: the portfolio holdings contribute directly to the impact goals of the strategy (investee contribution); and the investor supports and accelerates the impact that the investees have (investor impact)

3. **Measurement**: impact is assessed in an impact scorecard along the five dimensions of the IMP: what; how much; who; contribution; and impact risks; and
4. **Governance**: the impact is safeguarded through robust governance

Venture Philanthropy
A step further is venture philanthropy, which is in between impact PE and charity: unlike charity, it wants to preserve its capital invested to be able to invest in future projects. And unlike impact PE, it does not require a significantly positive financial return. For example, LGT Venture Philanthropy (part of LGT Asset Management) deploys philanthropic growth capital to organisations and companies with effective, innovative, and scalable solutions to social and environmental challenges: 'We scale innovative organizations by providing a tailored combination of capital, access to professional skills, management know-how and strategic advice. Our portfolio organizations are active in key impact sectors, including: education, health and environmental protection and restoration. Through our engagements, we directly contribute to the achievement of the Sustainable Development Goals (SDGs)'.[2]

Integrated Value
The methods for calculating integrated value in PE are the same as the ones for public equity (see Sect. 9.5 in Chap. 9). However, the calculation of integrated value would in many cases be relatively costly and not always necessary. Academic evidence shows that on average the exploitation of E and S (layoffs) by PE does not happen. Hence, calculation of integrated value in PE would make most sense in larger deals in which there are serious doubts about the overall value creation pattern. Examples are buyout deals with a change of ownership of a large company where much cost cutting is expected and/or where serious externalities are already being generated—think of the attempted takeover of Unilever by Kraft Heinz, driven by Brazilian PE company 3G Capital (see Chap. 18).

10.5 Conclusions

Private equity funds are set up to invest in private companies for a predefined multiyear period, aiming to make a return by improving their investee companies' performance and exiting them at a profit. Private equity companies, i.e. the companies that run private equity funds, come in several types, with different goals and methods. Private equity performs an important role in funding and fostering companies that are too small yet for the stock market and/or too risky for bank loans. Private equity as an asset class receives a growing allocation of pension fund money.

[2] Source: https://www.lgtvp.com/en/#button2

Like in public equity, the relevance of E and S to F is growing in private equity. This is because of investor interest and as a result of E and S driving fundamentals. However, in the application of sustainability considerations, private equity lags the public equity space. The main difficulty lies in getting the right information for the investors in private equity funds, as many private equity funds are still reluctant to systematically report on E and S. Yet by nature, private equity is very well suited to sustainable investing since it is a fundamental form of investing, with active ownership, multiyear investment horizons, and close consideration of the company's business model and circumstances.

Given the active ownership role that private equity takes, value creation on E and S is potentially greater in private equity than in public equity. This applies especially to early stage investments, such as venture capital. However, value creation on E and S is more likely if the private equity fund actually steers on impact, which only a small subset seems to do.

The integrated view on private equity is again similar to the one on public equity, but with the added challenge of data and comparability. Ideally, pension funds can allocate to private equity not just on the basis of financial risk and return but also on integrated risk and return, as further discussed in Chap. 14.

Key Concepts Used in This Chapter

Buyout is a PE investment, whereby the PE company takes a majority stake in an investee company, funded with equity and loans, to take control of the company and change its strategy and operations for higher performance. There are several types of buyouts: LBOs, MBIs, and MBOs

General partner is responsible for managing the PE fund and has a fiduciary duty to act in the sole interest of the fund's investors

Growth equity invests at a more mature stage of a company, sometimes just after the VC phase, where a company's business model works well, but has not yet succeeded in growing fast

Leveraged buyout (LBO) is a buyout using debt to leverage the investee company

Limited partner takes a financial role in the PE company; they provide capital and pay fees to the PE company

Management buy-in (MBI) is a PE investment, where the PE company brings in an external management team

Management buyout (MBO) is a buyout, whereby the incumbent management team takes over, helped by the PE company

Multiples valuation is a type of relative valuation in which an asset's value is determined as a multiple of a financial statement metric such as profitability or book value.

Private equity (PE) invests in private companies by means of a non-traded equity stake for a multiyear period, with the aim to make a return by improving the investee companies' performance and exiting them at a profit

PE company raises and advises a PE fund through two entities: (1) the General Partner (GP) and (2) the investment manager

Value Driver Adjustments (VDA) are the adjustments made to value driver assumptions in a valuation model, based on an assessment of the company's material ESG issues

Venture capital (VC) invests in early stage (start-up) companies

Suggested Reading

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11 Case Study Integrated Valuation: Inditex

Overview
This chapter applies the tools of the previous chapters, such as the equity valuation models of Chap. 9 and the social and environmental valuation models of Chap. 5, to a particular company. It is a case study that gives an external perspective on the integrated value of Inditex as of January 2021 for educational purposes. It answers questions such as: how to calculate the integrated value of a company? Which company-reported data to use? How to fill the gaps from missing data in company reporting?

Inditex, or Industria de Diseño Textil, S.A., is a multinational clothing company, based in Arteixo, Spain. It is the largest fast fashion company in the world and operates over 7000 stores in almost 100 countries. The company is best known for its Zara brand, but also owns brands such as Bershka, Massimo Dutti, Pull&Bear, Zara Home, and Oysho. The fast fashion industry faces major social (S) and environmental (E) challenges. Moreover, since the industry is characterised by high levels of outsourcing, those challenges tend to be hidden down the supply chain.

In the following sections, we briefly introduce the nature of the company's activities and its value drivers. We then connect the company's business model and purpose to its external impacts and transition challenges. This allows us to value the company in various ways.

First, we make an assessment of its financial value F, including the effect of sustainability issues (inward view, Sect. 11.3), in several scenarios. We use the discounted cash flow (DCF) model for calculating F.

Second, we estimate Inditex' value on S and E (outward view, Sect. 11.4), with flows projections on S and E, similar to those of an ordinary DCF. These calculations indicate that there is significant value destruction on E and S, but also significant value creation on S.

Third, we compute the company's integrated value (IV) by summing FV, SV, and EV in several ways (Sect. 11.5). The company's integrated value turns out to be positive overall, but both positive SV and negative SV and EV turn out to be much larger than FV, which shows the importance of not netting. The large negative values need to be addressed: to be reduced and ideally eliminated. We therefore explore

D. Schoenmaker, W. Schramade, *Corporate Finance for Long-Term Value*, Springer Texts in Business and Economics, https://doi.org/10.1007/978-3-031-35009-2_11

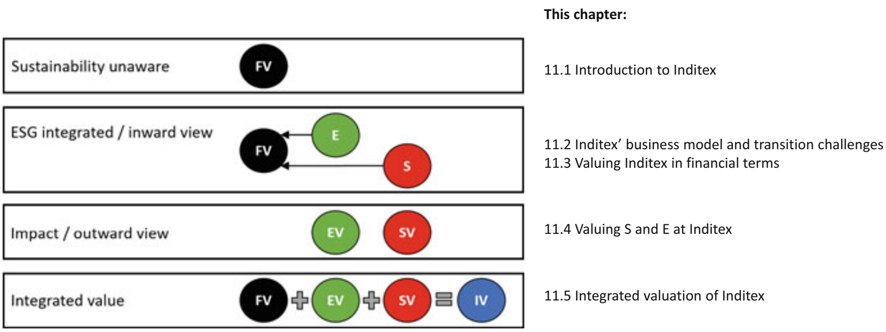

Fig. 11.1 Chapter overview

integrated value creation over time; how it can be improved; and how to communicate it to investors. See Fig. 11.1 for a chapter overview.

Learning Objectives
After you have studied this chapter, you should be able to:

- link a company's business model to its external impacts and transition exposures
- build a company valuation model that incorporates F, S, and E
- create and interpret a company value creation profile
- assess corporate investments on F, S, and E in the context of the company's value creation profile
- critically assess a company's information provisions on sustainability issues and the gaps therein

11.1 Introduction to Inditex

Inditex, officially known as Industria de Diseño Textil (which translates to 'Textile Design Industry'), is a Spanish clothing company with a large portfolio of global fast fashion brands such as Zara, Bershka, Pull&Bear, and many more. With more than 7200 stores in 93 countries it is the biggest fast fashion group in the world.

In 1975, Amancio Ortega and his wife Rosalia Mera opened their first fashion store for their brand Zara. Later that year, Ortega hired a local professor, José Maria Castellano, who would be responsible for growing the company's computing capabilities. In 1984, Castellano was appointed CEO after having developed a revolutionary design and distribution method that greatly improved the company's performance. A year later Inditex was created as a holding company for Zara and its production facilities. After expanding internationally by opening a store in Portugal in 1988, the company started developing other brands such as Pull&Bear in 1991, Lefties in 1993, and Bershka in 1998.

When Inditex had its IPO in 2001 at the Spanish Stock Exchange, the company was valued at €9 billion. Over the course of the 2000s the company experienced exponential growth, achieving a milestone 2000 stores in 2004 and 4000 stores in 2008. In the meantime, Castellano was replaced by current CEO Pablo Isla in 2005. While the company has grown to become the largest fashion retailer in the world, it was hit hard by the Covid-19 pandemic as the company saw its revenue decrease by 27.7% in 2020.

The company operates a number of brands but the Zara and Zara Home brands still account for more than two-thirds of sales. Geographically, the company's sales are skewed to Europe (over 60%, of which 25% in Spain), with significant presences in Asia-Pacific (25% of sales) and the Americas (14% of sales).

Inditex claims to employ a 'multi-concept strategy', with 'market segmentation through distinctive concepts'; independent management teams; a global presence; and the same business model across all concepts—i.e., with a high frequency of new collections; and outsourced production in low-cost countries. The business model is discussed further in Sect. 11.2.

Like any industry, the fast fashion industry is exposed to trends that affect its growth and the way it operates. According to the international consultancy PwC, the industry's key trends are sustainability and digitalisation.[1] For example, 3D design was quick to substitute fashion shows when those were no longer possible due to Covid-19 restrictions. Meanwhile customers are becoming more critical about clothing companies' sustainability performance, and they demand better information on the footprint of individual pieces of clothing. As a result, supply chain transparency is becoming more important and increasingly enabled by digitalisation.

Company Value Drivers

The financial valuation analysis (Sect. 11.3) starts with Inditex's value drivers: sales, margins, and capital. Table 11.1 shows Inditex's sales. Inditex has produced consistent growth numbers during the 2010s with a minor blip in 2013, due to additional investments in refurbishing flagship brands and opening many new stores globally. The lower growth at the end of the decade indicated to some, including Morgan Stanley, that the company's growth profile was fading.[2] While this could have played a part in the devastating sales drop in 2020, it should be largely attributed to the effects of the Covid-19 pandemic which saw a staggering drop in sales globally due to lockdown measures. However, with global fashion sales in 2020 declining between 15 and 30%, Inditex seemingly took a larger hit than most.[3]

[1] PwC, 2021, Evolving face of digitally enabled sustainable fashion—Sustainable and effective digital measures can set the industry on a greener track for the years to come.

[2] https://www.reuters.com/article/us-inditex-results-idUKKBN1QU1M1

[3] https://fashionunited.com/en/news/business/mckinsey-and-bof-find-90-percent-profit-decline-for-the-fashion-industry/2020120236835

Table 11.1 Sales of Inditex (in billions of €)

	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
Sales (€ billions)	13.8	15.9	16.7	18.1	20.9	23.3	25.3	26.1	28.2	20.4
Sales growth	10.4%	15.2%	5.0%	8.4%	15.5%	11.5%	8.6%	3.2%	8.0%	-27.7%

Table 11.2 Profitability of Inditex (in millions of €)

	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
EBIT (€ millions)	2,522	3,117	3,070	3,198	3,677	4,021	4,314	4,357	4,772	1,507
EBIT margin	18.3%	19.6%	18.4%	17.7%	17.6%	17.3%	17.1%	16.7%	16.9%	7.4%
EBITDA (€ millions)	3,258	3,913	3,926	4,103	4,699	5,083	5,277	5,457	7,598	4,552
EBITDA margin	23.6%	24.6%	23.5%	22.7%	22.5%	21.8%	20.9%	20.9%	26.9%	22.3%

Inditex's profitability has been remarkably consistent throughout the last decade, especially in terms of EBIT which ranged from 16.7 to 19.6% over the course of 9 years (see Table 11.2). The company's EBITDA has also performed well, although decreasing slightly over time. The strong increase in EBITDA in 2019 compared to 2018 is furthermore noticeable. This indicates that, although the company strongly improved its gross profit, there was also a significant growth in depreciation considering that EBIT stayed the same. The increased depreciation can be attributed to the 30.9% growth in assets during 2019.

Except for 2020, Inditex showed a strong financial performance over the past decade. Inditex's growth during the last decade is noticeable in the development of its assets, which has more than doubled since 2010 (see Table 11.3). In fact, assets grew faster than sales (falling sales-to-assets ratio), possibly indicating that the company is operating less efficiently than before. For most of the decade, its sales-to-assets ratio was around 1.2, which is similar to other companies in the fashion sector, such as H&M. In contrast to other financial numbers, Inditex's capex (investments) has been relatively inconsistent, particularly from 2017 onwards. In

Table 11.3 Capital of Inditex (in millions of €)

	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
Total Assets	10,959	12,890	13,756	15,377	17,357	19,621	20,231	21,684	28,391	26,418
Sales/ Assets	1.26	1.23	1.21	1.18	1.20	1.19	1.25	1.20	0.99	0.77
Capex	-1,349	-1,599	-1,351	-1,847	-2,416	-2,396	-833	-1,875	-2,377	2,514
Capex/ Sales	9.8%	10.1%	8.1%	10.2%	11.6%	10.3%	3.3%	7.2%	8.4%	-12.3%
ROA	17.6%	18.3%	17.3%	16.3%	16.6%	16.1%	16.6%	15.9%	12.8%	4.2%

2020 the capex was even negative, which means the company divested some of its assets. Finally, the Return on Assets has been healthy.

11.2 Inditex' Business Model and Transition Challenges

Ultimately, to value Inditex on F, S, and E, we need to understand the company's external impacts and transition challenges. This in turn requires an understanding of the company's business model and purpose.

11.2.1 Business Model

In both its company profile and its 2020 Annual Report (AR 2020), Inditex spends several pages explaining its business model. Inditex claims to have a unique business model, 'fully integrated, digital and sustainable'. But is it? And how can it be described in a more objective way? As discussed in Chap. 2, Johnson et al. (2008) argue that a successful business model has three components:

1. *A customer value proposition*: the model helps customers perform a specific 'job' that alternative offerings do not address;
2. *A profit formula*: the model generates value for the company through factors such as the revenue model, cost structure, margins, and/or inventory turnover;
3. *Key resources and processes*: the company has the people, technology, products, facilities, equipment, and brand required to deliver the value proposition to targeted customers. The company also has processes (training, manufacturing, services) to leverage those resources.

For Inditex, these three components can be described as shown in Fig. 11.2.

Crucially, Inditex's customer value proposition is driven by frequently issuing new collections. To minimise costs and maintain high levels of ROIC, the garments are produced in an outsourced supply chain over which the company exercises strong bargaining power but limited control. This means large negative external impacts can be created beyond the boundaries of Inditex' legal entities[4]—and indeed they are, as we will see later on. Strengths from an F perspective can be weaknesses from an S and E perspective. Box 11.1 provides a critical perspective on Inditex's marketing.

[4]It's questionable to what extent companies will be able to continue to hide behind foreign legal entities. The 2021 ruling against Royal Dutch Shell showed that judges increasingly do hold companies responsible for what they do in foreign legal entities they control. That might also become applicable to what their suppliers do—the EU is taking steps in that direction, for example by means of a supply chain directive: https://www.europarl.europa.eu/doceo/document/TA-9-2021-0073_EN.pdf

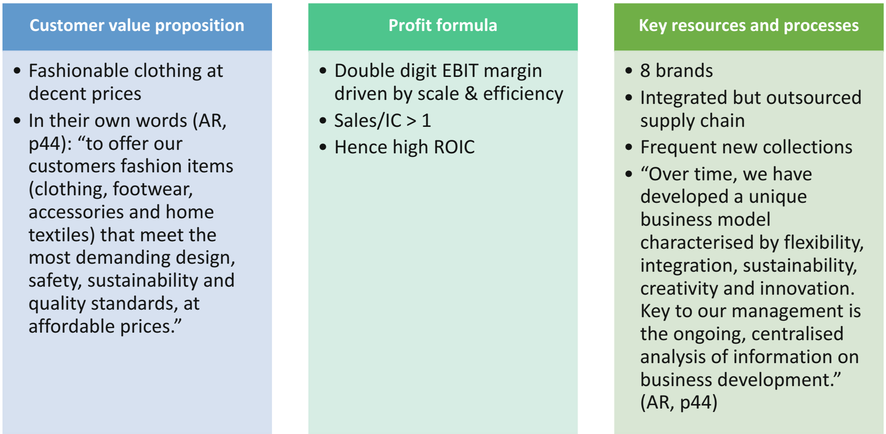

Fig. 11.2 The three components of Inditex' business model. Note: Authors' assessment based on Annual Report 2020. At Inditex (and many other companies) sales/invested capital (IC) is higher than sales/assets, since invested capital is lower than total assets, from which short-term liabilities are deducted (and networking capital added) to arrive at IC

Box 11.1 Sustainable Marketing

Fuller (1999) defines sustainable marketing as 'the process of planning, implementing, and controlling the development, pricing, promotion, and distribution of products in a manner that satisfies the following three criteria: (1) customer needs are met, (2) organisational goals are attained, and (3) the process is compatible with ecosystems'.

The above definition is over 20 years old, and with current knowledge one could argue that the third criterion should be refined to 'within social and planetary boundaries'. However, that does not change our judgement: that Inditex succeeds at criteria (1) and (2) while failing at (3).[5] To stay within planetary boundaries, Inditex has to adjust its marketing mix, do serious product system life cycle management, and broaden its view on customer value. This could mean switching to a model with lower product volumes, longer product lives, and selling fashion as a service, renting or leasing clothing instead of selling it. Such new models would cannibalise the company's existing models, which makes it a tough call for management. Still, it probably makes sense to at least do this in an experimental way alongside the current model, and the company seems to have started on this journey.

[5] See, for example, ShareCloth's Apparel overproduction summary: Apparel and Fashion Overproduction Report with Infographic (sharecloth.com).

11.2.2 Purpose

A company's purpose is the reason for its existence, which is grounded in the way it creates value for its clients and other stakeholders. Hence, it should be closely related to its business model and competitive position. In the case of Inditex, it is hard to find a stated purpose.

The word purpose is mentioned 79 times in the 2020 Inditex Annual Report but only once in the meaning that we are looking for—and that instance is in a table on page 581 of the report, in reference to its annual corporate governance report. In the latter report, the word purpose is used 83 times, but again only once in the meaning we are looking for, in a section on board responsibilities (page 167): 'Monitoring compliance with the company's internal codes of conduct and corporate governance rules, also ensuring that the corporate culture is aligned with its purpose and values'. However, the purpose itself is not mentioned.

The closest we find is this excerpt from the company's 'About us' section: 'Our workforce never loses sight of the customer. We work to create value beyond profit, putting people and the environment at the centre of our decision-making, and always striving to do and be better. It is fundamental to how we do business that our fashion is Right to Wear'.[6] And for the Zara brand, the website says: 'Bringing attractive and responsible fashion, as well as improving the customer's experience, are Zara's priorities'.[7]

Hence, Inditex' purpose is a question mark. And so is the fit of that purpose with what stakeholders want, and with what is needed for successfully navigating transitions.

11.2.3 Stakeholders

Value is created for a multitude of stakeholders. But who are the company's main stakeholders? And how do their interests relate to and conflict with each other? Like many companies, Inditex gives an overview of its stakeholders (as identified by Inditex itself) in Fig. 11.3.

The company also gives an overview of the associated tools for dialogue. However, the friction between stakeholders is not given—and one might even disagree with the list of identified stakeholders. It is therefore useful to fill out a stakeholder impact map, as done in Table 11.4.

The boldly framed box in the stakeholder map shows the main frictions: those with nature, the company's suppliers, and the employees of its suppliers. These are the result of the company's business model. First, the outsourced supply chain means

[6] https://www.inditex.com/about-us/who-we-are

[7] https://www.inditex.com/about-us/our-brands/zara

Source: Adapted from Inditex Annual Report 2020, page 42.

Fig. 11.3 Inditex's stakeholders according to Inditex. Source: Adapted from Inditex Annual Report 2020, page 42

Table 11.4 Stakeholder impact map for Inditex

Stakeholders	Goals	Helped or hurt?
Customers	Fast fashion at low prices	They get it – they are the company's focus of attention
Own employees	Decent pay & working conditions	Reasonably, they meet the official standards
Employees elsewhere in the chain	Decent pay & working conditions	Poor wages & working conditions, left to local suppliers
Suppliers	Profitability, growth and stability	Profitability and growth probably better than alternatives, but not stability: unreliable as orders are easily cancelled
Nature (Inditex: environment)	Operate within planetary boundaries	Hurt by high GHG emissions and waste
Investors (Inditex: shareholders)	High financial returns	So far, yes
Governments (Inditex: community)	Economic activity & taxes	Yes

Note: Authors' assessments. We identify roughly the same stakeholders as Inditex does, but some with different labels as the scope is slightly different

that costs are minimised at the expense of suppliers, who in turn minimise their costs at the expense of environmental costs and their employees. Second, the high frequency of new collections, transported over large distances, and whose leftovers are burned impose a very high environmental cost.

So far, the relation with customers seems to be fairly comfortable, but that is changing too: Neumann et al. (2020) find that perceptions of social responsibility directly affect consumers' attitudes towards fast fashion brands, as well as trust (a direct predictor of purchase intention) and perceived consumer effectiveness. Apparently, consumers need to perceive sustainability efforts of these brands as altruistic.

No.	Material Topic	Subtopics
1	Ethical Behaviour and Governance	• Sustainable corporate governance • Corporate ethics • Regulatory compliance and responsible practices • Anti-corruption • Grievance mechanisms
2	Risk Management and Control Systems	• Financial risk management and control systems • Non-financial risk management and control systems • Cybersecurity
3	Stakeholder Engagement	• Stakeholder commitment • Transparency and continuous dialogue • Alliances and partnerships
4	Responsible Communication	• Responsible communication and marketing • Product information and labelling • Brand management
5	Value Chain Transparency and Traceability	• Raw materials traceability • Processes traceability • Transparency
6	Responsible Purchasing Practices	• Supplier relations • Responsible purchasing training and commitment
7	Value Creation	• Financial performance • Socio-economic impact on society • Tax contribution and tax transparency • Community investment
8	Innovation	• Digitalisation • Innovation in sustainability • Process innovation
9	Customer Orientation	• Sales practices • Shopping experience

No.	Material Topic	Subtopics
10	Diversity, Equality and Inclusion	• Diversity • Equality • Inclusion
11	Quality of Employment	• Employment • Remuneration • Labour relations
12	Human Rights	• Human rights strategy • Due diligence procedures
13	Safe and Healthy Environments	• Work centres • Supply chain • Commercial spaces
14	Talent Management	• Talent attraction • Talent development • Talent retention
15	Socially Sustainable Production Environments	• Employee well-being • Industrial relations • Living wages • Women empowerment
16	Climate change	• Decarbonisation • Energy management • Emissions
17	Environmental Footprint Minimisation	• Water usage • Waste management • Management of chemical substances and sustainable processes in manufacturing
18	Protection of Natural Resources	• Biodiversity • Animal welfare
19	Product Sustainability	• Sustainable raw materials • Product quality, health and safety
20	Circularity	• Eco-design • Packaging • Recycling

Fig. 11.4 Inditex's material issues according to Inditex. Source: Adapted from Inditex Annual Report 2020, page 70

11.2.4 Financially Material Sustainability Issues

The stakeholder impact map gives good clues about the company's financially material sustainability issues: the issues that could or indeed already do affect the company's financial value drivers. Figure 11.4 gives an overview of the issues that Inditex deems material.

Some of these issues are purely on the E side (e.g., climate change; environmental footprint minimisation; protection of natural resources), some purely on the S side (e.g., diversity, equality and inclusion; quality of employment; human rights), while others are overarching or a mix of both (e.g., value chain transparency and traceability; value creation; ethical behaviour and governance).

It is hard to disagree with the above material issues, but that doesn't mean that they take them seriously enough. Inditex could cherish minor improvements on these issues while shunning the elephant in the room. For example, the practice of cancelling already produced goods is at odds with both ethical behaviour and responsible purchasing. And there seems to be very little progress on topics such as circularity and value chain transparency & traceability.

What is missing from the analysis is a clear view on how these topics relate to each other. Unfortunately, the company doesn't apply the concept of double materiality (i.e. clearly distinguishing how material issues affect Inditex—the inward perspective of Fig. 11.4) and how Inditex creates external impacts[8] (the outward

[8] On page 382 of its annual report, Inditex says that it wants to help 6 million people between 2019 and 2022 through its community investment program. But what does it mean? What impact will it have? It's probably positive, but not very material, hence it sounds like greenwashing.

perspective). And hence the feedback loop between internal and external impacts is not discussed (see Chap. 2 on double materiality).

11.2.5 External Impacts (Outward Perspective)

External impacts are typically not a company's favourite topic (as it often has a negative public relations effect), but it is very important to society: what kind of positive and/or negative external impacts does the company generate? To what extent does the company report about these external impacts? Can they be quantified, or even be priced? Remember that for both SV and EV, the value calculation can be done in the three steps as presented in Chap. 5:

1. *Materiality assessment*: determine important S and E factors
2. *Quantification*: express these factors in their own units (Q)
3. *Monetisation*: express these factors in money with shadow prices (SP)

In this section we take step 1 for Inditex; steps 2 and 3 follow in Sect. 11.4.

Be mindful that we present ways for outsiders (i.e. those without access to the detailed information that people within the company have) to value EV and SV. The company itself can go much further and in much more detail. It can actually compile impact-weighted accounts, i.e. an impact-weighted P&L and an impact-weighted balance sheet. The Impact Economy Foundation (2022) gives guidance on how to do that in its Impact-Weight Accounts Framework (IWAF) and provides principles accordingly (see Chap. 5). It takes the perspective of a company or an auditor, that means it emphasises precision, whereas we take the perspective of an investor or stakeholder who wants to have rough understanding. Some organisations, such as Alliander and ABN AMRO in the Netherlands, have already published impact statements in the spirit of the IWAF statements (see Chap. 17).

As an investor or stakeholder, our first objective is the same as in the IWAF framework: identification of material impacts. As shown in Appendix A5.1 of Chap. 5, IEF (2022) provides a list of impact categories, which we map to the Inditex business model in Table 11.5. We also add planetary boundaries impacts that are not included in IWAF. This assessment is based on multiple sources, such as sustainability research articles by asset managers, sustainability ratings agencies, and NGOs; and academic literature on sustainability in textiles and fashion.

Most of these issues are recognised as problems by Inditex. And the company has some goals on these topics, such as 100% eco-efficient stores and removal of plastics bags. However, the issues are discussed without putting them in the proper context and without being clear about the size of these problems. As a result, it is impossible to tell how close or far off these targets are in reducing the company's harm to (almost) zero. In fact, it turns out they do not even come close, as we will see later on, since these goals and all current efforts are mainly on the company's own operations, and not the vastly larger operations in its supply chains.

Table 11.5 Likely external impacts created by Inditex' business model, by IWAF impact category

Key impact categories	Likely positive or negative	Problematic if substantially negative
Profit	P	
Salaries	P	
Interest payments	P	
Taxes	P	
Payments to suppliers	P	
Payments from clients	N	
Cost of capital	N	
Change in fixed assets	?	
Client value of products	P	
Client value of services	N/A	
Value of impact materials	N	Potentially
Creation of intellectual capital	P	
Well-being of employment	?	Potentially
Value to employees due to training and experience	P	
Effects on human health	N	Potentially
Occupational health & safety incidents	N	Potentially
Time invested by employees	N	
Contribution to/limitation of climate change	N	Potentially
Contribution to/limitation of pollution[a]	N	Potentially
Contribution to/limitation of availability of scarce natural resources[b]	N	Potentially
Contribution to/limitation of poverty	Both	Potentially
Contribution to/limitation of human rights violations	N	Potentially

Source: Authors' analysis based on the Impact-Weight Accounts Framework (IWAF; IEF, 2022)
[a]Including nitrogen & phosphorus cycles
[b]Including deforestation, freshwater use, and biodiversity loss

Fortunately, some context is given. In its Annual Report, Inditex describes some initiatives, for example, on circularity: 'Under the Make Fashion Circular initiative, Inditex has participated in developing a common circular economy framework for fashion, which has been integrated into our strategy' (AR, 2020, p.280). And it says this on GHG emissions (AR, 2020, p.319): 'Inditex has set ambitious emissions reduction targets approved by the Science Based Target Initiative (SBTi), which envisage a 90% reduction in Scope 1 and 2 emissions and a 20% reduction in Scope 3 (purchased goods) emissions, in both cases for the 2018-2030 period. These targets are the first milestone in Inditex's ambitious emissions reduction strategy, whose purpose is to achieve decarbonisation by 2050'.

The trouble though is that Scope 3 is what matters most, since Scope 3 accounts for about 98% of the company's total emissions.[9] Hence, the company's focus on the least significant part is misleading and taints the credibility of its sustainability ambitions.

11.2.6 Transition

Inditex' negative external impacts are the main sources of the company's transition risks and opportunities. The x-curve of transition in Fig. 11.5 illustrates them by showing the current regime (top left) of fast fashion at the lowest possible prices; the emerging niches (bottom left), such as responsible fashion, second hand, recycled, and rented clothing, which provide the ingredients for the desired future regime (top right) of responsible & circular fashion; the bottom right gives examples for practices that need to be phased out, such as the burning of unsold clothing.

The question is how Inditex is going to navigate this transition. How quick and broad-based is the transition of the fast fashion sector? Can it significantly reduce its negative impacts without perishing in the process? How well prepared is Inditex compared to others? To what extent can Inditex adapt? The answers to these questions can be expressed in an estimate for parameters b_j and a_i from Eq. 2.1 in Chap. 2.

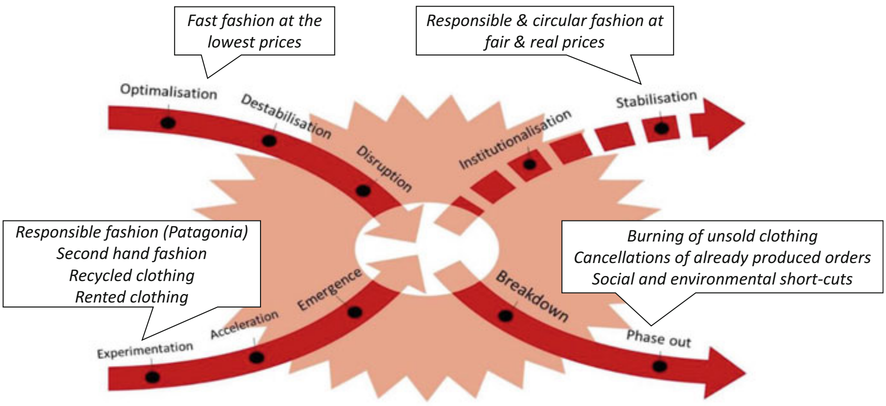

Fig. 11.5 X-curve of transition for Inditex and fast fashion. Note: Filled in for the fashion industry by the authors; adapted from Loorbach et al. (2017)

[9] On page 320 of its annual report 2020, Inditex gives data on its Scope 1, 2, and 3 emissions. The fact that the company does report its Scope 3 emissions (from 2019 onwards) is in itself positive since many other companies do not report their Scope 3 emissions.

Given the major negative impacts that the fast fashion industry generates for society on both S and E and the availability of substitutes, we rate the industry's transition exposure (b_j) quite high at 0.8. This means that a large part of the industry is likely to be transformed. On the adaptability of both the industry and the company (a_i), we take a more mixed view. On the one hand, there is plenty of scope to mitigate social issues in the supply chain; the company could stop burning clothes; and there are opportunities in adopting alternative business models based on better customer information, rental and recycling. On the other hand, the high frequency of new collections is such an integral part of the business model that one could question the company's (and the industry's) ability to really reduce its negative environmental impacts. And so far, this seems to remain out of scope. Thorisdottir and Johannsdottir (2020) find that CSR managers within the industry focus on supply chain innovation, eco-friendly products, and workers' safety. There are some sustainable fashion brands, but they are mostly small or medium-sized (Triodos Investment Management, 2021).

11.2.7 Management

The above considerations raise the question of management quality. Management has been very successful in growing the company in a profitable way. Operational excellence and customer centricity are major strengths. But the transition challenges demand a rethinking and redesigning of the business model. 'What got you here, won't get you there'. The key question is whether management is up to that challenge. The company's reporting suggests that management is still partly in denial, but strategic thinking tends to be ahead of reporting. Next, the company does experiment with alternative business models in, for example, recycling. Will it dare to allocate more resources to such strategic options? Will it dare to cut value destructive activities that are currently cash flow positive? These are the questions that investors and other stakeholders should be asking.

Interestingly, there is a change in management, with Óscar García Maceiras being named the new CEO, and Marta Ortega Pérez, the founder's daughter becoming the new chairwoman. A BBC news item is sceptical on her appointment:[10] 'She says she's grown up around the company and learned a lot in her time formally working there. But others will see this more as a Spanish version of the hit HBO series "Succession", where family members are given preference for top jobs over better qualified members of the team. Indeed shares in Inditex have fallen on news of the appointment'. The item also refers to a number of challenges that management faces: 'At a time when consumers are becoming more aware of the environmental costs of fast fashion, Zara particularly is in an awkward spot—its reputation is built on bringing style trends to High Street stores quickly and cheaply. There are also supply

[10] For example, see BBC News, 30 November 2021, Inditex: Zara founder's daughter becomes fashion giant's chair—BBC News

chain concerns. In November 2021, authorities in the French city of Bordeaux rejected plans by a Zara store to double its floor space, over allegations the fashion label may have profited from the forced labour of Uighurs in China. But the new chief executive and chairwoman are unlikely to be steering the Inditex ship without the help of founder Amancio. When he resigned as chairman in 2011, he didn't put his feet up. Instead the man known as "The Boss" has remained very much involved in the company. Though now aged in his 80s, it's a fair bet he'll remain so, even with the appointment of the new executive team'.

11.3 Valuing Inditex in Financial Terms (Inward Perspective)

What does this all mean for the valuation of Inditex' financial value? Let's take a step back and look at a basic valuation model for the company. To be clear: this section is only about F. As far as E and S are included, it is about their impact on F. This is the inward (or ESG integration) perspective. The next section takes the outward perspective and values E and S.

11.3.1 Basic Model: Before Assuming a Transition

As argued in Chaps. 6 and 9, the best method for valuing F is a DCF analysis. One can build a DCF from scratch in Excel or use a template in which the model is already prebuilt, including the formulas that relate the cells to each other. Table 11.6 shows such a template, filled out for Inditex per 1 January 2021. In the model, the grey cells represent historical data or assumed historical data that are filled in for the specific company; the black cells are assumptions; and the white cells give results from formulas. For example, the 2017 taxes on EBIT are the product of the 2017 EBIT (historical data) and the 2017 effective tax rate (assumed historical). The value driver assumptions are expressed in growth rates (such as sales growth) and ratios (such as the EBIT margin), where the historical ones (here 2017–2020) provide an indication for the value driver assumptions. For example, the 2017–2019 EBIT margins (and further back) give a good impression of what normal EBIT margins for Inditex look like, hence our 16.5% EBIT margin going forward..

Filling in the historical data is relatively straightforward, but making the assumptions requires making choices. One way to do that is to extrapolate the past into the future, i.e. take growth and margin assumptions that are simply the average of historical growth and margins. However, that's a naïve approach, especially for companies that have been growing very fast in the past and/or had very high margins.

Our preferred approach is to reverse-engineer the DCF to the current stock price. I.e., what growth, margins, and cost of capital does the share price imply? This is effectively the market's opinion, which one can contrast with one's own assumptions. So, the 0% upside is not a coincidence, but by design: we made adjustments to the value driver assumptions in such a way that they resulted in a

Table 11.6 Basic DCF for Inditex

Inditex			grey: historical		black: assumptions	white: calculated						WACC:	7.8%		TV growth:	2%
1/1/21					12/31/21	12/31/22	12/31/23	12/31/24	12/31/25	12/31/26	12/31/27	12/31/28	12/31/29	12/31/30	12/31/31	
	FY 2017	FY 2018	FY 2019	FY 2020	FY 2021	FY 2022	FY 2023	FY 2024	FY 2025	FY 2026	FY 2027	FY 2028	FY 2029	FY 2030	FY 2031	FY 2032
Value driver assumptions																
Sales growth		3.2%	8.2%	-27.9%	45.0%	4.5%	4.5%	4.5%	4.5%	4.5%	4.5%	4.5%	4.5%	4.5%	4.5%	2.0%
EBIT margin	17.0%	16.7%	16.9%	7.4%	16.5%	16.5%	16.5%	16.5%	16.5%	16.5%	16.5%	16.5%	16.5%	16.5%	16.5%	16.5%
Effective tax rate	25.0%	25.0%	25.0%	25.0%	25.0%	25.0%	25.0%	25.0%	25.0%	25.0%	25.0%	25.0%	25.0%	25.0%	25.0%	25.0%
Depreciation/sales	3.8%	4.2%	10.0%	14.9%	4.0%	4.0%	4.0%	4.0%	4.0%	4.0%	4.0%	4.0%	4.0%	4.0%	4.0%	4.0%
CAPEX/sales	7.0%	6.2%	4.1%	3.5%	4.0%	4.0%	4.0%	4.0%	4.0%	4.0%	4.0%	4.0%	4.0%	4.0%	4.0%	4.0%
NWC/sales			-12.1%	-12.5%	-12.5%	-12.5%	-12.5%	-12.5%	-12.5%	-12.5%	-12.5%	-12.5%	-12.5%	-12.5%	-12.5%	-12.5%
Value drivers																
Sales	25336	26145	28286	20402	29583	30914	32305	33759	35278	36866	38525	40258	42070	43963	45941	46860
EBIT	4314	4357	4772	1507	4881	5101	5330	5570	5821	6083	6357	6643	6942	7254	7580	7732
Taxes on EBIT	1,079	1,089	1,193	377	1,220	1,275	1,333	1,393	1,455	1,521	1,589	1,661	1,735	1,813	1,895	1,933
NOPLAT	3236	3268	3579	1130	3661	3826	3998	4178	4366	4562	4767	4982	5206	5440	5685	5799
Depreciation	963	1100	2826	3045	1183	1237	1292	1350	1411	1475	1541	1610	1683	1759	1838	1874
Gross CF	4199	4368	6405	4175	4844	5062	5290	5528	5777	6037	6308	6592	6889	7199	7523	7673
CAPEX	1772	1621	1152	708	1183	1237	1292	1350	1411	1475	1541	1610	1683	1759	1838	1874
increase in NWC		16	-3948	878	-1146	-166	-174	-181	-190	-198	-207	-216	-226	-236	-247	-115
Gross investment		1637	-2796	1586	37	1070	1119	1169	1221	1276	1334	1394	1457	1522	1591	1760
FCF		2731	9201	2589	4807	3992	4171	4359	4555	4760	4975	5198	5432	5677	5932	5914
				NPV calculation												
				Terminal Value (TV)												101959
				Period	1	2	3	4	5	6	7	8	9	10	11	11
				DF	0.928	0.861	0.798	0.740	0.687	0.637	0.591	0.548	0.509	0.472	0.438	0.438
				PV	4460	3436	3331	3228	3129	3033	2940	2850	2763	2678	2596	44620
				Sum of PV: Enterprise value	79064										TV	56%
				Other assets	0											
				Company value	79064											
				Net debt	-3089											
				Equity value	82153											
				Number of diluted shares outstanding	3110											
				Fair value stock price euro	26.4											
				Stock price, 4 January 2021	26.4											
				Implied upside	0%											

fair share price that equals the (then) current share price. This can deliver interesting information: sometimes the market prices in value drivers are much more aggressive than the historical ones, which could be a sign of overvaluation or of very good business prospects; other times, the forward-looking value drivers are much more modest than the historical ones, which could be a sign of undervaluation or of declining business. In the case of Inditex, the market seems to agree that its growth will slow down but that it can maintain its high margins.

Next to sales growth and margins, the cost of capital is the third value driver (see Chap. 9). We use the weighted average cost of capital (WACC) provided by Eq. 13.4 (see Chap. 13):

$$WACC = \frac{E}{V} \cdot r_E + \frac{D}{V} \cdot r_D \tag{11.1}$$

whereby r_E is the cost of equity and r_D the cost of debt. Chap. 12 explains in more detail how to calculate the cost of equity and debt. The basic idea is that the cost of equity is a combination of a risk-free rate r_f and a premium for market risk ($E[r_{MKT}] - r_f$). The exact cost of equity depends on a company's sensitivity to market risk, which is called the β_i. So, we only need to calculate the beta from market data (see Chap. 12 how the beta can be derived from the correlation of a company's stock returns with the stock market). We find a beta β_i of 1.21, based on 5-year monthly stock returns. The risk-free rate r_f of 1.5% and the market risk premium ($E[r_{MKT}] - r_f$) of 5% are generally applicable parameters. Using Eq. 12.15, we get $r_E = r_f + \beta_i \cdot (E[r_{MKT}] - r_f) = 1.5\ \% \ + 1.21 * 5\ \% \ = 7.6\%$.

For the cost of debt, we can add the credit risk premium to the risk-free rate. Inditex has an AA credit rating, which is equivalent to a credit risk premium of 1% (see Chap. 12). So, the cost of debt is $r_D = r_f + \text{AA spread} = 1.5\ \% \ + 1.0\ \% \ = 2.5\%$.

Table 11.6 shows that equity E is €82.2 billion and net debt D is −€3.1 billion (as Inditex's cash position is higher than its debt load). Using Eq. 9.1, we can calculate the enterprise value of the company $V = E + D =$ €82.2 − €3.1 = €79.1 billion. Using Eq. 11.1, Inditex's cost of capital is $WACC = \frac{E}{V} \cdot r_E + \frac{D}{V} \cdot r_D = 1.04 * 7.6\% - 0.04 * 2.5\% = 7.8\%$

The company's net debt is negative. With such low and negative leverage, the company's share price has relatively low sensitivity to the value driver assumptions, which tends to make the model more reliable. Nevertheless, one should do several checks to the model to avoid mistakes. For example, one could check sensitivities of the DCF value to value driver changes; do a multiples analysis; and check for behavioural biases such as extrapolation and overoptimism.

11.3.2 Value Driver Adjustments

One way to link sustainability to valuation is by means of value driver adjustments (VDAs, see Chap. 9). In that method, the financially material issues are assessed in terms of their impact on value drivers in three steps:

1. identify and focus on the most material issues;
2. analyse the performance and impact of these material factors on the individual company; does the company perform better or worse on them than competitors do?
3. quantify competitive advantages to adjust for value driver assumptions;

For example, in the case of Inditex one could argue that the company grows faster (i.e. higher share value) because of customer relations and innovation and that the cost of capital should be higher (i.e. lower share value) because of environmental issues. These views can be summarised in a table (like in Box 9.3 in Chap. 9) that gives the adjustments per value driver (sales growth, margins, and capital) per material issue, and how much they affect the fair value of the DCF. In this way, the analyst can argue why they value the company more or less due to sustainability issues. This is a powerful way to link sustainability to valuation. It is also very useful for comparing competing companies. The limitation of the VDA approach, however, is that it is still quite static, in that it does not explicitly take transitions into account. This is particularly important for companies, like Inditex, whose business models have so far been a strength, but are turning into a liability, which they already are in social and environmental terms.

11.3.3 Transition Valuation Scenarios

Qualitative transition scenarios can be deep and multifaceted, allowing management to identify new pathways for navigating transitions. Valuation scenarios, however, need to be simple to allow for quantification that makes intuitive sense. Table 11.7 describes such simple scenarios, along two dimensions: whether or not effective global climate mitigation occurs by 2030; and whether the company is well prepared for it.

To get to a scenario weighted valuation, we need to make models for each scenario and assign probabilities to them. We assign a 40% probability to effective global climate mitigation by 2030, and a 60% probability that Inditex is well prepared for it. Note however that this is not necessarily a good thing, since in

Table 11.7 Transition valuation scenarios for Inditex

	Effective global climate mitigation by 2030 (successful transition)	Mere climate adaptation, no serious mitigation by 2030 (unsuccessful transition)
Company is well prepared for climate mitigation	Scenario 1a: serious investment in recycling and in rental models; cutback on new collections; more ownership in the value chain	Scenario 2a: strategy as in 1a, but with less payoff
Company is ill-prepared	Scenario 1b: continued to operate in business-as-usual mode, missed trends, and paid high price	Scenario 2b: strategy as in 1b, but at no penalty

Table 11.8 Transition scenarios weighted valuation for Inditex

Scenario	DCF fair value per share	Probability	Main value driver assumptions (baseline from the basic scenario: 4.5% growth; 16.5% EBIT margin; 4% capex/sales)
1a (well prepared; successful transition)	€28.4	24% (60%*40%)	3 years of 3% growth rate, then back to 4.5% 3 years of 13% margins, then 20% 3 years of 6% capex/sales, then back to 4%
1b (ill-prepared; successful transition)	€10.4	16% (40%*40%)	−20% growth in 2023 and −15% growth in 2024, then 0% onwards* 3 years of 8% margins, then 11%
2a (well prepared; unsuccessful transition)	€22.5	36% (60%*60%)	10 years of 3% growth rate 3 years of 13% margins, then back to 16.5% 3 years of 6% capex/sales, then back to 4%
2b (ill-prepared; unsuccessful transition)	€31.9	24% (60%*40%)	6% sales growth 18% margins
Overall	€24.2		

Note: Authors' assumptions. *Of course, we could also model the drop to come later, much closer to 2030, with the same valuation impact. And yes, much worse scenarios are possible, in which the company fully misses the trend and fails

scenario 2a the company prepares for a transition that does not happen. Hence, the probability of scenario 1a is then 40%*60% = 24%. The probabilities of the other scenarios can be calculated through the same method. Table 11.8 shows how the valuation model differs per scenario, and what (probability-weighted) fair value results from all four scenarios together.

The most unfavourable scenario is 1b, in which the Inditex fair value is only €10.4 per share, versus €31.9 in the most advantageous scenario (2b). The weighted average fair value of all four scenarios is €24.2, which is below the January 2021 Inditex share price, suggesting that the company is overvalued. The overvaluation may be caused by not (sufficiently) considering the effect of E and S issues on financial value by most market analysts (see the adaptive markets hypothesis in Chap. 14).

Of course, all this is debatable, and people might differ in their opinions about the scenarios and their probabilities. In that sense, valuations are just opinions, and the market price is the aggregate of those opinions. Those who think that scenario 1b has a higher probability than the above 16% will likely arrive at a lower overall value for Inditex than our €24.2. And this is just the value of the Inditex share, i.e. an expression of the value of F. It does not say anything yet about the company's value in terms of E and S.

11.4 Valuing S and E at Inditex (Outward Perspective)

For valuing S and E, we would ideally have the same level of detailed information that we have on F. At present, however, we are still far removed from that level. For most companies, GHG emissions are available to some extent, but company level data on the other planetary boundaries are typically missing. On S, indicators are often given, but typically only in relation to a company's own operations; and reference to the SDGs is usually made, but not data that is actually useful in establishing the company's contributions to (not) achieving them. As we will see, Inditex is no exception in that it does provide quite some data, but not of the right nature to value S and E.

To arrive at calculating SV and EV, we proceed on the path taken in Sect. 11.2, where we took the first of the below three steps:

1. *Materiality assessment*: determine important S and E factors;
2. *Quantification*: express these factors in their own units (Q);
3. *Monetisation*: express these factors in money (SP)

11.4.1 Quantification: E and S in Their Own Units

When expressing E and S in its own units, we ideally obtain an overview like the one in Table 11.9, that is having yearly amounts for various types of E and S, both historically and projections for the coming years. The list is based on the issues identified in the External impacts part in Sect. 11.2.

Actually filling out a table like Table 11.9 is quite difficult: in practice, most companies only give historical data for some types of E; and then only for their own operations, not for their value chain. And for forward-looking data, they might give guidance or targets on, for example, GHG emissions. Indeed, for Inditex we find some historical numbers for 2019 and 2020 in the annual report, as well as some targets. For the 2021–2030 projections, we aim to make estimates based on relations with other company KPIs and company targets. The projections need to be linked to the company's activity levels. This link is imprecise: we can use sales as a proxy, and then ideally only the volume component of sales, so excluding price; but even then, there might be a mismatch between production volumes (which tend to drive emissions and other impacts) and sales volumes. In fact, Inditex discloses the amount of garments it places on the market, which is a proxy for sales volume.

In Table 11.10, we try to quantify the impacts that Inditex makes and start out with the activity levels, which help to put E and S into perspective. Unfortunately, this is a very sobering exercise: we only find usable data for GHG emissions. And even there the picture is clouded by the company's focus on Scope 1 and 2 (which is in direct control of Inditex), as it effectively hides its much larger Scope 3 emissions in its supply chain (98 to 99% of its total emissions) at the back of its AR 2020.[11] Its

[11] Scope 3 emissions are featured on page 320 of the AR, whereas Scope 1 and 2 are shown in the highlights early in the AR 2020.

Table 11.9 Expression of E and S in their own units

E	Unit	2018	2019	2020	…	2030
Contribution to/limitation of climate change	Tonnes of CO2 equivalent emissions	?	?	?	?	?
Contribution to/limitation of pollution	Tonnes of waste, by waste type; Tonnes of nitrogen & phosphorus used; Litres of freshwater used; etc.	?	?	?	?	?
Contribution to/limitation of availability of scarce natural resources	Number of forest acres converted; MSA reduction due to corporate activities, etc.	?	?	?	?	?

S	Unit	2018	2019	2020	…	2030
Client value of products & services	Client surplus (value - paid for)	?	?	?	?	?
Wellbeing of employment	Life satisfaction scores	?	?	?	?	?
Value to employees due to training and experience	Additional income	?	?	?	?	?
Effects on human health	Quality life years added or lost	?	?	?	?	?
Occupational health & safety incidents	Quality life years added or lost	?	?	?	?	?
Contribution to/limitation of poverty	Wage gap	?	?	?	?	?
Contribution to/limitation of human rights violations	Forced / underaged / discriminated / harassed workers	?	?	?	?	?

'main decarbonisation commitments' involve reducing Scope 1 and 2 by 90% by 2030, but the more important Scope 3 only by 20% by 2050—the company focuses on the former, while the latter is what matters.

Our assumptions are set accordingly, with a 2.5% annual reduction in Scope 3 emissions. This still results in 9.5 million tonnes of Scope 3 emissions by 2050. The other issues remain a series of question marks, for which we can look for proxies in external sources, which we will do in the next sub-section on monetisation.

The question marks mean that these impacts are not reported in the company's disclosure, which raises the question to which extent the company considers them. After all, the company's clothing products require cotton plantations, which use large amounts of water and nitrogen. There are emissions in transport and storage. And there is the waste generated across its supply chain, of which the company does report Scope 1 and 2, but not Scope 3; and does not split by waste type, which makes the data useless for our purposes. This also makes it impossible to determine the attribution of E and S: to what extent are they attributable to this company, and to what extent to other parts of the value chain?

Hence, the question of the user of an annual report should not just be: what's in the company's annual report? It should very much also be: what should be in their annual report that is currently not there? And how to communicate to the company that it should include it? As a rule, this amounts to timeseries data on the company's contributions to planetary and social boundaries, ideally in a way that is relatable to its operations volumes. The guiding principle is double materiality: inwardly and outwardly material social and environmental factors should be included.

Table 11.10 E and S in their own units

Production & energy use	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031
Garments sold (in thousands of tonnes)	511.2	528.8	545.0	450.1	607.7	604.7	601.6	598.6	595.6	592.7	589.7	586.7	583.8	580.9	578.0
change		3%	3%	-17%	35.0%	-0.5%	-0.5%	-0.5%	-0.5%	-0.5%	-0.5%	-0.5%	-0.5%	-0.5%	-0.5%
Global energy consumption (GJ)	6.8	7.1	6.8	4.6	6.1	5.9	5.8	5.6	5.5	5.4	5.2	5.1	5.0	4.8	4.7
change		4%	-4%	-33%	33.0%	-2.5%	-2.5%	-2.5%	-2.5%	-2.5%	-2.5%	-2.5%	-2.5%	-2.5%	-2.5%
Energy needs covered with renewables	41%	45%	63%	81%	83.0%	85.0%	87.0%	89.0%	91.0%	93.0%	95.0%	97.0%	97.0%	97.0%	97.0%
Fossil-based energy consumption (GJ)	4.0	3.9	2.5	0.87	1.03	0.89	0.75	0.62	0.49	0.38	0.26	0.15	0.15	0.15	0.14
change		-3%	-35%	-66%	19%	-14%	-16%	-18%	-20%	-24%	-30%	-42%	-3%	-2%	-3%
E	**2017**	**2018**	**2019**	**2020**	**2021**	**2022**	**2023**	**2024**	**2025**	**2026**	**2027**	**2028**	**2029**	**2030**	**2031**
Contribution to climate change															
Scope 1 + 2 emissions (T CO2eq)	0.49	0.51	0.35	0.12	0.14	0.12	0.10	0.09	0.07	0.05	0.04	0.02	0.02	0.02	0.02
change		4%	-31%	-65%	19.0%	-14.0%	-15.5%	-17.5%	-20.2%	-24.2%	-30.4%	-41.5%	-2.5%	-2.5%	-2.5%
Scope 3 emissions (T CO2eq)	na	na	20.15	14.89	19.80	19.31	18.82	18.35	17.89	17.45	17.01	16.59	16.17	15.77	15.37
change				-26%	33.0%	-2.5%	-2.5%	-2.5%	-2.5%	-2.5%	-2.5%	-2.5%	-2.5%	-2.5%	-2.5%
Scope 3 as a% of total emissions	na	na	98.3%	99.2%	99.3%	99.4%	99.4%	99.5%	99.6%	99.7%	99.8%	99.9%	99.9%	99.9%	99.9%
Total emissions (T CO2eq)			20.50	15.01	19.95	19.43	18.93	18.44	17.96	17.50	17.05	16.61	16.19	15.79	15.39
change				-27%	33%	-3%	-3%	-3%	-3%	-3%	-3%	-3%	-3%	-3%	-3%
Contribution to pollution	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?
Contribution to depletion scarce natural resources	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?
Contribution to nitrogen & phosphorus cycles	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?
Contribution to deforestation	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?
Freshwater use	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?
Contribution to biodiversity loss	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?
S	**2017**	**2018**	**2019**	**2020**	**2021**	**2022**	**2023**	**2024**	**2025**	**2026**	**2027**	**2028**	**2029**	**2030**	**2031**
Client value of products & services	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?
Wellbeing of employment	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?
Value to employees due to training and experience	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?
Effects on human health	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?
Occupational health & safety incidents	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?
Contribution to poverty	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?
Contribution to human rights violations	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?

11.4.2 Monetisation: E and S in Monetary Terms

The third step to arrive at calculating EV and SV is monetisation, which is the expression of impacts in monetary units. To do so is challenging, especially if the non-monetary units are missing. But even then it can be done. The Impact-Weighted Accounts Framework (IWAF) (IEF, 2022) provides monetisation factors or shadow prices, which can be multiplied by the original units to arrive at monetary values. Table 11.11 lists some of IWAF's shadow prices—see Appendix A5.1 for a full list of shadow prices with explanations.

From Table 11.11, we can directly apply the shadow price for contribution to climate change, which is €204 (=$224/1.1) per tonne of CO_2 equivalent in 2021. The carbon price is projected to increase with 3.5% per year (see Chap. 5). Total emissions (the top line in Table 11.12) are taken from Table 11.10. Following IEF (2022), we assume that Scope 3 carbon emissions are 50% attributable to Inditex, as primary company in the supply chain (see Chap. 5). Table 11.12 shows how the resulting flows are calculated and discounted at the social discount rate of 2.2% (see

Table 11.11 Examples of shadow prices, 2021

Key impact categories	Monetisation factor
Well-being of employment	$2647 per life satisfaction point (scale 0–100)
Effects on human health	$119,000 per DALY (disability-adjusted life year)
Occupational health & safety incidents	Fatal occupational accidents: $3,540,000 per accident Occupational injuries with breach of H&S standards: $3840 per accident
Contribution to/limitation of climate change	$224 per tonne of CO_2 equivalent (eq)
Contribution to/limitation of pollution—air pollution	Human toxicity: $119,000 per DALY Nitrogen deposition NH_3 from animal husbandry: $18.10/kg NH_3 eq Particulate matter (PM) formation: $75/kg PM2.5 eq
Contribution to/limitation of pollution—water pollution	Freshwater eutrophication: $290/kg P eq to freshwater Marine eutrophication: $20.10/kg N eq to marine water
Contribution to/limitation of availability of scarce natural resources	Land occupation—tropical forest $3030/(MSA*ha*yr) Land occupation—other forest $1450/(MSA*ha*yr) Scarce blue water use $1.49/m^3
Contribution to/limitation of poverty	Underpayment in the value chain—Wage gap of workers earning below minimum wage $1.56 per $1 of wage gap
Contribution to/limitation of human rights violations	Underage workers—below minimum age (12 or 13) for light work in non-hazardous economic work $21,600/child FTE Forced workers—$17.200/FTE Harassment—workers who experienced severe physical sexual harassment $85,800/worker Lack of freedom of association $527/violation

Source: Impact-Weight Accounts Framework (IEF, 2022)

Table 11.12 E flows and EV for climate change

E flows (climate change)	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031
Contribution to climate change												
Total emissions (T CO2eq), millions	15.0	19.9	19.4	18.9	18.4	18.0	17.5	17.0	16.6	16.2	15.8	15.4
Percentage attributable to Inditex	50%	50%	50%	50%	50%	50%	50%	50%	50%	50%	50%	50%
Attributed emissions	7.5	10.0	9.7	9.5	9.2	9.0	8.7	8.5	8.3	8.1	7.9	7.7
Carbon price, Euro	138	204	211	218	226	234	242	250	259	268	278	287
change in carbon price		47%	3.5%	3.5%	3.5%	3.5%	3.5%	3.5%	3.5%	3.5%	3.5%	3.5%
Cost of emissions (CO2), Euro billions	**-1.04**	**-2.03**	**-2.05**	**-2.06**	**-2.08**	**-2.10**	**-2.12**	**-2.13**	**-2.15**	**-2.17**	**-2.19**	**-2.21**
Cost of EV capital		2.2%										
Terminal Value (TV)												-100.5
Period		1	2	3	4	5	6	7	8	9	10	10
Discount factor		0.98	0.96	0.94	0.92	0.90	0.88	0.86	0.84	0.82	0.80	0.80
Present value (PV)		-2.0	-2.0	-1.9	-1.9	-1.9	-1.9	-1.8	-1.8	-1.8	-1.8	-82.6
Sum of PV, Euro billions		**-101.3**										

Chaps. 4 and 12) to arrive at the present value of Inditex's contribution to climate change, which amounts to −€101.3 billion.

Of course, that large negative number is a result of the assumptions we made (still resulting in 9.5 million tonnes of CO_2 equivalent, as stated in Sect. 11.4.1), which are in turn driven by Inditex's targets. For the other environmental and social issues, we lack the required data and cannot make such specific calculations. The rest of E is not there or hard to attribute (e.g., waste), and so is all of S. Hence, we don't have the volumes of units to multiply with the monetisation factors. This applies not just to Inditex but is also typical for most companies. So, for the remaining issues we need to take shortcuts, such as using data of comparable companies or industry averages. In this case, we look for apparel data elsewhere. A publication by Impact Institute (2019) on the true price of jeans is quite helpful. Table 11.13 lists the components of the true price of jeans.

The data from Table 11.13 allow us to calculate the proportions of negative S and E impacts in the true price of jeans, which we can extrapolate to apparel in general and Inditex in particular. We admit that this is a stretch, but it is the best we can do now given our current information.

Table 11.14 provides the proportions of E and S in the true price. The top panel expresses the amounts as percentage of E, which is €10.9 (see E total in Table 11.13). The first line shows the GHG emissions (climate change) from Table 11.13 as a percentage of E: 15% (=€1.61/€10.9). The second line shows the S total for each stage of the production process in Table 11.13 as a percentage of E: 202%. So, total S is twice as high as total E.

The bottom panel expresses E and S as a percentage of the sales price, which is €80 per jeans. The GHG emissions are 2% (=€1.61/€80) of sales. Other E are 12% of sales. To prevent overestimation, we include only 50% of bonded labour in the S calculation, which is 20% of sales.

Table 11.13 Components of the true price of jeans

S	Cotton cultivation	Denim textile production	Jeans manufacturing	Transport	Total
Discrimination	€ 0.05	€ 0.10	€ 0.10		€ 0.25
Occupational H&S risk	€ 0.15	€ 0.40	€ 0.20		€ 0.75
Overtime	€ 0.20	€ 0.05	€ 0.25		€ 0.50
Denied freedom of association		€ 0.45	€ 0.60		€ 1.05
Harassment		€ 0.95	€ 1.65		€ 2.60
Child labour	€ 0.60	€ 1.40	€ 0.10		€ 2.10
Insufficient income	€ 0.75				€ 0.75
Insufficient wages & social security	€ 0.70	€ 1.10	€ 0.25		€ 2.05
Bonded labour	€ 1.10	€ 10.85			€ 11.95
S total	**€ 3.55**	**€ 15.30**	**€ 3.15**	**€ 0.00**	**€ 22.00**
E	**Cotton cultivation**	**Denim textile production**	**Jeans manufacturing**	**Transport**	**Total**
Materials use	€ 0.05	€ 0.03			€ 0.08
Energy use	€ 0.20	€ 1.80	€ 0.03	€ 0.02	€ 2.05
GHG emissions	€ 0.25	€ 1.30	€ 0.05	€ 0.01	€ 1.61
Land use	€ 0.25				€ 0.25
Soil pollution	€ 0.35				€ 0.35
Air pollution		€ 1.57	€ 0.02	€ 0.01	€ 1.60
Water pollution	€ 0.95	€ 0.85		€ 0.01	€ 1.81
Water use	€ 2.80	€ 0.30	€ 0.05		€ 3.15
E total	**€ 4.85**	**€ 5.85**	**€ 0.15**	**€ 0.05**	**€ 10.90**
Total S & E (rounded)	**€ 8.40**	**€ 21.15**	**€ 3.30**	**€ 0.05**	**€ 32.90**

Source: Impact Institute (2019)

Table 11.14 Proportions of E and S in the true price of jeans

	Cotton cultivation	Denim textile production	Jeans manufacturing	Transport	Total
GHG emissions as a percentage of E	2%	12%	0.5%	0.1%	15%
S as a percentage of E	33%	140%	30%	0%	202%
Assuming an average sales price per jeans of €80:	**Cotton cultivation**	**Denim textile production**	**Jeans manufacturing**	**Transport**	**Total**
GHG emissions/sales price	0.3%	1.6%	0.1%	0.0%	2%
Other E/sales price	6%	6%	0%	0%	12%
S/sales price	5%	19%	4%	0%	28%
S excluding 50% of bonded labour/sales price	4%	12%	4%	0%	20%

Note: authors' calculations based on Impact Institute research. An alternative to using the price per jeans, would be to calculate the true prices per kg of fabric.

Table 11.15 Calculating E flows and EV for Inditex

E flows	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031
Cost of emissions (CO_2) attributed, € billions	-1.04	-2.03	-2.05	-2.06	-2.08	-2.10	-2.12	-2.13	-2.15	-2.17	-2.19	-2.21
Cost of other E issues as a % of sales	12.0%	11.5%	11.1%	10.6%	10.2%	9.8%	9.4%	9.0%	8.7%	8.3%	8.0%	7.7%
Sales, € billions	20.4	29.6	30.9	32.3	33.8	35.3	36.9	38.5	40.3	42.1	44.0	45.9
Cost of other E issues	-2.45	-3.41	-3.42	-3.43	-3.44	-3.45	-3.46	-3.47	-3.49	-3.50	-3.51	-3.52
Percentage attributable to Inditex	50%	50%	50%	50%	50%	50%	50%	50%	50%	50%	50%	50%
Cost of other E issues attributed, €billions	-1.22	-1.70	-1.71	-1.71	-1.72	-1.73	-1.73	-1.74	-1.74	-1.75	-1.75	-1.76
Total E flows, euro billions	**-2.26**	**-3.73**	**-3.76**	**-3.78**	**-3.80**	**-3.82**	**-3.85**	**-3.87**	**-3.89**	**-3.92**	**-3.94**	**-3.97**
Cost of negative EV capital		2.2%										
Terminal Value (TV)												-180.5
Period		1	2	3	4	5	6	7	8	9	10	10
Discount factor		0.98	0.96	0.94	0.92	0.90	0.88	0.86	0.84	0.82	0.80	0.80
Present value (PV)		-3.7	-3.6	-3.5	-3.5	-3.4	-3.4	-3.3	-3.3	-3.2	-3.2	-148.4
Sum of PV, euro billions		**-182.5**										

The above can be projected on Inditex in several ways. For example, we could assume that the other E impacts (i.e. E excluding GHG emissions) are 12% of sales of €29.6 bn in 2021 (Table 11.6): €3.5 bn per year. Or that the other E impacts are 6× larger than GHG emission impacts of €2.0 bn in 2021 (Table 11.12): €12.0 bn per year. However, we also observe that GHG emission impacts as a percentage of sales are much higher at Inditex (7% of sales, calculated as € 2.03 bn from Table 11.12 divided by €29.6 bn from Table 11.6) than in jeans (only 2% of sales in Table 11.14). This is partly due to much higher carbon prices, but does not fully explain the difference. We therefore feel that it's better to stay on the lower side and go with the 12% of sales assumption for the other E impacts.

Next, we give Inditex the benefit of the doubt that it will materially bring down that number over time, with a 4% annual improvement. In addition, we assume that they are only 50% attributable to Inditex (as we do in Table 11.12). After all, not all these emissions are directly due to Inditex' activities; a part is at suppliers—although then too, Inditex shares part of the responsibility. Chapter 5 explains that 50% of the E and S effects should be attributed to the integrated valuation of Inditex, as primary company in the supply chain, and the other 50% to the integrated valuation of other companies in the supply chain. Based on these assumptions, we calculate total E flows in Table 11.15. They amount to circa −€3.7 bn per year and a total EV of −€182.5 bn.

For calculating S flows, we take a similar approach. The results are shown in Table 11.16. In the true price of jeans, S accounts for 28% of sales. However, that number is inflated by a very high number for bonded labour, which accounts for over half (€11.95 out of €22.20) of the negative S in the true price of jeans. To be on the conservative side, we take only half of that amount for the negative impacts of

[12] Inditex reports paid taxes of €1.9 billion in 2020, but these include people taxes of €0.7 billion and product taxes of €0.7 billion (AR 2020, page 193). These taxes are borne by employees and customers, respectively.

Table 11.16 Calculating negative S flows and negative SV for Inditex

Negative S flows	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031
Negative S flows as a % of sales	20.3%	19.5%	18.7%	18.0%	17.2%	16.6%	15.9%	15.3%	14.6%	14.1%	13.5%	13.0%
Sales, € billions	20.4	29.6	30.9	32.3	33.8	35.3	36.9	38.5	40.3	42.1	44.0	45.9
Cost of negative S issues	4.14	5.77	5.78	5.80	5.82	5.84	5.86	5.88	5.90	5.91	5.93	5.95
Percentage attributable to Inditex	50%	50%	50%	50%	50%	50%	50%	50%	50%	50%	50%	50%
Cost of neg S issues attributed, € billions	2.07	2.88	2.89	2.90	2.91	2.92	2.93	2.94	2.95	2.96	2.97	2.98
Total negative S flows, euro billions	**-2.07**	**-2.88**	**-2.89**	**-2.90**	**-2.91**	**-2.92**	**-2.93**	**-2.94**	**-2.95**	**-2.96**	**-2.97**	**-2.98**
Cost of negative SV capital		2.2%										
Terminal Value (TV)												-135.3
Period		1	2	3	4	5	6	7	8	9	10	10
Discount factor		0.98	0.96	0.94	0.92	0.90	0.88	0.86	0.84	0.82	0.80	0.80
Present value (PV)		-2.8	-2.8	-2.7	-2.7	-2.6	-2.6	-2.5	-2.5	-2.4	-2.4	-111.2
Sum of PV, euro billions		**-137.2**										

apparel. We arrive at negative S impacts of 20.3% of sales attributable to Inditex, which we apply in Table 11.16. Again, we give Inditex the benefit of the doubt that it will materially bring down that number over time, with a 4% annual improvement. We also attribute 50% of the negative S impacts to Inditex, because part of the negative S impacts occur at suppliers for which Inditex bears some responsibility as primary company in the supply chain. Based on these assumptions, we calculate total S flows in Table 11.16. They amount to circa −€2.9 bn per year and total negative SV of −€137.2 bn.

The above numbers only include the negative S impacts of Inditex. However, the company also creates positive S impacts, such as the client value of its products (on top of what people pay for them), taxes, and the well-being of employment. The calculation of positive SV is shown in Table 11.17.

Table 11.17 Calculating positive S flows and positive SV for Inditex

Positive S flows	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031
Paid taxes, € billions	0.5	1.3	1.3	1.4	1.5	1.5	1.6	1.7	1.7	1.8	1.9	2.0
% of sales	2.2%	4.3%	4.3%	4.3%	4.3%	4.3%	4.3%	4.3%	4.3%	4.3%	4.3%	4.3%
Consumer surplus, € billions	1.5	2.1	2.2	2.3	2.4	2.6	2.7	2.8	2.9	3.0	3.2	3.3
% of sales	7.2%	7.2%	7.2%	7.2%	7.2%	7.2%	7.2%	7.2%	7.2%	7.2%	7.2%	7.2%
Wellbeing of employment, € billions	0.7	0.7	0.7	0.8	0.8	0.8	0.9	0.9	0.9	1.0	1.0	1.1
% of sales	3.4%	2.3%	2.3%	2.3%	2.3%	2.3%	2.3%	2.3%	2.3%	2.3%	2.3%	2.3%
Total Positive S flows, euro billions	**2.6**	**4.1**	**4.3**	**4.5**	**4.7**	**4.9**	**5.1**	**5.3**	**5.6**	**5.8**	**6.1**	**6.4**
% of sales	12.9%	13.9%	13.9%	13.9%	13.9%	13.9%	13.9%	13.9%	13.9%	13.9%	13.9%	13.9%
Cost of positive SV capital		2.2%										
Terminal Value (TV)												290.0
Period		1	2	3	4	5	6	7	8	9	10	10
Discount factor		0.98	0.96	0.94	0.94	0.90	0.88	0.86	0.84	0.82	0.80	0.80
Present value (PV)		4.0	4.1	4.2	4.3	4.4	4.5	4.6	4.7	4.8	4.9	238.4
Sum of PV,euro billions		**282.9**										

Paid taxes of €0.5 billion were 2.2% of sales in 2020,[12] but that number is not representative due to the Covid-19 pandemic. The corporate tax expense amounted to about €1.0 billion in the preceding years, or 3.7% of sales. The property and environmental taxes were 0.6% of sales. Combining the taxes, we arrive at a tax rate of 4.3% of sales.

The consumer surplus is a measure of consumer welfare and is defined as the social valuation of a product in excess of the price actually paid. As explained in Chap. 5, the consumer surplus is calculated as $\left(\frac{Sales}{Price\ elasticity\ of\ demand} x \frac{1}{2}\right)$. Khaled and Lattimore (2006) find an average price elasticity of men's and women's clothing of 3.452. In the case of Inditex, the consumer surplus amounts to €2.955 billion (= €20.4 billion/3.452*0.5). This value has been created together by Inditex and its supply chain partners. We assume that the consumer surplus is 50% attributable to Inditex (and can be included in its integrated valuation), i.e. €1.478 billion, or 7.2% of sales.

The well-being of employment refers to additional well-being experienced by employees resulting from their employment at the company. We assume two life satisfaction points of €4813 (=2*$2647/1.1) (see Table 11.11). If we apply this to Inditex' workforce of 144,116, we arrive at €694 million, or 3.4% of sales. However, since 2020 was a year with dramatically lower sales (i.e. inflating employees/sales), we have to correct this number for the lower sales of 31% in 2020 (which is a combination of a 28% drop in sales combined with an average sales growth of 3%) and use 2.3% (=3.4%*[100%–31%]) from 2021 onwards.

Adding up these numbers gives positive S flows of 13.9% of sales, which is over €4 billion per year—and growing; and a positive SV of €282.9 billion. Admittedly, positive SV benefits from growth, whereas negative SV (and negative EV) are based on more or less stable flows, since the reductions are already partly factored in.

Again, the above numbers are based on very rough assumptions, and hence very imprecise. However, they are the best estimate we have at this stage. And they point the way forward towards better data. For example, having academic evidence on the social value of apparel could help us make better assumptions. This applies even more strongly to data disclosed by the company on E and S in their own units.

11.5 Integrated Valuation of Inditex

Now that we have calculated estimates of EV and SV, we can calculate the company's integrated value with Eq. 1.4 from Chap. 1: $IV = FV + b \cdot SV + c \cdot EV$. Figure 11.6 provides a schematic overview of the IV calculation.

As indicated in Chap. 6, the integrated value calculation can be done in several ways. We can add up FV, SV, and EV with equal or differing weights; and we could

[12] Inditex reports paid taxes of €1.9 billion in 2020, but these include people taxes of €0.7 billion and product taxes of €0.7 billion (AR 2020, page 193). These taxes are borne by employees and customers, respectively.

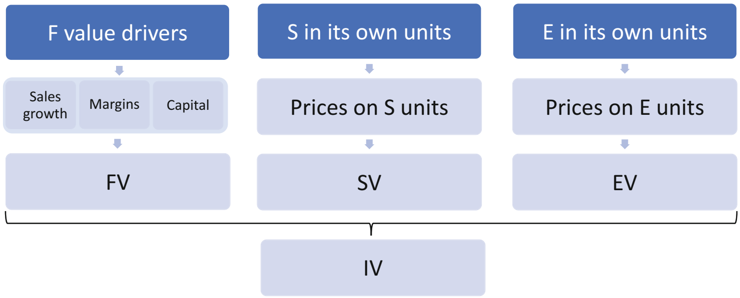

Fig. 11.6 Towards IV

Table 11.18 IV calculation for Inditex, Euro billions, 2021

IV calculation (equal weights)	Value (Euro billions)	Source calculation
FV (enterprise value)	79	Table 11.6
Positive SV	283	Table 11.17
Negative SV	−137	Table 11.16
Negative EV	−183	Table 11.15
IV	*42*	

Note: FV is the company's enterprise value, which is the sum of equity and debt value

vary those weights depending on the sign of the values. In the basic IV model with equal weights ($b = c = 1$), we get $IV = FV + SV + EV$. For Inditex we then arrive at an integrated value (IV) of €42 billion for 2021, as shown in Table 11.18 and Fig. 11.7. Inditex's integrated value is about half of its financial value of €79 billion.

Given the nature of the data and assumptions, these numbers are very rough estimates. But they do give a clear indication of the health (or lack thereof) of Inditex's business model. The IPV is still positive, which means that on a net basis, Inditex creates value for society. However, this result is mainly driven by its substantial positive SV (€283 billion), which to a large extent balances the company's negatives on E and S. The negatives on E and S are very large on an

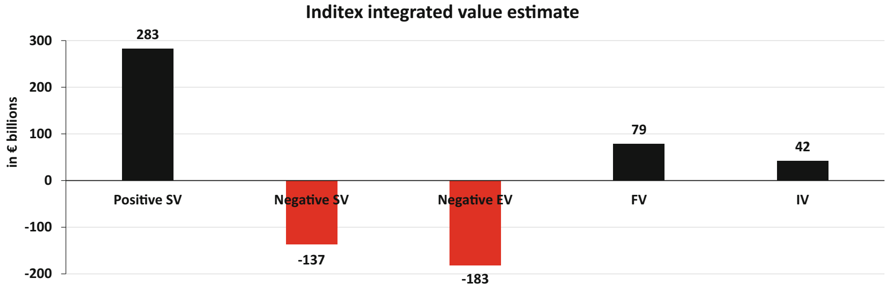

Fig. 11.7 Composition of Inditex's IV in basic IV model ($b = c = 1$)

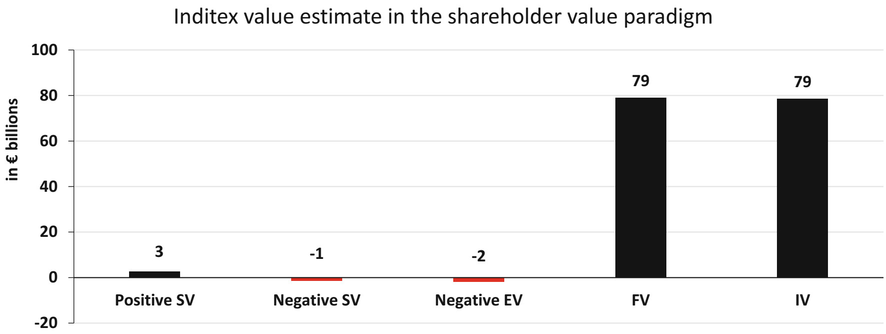

Fig. 11.8 Inditex IV composition in shareholder model ($b = c = 0.01$)

absolute basis (−€320 billion), however, and should be focus areas: how can they be reduced or preferably, eliminated?

These results illustrate the importance of not netting the values: both positive SV and negative SV are much larger than IPV, and so is their balance. And the process to get here shows how hard it is to obtain the right numbers. Unfortunately, Inditex does not report in a way that allows us to get more precise estimates, as do the vast majority of other companies. The cynic will say that they never will. But that remains to be seen: companies like Bureau Veritas and ABN AMRO are already (partially) doing this (see, for example, the case study on ABN AMRO's impact statements, Schramade, 2019). The EU's Corporate Sustainability Reporting Directive (CSRD, see Chap. 17) demands that companies report on their negative impacts. Of course, that sustainability reporting will not be perfect right away, but it will likely get better over time. For now, most companies and investors are effectively blind on SV and EV. This is more or less the same as having a, b, and c of close to 0, as in Fig. 11.8 (please note that the scale of the y-axis differs from Fig. 11.7).

On the Right Path? Value Creation Profiles in 2030 and 2050

Figure 11.7 gives Inditex's current integrated valuation profile. It looks unhealthy now, but the company might be able to improve it. The key questions are: (1) what is the path to a healthy business (FV, SV, and EV all >0)? and (2) is Inditex doing the right things to be on that healthy path?

To assess that, it is helpful to make projections of the company's future value creation profiles—given its current efforts and targets discussed earlier in this chapter. To be able to estimate annual value flows in 2050, a much longer explicit forecast period is needed than typically used. Figure 11.9 shows Inditex's projected evolution from 2021 to 2030 and 2050. 2050 looks better than now, but still unhealthy on E and S; and 2030 is not much of an improvement over 2021.

So, in spite of giving the company the benefit of the doubt in many ways, it is still not good enough and hard to link to targets. Figure 11.10 shows a more ambitious trajectory, in which the negative values for EV and SV are halved by 2030 and gone

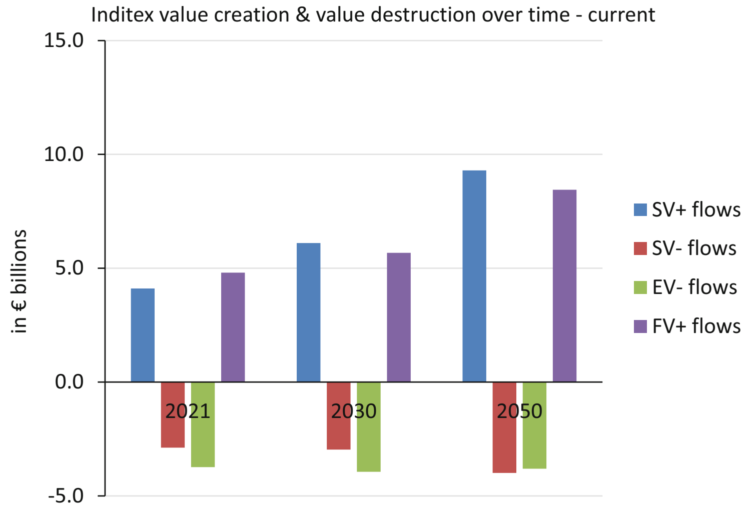

Fig. 11.9 Inditex's composition of annual value flows over time—current trajectory

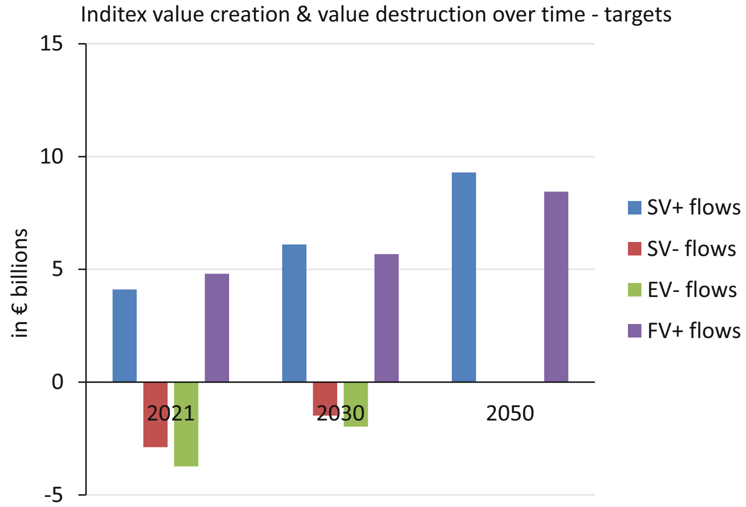

Fig. 11.10 Inditex's composition of annual value flows over time—ambitious trajectory

in 2050. Ideally, the company presents targets in line with this figure and communicates to investors accordingly.

Typical investor presentations focus on the companies' performance on F, sometimes with a bit on S and E—but not as types of value in their own right. Instead, companies could show projections of value flows like Figs. 11.9 and 11.10. But they will admittedly only present these projections if they put the company in a positive light. In the absence of reporting on SV and EV, moreover, we do not expect them to

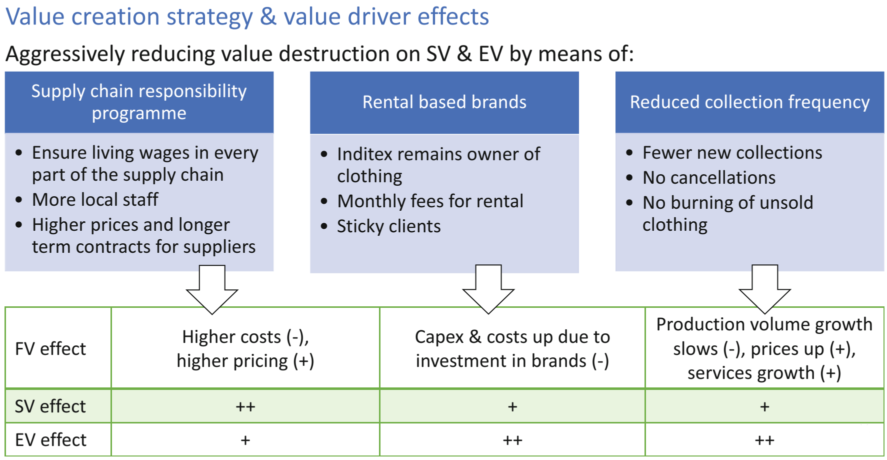

Fig. 11.11 Hypothetical investor presentation slide for Inditex

explicitly make S and E values in their own right in investor presentations any time soon. Still, companies could better communicate on this by:

- Stating their targets on F, S, and E;
- Showing the path to achieving them;
- Explaining how these targets and types of values affect each other.

Figure 11.11 gives an indication of how that can be done.

Some companies are already doing this. An example is the Asahi slide shown in Box 7.1 of Chap. 7. Ideally, companies show a slide like Asahi's 'Our approach to sustainability investment', as well as subsequent slides that further explain how this is being done and what it means for specific value drivers. For example, Inditex might indicate that a recycled clothing brand has lower physical product volumes, but higher service volumes, higher profit margins, and better E flows.

11.6 Conclusions

This analysis of Inditex shows that it is possible to (roughly) estimate a company's SV and EV from the outside. That is important: the language of business is money, and by expressing S and E in monetary terms, we make them visible, and more likely to be managed. Research among investors has shown that the willingness to pay for positive impacts is higher when investors have a value estimate (Brodback et al., 2021). The same could apply to corporate managers: when considering an investment with an NPV of −€50 million that reduces GHG emissions, it likely helps them to know that the corresponding environmental value improvement is well in excess of that €50 million.

The analysis also makes clear that much crucial data is missing, forcing us to make a lot of assumptions. As a result, our estimates are quite imprecise. Still, the analysis is valuable. First, for the company itself: it shows where the problems are and helps them to think in terms of trade-offs and new business models. Second, on a systems level: it gives clear indications of what kind of data is needed and should be reported on. Many currently reported KPIs are not that helpful in value terms, and we (investors, regulators, NGOs, etc.) can and should ask companies for more (F, S, and E) value relevant reporting.

Ideally, Inditex hires an expert advisor like Impact Institute to build impact-weighted accounts for them. From the inside, the analysis can go much deeper than we did here. And while doing that analysis, company management learns valuable lessons on the nature of its value creation (and destruction) processes. Part of the internal analysis would be disclosed externally, allowing us to understand the company and its competitors better. Companies that make impact statements raise the bar, both for themselves and for the industry, including their competitors and stakeholders.

Key Concepts Used in This Chapter

Business models are the ways in which companies make money

E flows are the value flows on environmental capital

External impacts refer to value creation or destruction by companies for others (i.e. external stakeholders)

Financially material issues are those issues that affect the company's financial value drivers and valuation

Monetisation factors are prices or damages by which units of E and S can be multiplied to arrive at EV and SV

Purpose is the reason a company exists

S flows are the value flows on social capital

Stakeholder impact map is a matrix that outlines stakeholders; what they want; what they get; and what kind of frictions exist between them

Value drivers are the factors that drive valuation; for F, they are sales, margins, and capital; for E and S, they are the relevant units and monetisation factors; and for S, E, and F, there are underlying issues (in the nature of the business model) that drive the value drivers.

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Part IV

Risk, Return and Impact

Risk-Return Analysis

12

Overview

Risk-return analysis is central to financial decision-making. The basic idea is that risk-averse investors ask compensation for higher risk, in the form of a risk premium on risky assets. The chapter starts with an historical overview of risk and realised return over the last century. This overview highlights the risk of the downturn of the business cycle, including major downturns like the Great Depression of the 1930s and the Global Financial Crisis of 2008/2009, putting stock prices downwards.

The key insight of *portfolio theory* is that a company's risk, at least as measured by the distribution of its historical stock returns, can be split into systematic or market-wide risk and idiosyncratic risk. As idiosyncratic risk can be diversified away in a portfolio, investors are only rewarded with a risk premium for the market risk component. The Capital Asset Pricing Model, which is commonly used, states that in equilibrium all investors hold a combination of the risk-free asset, such as government bonds, and the market portfolio; and that expected returns only contain a risk premium for market risk as measured by beta.

But historical risk-return analysis has limitations in accurately assessing current and future financial risk. So, this chapter also explores forward-looking measures of financial risk and return. It is important to include the social and environmental risks as well. We expand the single market model to a multifactor model by adding social and environmental factors. This allows us to derive the influence of social risk and environmental risk on financial risk.

Yet, another step is to assess social and environmental risk in their own right, as well as their impact on integrated risk. This, in turn, allows us to estimate the cost of integrated capital, which is the subject of Chap. 13. And that should give corporate managers the tools to make that assessment in their investment decisions. Company examples show that integrated risk-return analysis leads to different, and more sustainable, decisions. See Fig. 12.1 for a chapter overview.

Learning Objectives

After you have studied this chapter, you should be able to:

D. Schoenmaker, W. Schramade, *Corporate Finance for Long-Term Value*, Springer Texts in Business and Economics, https://doi.org/10.1007/978-3-031-35009-2_12

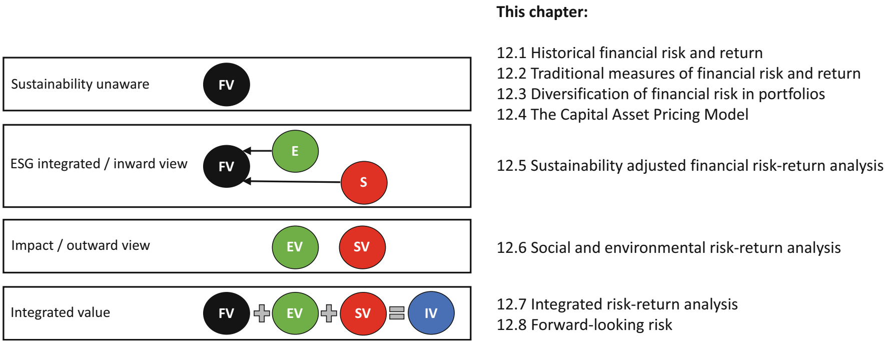


Fig. 12.1 Chapter overview

- analyse risk and return profiles for all types of capital
- differentiate risk-return profiles between various types of financial instruments and various types of capital
- apply rules of thumb in assessing risk-return in corporate investment decisions
- evaluate the pros and cons of various measures of risk and return
- analyse risk in both backward-looking and forward-looking ways

12.1 Historical Financial Risk and Return

Financial return and financial risk are central to financial decision-making. It all boils down to two key questions for investors:

1. *Financial return*: what can you earn on investing in an asset?
2. *Financial risk*: what can you lose on holding an asset?

Investors are assumed to be risk averse, so they ask compensation for higher risk in the form of a risk premium on risky assets. We start our analysis of return and risk with historical realised annual returns. The average annual return $\overline{r}$ is the average realised return for years $n = 1$ to N:

$$\text{Average annual return}: \overline{r} = \frac{1}{N} \cdot (r_1 + r_2 + \ldots + r_N) = \frac{1}{N} \cdot \sum_{n=1}^{N} r_n \tag{12.1}$$

Table 12.1 documents the global average annual returns from 1870 to 2015 for 16 countries (14 European countries together with the USA and Japan). Analysing the rate of return on a number of asset classes, Jorda et al. (2019) find that the nominal return on equities is about 10.5%, on government bonds 6%, and on Treasury bills 4.5%. Treasury bills are short-term government bonds with a maturity of up to 1 year.

Table 12.1 Global average annual returns from 1870 to 2015 (in 16 countries)

Asset class	Average nominal returns	Average real returns	Decadal moving average real returns
Treasury bills	4.6%	1.0%	−5% to +6%
Government bonds	6.1%	2.5%	−7% to +8%
Equities	10.7%	6.9%	−4% to +15%
Risk premium (relative to bills)	6%	6%	0% to 13%
Risk premium (relative to bonds)	4.5%	4.5%	0% to 13%

Source: Jorda et al. (2019)
Note: The risk premium is the return on equities minus the return on treasury bills or government bonds (the risk-free rate)

Because of wide differences in inflation across time and countries, it is helpful to compare returns in real terms. Inflation $i_{i,t} = \frac{(CPI_{i,t} - CPI_{i,t-1})}{CPI_{i,t-1}}$ is the realised consumer price index (CPI) inflation rate in a given country i and year t. Inflation-adjusted real returns r^r for an asset class is:

$$\text{Real return}: r^r = \frac{(1+r)-(1+i)}{1+i} = \frac{r-i}{1+i} \approx r - i \tag{12.2}$$

$$= \text{nominal return} - \text{inflation}$$

Given an average inflation of about 3.5% over the 1870–2015 period, real returns are lower than nominal returns in Table 12.1. The returns are also volatile. While Sect. 12.2 provides more detailed measures of volatility (risk), here we use a broad measure to provide an overview: the decadal moving average is the average return over the last 10 years (decade). It is called a moving average because each year, the current year's return replaces the latest year's return. This long-term average provides a straightforward picture of the variation in a time series. The decadal moving average of real returns on equities fluctuates between −4% and + 15% over the 1870–2015 period. The risk premium, an important indicator in asset pricing, is measured as the return on a risky asset class, such as equities, minus the return on a safe asset, such as bills or bonds (see Eq. 12.8 in Sect. 12.2 below). Table 12.1 shows that the historical risk premium relative to bills is about 6% for equities, while the historical risk premium relative to bonds is 4.5%.

The aggregate picture hides significant variation within and between asset classes due to differing risk profiles. Not all equity markets have been equally successful over this long period. Dimson et al. (2021) document real annualised equity returns in local currencies over the 1900–2020 period, ranging from 1% for Austria and 2% for Italy, to over 6% for Australia, South Africa, Sweden, and the USA. They also find significant variation in equity risk premiums (relative to Treasury bills) over that same period, from 3% in Belgium, Spain, and Norway, to 6% in the USA, South Africa, Finland, Australia, Germany, and Japan (see Fig. 12.2).

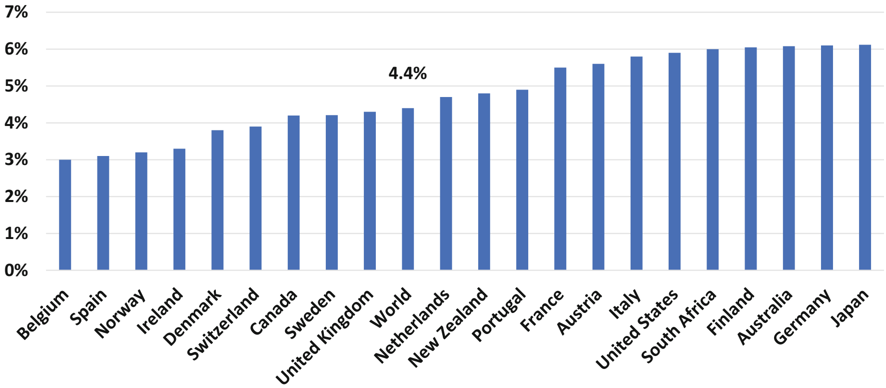


Fig. 12.2 Equity risk premiums (relative to bills) from 1900 to 2020 (for 21 countries). Source: Data from Dimson et al. (2002, 2021). Note: The risk premium is the return on equities minus the return on bills (the risk-free rate)

Table 12.2 Equity returns from 1870 to 2015

	Equity		
Time period	Real capital gain	Dividend income	Real total return
Full sample	2.8%	4.1%	6.8%
Post-1950	4.7%	3.8%	8.4%

Source: Jorda et al. (2019)

While Dimson et al. (2021) report an average world equity risk premium relative to bills of 4.4% and relative to bonds of 3.1%, Jorda et al. (2019) find 6% and 4.5%, respectively, in Table 12.1. Note that the number of countries and time period of analysis are different. We show both sets of figures to highlight differences in reported numbers. When you consult different data sources, it is very common to get slightly different numbers.

We now focus on equity returns. The total annual return on a financial asset r can be divided into two components: the capital gain from the change in the asset price P and a yield component y that reflects the cash-flow return on an investment.

$$\text{Total return}: r_{t+1} = \frac{P_{t+1} - P_t}{P_t} + y_t \tag{12.3}$$

$$= \text{capital gain} + \text{dividend yield}$$

For equities, the yield is the dividend yield (which is calculated as the dividend payment divided by the stock price). Table 12.2 shows that for the total return of equities both the capital gain and dividend income are important. Table 12.2 also shows that more recent returns (from 1950 to 2015) are higher than over the full sample period (1870–2015). A further breakdown of the post-1950 period in Fig. 12.3 shows that real returns on equities and government bonds have been

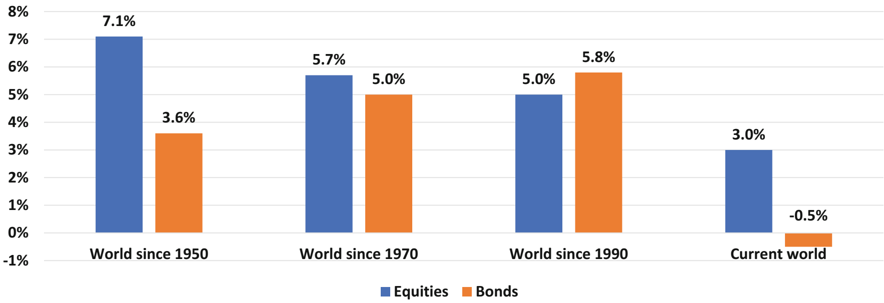


Fig. 12.3 Real returns over selected time periods (for 21 countries). Source: Data from Dimson et al. (2021)

relatively high until the 1990s. Only current returns in the low interest environment from 2015 to 2021 have been very low: 3% for equities and −0.5% for government bonds. The high (until recently) returns on financial capital seem to be at the expense of social and natural capital, which have been reduced (Dasgupta, 2021).

Example 12.1 shows how the historical return of an individual stock can be calculated using data on stock prices and dividend payments.

Example 12.1 Calculating Historical Stock Returns

Problem

What is the realised annual return for Philips stock in 2020?

Solution

From stock market data, we can take the stock prices and dividends of Philips over 2020. We assume that dividends are reinvested. The table provides these data.

Date	Price	Dividend
31/12/19	43.96	
4/6/20	41.97	0.85
31/12/20	43.78	

Using Eq. 12.3, we can calculate the historical total return:

$$r_{t+1} = \frac{P_{t+1} - P_t}{P_t} + y_t = \frac{43.78 - 43.96}{43.96} + \frac{0.85}{43.96} = 1.52\%$$

So, the 2020 return on the Philips stock is 1.52%, which is a combination of a drop in the stock price of −0.41% and a dividend yield of 1.93%. ◄

Historical series show that returns can turn negative during wars and times of crisis. The bill rate, which is a proxy for the risk-free rate, averages about 1% (Table 12.1). The decadal moving average fluctuates from −4% during WWI in the 1910s; to +6% post WWI in the 1920s ahead of the Great Depression of the

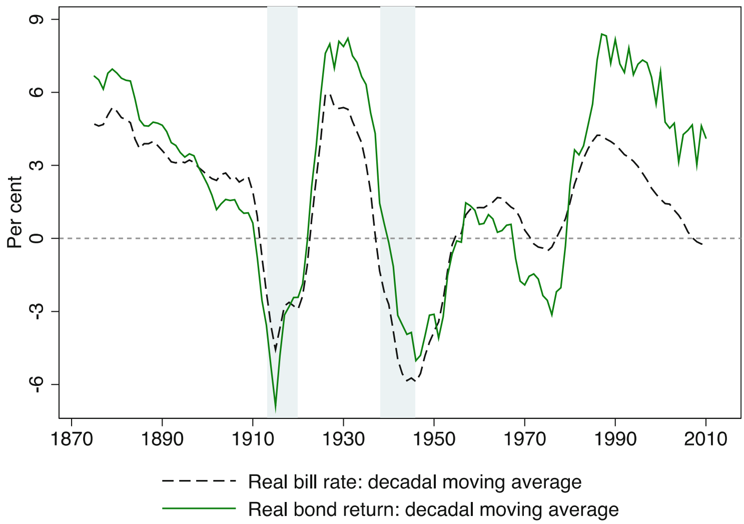


Fig. 12.4 The real bill rate from 1870 to 2015. Source: Adapted from Jorda et al. (2019)

1930s; and then again to −5% during WWII in the 1940s (see Fig. 12.4). More recently, the decadal moving average of the bill rate moved up to 3% in the 1980s and subsequently declined to 0% in 2015 (Jorda et al., 2019). This decline was driven by an increase in the premium paid for holding such safe and liquid assets and by lower global economic growth.

12.2 Traditional Measures of Financial Risk and Return

Asset pricing has several ways to slice and dice financial risks for investors. An investor typically uses standard measures for risk and return.

While assets or projects can be expressed in prices or cash flows, their performance is typically measured as a return r: the percentage increase in the value of an investment per euro invested in the asset. Risky assets have uncertain returns in the future. The probability distribution shows the distribution of returns, by assigning a probability or likelihood p_r to each possible return. Figure 12.5 shows the probability distribution of an asset.

Given the distribution of returns, we can now calculate the expected or mean return $E[r]$ as a weighted average of possible returns, with the probabilities as weights:

$$\text{Expected return} : E[r] = \sum_r p_r \cdot r \tag{12.4}$$

$$= \text{probability} \times \text{each possible return}$$

We illustrate the calculations with a stock that costs €100 today, with possible prices in 1 year of €95 (with 25% probability), €110 (with 50% probability), and

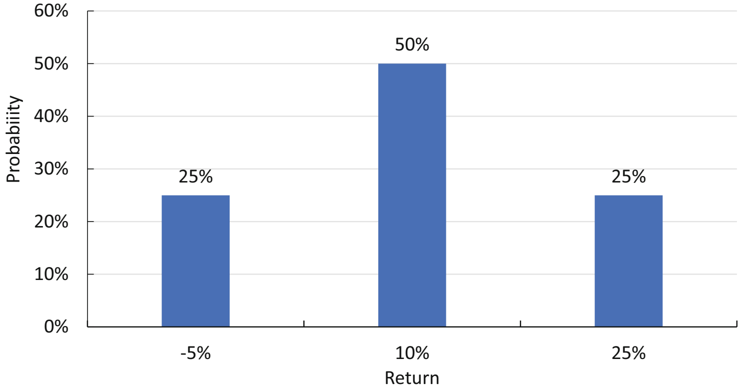


Fig. 12.5 Probability distribution of returns

Table 12.3 Probability distribution of returns for a stock

Current stock price	Stock price in 1 year	Probability distribution	
		Return r	Probability p_r
€100	€95	−5%	25%
	€110	10%	50%
	€125	25%	25%

€125 (with 25% probability). Table 12.3 shows the set-up. Using Eq. (12.4), the expected return of the stock can be calculated as follows: $E[r] = 25\ \% \cdot -5\ \% + 50\ \% \cdot 10\ \% + 25\ \% \cdot 25\ \% = 10\%$.

12.2.1 Variance and Standard Deviation

The standard statistical measures of the risk probability distribution are variance and standard deviation. [1] The variance of the return distribution is the expected squared deviation from the mean return in Eq. (12.4):

$$\text{Variance}: Var[r] = E\left[(r - E[r])^2\right] = \sum\nolimits_r p_r \cdot (r - E[r])^2 \tag{12.5}$$

The standard deviation is simply the square root of the variance:

$$\text{Standard deviation}: SD[r] = \sqrt{Var(r)} \tag{12.6}$$

The variance is typically written as σ^2 and the standard deviation as σ. The variance shows the spread of the distribution of the returns. On the one extreme, a return is risk-free, when it does not deviate from its mean. By contrast, a distribution

[1] This applies to the normal distribution, which is commonly used for asset returns.

Table 12.4 Average annual returns and risk from 1870 to 2015 (in 16 countries)

Asset class	Average annual returns	Standard deviation
Treasury bills	4.6%	3.3%
Government bonds	6.1%	8.9%
Equities	10.7%	22.6%

Source: Jorda et al. (2019)

of returns with a wide spread has a high variance. The variance of our stock return is: $Var[r] = 25\ \% \cdot (-5\ \% - 10\%)^2 + 50\ \% \cdot (10\ \% - 10\%)^2 + 25\ \% \cdot (25\ \% - 10\%)^2 = 0.01125$, and the standard deviation is $SD[r] = \sqrt{Var(r)} = \sqrt{0.01125} = 0.106$. As the standard deviation is typically expressed as a percentage, the standard deviation of the stock is 10.6%. The standard deviation can predict future values with a certain confidence level (about 68% for 1 standard deviation). In finance, this standard deviation is also called the volatility of a stock. Table 12.4 reports the standard deviation of the asset classes from Table 12.1. As discussed before, stocks are far more volatile at 22.6% than government bonds and Treasury bills. Treasury bills, which proxy for the risk-free rate, has the lowest volatility at 3.3%.

Example 12.2 provides a further illustration of calculating a stock's expected return and volatility. The advantage of the above risk measures is that they are straightforward to calculate, which explains their popularity in use. However, they do not correspond well with how people experience and interpret risk, and they might not be very representative of future risks, as we will see in Sects. 12.5–12.8 of this chapter.

Example 12.2 Calculating the Expected Return and Volatility

Problem

Suppose stock X is equally likely to have a 20% return or a −10% return. What are the stock's expected return and volatility?

Solution

We can calculate the expected return by taking the probability-weighted average of possible returns (Eq. 12.4):

$$E[r] = \sum\nolimits_r p_r \cdot r = 50\% \cdot 0.20 + 50\% \cdot -0.10 = 5.0\%$$

Next, we can calculate the variance (Eq. 12.5):

$$Var[r] = \sum\nolimits_r p_r \cdot (r - E[r])^2 = 0.50 \cdot (0.20 - 0.05)^2 + 0.50 \cdot (-0.10 - 0.05)^2$$
$$= 0.0225$$

Finally, the volatility (or standard deviation) is the square root of the variance (Eq. 12.6):

$$SD[r] = \sqrt{Var(r)} = \sqrt{0.045} = 15\%$$ ◀

12.2.2 Historical Returns and Historical Volatility

As the future probability distribution of returns is not known, investors use historical returns to calculate the expected return and volatility of assets. The historical return is the realised return over a particular time period in the past. The underlying assumption is that the volatility of historical return patterns provides a good indicator or proxy of future risk. However, structural changes at companies and in the wider economy, including sustainability trends, violate this assumption, as we discuss later in this chapter.

In Sect. 12.1, we show how the average return (Eq. 12.1) and total return (Eq. 12.3) of assets for specific time periods can be calculated on the basis of realised annual returns. The variance and volatility of historical returns can also be calculated. Over a timespan of N periods, each return gets an equal weight of $\frac{1}{N}$ which means that $p_r = \frac{1}{N}$. But there is one peculiarity. Calculations in Eqs. (12.5) and (12.6) are based on the mean or expected return. As we do not know the mean, we use the best estimate for the mean, which is the average realised return. In doing that, we have to divide by $N - 1$ rather than N because we lose one piece of independent information (called one degree of freedom) in the estimation. The variance of realised returns then becomes:

$$\text{Variance of realised returns}: Var[r] = \frac{1}{N-1} \cdot \sum_{n=1}^{N} (r_n - E[r])^2 \qquad (12.7)$$

The standard deviation or volatility of realised annual returns is again the square root of the variance of realised returns. We can now calculate the average annual return and volatility of assets classes. Table 12.4 above shows these data on a global level for 16 countries. Table 12.5 shows historical returns and volatility for the USA, the largest market. Berk and DeMarzo (2020) distinguish between the large companies that are part of the S&P 500 index and small stocks. Small stocks or companies are far riskier (with close to 40% volatility) than large companies (with 20% volatility) for several reasons. Small stocks are traded less frequently and are

Table 12.5 Average annual returns and volatility for the USA, from 1926 to 2017

Asset class	Average annual return	Standard deviation
Treasury bills	3.4%	3.1%
Corporate bonds	6.2%	6.4%
S&P 500	12.0%	19.8%
Small stocks	18.7%	39.2%

Source: Berk and DeMarzo (2020)

thus less liquid, leading to a larger bid-ask spread. Next, small companies often have less of a track record based on a proven business model. Finally, by their very size, small companies are less able to absorb shocks without defaulting.

Example 12.3 calculates the historical return and volatility of an individual stock. The high average annual return at 200% and the very high volatility at 347% in this particular case (Tesla stock) show the importance of diversification. Diversification will moderate the return, but even more so will reduce the volatility, as firm-specific risk is eliminated in a diversified portfolio.

Example 12.3 Calculating the Historical Return and Volatility

Problem

What is the annual historical return on Tesla stock and the volatility from 2017 to 2020? Tesla is a growth company and has not paid any dividends to date. So, all we need to know is the stock price development.

Solution

From stock market data, we can take the stock prices of Tesla over the 2017–2020 period. The table provides these data in the first two columns.

Date	Price	Annual return
31/12/16	42.74	
31/12/17	62.27	45.69%
31/12/18	66.77	7.23%
31/12/19	86.08	28.92%
31/12/20	705.67	719.78%

Using Eq. 12.3, we can calculate the historical annual return for 2017:

$$r_{t+1} = \frac{P_{t+1} - P_t}{P_t} = \frac{62.27 - 42.74}{42.74} = 45.96\%$$

The annual returns are reported in the third column. The average annual return (Eq. 12.1) is then:

$$\overline{r} = \frac{1}{N} \cdot \sum_{n=1}^{N} r_n = 200.41\%$$

The variance of the Tesla stock is very high. Using Eq. 12.7, the variance is

$$Var[r] = \frac{1}{N-1} \cdot \sum_{n=1}^{N} (r_n - E[r])^2 = 12.01$$

Finally, the volatility is the square root of the variance (Eq. 12.6):

$$SD[r] = \sqrt{Var(r)} = \sqrt{12.01} = 346.61\%$$

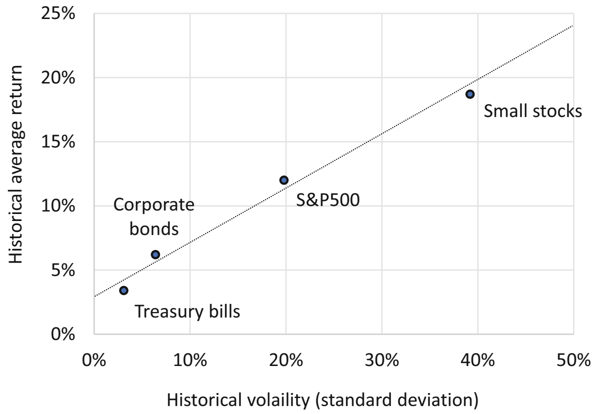


Fig. 12.6 Historical trade-off between risk and return, USA, 1926–2017. Source: Adapted from Berk and DeMarzo (2020)

So, Tesla is a real growth stock (at least up to 2020) and extremely volatile as well. ◀

Risk-averse investors demand a higher reward—in the form of a higher return—for higher risk. Figure 12.6 suggests that this relationship is more or less linear. As bills are seen as a risk-free asset for investors r_f, the expected return in excess of the bill rate is the risk premium RP that investors receive for holding a risky asset i:

$$\text{Risk premium}: RP = E[r_i] - r_f \tag{12.8}$$

$$= \text{expected asset return} - \text{risk-free rate}$$

Looking at the historical trade-off between risk and return, an interesting question is: over which minimum period would stocks dominate government bonds? In a long time-series of stock and government bond returns, Siegel (2020) finds that US stocks have outperformed US bonds in every 30-year period since 1850, though that neared zero in the Great Depression of the 1930s and again in the Global Financial Crisis of 2008–2009. Over shorter holding periods, the cumulative return on a stock portfolio could occasionally drop below the cumulative return on a bond portfolio. In particular that can happen during financial crises when stock markets collapse (see Fig. 12.7).

12.3 Diversification of Financial Risk in Portfolios

The returns of individual companies usually don't move fully in tandem (or more technically, are not fully correlated). To hedge against risk, an investor may want to diversify its stock holdings in an investment portfolio. The classical example is to hold a portfolio with stock in a company that produces umbrellas and stock in another company that produces ice cream. Whatever the weather in the summer—rain or sunshine—the investor will make a return on one of the stocks. Thus, they

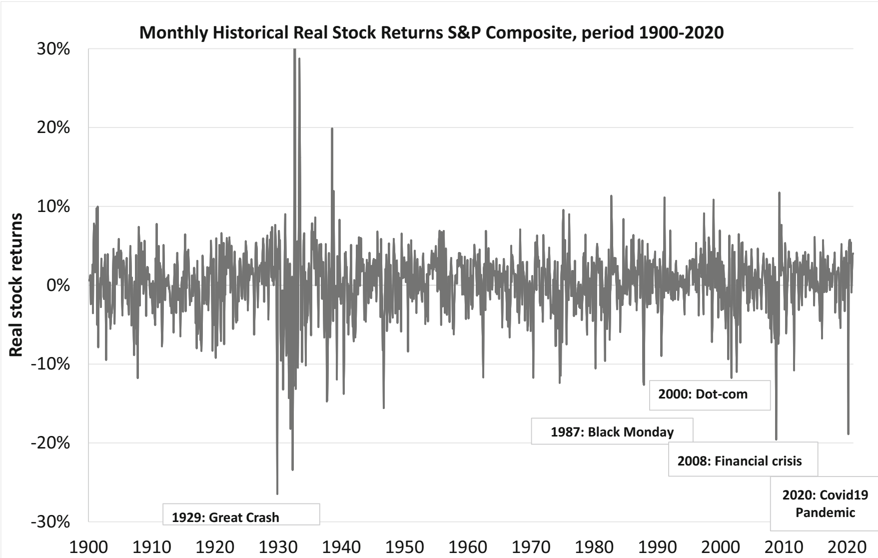


Fig. 12.7 Stock market performance and financial crises, 1900–2020

limit their potential losses, as well as upside potential. That is the principle behind portfolio diversification.

The risk of fluctuating stock prices can be split into:

1. *Firm-specific risk* that is unique to the company. This risk is called idiosyncratic risk and can be diversified in a portfolio; and
2. *Market risk* that is common to all companies. This risk is called systematic risk and cannot be diversified.

An example of market-wide or common risk is the business cycle. In a downturn, almost all companies will face reduced revenues and thus lower returns. Another source of common risk is changes in the policy rate of central banks. All companies are affected by changes in interest rates.

The question is how many stocks you need for a diversified portfolio. Statman (2004) shows that a well-diversified stock portfolio needs to include just 50–100 stocks to eliminate firm-specific or idiosyncratic variance of stock returns. There are smaller benefits of diversification beyond those 100 stocks, but they are exhausted when the number of stocks surpasses 300 stocks (see Fig. 12.8). Risk management should monitor that the stocks are not overly correlated (reducing their diversification potential) and are spread over sectors and countries. Moreover, diversification gains are mainly driven by a well-balanced allocation over different asset classes, like stocks, bonds, and real estate. Thus, for diversification it is more important to have a portfolio in each asset class (that can be more or less concentrated) than to

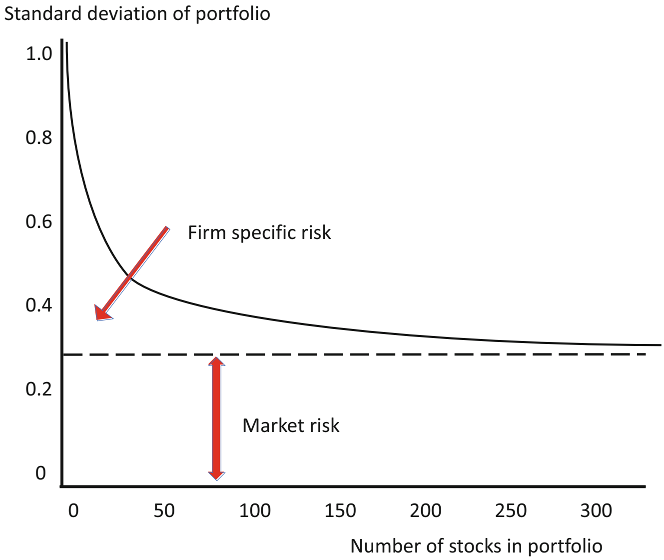


Fig. 12.8 Diminishing benefits of diversification. Source: Adapted from Statman (2004)

have a very diversified portfolio (beyond 100–300 securities) in a single asset class (Schoenmaker & Schramade, 2019).

12.3.1 Portfolio Return

We can calculate portfolio return and risk in a more formal way. The expected portfolio return r_p is a weighted combination of individual stock returns r_i, with weights x_i for each stock i:

$$\text{Expected portfolio return}: E[r_p] = \sum_i x_i \cdot E[r_i] \tag{12.9}$$

12.3.2 Variance of a Two-Stock Portfolio

Whereas the expected portfolio return requires a simple calculation, the derivation of portfolio risk is more difficult. Only when the stocks are fully correlated (that is, the spread of future outcomes for both stocks move fully in tandem), can we take the average of the individual standard deviations. This case is called perfect correlation: $\rho = 1$. In practice, most stocks have a correlation of less than 1: $0 \le \rho < 1$. Stocks can even be negatively correlated: $-1 \le \rho < 0$. That is likely the case for our umbrella and ice cream companies. If it is a rainy summer, the umbrella company has positive returns, while the ice cream company makes a loss. If it is a sunny summer, the profit and loss are reversed between the companies. Box 12.1 explains the role of correlation in stock markets.

Box 12.1 Correlation in Stock Markets

Correlation measures the degree to which two variables move in relationship to each other. In finance, it is often used to measure the co-movement of two stocks or the co-movement of a stock with the market index, such as the S&P 500.

The correlation coefficient ranges between -1 and 1: $-1 \leq \rho \leq 1$. We distinguish three cases:

1. Perfect correlation $\rho = 1$: This is an extreme case. In practice, companies in the same industry with similar characteristics (size, strategy, business model, workforce, etc.) may have a correlation close to 1. For example, the stock price of oil companies may react more or less similarly to news about changes in the oil price.
2. Positive correlation $0 \leq \rho < 1$: This is the most common case. Companies' stock prices may react slightly differently on economy-wide news, but the direction of the movement (up or down) is similar.
3. Negative correlation $-1 \leq \rho < 0$: Some companies behave countercyclically. An outplacement agency has more work in order to help laid-off workers during an economic downturn or recession, when most companies face reduced revenues lowering their stock price.

The portfolio variance is made up of the variance of the individual stocks and the covariance between the individual stocks. The covariance between two stocks σ_{12} is the product of the correlation coefficient ρ_{12} and the two standard deviations:

$$\text{Covariance}: \sigma_{12} = \rho_{12} \cdot \sigma_1 \cdot \sigma_2 \qquad (12.10)$$

The portfolio variance then becomes:

$$\text{Portfolio variance}: Var\left[r_p\right] = x_1^2 \cdot \sigma_1^2 + x_2^2 \cdot \sigma_2^2 + 2 \cdot x_1 \cdot x_2 \cdot \rho_{12} \cdot \sigma_1 \cdot \sigma_2 - i \qquad (12.11)$$

$$= \text{variance of two stocks} + \text{covariance between stocks}$$

Again, the standard deviation of a portfolio is the square root of the portfolio's variance. Example 12.4 illustrates the working of these formulas for a two-stock portfolio.

Example 12.4 Calculating Return and Volatility of Two-Stock Portfolio

Problem

Suppose there is a portfolio with two stocks X and Y, whose returns have the following characteristics:

Stock	Expected return	Standard deviation	Correlation
X	10%	20%	0.6
Y	15%	40%	

(a) What is the expected return and volatility of an equally weighted portfolio?
(b) What is the portfolio's volatility, if you demand an expected return of 12%?
(c) Which portfolio is more efficient?

Solution

(a) The expected return of the equally weighted portfolio is (Eq. 12.9):

$$E\left[r_p\right]=\sum_i x_i \cdot E[r_i]=50\% \cdot 0.10+50\% \cdot 0.15=12.5\%$$

Next, we can calculate the portfolio variance (Eq. 12.11):

$$Var\left[r_p\right]=x_1^2 \cdot \sigma_1^2+x_2^2 \cdot \sigma_2^2+2 \cdot x_1 \cdot x_2 \cdot \rho_{12} \cdot \sigma_1 \cdot \sigma_2=0.5^2 \cdot 0.2^2+0.5^2 \cdot 0.4^2 \\ +2 \cdot 0.5 \cdot 0.5 \cdot 0.6 \cdot 0.2 \cdot 0.4=0.074$$

Finally, the volatility is the square root of the variance (Eq. 12.6):

$$SD[r]=\sqrt{Var(r)}=\sqrt{0.074}=27.2\%$$

(b) The weights of the 12% return portfolio can be calculated using Eq. 12.9. You can solve the following equation: $x_1 \cdot 0.10 + (1 - x_1) \cdot 0.15 = 12.0\%$. The solution is $x_1 = 0.6$ and $x_2 = 1 - 0.6 = 0.4$. Alternatively, you can do it by trial and error.

Next, you can calculate the portfolio variance:

$$Var\left[r_p\right]=0.6^2 \cdot 0.2^2+0.4^2 \cdot 0.4^2+2 \cdot 0.6 \cdot 0.4 \cdot 0.6 \cdot 0.2 \cdot 0.4=0.063$$

Again, the volatility is the square root of the variance:

$$SD[r]=\sqrt{0.063}=25.1\%$$

(c) The efficiency of the portfolio depends on your criterion. For risk-averse investors, the second portfolio seems to be more efficient. Return is only reduced by 4% (i.e. 0.5% divided by 12.5%), while volatility is reduced by 8% (i.e. 2.1% divided by 27.2%). The first stock has far lower volatility and only slightly lower return; it is thus useful to tilt the two-stock portfolio towards the first stock. ◀

12.3.3 Variance of Large Portfolios

We can also derive the general formula for the variance of a portfolio with N stocks. The weight of each stock is: $x_i = \frac{1}{N}$. Figure 12.9 shows that for such a portfolio we have N cells with the variance of each stock $x_i^2 \cdot \sigma_i^2$ (the shaded diagonal cells), while the remaining $N^2 - N$ cells contain the covariances between stocks $x_i \cdot x_j \cdot \rho_{ij} \cdot \sigma_i \cdot \sigma_j$. Equation (12.11) can then be rewritten as follows:

$$\text{Portfolio variance}: Var\left[r_p\right] = N \cdot \left(\frac{1}{N}\right)^2 \cdot \sigma_i^2 + \left(N^2 - N\right) \cdot \left(\frac{1}{N}\right)^2 \cdot \rho_{ij} \cdot \sigma_i \cdot \sigma_j \tag{12.12}$$

$$= \frac{1}{N} \cdot \sigma_i^2 + \left(1 - \frac{1}{N}\right) \cdot \rho_{ij} \cdot \sigma_i \cdot \sigma_j$$

$$= \frac{1}{N} \times \text{average variance} + \left(1 - \frac{1}{N}\right) \times \text{average covariance}$$

As the number of stocks in the portfolio N increases, the portfolio variance becomes the average covariance of the stocks in the portfolio. The correlation of each stock with the portfolio thus determines its contribution to overall portfolio risk, while its own variance no longer matters. This is the core of portfolio diversification. Only the covariance of a stock's return with portfolio return (the systematic or market-wide risk) counts, while the unsystematic or idiosyncratic risk disappears in the portfolio. Example 12.5 shows how this is calculated.

Example 12.5 Calculating Variance of a Portfolio

Problem

An asset manager holds a very large equally weighted portfolio (that is, all stocks in equal weight). The stocks are from different countries and different industries, with a low correlation of 15% and a volatility of 30%. What is the volatility of the portfolio?

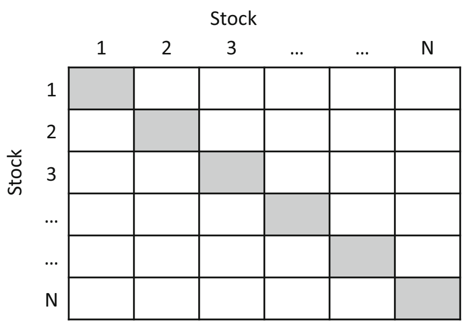


Fig. 12.9 Variance and covariance in a portfolio. Source: Adapted from Brealey et al. (2022). Note: The N-shaded diagonal cells contain the variance of each stock; the $N^2 - N$ remaining off-diagonal cells represent the covariance between stocks

Solution

First, note that the amount of stocks (N) goes to infinity for a very large portfolio. Using Eq. 12.12, $\frac{1}{N}$ goes to 0. So, the correct calculation of the portfolio variance is given by:

$$Var\left[r_p\right] = average\ covariance = \rho_{ij} \cdot \sigma_i \cdot \sigma_j$$

$$Var\left[r_p\right] = 0.15 \times 0.30 \times 0.30 = 0.0135$$

The portfolio volatility equals $\sqrt{0.0135} = 11.6\%$, which is lower than the volatility of the individual stocks at 30%. Diversification of stocks (with a correlation of less than one) thus pays off. ◄

12.4 The Capital Asset Pricing Model

The risk-return measures and the principles of portfolio diversification provide the building blocks for deriving the Capital Asset Pricing Model (CAPM). This is the main theory in finance explaining the relationship between risk and return. The short story is as follows: Investors can construct efficient portfolios of stocks with maximum return given risk. In equilibrium, all investors hold proportions of the market portfolio, which provides the best available risk-return combination. Next, a stock price's fluctuations can be split into market risk and firm-specific risk. As firm-specific risk can be diversified away in the market portfolio, the investor will only be rewarded for the market risk. The market risk, measured by a stock's beta, is the co-movement of a stock with the market portfolio. The reward for this market risk is the market risk premium.

The CAPM makes some strong assumptions which are summarised in Box 12.2. The CAPM starts with building the efficient frontier of risky stocks. As discussed in Sect. 12.3, diversification through combining risky stocks in a portfolio eliminates the idiosyncratic or firm-specific risk of individual stocks. An efficient portfolio is a stock portfolio whereby investors cannot increase return given the level of volatility. *The efficient frontier is then the combination of highest return portfolios for each volatility level*. Figure 12.10 depicts this efficient frontier (blue curve) in the so-called mean-variance framework, whereby the y-axis shows the expected return (mean) and the x-axis the risk measure of volatility (standard deviation as square root of the variance). Individual stocks lie below this efficient frontier (blue curve) because they carry both idiosyncratic (firm-specific) and market risk. Individual stocks are thus 'less efficient' in terms of risk-return.

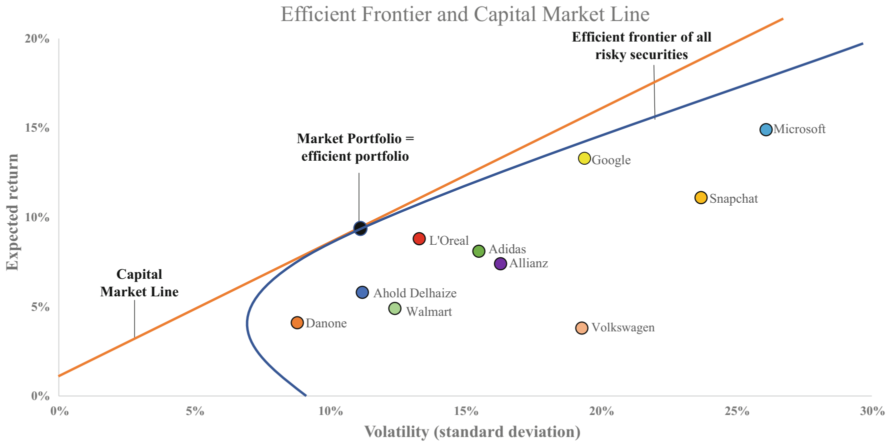


Fig. 12.10 The efficient frontier and capital market line. Note: The efficient frontier is based on monthly returns of the stocks from 2010 to 2021

Box 12.2 Assumptions Behind the CAPM

The CAPM makes several assumptions about individual investor behaviour and about market structure (Bodie et al., 2018).

Investor behaviour

- Risk-averse investors optimise risk-return (maximising return given the level of volatility)
- Investors have homogeneous expectations (they use identical information and draw the same conclusions from this information); this is consistent with the efficient market hypothesis (see Chap. 14)

Market structure

- All assets are publicly held and trade on market exchanges
- Investors can borrow and lend at a common risk-free rate
- There are no taxes or transaction costs

The next step is to choose the best stock portfolio on this efficient frontier for investors. Assuming that investors can freely borrow and lend, they hold a combination of the risk-free asset and an efficient portfolio. The capital market line (straight orange line) in Fig. 12.10 shows this combination. To earn the highest possible return given volatility, investors choose the portfolio with the steepest possible line; that is the line with the highest possible risk-adjusted return. This tangent portfolio provides the highest possible return for a given level of volatility of any (efficient) portfolio available; all other portfolios on the efficient frontier lie below the capital market line. Assuming that investors have homogeneous expectations, all investors want to hold this tangent portfolio. The tangent portfolio then becomes the market portfolio. A key insight of the CAPM is that all investors hold a combination of the risk-free asset and the market portfolio in equilibrium.

As all investors hold the same portfolio, an individual investor basically holds a share of the market portfolio. According to the CAPM, the market portfolio contains all available stocks in the market. In practice, this market portfolio is often represented by a market index of the largest companies in a stock market. Box 12.3 provides an overview of the leading market indices.

Box 12.3 Leading Market Indices

Each stock market has an index representing the largest companies traded in that market, also called the large caps. These stocks are the most liquid. Companies are keen to get in the market index, as that improves the tradability and visibility of their stock. Market indices can be equally weighted (all top 100 or top 500 companies get an equal weight in the index) or value-weighted (the top 100 or top 500 companies are weighted by their market capitalisation).

Some leading market indices are:

- the S&P 500 for the USA
- the STOXX Europe 600 for Europe
- the FTSE 100 for the United Kingdom
- the Shanghai SE Composite Index for China
- the Nikkei 225 for Japan

At the global level, international investors use:

- the MSCI World Index which covers over 1500 large and mid-cap companies across 23 developed markets
- the FTSE All-World index which covers over 3100 companies in 47 countries

Next, we need to derive a stock's co-movement with, or sensitivity to, the market portfolio. This co-movement is the covariance of the stock with the market portfolio, as explained in Sect. 12.2. A stock's beta β_i measures the sensitivity of that stock's return, to the return on the market portfolio. Or more precisely, the co-movement of the stock's fluctuations σ_i with the fluctuations of the market portfolio σ_{mp}. We use the correlation coefficient $\rho_{i,\,mp}$ to measure the co-movement. The beta of stock i is calculated as follows:

$$\text{Beta} : \beta_i = \frac{\sigma_i \cdot \rho_{i,mp}}{\sigma_{mp}} \tag{12.13}$$

Beta thus measures the sensitivity of a stock to market-wide risk factors: to what extent are a company's revenues and costs related to general economic conditions? Building on Eq. 12.8, the market risk premium RP_{MKT} is the expected market return minus the risk-free rate:

$$\text{Market risk premium}: RP_{MKT} = E[r_{MKT}] - r_f \tag{12.14}$$

$$= \text{expected market return} - \text{risk-free rate}$$

We can now estimate the cost of equity capital for a company. Remember that the investor is only rewarded for the systematic or market risk embedded in the company's stock price. The cost of equity then becomes a combination of the risk-free rate and the market risk:

$$\text{Cost of equity}: r_i = r_f + \beta_i \cdot \left(E[r_{MKT}] - r_f\right) \tag{12.15}$$

$$= \text{risk-free rate} + \beta_i \times \text{the market risk premium}$$

Equation (12.15) is the central risk-return relationship of the CAPM. The calculation of the cost of equity depends on the time period for which the risk-free rate and the market risk premium are estimated. Using historical data from Table 12.1 with a risk-free rate of 4.5% and a risk premium of 6%, the cost of equity capital for a stock with a beta of 1 becomes: $r_i = 4.5\ \% \ + 1.0 \cdot [6.0\%] = 10.5\%$. The most recent estimates from Fig. 12.3 are a risk-free rate of 2% (which is a combination of the real bill rate of −0.5% and an inflation of 2.5%) and a market risk premium of 3%. This leads to a far lower cost of equity: $r_i = 2.0\ \% \ + 1.0 \cdot [3.0\%] = 5.0\%$, which reflects the low rate situation in the 2010s and early 2020s.

Example 12.6 shows how the beta and the cost of equity of individual companies can be calculated. It appears that with relatively little information—only the stock's volatility and its correlation with the market portfolio—a company's cost of equity capital can be calculated in a straightforward way.

Example 12.6 Calculating the Beta and Cost of Equity

Problem

Suppose the S&P 500 has an expected return of 7% and a volatility of 15%. Apple stock has a volatility of 19% and has a correlation of 0.6 with the market. Oracle Corporation stock has a volatility of 35% and a correlation of 0.4. Assume the risk-free rate is 2%. Calculate the cost of equity capital for Apple and Oracle, by first deriving their beta.

Solution

First, calculate the beta of Apple and Oracle using Eq. 12.13:

$$\beta_{Apple} = \frac{\sigma_A \cdot \rho_{A,S\&P}}{\sigma_{S\&P}} = \frac{0.60 * 0.19}{0.15} = 0.76$$

$$\beta_{Oracle} = \frac{\sigma_O \cdot \rho_{O,S\&P}}{\sigma_{S\&P}} = \frac{0.4 * 0.35}{0.15} = 0.93$$

The sensitivity of Apple to the S&P 500 is 0.76. That means if the S&P 500 moves 1%, Apple tends to move 0.76%. Oracle's market exposure is a bit higher with a beta of 0.93. We use Eq. 12.15 to calculate the firm's cost of equity capital:

$$r_{Apple} = r_f + \beta_A \cdot \left(E[r_{S\&P}] - r_f\right) = 0.02 + 0.76 * (0.07 - 0.02) = 5.8\%$$

$$r_{Oracle} = r_f + \beta_O \cdot \left(E[r_{S\&P}] - r_f\right) = 0.02 + 0.93 * (0.07 - 0.02) = 6.7\%$$ ◀

The final step of the CAPM is the security market line (SML), which shows the graphic representation of the risk-return relationship. The security market line in Fig. 12.11 plots the expected return against the beta of each stock or portfolio. The slope is the risk premium of the market portfolio: the market portfolio with $\beta_{MKT} = 1$ on the x-axis delivers the expected return on the market portfolio $E[r_{MKT}]$ on the y-axis in Fig. 12.11. Following Eq. 12.15, the SML is an easy tool. Given the market-related risk of an investment (measured by its beta), the SML shows the required return necessary to compensate investors for risk as well as the time value of money. 'Fairly' priced stocks should be exactly on the SML, whereby only the systematic or market risk of a stock is priced in and compensated.

Limitations to Measures of Historical Risk and Return

The traditional risk-return models discussed so far are essentially based on patterns of historical financial returns and volatility. Using backward-looking statistics, the

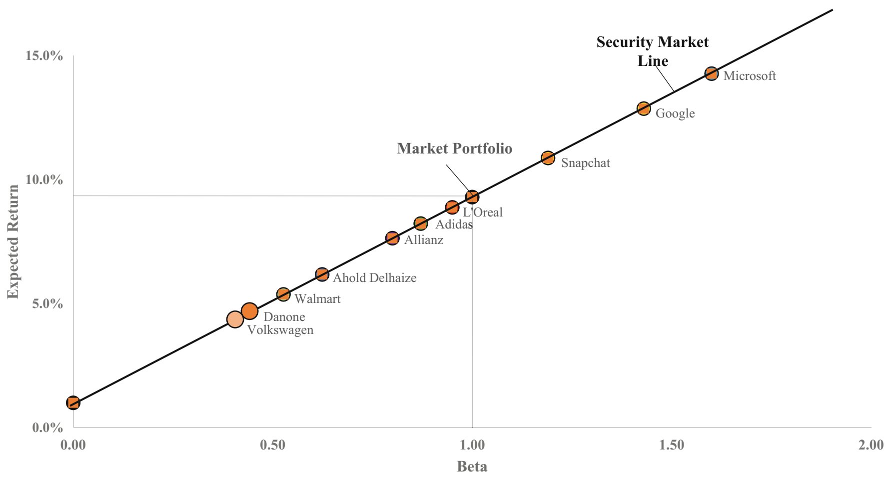


Fig. 12.11 The security market line. Note: The stocks in the security market line are taken from Fig. 12.10

implicit assumption is that the risk-return relationships remain the same in the future. But that is subject to the Lucas critique. Lucas (1976) basically argues that the structure of the historical relationships will change, when the nature of the assets changes due to policy changes. So historical relationships are not always a good guide for the future. Government policies (or stakeholder pressure) to address sustainability challenges, as discussed in Chaps. 1 and 2, may well turn the tables on the stock market. Profitable companies in the past may become stranded assets in the future (often quoted examples are oil and tobacco companies), while new companies providing solutions to the sustainability challenges rise in value (e.g. Tesla with its electric cars).

Next, there are severe limitations to the benchmarks that are used by investors. Box 12.3 provides an overview of commonly used market indices. However, market indices change a lot over time. Dimson, Marsh, and Staunton (2021) document some major changes in the:

1. Weightings of countries:
   (a) In 1900, the United Kingdom accounted for 24% of global stock market value, followed by the USA (15%), Germany (13%), France (11%), and Russia (6%);
   (b) In 2021, the USA accounted for 56% of global stock market value, followed by Japan (7%), the United Kingdom (5%), China (4%), and France (3%). This geographic distribution is much more skewed, with a dominant position for the USA.
2. Weightings of sectors:
   (a) In 1900, rail made up over 60% of the US stock market, and almost 50% of the UK stock market. Other large sectors in both markets in 1900 were banking; mining; iron, coal & steel; utilities; textiles; and tobacco.
   (b) In 2021, large sectors were technology, industrials, health, retail, banking, and oil & gas. Most of these sectors have much fewer physical assets and much more intangible assets.

A case in point is the position of the oil industry. Box 12.4 discusses the rise and decline of the oil industry, supporting the Lucas critique. *More broadly, today's market index represents yesterday's industry. Old companies and industries are slowly fading out, while new companies and industries are added after much delay*. Only when a company becomes large enough, will it be included in the main index. Moreover, some sustainable companies of the future have yet to be established. Historical patterns are therefore an incomplete guide to the future. Section 12.8 discusses forward-looking measures of risk.

Box 12.4 The Oil Industry Now and in the Future

The stock market shows the rise and likely decline of the oil & gas industry. At the turn of the twentieth century, oil companies, such as Standard Oil established in 1870 by Rockefeller, started to emerge. By the late twentieth century, oil companies such as Exxon, Shell, and BP, were among the largest companies in the world. In the USA, Big Tech has already replaced the oil sector, which is now less than 5% of the US stock market. In the United Kingdom, the oil sector still makes up about 10% of the stock market.

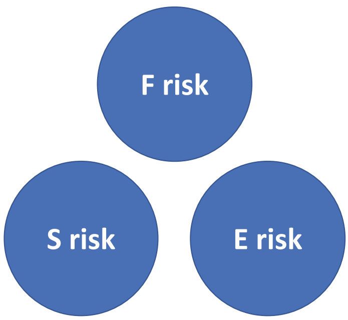
Rising carbon taxes shift the focus from fossil fuels to renewable energy. The European Green Deal aims to reduce carbon emissions by 55% in 2030 and to zero by 2050. So, the share of the oil sector is expected to shrink accordingly, as fossil fuels are a major source of carbon emissions.

Another limitation is that stock prices react primarily to news about financial risks, as reported quarterly and annually by companies in their financial reports. Up until now, there has been less attention paid to other risk indicators, such as social and environmental risks. The next sections explore how these limitations can be overcome.

12.5 Sustainability Adjusted Financial Risk-Return Analysis

As discussed, stock prices react primarily to news about financial risks as reported by companies, as well as broader economic news. There is less attention for other risk indicators, such as social and environmental risks. These risk indicators are not themselves financial in nature, but could have financial implications. Equity analysts are not asking for this type of information in analyst calls with senior management (see Chap. 17). Even if companies report on these other risks, analysts still target their questions towards understanding the quarterly financial results. Following Lukomnik and Hawley (2021), we suggest including social and environmental risks as sources of systematic risk, to get a full picture of a company's financial performance and risk. Figure 12.12 illustrates the multiple risk sources of systematic risk.

Fig. 12.12 Risk sources of systematic risk



Just like financial risk in the previous section (Sect. 12.4), social and environmental risks can be split into idiosyncratic (firm-specific) risks, which can be diversified, and systemwide risks, which cannot be diversified. An increase in temperature (due to climate change) or a loss of biodiversity now, may lead to lower economic growth (and thus lower financial returns or more financial risk) in the future. These environmental risks are then additional sources of systematic risks, which are priced with a risk premium in the cost of capital or discount rate (see below). By contrast, an instance of water pollution by an individual company is an idiosyncratic risk, which is not priced because it can be diversified.

How to integrate the systematic aspects of social and environmental risks in our cost of equity capital calculations? In the risk-return relationship of the CAPM (Eq. 12.15), a stock's return depends on its co-movement with the market. The market risk premium captures a wide range of financial and macroeconomic risks in a single factor. We expand this single-factor model to a multifactor model by adding social and environmental risk factors as sources of systematic risk. In this multifactor model, a company's adjusted cost of equity capital r_i is:

$$\text{Adjusted cost of equity capital}: r_i = r_f + \beta_i^{MKT} \cdot RP_{MKT} + \beta_i^{SF} \cdot RP_{SF} + \beta_i^{EF} \cdot RP_{EF} \quad (12.16)$$

$$= \text{risk-free rate} + \beta_i^{MKT} \times \text{market risk premium} + \beta_i^{SF} \times \text{social risk premium} + \beta_i^{EF} \times \text{environmental risk premium}$$

Similar to the market risk premium MKT in Eq. 12.14, the social and environmental risk premiums RP_{SF} and RP_{EF} can be defined as follows:

$$\text{Social risk premium}: RP_{SF} = E[r_{SF}] - r_f \quad (12.17)$$

$$= \text{expected return on social factor} - \text{risk-free rate}$$

$$\text{Environmental risk premium}: RP_{EF} = E[r_{EF}] - r_f \quad (12.18)$$

$$= \text{expected return on environmental factor} - \text{risk-free rate}$$

The market risk premium is the excess return (that is, the return in excess of the risk-free rate) on the market portfolio. Just like the market portfolio has unit exposure $\beta^{MKT} = 1$ to market risk, we can construct factor-mimicking portfolios that have unit exposure to the social factor $\beta^{SF} = 1$ and environmental factor $\beta^{EF} = 1$, respectively, and zero exposures to the other factors. The expected returns on the social and environmental factor portfolios determine the social and environmental risk premiums in Eqs. 12.17 and 12.18.

12.5.1 Social and Environmental Factor Portfolios

In this setting, we add social and environmental factor portfolios to the market portfolio of the CAPM. How do we derive the other two portfolios? We can devise trading strategies that capture social risk and environmental risk, respectively, which is not captured by the market portfolio.

The construction of the portfolios is based on the S(ocial) and E(nvironmental) pillar of companies' ESG rating. ESG ratings summarise a company's performance on environmental, social, and governance issues, as measured by an ESG rating agency (see Chap. 14). For example, the environmental factor portfolio could be constructed by taking the bottom third of the E rating of the STOXX Europe 600 companies in Europe (or the S&P 500 companies in the USA). These companies form a value-weighted portfolio called the brown portfolio. Next, the top third of the E rating of the STOXX Europe 600 companies form a value-weighted portfolio called the green portfolio.

A trading strategy that takes a long position in the brown portfolio, which it finances with a short position in the green portfolio, produces the environmental risk premium. The long position means that the investor owns the brown portfolio, while the short position means that the investor has to deliver the green portfolio. This portfolio which is long in brown stocks and short in green stocks is called the brown-minus-green (BMG) E portfolio. So, this environmental factor portfolio is long on high E risk companies (companies with a low E rating) and short on low E risk companies (companies with a high E rating) and nicely captures the environmental risk premium.

A similar trading strategy can be set up by taking the bottom third of the S rating (bad S companies) and the top third of the S rating (good S companies) of the STOXX Europe 600 companies. This bad-minus-good (BMG) S portfolio captures the social risk premium.

12.5.2 Challenges of the Multifactor Model

There are several challenges in the application of the multifactor model in practice. The first challenge is to construct the social and environmental factor portfolios based on ESG ratings. As discussed in Chap. 14, the data quality of ESG ratings is currently not very high, but is expected to rise over time. The second challenge is to derive social and environmental risk premiums from financial market data. Remember that the social and environmental risk premium are estimated by trading the social and environmental factor portfolios in the market. As explained earlier, the derivation of the risk-return relationship in the CAPM makes the assumption of efficient financial markets (see Box 12.2). The *efficient markets hypothesis* states that stock prices incorporate all relevant information (Fama, 1970). By contrast, the *adaptive markets hypothesis* argues that the degree of market efficiency depends on an evolutionary model of individuals adapting to a changing environment (Lo, 2004, 2017). Chapter 14 discusses the information efficiency of markets in more detail.

Social and environmental risks have only recently been considered as relevant for stock prices, often after major news events. Examples are big litigation cases against tobacco companies based on the health effects of smoking and against oil companies on not adhering to the Paris climate agreement of 2015. Pastor et al. (2022) find an average environmental risk premium of 1.4% (per year) for US companies over the 2012–2020 period. The environmental risk premium increases from 1.2% in 2012 to 1.9% in 2017–2020. Their findings are based on a broad environmental score, across 13 environmental issues related to climate change, natural resources, pollution, and waste.

On a narrow scope, Bolton and Kacperczyk (2023) investigate the relationship between carbon emissions and stock returns. They find that a one-standard deviation increase in emissions yields higher annual stock returns of 3.6% for scope 1 emissions and 4.6% for scope 3 emissions. In their overall sample of 77 countries, Bolton and Kacperczyk (2023) find that there was no significant carbon premium right before the Paris agreement, but a highly significant and large premium in the years after the agreement. This suggests that the Paris agreement has changed investors' awareness regarding the impending regulatory changes to combat climate change. Interestingly, Bolton and Kacperczyk (2023) interpret the carbon premium (in the form of higher returns) as a reward for carbon transition risk, which reflects the uncertain rate of adjustment towards carbon neutrality.

On the social side, there are no estimates yet based on a broad social score. On a narrow scope, Hong and Kacperczyk (2009) find a risk premium for sin stocks (alcohol, tobacco, and gaming) of 2.5% per year for US companies over the 1965–2006 period. A more recent study finds a risk premium for the same sin stocks of 2.8% per year for US companies over the 1999–2019 period (Zerbib, 2022). Table 12.6 summarises the findings on environmental and social risk premiums. More targeted studies typically find larger premiums than broad-based factor portfolios. Table 12.6 shows an environmental risk premium of 1.9%. The social risk premium is lower and likely to be in the range of 1.0–1.5%.

But there is also evidence that stock prices do not discount certain social or environmental risks efficiently. Hong et al. (2019) investigate the impact of droughts on food stock prices. They find that food stock prices underreact to increased drought

Table 12.6 Environmental and social risk premiums

Type of risk premium	Annual risk premium	Period	Companies
Environmental risk premium			
* Broad environmental pillar	1.2–1.9%	2012–2020	US
* Carbon risk premium	3.6–4.6%	2005–2018	Global
Social risk premium			
* Broad social pillar	n.a.	n.a.	n.a.
* Sin risk premium	2.5% 2.8%	1965–2006 1999–2019	US US

risk. Other social and environmental risks, such as human right violations, underpayment, biodiversity loss, and water scarcity, may also not (yet) be considered as systematic risk sources by analysts and thus not (yet) be incorporated in stock prices.

The market beta β_i^{MKT} (as in the CAPM) measures the sensitivity of company i to financial and economy-wide risks. The factor betas, β_i^{SF} and β_i^{EF}, measure the company's sensitivity to social risk (e.g. public health; social inequality; safety and health of workers; low wages in supply chain) and environmental risk (e.g. carbon emissions; biodiversity loss; pollution; waste). The social and environmental beta coefficients can be interpreted as follows:

- $\beta_i^{SF}, \beta_i^{EF} > 1$ reflect relatively high exposure indicating that this company is not prepared for the sustainability transition
- $0 < \beta_i^{SF}, \beta_i^{EF} < 1$ reflect relatively low exposure indicating this company is partly prepared for transition
- $\beta_i^{SF}, \beta_i^{EF} < 0$ reflect that the company's activities will likely benefit financially from transitions.

12.5.3 Working of the Multifactor Model

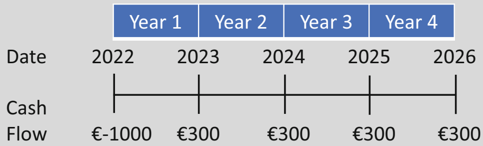
The working of the multifactor model can be illustrated with some hypothetical examples. Chapter 13 discusses company cases. Let's start with the environmental risk premium for carbon emissions. Box 12.5 illustrates that differences in sensitivity to carbon risk lead to different discount factors and project values. A lower carbon exposure leads to a higher value of a project with the same underlying cash flow pattern, due to a lower discount factor.

A similar example is given for the social risk premium. When a company invests in factory safety, it does not only reduce the interruption of the production process (less revenues lost), but it also reduces its social risk exposure as it improves the safety of its employees. An often-used indicator for safety performance is the lost-time injury frequency rate (LTIFR), which refers to the number of lost-time injuries within a given accounting period, relative to the total number of hours worked in that period. Box 12.6 shows how we can calculate the combined production and employee safety benefits of an investment in factor safety.

The factor safety investment already showed how a company can improve its risk profile. This is important for companies that want to put their business model on a more sustainable footing. The choice of the appropriate discount rate for new projects is crucial. Box 6.3 in Chap. 6 illustrated how Shell, a major oil company, turned down an investment opportunity to reduce its carbon emissions, because it used the wrong discount rate (i.e. too high discount rate) leading to a lower valuation.

Box 12.5 Impact of Differing Carbon Intensity on Discounting and Values

We consider three projects with identical cash flows, but differing carbon intensity. The basic set-up is an initial investment of €1000 and four annual net inflows of €300.



The first project is an investment in a forestry project, whereby trees capture carbon. The project has a negative environmental beta of 0.5: $\beta_1^{EF} = -0.5$. The second project concerns the investment in a low-carbon technology, with a beta of 0.2: $\beta_2^{EF} = 0.2$. The third project invests in a high-carbon technology, with a beta of 1.2: $\beta_3^{EF} = 1.2$. The projects have unit exposure to market risk $\beta_i^{MKT} = 1.0$ and no exposure to social risk $\beta_i^{SF} = 0$. We further assume a risk-free rate of 2%, a financial risk premium of 4%, and an environmental risk premium of 2%. We can now calculate the adjusted cost of equity capital with Eq. 12.16, which moves from $5.0\ \% \ = 2\ \% \ + 1 * 4\ \% \ - 0.5 * 2\%$ for project 1, to $6.4\ \% \ = 2\ \% \ + 1 * 4\ \% \ + 0.2 * 2\%$ project 2 and $8.4\ \% \ = 2\ \% \ + 1 * 4\ \% \ + 1.2 * 2\%$ for project 3.

Project	Environmental betaβ_i^{EF}	Adjusted cost ofequity capital r_i	Adjusted Net Present Value NPV_i
1	−0.5	5.0%	€63.8
2	0.2	6.4%	€30.1
3	1.2	8.4%	€−15.1

Using Eq. 4.4, we can calculate the adjusted net present value of the project. The first project has the highest net present value of $€\ 64 = -1{,}000 + \frac{300}{(1+0.05)} + \frac{300}{(1+0.05)^2} + \frac{300}{(1+0.05)^3} + \frac{300}{(1+0.05)^4}$, as future cash flows are more valuable due to the low discount rate. The low-carbon project has only a small mark-up on the financial discount rate and has an adjusted net present value of €30. The high-carbon project has a high discount factor due to the large exposure to carbon risk, resulting in a negative adjusted net present value of € −15.

Box 12.6 Investment in Safety

A company is contemplating an investment in the safety of one its factories. The factory is currently generating an annual net cash flow of €10,000.

We assume a unit exposure to market risk $\beta_i^{MKT} = 1.0$, average exposure to social risk $\beta_i^{SF} = 0.6$, and no exposure to environmental risk $\beta_i^{EF} = 0$. We further assume a risk-free rate of 2%, a financial risk premium of 4%, and a social risk premium of 1%. The adjusted cost of equity capital for this company (Eq. 12.16) is $r_i = 2\ \% + 1 * 4\ \% + 0.6 * 1\ \% = 6.6\%$. Using Eq. 4.5, we can now calculate the present value of this factory as $PV = \frac{CF}{r} = \frac{€\ 10{,}000}{6.6\%} = €\ 151{,}515$.

The safety investment requires an initial investment of €2500 and leads to improved annual cash flows of €100 due to less disruption in the production process. The increased safety of the factory results in a lower beta for social risk: $\beta_i^{SF} = 0.5$, yielding a lower adjusted cost of equity capital for the company $r_i = 2\ \% + 1 * 4\ \% + 0.5 * 1.0\ \% = 6.5\%$. The present value of this investment is $PV = -2{,}500 + \frac{€\ 100}{6.5\%} = € - 962$. On the face of it, the company will decline this safety investment proposal. However, there is also a reduction in the social risk profile of the factory leading to a lower discount factor. The present value of the company now becomes: $PV = \frac{€\ 10{,}000}{6.5\%} = €\ 153{,}846$, an improvement of € 2331. The safety investment thus turns into an overall profitable project of €1369 and should be done (Table 12.7).

The advantage of the multifactor model is that it accounts for E risks and S risks, but only to some extent. Its effectiveness is limited by the quality of data, and transitions are typically not well accounted for (see Chap. 2). Nor does it give measures of adaptability and robustness to shocks. It is up to further research to explore those issues.

Table 12.7 Impact of differing carbon discount factors

Project base	Social risk beta β_i^{SF}	Adjusted cost of equity capital r_i	Adjusted net present value NPV_i
A. Before the safety investment			
Value factory	0.6	6.6%	€ 151,515
B. After the safety investment			
Safety investment	0.5	6.5%	€ –962
Value factory	0.5	6.5%	€ 153.846
Overall value increase			
Safety investment	–0.1	–0.1	€ –962
Improved factory safety			€ 2331
Total value increase			€ 1369

12.6 Social and Environmental Risk-Return Analysis

The previous Sect. 12.5 derived the adjusted cost of financial capital by including the effects of social and environmental risks on the financial risk-return relationship. The next step for calculating the integrated risk-return is examining the social and environmental risk-return relationship. Chapter 4 already explained that the stakeholders of a company's social and environmental value are part of wider society. These stakeholders include employees, consumers, suppliers, (local) communities, and future generations. The social discount rate is the appropriate discount rate for these stakeholders. Equation 4.8 provides the basic social discount rate for social and environmental value:

$$\text{Basic social discount rate}: r^s = \delta + \eta \cdot g \tag{12.19}$$

The first parameter δ reflects the time preference between current and future generations. Equal treatment of current and future generations gives us a time preference of zero: $\delta = 0$. See Sect. 4.3 for a full discussion of the rationale for a zero-time preference in social discounting. The growth rate g is driven by growth in consumption. Given a diminishing marginal utility of consumption, the growth rate is multiplied by the elasticity of marginal utility of consumption η. The elasticity measures how utility changes with consumption.

Next, we introduce risk into the social discount rate. There are several sources of risk related to the growth factor in Eq. 12.19:

1. *Growth risk*: the macroeconomic risk that the growth rate of consumption fluctuates;
2. *Company risk*: the correlation between company risk and growth risk;
3. *Catastrophe risk*: the extreme element of macroeconomic risk of rare disasters (deep recessions) or society collapse.

Fluctuations of the growth rate give rise to uncertainty about future growth of consumption. Gollier (2012) adds a prudence term for uncertainty about consumption growth (based on the variance of consumption growth σ_g^2). Uncertainty about future consumption leads to higher precautionary investing in the future, today. The prudence term is therefore deducted from the social discount rate, as the resulting lower social discount rate increases the present value of future benefits of investing. This in turn leads to higher precautionary investing.

Next, company risk and growth risk can be correlated. As with the CAPM, we can distinguish between a systematic and an unsystematic component. The unsystematic component (unexpected additional social and environmental benefits or costs) can be diversified away. The systematic component presents the relationship between macroeconomy fluctuations (again measured by σ_g^2) and uncertainty about the social and environmental benefits of the company. This systematic component is added to the social discount rate.

The risk premiums for growth and company risk are very small (less than 0.1%) and opposite (Gollier, 2012). The main reason for the small risk premiums is the low variance of consumption growth. We therefore exclude these risk premiums from the social discount rate formula for practical reasons.

The final source of risk is represented by the catastrophic risk parameter L. The rationale for this risk parameter is the likelihood that there will be some catastrophic event so devastating that social and environmental returns from companies are eliminated. Catastrophe risk can be seen as an extreme form of systematic company risk. The futurologist, Toby Ord (2020), distinguishes between man-made catastrophes, such as unaligned artificial intelligence and engineered pandemics, and natural catastrophes, such as supervolcanic eruptions or a comet impact. Ord (2020) argues that the probability of man-made catastrophes is far higher (in the relatively near future) than that of natural ones. His estimate of a catastrophe happening at some point in the next 100 years is 1 in 6. Box 12.7 shows how the 100-year catastrophe risk rate can be translated into an annual risk parameter L of 0.2%.

Box 12.7 Calculating Annual Catastrophe Risk

Ord (2020) estimates the probability of a catastrophe occurring in the next 100 years as 1 in 6, which is 16.7%. The 100-year survival rate of 83.3% (=100–16.7%) can be transformed into an annual survival rate of 99.8% as $\sqrt[100]{0.833} = 0.998$. So, the annual catastrophe risk parameter L amounts to 0.2% (=100–99.8%). Of course, this risk parameter is based on Ord's subjective evaluation of the occurrence of catastrophes. Nevertheless, it provides a 'ballpark' parameter for thinking about catastrophe risk.

Building on Eq. 12.19, we expand the social discount rate r^s with a risk parameter L:

$$\text{Expanded social discount rate}: r^s = \delta + \eta \cdot g + L \tag{12.20}$$

We are now ready to estimate the expanded social discount rate. As explained in Chap. 4, Dasgupta (2021) sets the time preference δ at 0% and growth g at 1.3%. Reviewing several studies, Groom and Maddison (2019) find an elasticity η of 1.5. The final parameter is Ord's catastrophic risk parameter L of 0.2%. Summing these parameters, Table 12.8 calculates a social discount rate of 2.2%.

Table 12.8 Parameters for the expanded social discount rate

Social discount rate $r^s = \delta + \eta \cdot g + L$ with $g = 1.3\%$			
Time preference δ	Elasticity η	Risk parameter L	Discount rate r^s
0%	1.5	0.2%	2.2%

Source: Authors based on Groom and Maddison (2019), Ord (2020), and Dasgupta (2021)

12.7 Integrated Risk-Return Analysis

We are now ready to wrap the components together in the cost of integrated capital. Eq. 12.16 provides us the adjusted cost of equity capital r_i. For the sake of simplicity, we assume full equity financing—the cost of equity is then the cost of financial capital. Chapter 13 introduces the cost of financial capital as weighted average of the cost of equity and the cost of debt. Eq. 12.20 gives the expanded social discount rate r^s for social and environmental capital. The cost of integrated capital r_i^{IV} is then the weighted average of these costs of capital:

$$\text{Cost of integrated capital}: r_i^{IV} = \frac{FV}{IV} \cdot r_i + \frac{SV + EV}{IV} \cdot r^s \tag{12.21}$$

The weights are provided by the company's respective value components: FV, SV, and EV divided by integrated value: $IV = FV + SV + EV$. In this way, the weights add up to one. The value components are introduced in Chaps. 5 and 6. Subsequent chapters show how to estimate the value components for companies. Please note that the value components can be negative. The derivation of the cost of integrated capital is relatively easy once one knows the adjusted cost of equity capital r_i and the cost of social and environmental capital r^s.

Given that the adjusted cost of equity capital is higher than the cost of social and environmental capital $r_i > r^s$, companies with relatively more social and environmental value face a lower cost of integrated capital than companies with lower or negative social and environmental value. Example 12.7 presents differing costs of integrated capital. The medtech company with positive social value faces a cost of integrated capital of 4.7%, while the oil company with negative environmental value faces a cost of integrated capital 20.3%. This difference is very large. The difference in the adjusted cost of financial capital is far smaller: 6% for the medtech company versus 9% for the oil company. The big difference in the cost of integrated capital of the two companies is caused by the difference in the risk profile of the two companies: the medtech's social assets (lowering its cost of integrated capital) and the oil company's environmental liabilities (strongly increasing its cost of integrated capital).

Example 12.7 Calculating the Cost of Integrated Capital

Problem

Suppose an oil company's cost of financial capital is 9% and its cost of social and environmental capital is 2.2%. Next, a medtech company has a cost of financial capital of 6% and a similar cost of social and environmental capital of 2.2%.

The value dimensions are as follows:

Value dimension	Oil company	Medtech company
Financial value	8	4
Social value	−1	3
Environmental value	−4	−1
Integrated value	*3*	*6*

What is the cost of integrated capital of the two companies?

Solution

Using Eq. 12.21, we can calculate the cost of integrated capital:

$$r_i^{IV} = \frac{FV}{IV} \cdot r_i + \frac{(SV + EV)}{IV} \cdot r^s$$

For the oil company, the cost of integrated capital is:

$$r_{oil}^{IV} = \frac{8}{3} \cdot 9\% + \frac{(-1-4)}{3} \cdot 2.2\% = 20.3\%$$

And for the medtech company, the cost of integrated capital is:

$$r_{med}^{IV} = \frac{4}{6} \cdot 6\% + \frac{(3-1)}{6} \cdot 2.2\% = 4.7\%$$

The table below gives an overview of both companies' cost of integrated capital as well as the individual cost of capital components:

Cost of capital	Oil company	Medtech company
Financial	9.0%	6.0%
Social	2.2%	2.2%
Environmental	2.2%	2.2%
Integrated	*20.3%*	*4.7%*

◄

12.8 Forward-Looking Risk

Given the limitations of historical or backward-looking risk measures as discussed in Sect. 12.4, it makes sense to develop forward-looking risk measures that are able to take transitions into account. Figure 12.13 illustrates the time connection between backward- and forward-looking risk. Forward-looking risk measures tend to be of a more qualitative nature. The challenge is to quantify them.

But let's take a step back and consider alternative definitions of risk. In his book 'The most important thing', hedge fund manager Howard Marks says 'There are many kinds of risk. But volatility may be the least relevant of them all', with

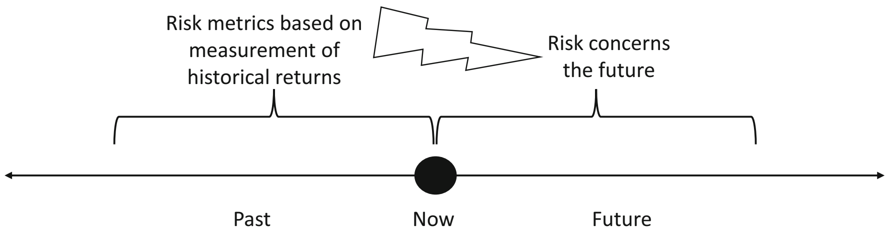


Fig. 12.13 Backward and forward-looking risk

volatility chosen by academics just for its measurement convenience (Marks, 2011, p35). In Marks' view, risk is the likelihood of losing money, the possibility of permanent financial loss. In a large survey with finance professionals, Holzmeister et al. (2020) also find that finance professionals perceive the probability of losses as the strongest risk indicator, and not volatility (the most common risk measure in finance). [2] This financial loss aversion could be extended to the possibility of permanent nonfinancial losses, like permanent negative social and/or environmental impact.

Marks (2011) also identifies other, secondary types of risk that are important because they affect behaviour, such as the risk of falling short of one's goals, risk of underperformance, career risk, risk of being considered unconventional, and illiquidity risk. And just like the main risk of losing money, these risks are not quantified in a straightforward and standard way. But there are ways to quantify them, such as:

- Scenario analysis;
- Options analysis (see Chap. 19); and
- Replace historical parameters in models with forward-looking estimates.

12.8.1 Scenario Analysis

Scenario analysis is a process of analysing possible future events by considering alternative possible outcomes (sometimes called 'alternative worlds'), as discussed in Chap. 2. Scenario analysis can be used to analyse the effects of possible future events on the value of a company. The scenario construction process requires some choices on parameters (TCFD, 2020):

[2] In technical terms, the mean is the first moment of a distribution of returns, the variance (or volatility) is the second moment, and the skewness is the third moment. Skewness measures the asymmetry of a distribution. Loss aversion means that investors prefer a distribution that is skewed to the right (which means less losses at the left side of the distribution).

- *Time horizon*: sufficiently long;
- *Number and diversity of scenarios*: 3–4 differing scenarios;
- *Focal question*: critical question that company (or investor) wants to address;
- *Drivers of change*: main clusters of risk;
- *Impact on companies*: translate scenarios into impact on companies;
- *Probabilities of scenarios*: assign probabilities to scenarios.

A first parameter is the time horizon. The time horizon should be short enough to be plausible and long enough for important changes with an impact on future business to take place. For climate transition scenarios, typical horizons are 2030 and 2050. Another parameter is the number and diversity of scenarios. Typically 3–4 scenarios are chosen, which are sufficiently different.

Important parameters are selecting the focal question and the most important drivers of change for that question. Critical questions seek to gain insight into the impact of an overarching trend or phenomenon on the company. Examples of such overarching trends are climate change, water scarcity, digitalisation, demographics, and labour practices in the value chain (e.g. human rights and living wage).

The next step is to identify the underlying drivers of change. In the case of climate change, for example, typical clusters of drivers are policy or technology induced transition risk (risk of transition to low carbon) and environmentally-driven physical risk (risk of flooding or drought). Figure 12.14 provides an example of a scenario matrix for climate risk, which is relevant for carbon-intensive sectors. On the vertical axis, the driver is physical risk: scenarios 1 and 2 have high physical risk with global warming. On the horizontal axis, the driver is transition risk: scenarios 2 and 4 have high transition risk with impact on carbon-intensive companies.

In the case of other focal questions, a company has to choose the relevant drivers of change, like demographics (early vs late ageing), labour practices (early vs late

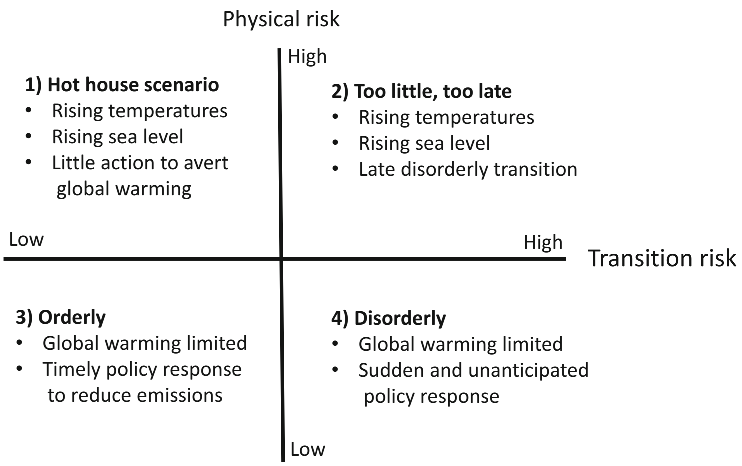


Fig. 12.14 Scenario matrix for climate risk

Table 12.9 Valuations calculated for scenarios for oil company

	No transition by 2030	Transition by 2030
Company does not change	\$50 (30%)	\$0 (30%)
Company does position for transition	\$40 (20%)	\$60 (20%)

Table 12.10 Transition scenarios weighted valuation for Inditex

	No transition by 2030	Transition by 2030
Company does not change	€31.9 (24%)	€10.4 (16%)
Company does position for transition	€22.5 (36%)	€28.4 (24%)

implementation of living wage), innovation (rapid vs slow), or digitalisation (early vs late digitalisation). The appropriate choice of question and drivers depends on the sector, as each industry is facing its own medium to long-term challenges.

The next step is to assess how a company is affected by the scenarios. Let's take an oil company with a current stock price of \$40. A valuation based on a simple extrapolation of current cash flows (business-as-usual scenario) delivers a stock price of \$50. That looks like the company is 20% undervalued in the market. But we can calculate the fair value of the company's stock based on climate transition risk scenarios. Table 12.9 shows the stock price under the various scenarios: the business-as-usual scenario (company does not change and no transition) with a value of \$50, the collapse scenario (company does not change and transition) with a value of \$0, the prepared but no transition scenario with a value \$40, and finally the prepared and transition scenario with a value of \$60.

The final step is to synthesise the scenario results by weighting the probabilities attached to each scenario, which add up to 100%. The probabilities are rough estimates of the likelihood of each scenario. Assigning probabilities to our company in Table 12.9 produces a fair price of \$35 (=0.3*\$50 + 0.3*\$0 + 0.2*\$40 + 0.2*\$60). So, the stock seems to be overvalued by 14% at the current market price of \$40.

12.8.2 Inditex Case Study

In Chap. 11, we did a similar analysis of Inditex's transition scenarios. Table 12.10 reproduces the numbers from Tables 11.7 and 11.8. Inditex's fair price is €24.2 (=0.24*€31.9 + 0.16*€10.4 + 0.36*€22.5 + 0.24*€28.4).

12.8.3 Strategy-Setting

Scenario outcomes can be used as input for the strategy-setting (see Chap. 2). The company can increase its value by better preparing itself for transition, and thus avoid the costly collapse scenario. Good management would take strategic action on its own initiative. Alternatively, investors can demand from the company that it prepares itself for transition in the process of engagement (see Chap. 3). If the company is not prepared to take action (and thus reduce its negative climate impact and increase its value), the investor may divest from the company as it is overvalued on the basis of the climate risk scenario analysis.

12.8.4 Transition Pathways

Scenario analysis can also be applied to the social and environmental impacts. It is rather time-consuming for investors to do scenario analysis for all its investee companies. There are several investor-led initiatives, in particular in the area of climate transition preparedness, to make these company assessments. An example is the Transition Pathway Initiative (TPI) that provides assessments of companies' preparedness for the transition to a low-carbon economy (TPI, 2021). TPI uses several climate benchmark scenarios:

- The most stringent is the Paris 1.5 °C global warming scenario;
- The medium benchmark is the 2 °C global warming scenario;
- The least stringent is the Paris pledges (to reduce emissions) by national governments.

Figure 12.15 shows the downward pathway for these benchmarks from 2015 to 2050. The global carbon reduction benchmarks are split into sectoral carbon

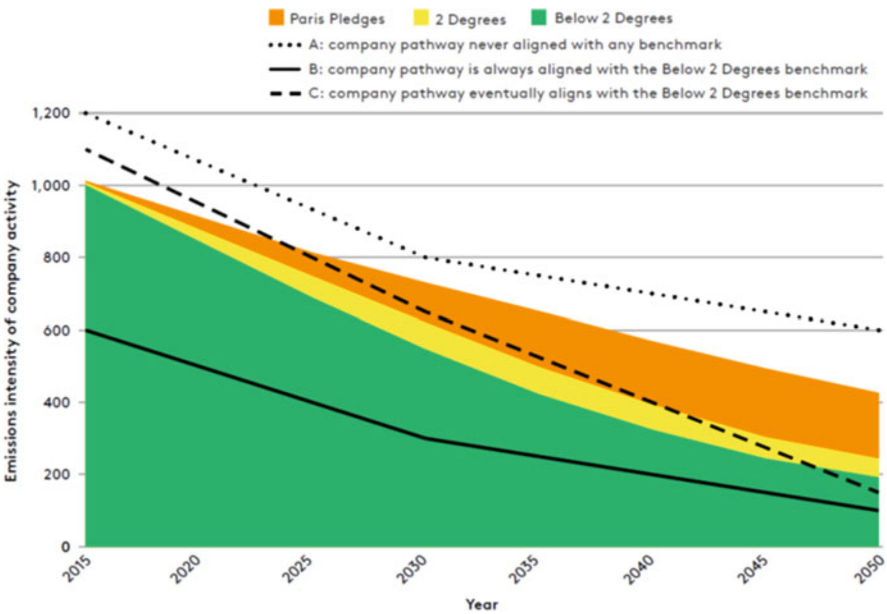


Fig. 12.15 Stylised examples of companies aligning with climate benchmarks. Source: Transition Pathway Initiative (2021)

benchmarks, for example, for electricity and steel. The assigned carbon budget for each sector is divided by activity (e.g. megawatt hours of electricity and tons of crude steel produced) to obtain sectoral carbon intensity benchmarks. Carbon intensity is defined as follows:

$$\text{Carbon intensity} : CI = \frac{carbon\ emissions}{activities} \tag{12.22}$$

The final step is to plot a company carbon reduction pathway against the benchmarks to check whether a company is Paris-aligned, and thus prepared for transition. If a company's emissions reduction pathway always lies above the Paris Agreement benchmarks, then clearly it cannot be described as Paris-aligned and transition prepared (line A in Fig. 12.15); and vice versa for a company whose pathway always lies below them (line B in Fig. 12.15). The difficult cases are those that lie in between (line C in Fig. 12.15). In this case, company C eventually becomes Paris-aligned, close to the finishing year of 2050. As company C has an overshoot in the early years, which is not compensated in later years, it is not aligned.

There is evidence of backloading in several sectors, like car manufacturing, cement, energy, and oil & gas. This means that TPI expects most reductions to take place towards the end of the Paris agreement (2050). The pathways take into account this backloading. Therefore, there is no 'excuse' for companies to be behind on the pathway, since it will stay behind in case of an increase in expected reductions from TPI.

12.8.5 Uncertainty

Scenario analysis has its limits. Good scenario planning designs diverse scenarios capturing the main sources of risk. And you should be able to assign probabilities to the scenarios. But the challenge is to account for real uncertainty in scenarios. Can you, for example, account for tail risks? Tails risk refers to the chance of a loss occurring due to a rare event (Taleb, 2007). In terms of probability distribution, tail risk involves an abrupt move of more than three standard deviations, while most risks are within one or two standard deviations from the mean (see Sect. 12.2). Real option analysis can be used to deal with uncertainty when the probability distribution is unknown (see Chap. 19).

12.8.6 Forward-Looking Indicators

There are topic-specific forward-looking indicators that can be applied as well. For example, for climate there is the Implied Temperature Rise (ITR). An asset's ITR indicates by how many degrees global temperatures would rise if the asset remained on its current pathway and all assets were alike. This may sound very theoretical, but

ITR allows for comparison across assets and asset classes and is an indicator of the risk that the asset will go out of business.

12.9 Conclusions

This chapter reviews historical risk and return patterns for various asset classes. Risk-averse investors demand a higher return for riskier assets. A company's risk can be split into systematic or market-wide risk; and idiosyncratic risk, which can be diversified away in a portfolio. Investors are only rewarded with a risk premium for the market risk component. The Capital Asset Pricing Model (CAPM) states that in equilibrium, all investors hold a combination of the risk-free asset, such as government bonds, and the market portfolio.

But historical risk-return analysis has a limited capacity for assessing future financial risk. Forward-looking measures of financial risk and return are also needed. Next, responsible investors want to include the social and environmental risks in their financial risk-return analysis. To do so, we expand the single market model of the CAPM into a multifactor model by adding social and environmental factors. This allows us to derive the risk premium for the adjusted cost of financial capital.

The final step is deriving the cost of social and environmental capital (as we did in Chap. 4). Combining the cost of the three capitals yields the cost of integrated capital. This cost of integrated capital gives corporate managers the tool to make an integrated risk-return assessment in their investment decisions. Company examples illustrate that integrated risk-return analysis leads to different, more sustainable, decisions.

Key Concepts Used in This Chapter

Adaptive markets hypothesis implies that the degree of market efficiency depends on an evolutionary model of individuals adapting to a changing environment

Beta measures the sensitivity of a company's stock price to general market movements (with reference to market, social or environmental risk)

Capital Asset Pricing Model (CAPM) is the main asset pricing model in finance explaining the relationship between risk and return

Capital market line is the combination of the risk-free asset and the market portfolio

Correlation measures the degree to which two variables move in relationship to each other

Cost of capital refers to the required return on an investment

Discount rate refers to the interest rate used to determine the present value of future cash flows

Efficient markets hypothesis states that stock prices incorporate all relevant information and thus on average reflect the long-term fundamental value of the firm

Expected return is a weighted average of possible returns, with the probabilities of these possible returns as weights

Factor models use risk factors (relating to market, social or environmental risk) to explain a stock's risk and returns

Factor portfolio is a portfolio with unit risk exposure to a particular risk factor (market, social or environmental risk) and no risk exposure to other factors

Financial discount rate or *cost of financial capital* is the discount rate used to discount financial capital.

Idiosyncratic risk refers to firm-specific risk that can be diversified in a portfolio

Loss aversion is the observation that people experience losses asymmetrically more severely than equivalent gains

Market index represents an entire stock market and thus tracks the market's changes over time

Market portfolio refers to the portfolio which contains all available assets in a market

Portfolio theory shows that a company's risk can be split in systematic or market-wide risk and idiosyncratic risk, which can be diversified away in a portfolio

Realised return refers to the return on an asset in the past

Risk refers to the variation of future returns

Risk-free asset is a safe asset, such as government bills or bonds

Risk premium refers the return on a risky asset, such as equities, minus the return on the risk-free asset

Scenario analysis is a process of analysing possible future events by considering alternative possible outcomes (sometimes called 'alternative worlds'); it can be used to analyse the effects of possible future events on the value of a company

Security market line plots the expected return against the risk (measured by the beta) of each stock

Social discount rate is the discount rate for social projects and can be used to discount social and environmental capital.

Systematic risk refers to market-wide risk that cannot be diversified in a portfolio

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Cost of Capital

13

Overview

A company's value is determined by its expected cash flows and its cost of capital, which increases with risk. In the previous chapters, we dived into the determinants of cash flows and risk, but we did not yet take a close look at the company's cost of capital. This chapter does exactly that.

We start with the cost of financial capital r^{FV}, which is the required minimum return on financial capital that is used in investment decisions. One can apply r^{FV} to specific types of financial capital (debt, equity) and it is typically expressed in terms of the WACC (weighted average cost of capital) for the company's overall cost of capital; the cost of equity r_E; the cost of debt r_D; or the project cost of capital. Subsequently, we consider the impact of S (social) and E (environmental) risks on the cost of financial capital. That is, to what extent do companies incur additional (or reduced) financial risk from their S and E exposures?

We then address the cost of social capital r^{SV} and the cost of environmental capital r^{EV} in their own right. Given their nature, these tend to be much lower than a company's cost of financial capital. The flip side is that the present value of assets and liabilities on E and S tends to be quite high, as discounting with a low discount rate reduces the present value of underlying value flows in a limited way. They are an interesting expression of the claims that nature and society might have on companies.

Finally, we put r^{FV}, r^{SV}, and r^{EV} together to obtain the cost of integrated capital, r^{IV}, which is the return on integrated assets that is demanded by the company's stakeholders on aggregate. Interestingly, r^{IV} gives an indication of the overall risk of the company, which can differ substantially from the risk picture that emerges from a purely financial perspective, even if that financial perspective is taken on an ESG integrated basis. Financial markets correct unsustainable activities to only a limited degree. An integrated perspective is needed to capture the full risk of not operating sustainably. And it might be the precursor of future financial risk. See Fig. 13.1 for a chapter overview.

Learning Objectives

After you have studied this chapter, you should be able to:

D. Schoenmaker, W. Schramade, *Corporate Finance for Long-Term Value*, Springer Texts in Business and Economics, https://doi.org/10.1007/978-3-031-35009-2_13

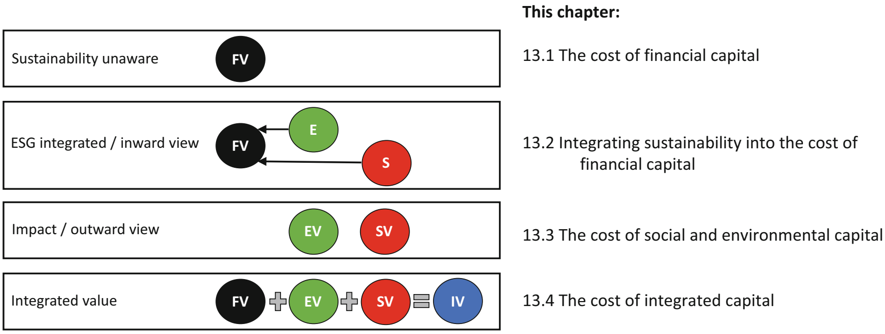

Fig. 13.1 Chapter overview

- calculate the cost of capital for equity, debt, social capital, environmental capital, and integrated capital
- explain the drivers of the various cost of capital measures
- relate the costs of the various types of capital to each other
- apply the appropriate cost of capital measure for valuing a company or project
- appraise the cost of integrated capital and its implications

13.1 The Cost of Financial Capital

When evaluating investments using a DCF analysis (see Chaps. 4–7), managers and investors need an estimate of the cost of capital for those investments to discount future cash flows. What is the minimum return that is needed given the risk profile of the investment? For shareholders, this is the cost of equity; for bondholders, the cost of debt; and for corporate managers, it is the project cost of capital.

13.1.1 Cost of Equity Capital

The cost of equity is the return a company theoretically pays to its shareholders, to compensate for the risk they undertake by investing their capital. That compensation depends not only on the risk of the specific investment, but also on the pricing of risk on similar and other investments, the degree of risk aversion, and the supply and demand of capital. This is not exact science, but an approximation is given by the capital asset pricing model (CAPM, see Sect. 12.4), which gives the cost of equity capital r_i of security (company) i given its systematic risk measured by beta β_i:

$$r_i = r_f + \beta_i \cdot \left(E[r_{MKT}] - r_f\right) \tag{13.1}$$

With the risk premium for security i being: $\beta_i \cdot (E[r_{MKT}] - r_f)$;
And the market risk premium is: $(E[r_{MKT}] - r_f)$.

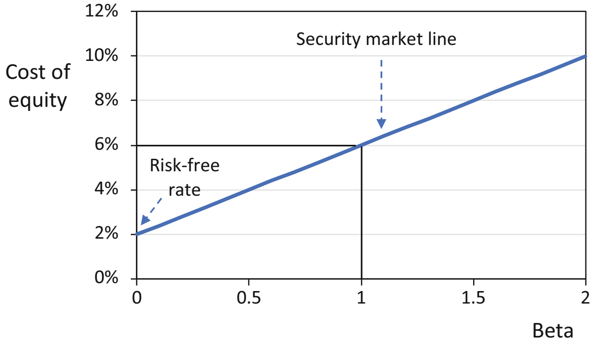

Fig. 13.2 The security market line

Making assumptions or estimates on the parameters of the above formulae allows us to draw the security market line for security *i* in Fig. 13.2.

In Fig. 13.2, the risk-free rate is 2%, the expected market return is 6%, and hence the market risk premium is 6–2% = 4%. At a beta of 0, the cost of equity equals the risk-free rate, that is 2%. The cost of equity rises proportionally with beta, hitting 6% (i.e. the expected market return) at a beta of 1, and rising well above that at betas above 1.

In practice it is quite difficult to establish the security market line, since the exercise is littered with empirical questions, such as: What is the market portfolio? What is the risk-free rate? What is the beta of a specific security? What is the horizon of the expected return? To what extent are historical data representative of the future?

Estimating the Market Risk Premium

The market risk premium in Eq. 13.1 is defined as the expected market return $E[r_{Mkt}]$ minus the risk-free rate r_f. The risk-free rate is derived from the government yield curve, which provides the safest asset in a country (see Chap. 4). The maturity choice of the risk-free rate should match the maturity of the cash flows. For long-term assets, such as stocks, the 10-year or 30-year government bond yield provides a good proxy for the risk-free rate. Figure 4.8 shows that the risk-free rate on long-term US government bonds was about 3.5% and about 2% on long-term German government bonds (the benchmark for euro-area stocks) at the time of writing in late 2022.

The estimation of the market risk premium is more demanding. Chapter 12 highlights that the historical risk premium can only be estimated over a long period because markets fluctuate. Table 13.1 provides evidence for the US stock market (which makes up about 65% of the world stock market), Europe (which makes up about 20% of the world stock market), and the world market. Table 13.1 shows that the observed risk premium has declined over time. The evidence suggests a risk premium over 1-year government bonds of 3.5–6.5% and a risk premium over 10-year government bonds of 3–5%.

Table 13.1 Historical risk premium (in %)

Market	USA		Europe	World
Period	1928–2021	1971–2021	1900–2017	1900–2017
Risk premium over 1-year government bonds	6.7%	6.7%	3.5%	4.3%
Risk premium over 10-year government bonds	5.1%	4.5%	3.0%	3.2%

Source: Damodaran (2022)

Estimating Betas

A company's beta is a measure of the company's stock price volatility relative to the market's volatility. Historical betas can be estimated using linear regression analysis on historical returns against the relevant index (see Box 12.3 on leading market indices). For the market portfolio, typically a well-known index is chosen, such as the S&P500 or the MSCI World Index. Let's apply this to two large listed companies with comparable activities: Nike ($196 billion market cap) and Adidas (€38 billion market cap), as of April 2022. Betas are often calculated on a 5-year monthly basis ($5*12 = 60$ observations) or on a 2-year weekly basis ($2*52 = 104$ observations), but one can use different frequencies and windows as well. This can give quite different results, as measuring at shorter frequencies leads to higher volatility. Taleb (2007) argues that volatility measured at short frequencies (e.g. 1 day or 1 week) contains a lot of random noise and he therefore recommends focusing on longer frequencies. Table 13.2 gives 2-year, 5-year, and 10-year betas, against both a home country index and a world index, first on a monthly and then on a weekly basis, for Nike and Adidas.

Table 13.2 Nike & Adidas betas

Monthly beta				
	Nike		Adidas	
	vs S&P500	vs MSCI World	vs DAX30	vs MSCI World
2-year	0.80	0.80	0.81	0.94
5-year	0.92	0.92	0.69	0.81
10-year	0.77	0.73	0.72	0.77
Average	*0.83*	*0.82*	*0.74*	*0.84*
Weekly beta				
	Nike		Adidas	
	vs S&P500	vs MSCI World	vs DAX30	vs MSCI World
2-year	1.16	1.20	1.22	1.17
5-year	1.05	1.12	1.07	1.00
10-year	1.01	1.00	0.94	1.02
Average	*1.07*	*1.11*	*1.08*	*1.06*

Note: All betas are calculated using data series ending in December 2021

As expected, the betas of both companies are quite similar to each other, since they are in the same industry. However, whereas the monthly betas of both companies are well under one (0.81 on average), their weekly betas are 34% higher (1.08 on average). In addition, there is also quite a difference for Adidas between the world index and the home country index (DAX30), which is partly a result of Nike's home index (S&P500) being much bigger in the world index than the DAX.

The above numbers show that historical betas can differ significantly, depending on the way they are calculated in terms of frequency, window, and index used. But perhaps a more fundamental problem is that beta is meant to be forward-looking. Hence, historical betas may not be representative since a company's systematic risk can change over time. See Chap. 12 for a discussion of forward-looking risk. The methods discussed there can be used to adjust historical betas.

Another problem is that betas can only be calculated for companies with sufficient historical pricing data, i.e. only for companies that have been listed for a while, not for unlisted (private) or recently-listed companies. In such a case, however, one can make an estimate of beta by looking at betas of comparable companies. Suppose a Norwegian salmon harvesting company is on the verge of doing an IPO (an initial public offering, i.e. listing of its stock on a stock exchange; see Chap. 16). The investment bankers helping on the IPO, as well as the investors who are interested in participating in the IPO, can then estimate the company's beta by considering the betas of other Norwegian salmon harvesters. Table 13.3 gives an overview of those betas and nicely illustrates why that's not a completely trivial exercise.

First, betas can be measured in several ways, as discussed. Table 13.3 gives two of them: 5-year monthly betas (5*12 = 60 observations) and 2-year weekly betas (2*52 = 104 observations). So, they differ both in frequency and in time period. That is important since betas can change over time.

Second, how to aggregate the observations: do you take the average or the median of the betas? And do you include or exclude outliers? In the above example, Norway Royal Salmon has a striking 5-year monthly beta of 0.00, and while its 2-year weekly beta looks more normal, it is still significantly lower than the betas of its peers. Taking the 5-year monthly beta, we find an average beta of 0.54 (excluding

Table 13.3 Industry betas for Norwegian salmon harvesting

vs MSCI World	5-year monthly beta	2-year weekly beta	Average beta
Bakkafrost	0.41	0.48	0.45
SalMar	0.31	0.21	0.26
Mowi	0.70	0.46	0.58
Leroy Seafood	0.55	0.58	0.57
Austevoll Seafood	0.64	0.59	0.62
Grieg Seafood	0.62	0.74	0.68
Norway Royal Salmon	0.00	0.34	0.17
Average	*0.46*	*0.48*	*0.47*
Median	*0.55*	*0.48*	*0.57*
Average (without Royal)	*0.54*	*0.51*	*0.52*

Norway Royal Salmon) which is close to the median of 0.55. Even after making these adjustments, one can still question if such a low beta is the right estimate going forward.

Example 13.1 shows how one can calculate the cost of equity capital for the Norwegian salmon farmer, using industry betas.

Example 13.1 Calculating the Cost of Equity Capital

Problem

Suppose the risk-free rate is 2% and the market risk premium is 4%. What is the cost of equity capital for a Norwegian salmon farmer?

Solution

First, we have to make a choice for the maturity of the estimated betas (monthly vs weekly). As longer-term betas are more stable, we choose the 5-year monthly beta from Table 13.3. Next, we take the industry average without the outlier Norway Royal Salmon. This gives us a beta of 0.54.

We can calculate the expected return by taking the cost of equity capital Eq. 13.1:

$$r_i = r_f + \beta_i \cdot \left(E[r_{MKT}] - r_f\right) = 2\% + 0.54 \cdot 4\% = 4.2\%$$

As explained, the low beta for the Norwegian salmon industry gives us a rather low cost of equity capital of 4.2%. ◀

13.1.2 Cost of Debt Capital

The cost of debt can be calculated in a similar way as the cost of equity, by estimating debt betas using CAPM. However, that is hard given the infrequent trading of most public debt. Moreover, the risk of default (and thus the debt beta) is very low for investment-grade bonds, as shown in Table 13.4. The cost of debt is more commonly calculated using credit ratings, as described in Chap. 8. Following Eq. 8.8, the cost of debt r_D can be calculated as follows:

$$E[y] = (1 - PD) \cdot y + PD \cdot (y - LGD) = y - PD \cdot LGD = r_D \tag{13.2}$$

where PD is the probability of default, y is the yield (promised interest), and LGD the loss given default (the fraction of the principal and interest lost in case of default). While the yield y can be observed in the market, we need estimates for PD and LGD. Using Box 8.1 from Chap. 8, Table 13.4 shows that the default rates PD and debt betas β_D are quite low for investment-grade bonds, but can be much higher for junk bonds. The extremes on both sides are interesting. On the safe side, AAA, AA, and A rated bonds have extremely low credit risk with default rates at 0.00, 0.02, and 0.05%, respectively, and the debt beta is below 0.05. A company's debt beta measures the volatility of the company's debt relative to the market's volatility.

Table 13.4 Default rates and debt betas by credit rating

Rating agency	Moody's	S&P's and Fitch	Long-term average default rate	Debt betas
Type of bonds	**Investment grade bonds**			
	Aaa	AAA	0.00%	
	Aa	AA	0.02%	<0.05
	A	A	0.05%	
	Baa	BBB	0.16%	0.10
Type of bonds	**Junk or high yield bonds**			
	Ba	BB	0.61%	0.17
	B	B	3.33%	0.26
	Caa	CCC		0.31
	Ca	CC	27.08%	-
	C	C		-

Source: S&P Global Ratings (2020a) for long-term default rates (1981–2019 average) and Berk and DeMarzo (2020) for debt betas

On the risky side, default rates for CCC, CC, and C rated bonds increase to over 25% and only for CCC rated bonds can a reliable beta of 0.31 be estimated. So, it often does not make sense to use debt betas for relatively safe bonds, since they are very low and difficult to estimate precisely. Finally, the long-term average loss given default rate *LGD,* the last variable of Eq. 13.2 to estimated, is 60% for bonds (S&P Global Ratings, 2020b).

Example 13.2 shows how we can calculate the cost of debt capital for a salmon farmer.

Example 13.2 Calculating the Cost of Debt Capital

Problem

The Norwegian salmon farmer, SalMar, has a rating of BBB and a yield of 3.22% in June 2022. The loss given default is 60%. What is SalMar's cost of debt capital?

Solution

Using Table 13.4, a BBB rating implies a probability of default (PD) of 0.16%. The loss given default (LGD) is 60%. And the yield is 3.22%.

We can calculate the cost of debt capital using Eq. 13.2:

$$r_D = y - PD \cdot LGD = 3.22\% - 0.16\% * 60\% = 3.12\%$$

SalMar's cost of debt capital is 3.12%. ◀

13.1.3 Weighted Average Cost of Capital

Debt and equity are just components of the company's overall capital. How can we calculate the company's cost of capital? Table 13.5 provides a balance sheet for company X, based on market values.

The sum of debt D and equity E provides the company's overall value (the right side of Table 13.5). In Chap. 9, we introduced enterprise value V as the market value of the company's underlying business (using its assets) before financing by equity and debt (the left side of Table 13.5). To balance both sides of the balance sheet, the company's overall value (based on equity and debt) should match the company's enterprise value (based on assets). We can thus derive the simplified equation for enterprise value V as follows:

$$\text{Enterprise value}: V = E + D \tag{13.3}$$

Likewise, the cost of debt and the cost of equity are components of the overall cost of capital r_U, which is also known as the weighted average cost of capital (WACC):

$$WACC = r_U = \frac{E}{V} \cdot r_E + \frac{D}{V} \cdot r_D \tag{13.4}$$

The calculation of WACC seems straightforward since it is the weighted average of the cost of equity capital r_E and the cost of debt capital r_D. In our simple example of company X in Table 13.5, the WACC is $0.6 * 10\ \% + 0.4 * 2.5\ \% = 7\%$.

However, it should be noted that the presence (and weight) of debt in the capital structure affects the cost of equity. Chapter 15 (capital structure) shows the effect of leverage on the cost of equity capital. Another aspect is the presence of corporate tax. As interest expenses can be deducted from taxable income, the after-tax interest rate is the relevant indicator for a company's net cost of debt capital: $r_D \cdot (1 - \tau_C)$, whereby τ_C is the company's tax rate. The tax-adjusted WACC formula becomes then:

$$\text{After} - \text{tax } WACC = \frac{E}{V} \cdot r_E + \frac{D}{V} \cdot r_D \cdot (1 - \tau_C) \tag{13.5}$$

The tax savings reduce the cost of capital of a levered company in comparison with the cost of capital of an unlevered company r_U. Combining Eqs. 13.4 and 13.5, we get:

Table 13.5 Market-value balance sheet, company X

	Value	Discounted at		Value	Discounted at
Assets	100	?%	Debt	D = 40	2.5%
			Equity	E = 60	10%
Enterprise value	V = 100	?%	Enterprise value	V = 100	?%

$$\text{After} - \text{tax } WACC = r_U - \frac{D}{V} \cdot r_D \cdot \tau_C \qquad (13.6)$$

Assuming a corporate tax rate of 20%, the after-tax WACC of company X is $0.6 * 10\ \% \ + 0.4 * 2.5\ \% \ * (1 - 0.20) = 6.8\%$. The after-tax WACC is 0.2% lower than the WACC of 7.0%. We can check this calculation by calculating the tax savings (the second term in Eq. 13.6): $\frac{D}{V} \cdot r_D \cdot \tau_C = 0.4 * 2.5\% * 20\% = 0.2\%$. The role of corporate tax and related tax savings is further discussed in Chap. 15 on capital structure.

Examples 13.3 and 13.4 show how you can calculate the WACC for a company.

Example 13.3 Calculating the WACC

Problem

Company Y has a cost of equity capital of 8% and a cost of debt capital of 3%. The company's market capitalisation is € 200 million and its outstanding debt € 70 million. The corporate tax rate is 25%. What is the unlevered cost of capital and what is the after-tax WACC for company Y?

Solution

Combining equity (market cap) and debt, we obtain company's Y value at € 270 million. We can now calculate the unlevered cost of capital r_U using Eq. 13.4:

$$WACC = r_U = \frac{E}{V} \cdot r_E + \frac{D}{V} \cdot r_D = \frac{200}{270} \cdot 8\% + \frac{70}{270} \cdot 3\% = 6.7\%$$

We can calculate the after-tax WACC using Eq. 13.5:

$$\text{after} - \text{tax } WACC = \frac{E}{V} \cdot r_E + \frac{D}{V} \cdot r_D \cdot (1 - \tau_C) = \frac{200}{270} \cdot 8\% + \frac{70}{270} \cdot 3\% \\ * (1 - 0.25) = 6.5\%$$

The after-tax WACC is lower than the pre-tax WACC (the unlevered cost of capital) due to tax savings on the interest payments. To check: $\frac{D}{V} \cdot r_D \cdot \tau_C = \frac{70}{270} * 3\% * 25\% = 0.2\%$. ◀

Example 13.4 Calculating SalMar's WACC

Problem

We would like to calculate the WACC of our Norwegian salmon farmer, SalMar. Suppose the risk-free rate is 2% and the market risk premium is 4%. SalMar's beta is 0.31 (Table 13.3) and its cost of debt capital is 3.12% (Example 13.2). Next, SalMar's equity is NOK 50.6 billion and its debt is NOK 12.6 billion. The Norwegian corporate tax rate is 22%.

What is the cost of equity and the pre-tax and after-tax WACC of SalMar?

Solution

The first step is to calculate the cost of equity using Eq. 13.1:

$$r_i = r_f + \beta_i \cdot \left(E[r_{MKT}] - r_f\right) = 2\% + 0.31 * 4\% = 3.24\%$$

We can calculate the pre-tax WACC using Eq. 13.4:

$$WACC = \frac{E}{V} \cdot r_E + \frac{D}{V} \cdot r_D = \frac{50.6}{63.2} \cdot 3.24\% + \frac{12.6}{63.2} \cdot 3.12\% = 3.22\%$$

We can calculate the after-tax WACC using Eq. 13.5:

$$\text{after} - \text{tax } WACC = \frac{E}{V} \cdot r_E + \frac{D}{V} \cdot r_D \cdot (1 - \tau_C) =$$

$$\frac{50.6}{63.2} \cdot 3.24\% + \frac{12.6}{63.2} \cdot 3.12\% \cdot (1 - 22\%) = 3.08\%$$

The pre-tax WACC is 3.22% and the after-tax WACC 3.08%. SalMar's low beta of 0.31 and low leverage of 19.9% $\left(= \frac{D}{V} = \frac{12.6}{63.2}\right)$ give it a very low cost of capital. ◄

13.1.4 Project Cost of Capital

Company betas reflect the market risk of the average project in a company. Project risk can deviate substantially from company risk. For example, when a pharmaceutical company wants to invest in a new headquarters building, the beta of the pharmaceutical industry is not very helpful. It is better to use the beta of commercial real estate to determine the project's cost of capital. So, it is important to identify companies or sectors comparable to the project.

The observed company betas are related to equity β_E. These company betas are levered, i.e. they reflect the leverage of the companies involved. But unlevered ones are needed, which reflect the beta of a company's total assets (see Fig. 13.3). The asset beta, or unlevered beta β_U, is calculated as follows:

$$\beta_U = \frac{E}{E+D} \cdot \beta_E + \frac{D}{E+D} \cdot \beta_D \tag{13.7}$$

Most unlevered (asset) betas are lower than levered (equity) betas, reflecting the lower risk of the underlying assets before levering up. Going back to our Norwegian salmon farmer, Table 13.6 shows the levered betas (columns 2 and 3) taken from the

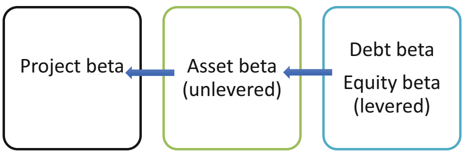

Fig. 13.3 Determining the project beta

Table 13.6 Industry betas for Norwegian salmon harvesting

vs MSCI World	5-year monthly beta	2-year weekly beta	E/ (E + D)	Unlevered 5-year monthly beta	Unlevered 2-year weekly beta	Average
Bakkafrost	0.41	0.48	0.77	0.32	0.37	0.34
SalMar	0.31	0.21	0.67	0.21	0.14	0.17
Mowi	0.70	0.46	0.63	0.44	0.29	0.36
Leroy Seafood	0.55	0.58	0.71	0.39	0.41	0.40
Austevoll Seafood	0.64	0.59	0.55	0.35	0.32	0.34
Grieg Seafood	0.62	0.74	0.64	0.39	0.47	0.43
Norway Royal Salmon	0.00	0.34	0.58	0.00	0.20	0.10
Average	*0.46*	*0.49*	*0.65*	*0.30*	*0.31*	*0.31*
Median	*0.55*	*0.48*	*0.64*	*0.35*	*0.32*	*0.34*
Average (without Royal)	*0.54*	*0.51*	*0.66*	*0.35*	*0.33*	*0.34*

market (see Table 13.3) and the unlevered betas (columns 5 and 6) calculated with Eq. 13.7. The bottom row of Table 13.6, which excludes the outlier Norway Royal Salmon, provides the industry betas for Norwegian salmon harvesting. For ease of exposition, we assume that the beta of debt is zero in our calculations. Debt betas are usually very low, as shown earlier in Table 13.4.

Figure 13.3 shows the steps from an observed (levered) equity beta to an unlevered asset beta. The final step is to select the relevant asset beta for the project. Figure 13.4 provides an overview of industry asset betas. The total market asset beta is 0.93. High risk industries are semiconductors (asset beta of 1.49), information services (1.16), oil and gas production and exploration (1.13), and chemicals (1.06). By contrast, stable industries are utilities (0.50), real estate (0.58), and telecom (0.65). Example 13.5 shows how we can calculate the pharmaceutical company's cost of capital for its headquarters.

Example 13.5 Calculating the Headquarters' Project Cost of Capital

Problem

Pharma company X wants to build a new headquarters. It is fully financed with equity. The risk-free rate is 3% and the market risk premium is 4%. What is the project's cost of capital?

Solution

As explained, we should take the real estate asset beta of 0.58 instead of the pharma beta of 0.97, which are both taken from Fig. 13.4. As the headquarters is fully equity financed, the unlevered or asset beta can be used to calculate the

Fig. 13.4 Industry asset betas (2022). Source: Data from Damodaran (2022). Note: Assets betas are based on 2-year and 5-year weekly betas for global companies. The total market asset beta (0.93) is without financials

project's cost of capital. Using Eqs. 13.4 and 13.1, we can calculate the project's cost of capital:

$$r_u = r_E = r_f + \beta_i \cdot \left(E[r_{MKT}] - r_f\right) = 3\% + 0.58 \cdot 4\% = 5.3\%$$

The project's cost of capital of 5.3% is lower than the pharma company's cost of capital of 6.9% = 3% + 0.97*4%. So, the cost of capital better reflects the risk of the project when selecting the appropriate asset beta for the building project. ◄

13.2 Integrating Sustainability into the Cost of Financial Capital

Let's now explore how S and E risks could affect the cost of financial capital. There is empirical evidence that S and E affect the cost of equity and the cost of debt. For example, companies with better sustainability scores tend to have cheaper financing (El Ghoul et al., 2011; Albuquerque et al., 2019) and better access to finance (Cheng et al., 2014). These effects can be expressed and estimated in an adjusted cost of equity capital.

13.2.1 Adjusted Cost of Equity Capital

The factor behind a lower cost of equity capital is lower systematic risk. Companies with better sustainability performance have lower betas for social risk β_i^{SF} and/or environmental risk β_i^{SF}. From Chap. 12, we reproduce the adjusted cost of equity capital Eq. (12.16):

$$\text{Adjusted cost of equity capital}: r_i = r_f + \beta_i^{MKT} \cdot RP_{MKT} + \beta_i^{SF} \cdot RP_{SF} + \beta_i^{EF} \cdot RP_{EF} \tag{13.8}$$

$$= \text{risk-free rate} + \beta_i^{MKT} \text{ x market risk premium} + \beta_i^{SF} \text{ x social risk premium} + \beta_i^{EF} \text{ x environmental risk premium}$$

As social and environmental risks have only recently been considered as relevant for stock prices, there are no long-term estimates for the social and environmental risk premium yet, unlike for the market risk premium. Chapter 12 provides emerging evidence on the social and environmental risk premium. Table 13.7 shows that the social risk premium is in the range of 1.0–1.5%, while the environmental risk premium is 1.9%.

The challenge is to estimate company betas for social and environmental risk. We cannot derive historical betas like those for market risk, as there is no reliable history of the social and environmental index against which we can regress historical company returns. For the estimation of company exposure to social and environmental risks, we can use several approaches. The most comprehensive approach is a value-based approach using our estimates for SV and EV, based on material social and environmental factors. Negative values for SV and EV indicate that a company causes social and environmental problems. So, it is exposed to social and environmental risks, which implies a positive beta $\beta_i^{SF}, \beta_i^{EF} > 0$. By contrast, positive values for SV and EV show that a company contributes to solving social and environmental challenges, which implies a negative beta $\beta_i^{SF}, \beta_i^{EF} < 0$. SV and EV thus are negatively related to the social and environmental betas. But how can we estimate the precise size of the social and environmental betas? A pragmatic method to gauge the effect of a company's social and environmental risks on its financial risk profile is to relate SV and EV to FV. We can thus derive a proxy for the factor betas:

$$\text{Factor betas}: \beta_i^{SF} = -\frac{SV}{FV} \text{ and } \beta_i^{EF} = -\frac{EV}{FV} \tag{13.9}$$

The calculation of the factor betas is straightforward, once we know a company's social, environmental, and financial value (see Chap. 5). For example, an oil

Table 13.7 Social and environmental risk premiums

Type of risk premium	Risk premium (in %)
Social risk premium	1–1.5%
Environmental risk premium	1.9%

Source: Table 12.6 from Chap. 12

company with a large negative *EV* (due to large scope 3 carbon emissions) relative to its *FV* faces a high environmental beta. A pharmaceutical company that is developing drugs that can save lives has a positive *SV* and thus a negative social beta.

Of course, when data are not available to perform a complete calculation of *SV* and *EV*, you can make ad hoc assessments of the factor betas according to S and E exposures. For example, in the abovementioned salmon harvesting example, one could argue that health and climate concerns might lower social and environmental betas in the near future (since salmon is healthier than beef and pork, at lower carbon footprints), whereas a potential taboo on eating animals would increase its social beta in the longer run. Key is to include all material social and environmental factors in your assessment.

Another, albeit more debatable (see below), approach to calculate factor betas is using a company's ESG ratings, which have an environmental, social, and governance pillar. Referring back to Sect. 12.5, remember that our environmental risk premium is based on a broad environmental score, across 13 environmental issues related to climate change, natural resources, pollution, and waste. So, we need broad environmental and social scores for companies. Next, the social and environmental factor portfolios are constructed as bad (the lowest third) minus the good (the top third), which represents a wide difference in social and environmental performance between companies. Companies with low scores have high betas, while companies with high scores have low (or even negative) betas. This negative relationship might be counterintuitive, but is correct. Low S and E scores indicate a poor performance on S and E factors and thus a high exposure to social and environmental risks, which is measured by the social and environmental beta, respectively.

Given the wide availability of ESG ratings, this ESG approach is tempting, but it has severe limitations. First, this approach only works with absolute scores. So, all companies with severe environmental problems get a low environmental score. However, some ESG ratings methods, like the best-in-class method, use relative scores. Best-in-class assigns high scores to the leaders within an industry (regardless of the industry environmental profile). The best oil company (i.e., the oil company with the least amount of carbon emissions) would then get a high score, as best-in-class. But this oil company will still have large carbon emissions (suggesting a low absolute score). Second, there are severe shortcomings with ESG ratings, as highlighted in Box 14.3 in Chap. 14.

Example 13.6 provides an example of calculating the adjusted cost of equity capital for a chemical company. As can be expected, the chemical company's adjusted equity cost is higher due to pollution and carbon emissions. Estimating the adjusted cost of equity capital is work in progress, as S and E risks are only recently included in empirical estimations and not yet available for many companies. The adaptive markets hypothesis suggests that the quality of the estimations and the number of companies covered may increase over time when more data becomes available and more analysts pay attention. In the absence of hard data, heuristics may be superior. In practice, equity analysts tend to make direct adjustment in the cost of equity capital, rather than via beta, as for example shown in case studies of the Principles for Responsible Investing (PRI, 2018).

Example 13.6 Calculating the Adjusted Cost of Equity Capital

Problem

An American chemical company has a market beta of 1.1 and an enterprise value of \$50 million. Its environmental value is −\$60 million and its social value −\$10 million. The risk-free rate is 3% and the market risk premium is 4%. What is the chemical company's cost of equity capital? And what is the chemical's company adjusted cost of equity capital? Please use the value-based method to calculate the adjusted cost of equity capital.

Solution

Let's start with the cost of equity capital, using Eq. 13.1:

$$r_i = r_f + \beta_i \cdot \left(E[r_{MKT}] - r_f\right) = 3\% + 1.1 \cdot 4\% = 7.4\%$$

So, the chemical company has a cost of equity capital of 7.4%. The provided data indicate that the chemical company has major environmental problems and minor social problems. Let's see to which adjustments this leads in the cost of equity capital. Using the value-based method, we derive the social and environmental beta as follows, using Eq. 13.9:

$$\beta_i^{SF} = -\frac{SV}{FV} = -\frac{-10}{50} = 0.2 \text{ and } \beta_i^{EF} = -\frac{EV}{FV} = -\frac{-60}{50} = 1.2$$

Next, we can take the social and environmental risk premiums from Table 13.7. We can now insert these betas and risk premiums in the adjusted cost of equity capital (Eq. 13.8):

$$r_i = r_f + \beta_i^{MKT} \cdot RP_{MKT} + \beta_i^{SF} \cdot RP_{SF} + \beta_i^{EF} \cdot RP_{EF} =$$

$$3\% + 1.1 \cdot 4\% + 0.2 \cdot 1.25\% + 1.2 \cdot 1.9\% = 9.9\%$$

The value-based method, which includes social and environmental risks, leads to a substantially higher adjusted cost of equity capital of 9.9% than the cost of equity capital of 7.4%. This higher adjusted cost of equity capital reflects the social and environmental risks of the chemical company. ◄

13.2.2 Adjusted Cost of Debt Capital

There is also evidence that sustainability concerns lead to higher cost of debt capital (Chava, 2014). Following Eq. 13.2, the cost of debt r_D is calculated as follows:

$$\text{Adjusted cost of debt capital}: r_D = y - PD \cdot LGD \quad (13.10)$$

Sustainability risks can increase the probability of default PD, which the debt provider translates into a higher contractual interest rate y. Remember that the yield

y has to cover expected credit losses (related to PD) as well as a credit risk premium (see Chap. 8). The adjusted cost of debt capital thus rises.

Banks offer sustainability-linked loans, whereby the interest rate is linked to an external ESG rating. Box 13.1 provides an example where ING bank links the interest rate on a loan facility for health technology company Philips to its sustainability performance and rating. If the rating goes up, the interest rate goes down and vice versa. Philips is thus incentivised to improve its sustainability, while ING reduces the risk of its loan.

Box 13.1 Sustainability-Linked Loan for Philips

In April 2017, the healthcare technology company Philips agreed an innovative first-of-its-kind €1bn loan facility with a consortium of banks that features an interest rate linked to the technology firm's year-on-year sustainability performance. The nature of the loan facility means if Philips' sustainability performance improves (as measured by Sustainalytics), the interest rate it has to pay goes down, and vice versa.

As part of the consortium of 16 banks offering the loan, ING Bank has conducted the credit risk assessment and acted as the sustainability coordinator for the loan. Philips' sustainability performance has been assessed and benchmarked by Sustainalytics, an independent provider of ESG ratings.

ING indicated that the loan agreement with Philips was an additional way for the bank to support and reward clients seeking to become more sustainable. The loan facility follows Philips' 'Healthy People, Sustainable Planet' programme, through which it is aiming to become 'carbon-neutral' throughout its global operations and source all of its electricity needs from renewable sources (SDG 12) and to improve the lives of 3 billion people a year by making the world healthier and more sustainable through innovation (SDG 3).

In a 2022 repeat transaction for Philips, ING again acted as sustainability coordinator, arranging a sustainability-linked loan with ambitious KPIs aligned with Philips' sustainability goals for lives improved, lives improved in underserved communities, circular revenues, and operational carbon footprint.

The adjustment for sustainability risks is small for investment-grade debt (just a few basis points), as the credit risk on this debt is already very low anyway. Bigger adjustments to the cost of debt capital can be made for junk bonds, which are riskier. As the credit risk on junk bonds is more similar to equity risk, adjustments to the cost of debt capital can be made in a similar way, as shown above, for the adjusted equity risk of capital.

13.2.3 Adjusted WACC

The calculation of a company's WACC remains the same (see Eqs. 13.4 and 13.5). Only the inputs of r_E (r_i from Eq. 13.8) and r_D (from Eq. 13.10) into the WACC calculation change. Example 13.7 calculates the adjusted WACC of our chemical company.

Example 13.7 Calculating the Adjusted WACC

Problem

Our American chemical company, introduced in Example 13.6, has a market capitalisation of \$40 million and a debt of \$10 million. The cost of debt capital is 4%. What is the chemical's company WACC? And what is the chemical's company adjusted WACC?

Solution

The enterprise value of \$50 million is financed by equity of \$40 million and debt of \$10 million. The low leverage indicates that the chemical's company debt is relatively safe and thus investment grade. Using Eq. 13.4, we can calculate the WACC as follows:

$$WACC = \frac{E}{V} \cdot r_E + \frac{D}{V} \cdot r_D = \frac{40}{50} \cdot 7.4\% + \frac{10}{50} \cdot 4\% = 6.7\%$$

As the chemical's company cost of debt is investment grade, the adjustment for sustainability risks is small. So, there is no need to adjust the cost of debt. The adjusted cost of equity is 9.9% (see the value-based method in Example 13.6). The adjusted WACC becomes then:

$$\text{adjusted } WACC = \frac{E}{V} \cdot r_E + \frac{D}{V} \cdot r_D = \frac{40}{50} \cdot 9.9\% + \frac{10}{50} \cdot 4\% = 8.7\%$$

The adjusted WACC is 2% higher than the WACC. This higher adjusted WACC reflects the chemical company's environmental risk. ◄

13.3 The Cost of Social and Environmental Capital

The previous section discussed the impact of S and E risks on the cost of financial capital, but S and E also have their own cost of capital. Given their nature, these tend to be much lower than a company's cost of financial capital. The counterparty of companies' *SV* and *EV* is the wider society, representing current and future generations. Low social discount rates imply that current and future generations are treated more or less equally. The flip side is that the valuation of liabilities on S and E tends to be quite high versus their value flows. They are an interesting expression of the claims that society and nature might have on companies.

Table 13.8 Parameters for the expanded social discount rate

Time preference δ	Elasticity η	Growth rate g	Risk parameter L	Discount rate r^s
0%	1.5	1.3%	0.2%	2.2%

Source: Table 12.7 from Chap. 12

From Chap. 12, we can take the social discount rate r^s for discounting social and environmental capital (Eq. 12.20):

$$\text{Social discount rate}: r^s = \delta + \eta \cdot g + L \tag{13.11}$$

The first parameter δ reflects the time preference between current and future generations. Equal treatment of current and future generations gives us a time preference of zero: $\delta = 0$. Next, the growth rate g is driven by growth in consumption. Given a diminishing marginal utility of consumption, the growth rate is multiplied by the elasticity of marginal utility of consumption η. The elasticity measures how utility changes with consumption. Finally, the risk parameter L reflects the extreme element of macroeconomic risk of rare disasters or society collapse. Table 13.8 reproduces the parameter estimates from Chap. 12.

Table 13.8 shows that the social discount rate is 2.2%. This social discount rate r^s is applicable to the discounting of social capital r^{SV} and environmental capital r^{EV}. There is no differentiation across different forms of social and environmental capital. There is also no company-specific component, as the social discount rate reflects the cost from a societal perspective for using social and environmental capital, as discussed in Chap. 4.

A final question is about the correlation between company (or project) risk and growth risk. Given the low variance of consumption growth (Gollier, 2012), the correlation can be ignored for practical purposes. So, there is no need for company- or project-specific adjustments of the social discount rate.

What does such a low cost of social and environmental capital mean? A lower cost of capital leads to a higher present value of social and environmental flows (positive or negative) than the present value of financial flows with a higher cost of financial capital. Let's illustrate this point with two examples. The first is a medtech company that produces medical equipment that helps recovering patients in extending their life (see Table 13.9). Assuming constant flows over time, Table 13.9 provides the annual cash flows and social flows. The medtech has annual cash flows of € 450 million, while the annual social flows are €150 million (based on 2000 lives extended at €75,000 per quality life year). The annual financial flows are three times the annual social flows. But discounting changes the picture. The present value of the annual cash flows is $PV = \frac{CF}{r} = \frac{450}{0.066} = 6{,}818$ million and the present value of the annual social flows is $\frac{150}{0.022} = 6{,}818$ million. These present values are equal! As the cost of social capital (2.2%) is three times smaller than the cost of financial capital (6.6%), the present value of €1 of social flows is three times larger than the present value of €1 of financial flows. So, the annual social flows translate into a relatively large social asset. For the medtech company, this means that its total

Table 13.9 Financial and social value of a medtech company

Medtech company	Value in EUR millions
Financial flows	
Annual cash flows (in EUR millions)	450
Discount factor	6.6%
Financial value (PV in EUR millions)	*6818*
Social flows	
Quality life years extended annually	2000
Quality life year in EUR	75,000
Annual social flows (in EUR millions)	150
Discount factor	2.2%
Social value (PV in EUR millions)	*6818*
Company value (in EUR millions)	*13,636*

Table 13.10 Financial and environmental value of an oil company

Oil company	Value in EUR millions
Financial flows	
Annual cash flows (in EUR millions)	800
Discount factor	6.6%
Financial value (PV in EUR millions)	*12,121*
Environmental flows	
Carbon emissions (thousands of tonnes CO_2)	1800
Shadow price of emissions, EUR/tonne	200
Annual environmental flows (in EUR millions)	−360
Discount factor	2.2%
Environmental value (PV in EUR millions)	*−16,364*
Company value (in EUR millions)	*−4242*

(or integrated) value is for 50% determined by its financial flows and 50% by its social flows.

The second example in Table 13.10 concerns an oil company, which sells oil at a net profit but is also responsible for the resulting carbon emissions from consumers' use of the oil. Annual cash flows amount to €800 million. The annual carbon emissions attributed to the oil company is 1.8 million tonnes of CO_2. At a shadow price of €200 per tonne, these annual carbon emissions translate into negative annual environmental flows of €360 million. This is slightly less than half of the annual financial flow. Assuming no social flows, the company's annual total flows are € 440 (=800–360) million. But when we discount the two flows at their respective costs of capital, the picture changes dramatically. The financial value is €12,121 million (the continuous €800 million cash flow discounted at 6.6%), while the environmental value is € −16,364 million (the continuous negative €360 million environmental flow discounted at 2.2%). The annual carbon emissions turn into a very large negative environmental value. This puts the company's value in negative territory (€ −4242 million).

These two company examples show that a low social discount rate can turn positive (negative) social and environmental flows into relatively large social and environmental assets (liabilities). Whereas financial discounting reduces the value of future cash flows substantially, social and environmental discounting does that to a lesser extent.

13.4 The Cost of Integrated Capital

In the previous sections, we considered r_i^{FV} (which is the adjusted WACC), r^{SV} and r^{EV} separately, as well as their drivers. We now put them together in the cost of integrated capital r_i^{IV} (Eq. 12.21), which is the return demanded on all types of capital combined.

$$\text{Cost of integrated capital}: r_i^{IV} = \frac{FV}{IV} \cdot r_i^{FV} + \frac{SV}{IV} \cdot r^{SV} + \frac{EV}{IV} \cdot r^{EV} \qquad (13.12)$$

An interesting exercise is to see what happens to r_i^{IV}, when we keep FV and SV constant but let EV rise. In other words, what is the impact on the company's cost of integrated capital when its environmental profile improves from −50 to +50? Table 13.11 shows our simulation. The starting position is: $FV = 100$, $SV = 0$, and $EV = -50$. As we are only interested in the impact of changing EV, we put SV at zero. Next, the cost of the capitals is: $r_i^{FV} = 6.0\%$, $r^{SV} = 2.2\%$, and $r^{EV} = 2.2\%$. While keeping FV constant at 100, r^{IV} moves from 9.8% when EV is −50 to 4.7% when EV is 50 in Table 13.11.

Figure 13.5 shows the declining trend graphically. The orange midpoint reflects the cost of financial capital of 6%. To the left are E liabilities $EV < 0$ which increase

Table 13.11 Simulation of the cost of integrated capital

FV	SV	EV	IV	FV/IV	SV/IV	EV/IV	r^{FV}	r^{SV}	r^{EV}	r^{IV}
100	0	−50	*50*	2.0	0.0	−1.0	6.0%	2.2%	2.2%	*9.8%*
100	0	−40	*60*	1.7	0.0	−0.7	6.0%	2.2%	2.2%	*8.5%*
100	0	−30	*70*	1.4	0.0	−0.4	6.0%	2.2%	2.2%	*7.6%*
100	0	−20	*80*	1.3	0.0	−0.3	6.0%	2.2%	2.2%	*7.0%*
100	0	−10	*90*	1.1	0.0	−0.1	6.0%	2.2%	2.2%	*6.4%*
100	0	0	*100*	1.0	0.0	0.0	6.0%	2.2%	2.2%	*6.0%*
100	0	10	*110*	0.9	0.0	0.1	6.0%	2.2%	2.2%	*5.7%*
100	0	20	*120*	0.8	0.0	0.2	6.0%	2.2%	2.2%	*5.4%*
100	0	30	*130*	0.8	0.0	0.2	6.0%	2.2%	2.2%	*5.1%*
100	0	40	*140*	0.7	0.0	0.3	6.0%	2.2%	2.2%	*4.9%*
100	0	50	*150*	0.7	0.0	0.3	6.0%	2.2%	2.2%	*4.7%*

This table calculates the cost of integrated capital r_i^{IV}. The first three columns provide the three dimensions, which can be added up to IV. Columns 5–7 calculate the weight of the value dimensions. Please note that these weights add up to 1, as required. The final columns provide the costs of capital, whereby r_i^{IV} is calculated as a weighted average of the cost of financial, social, and environmental capital

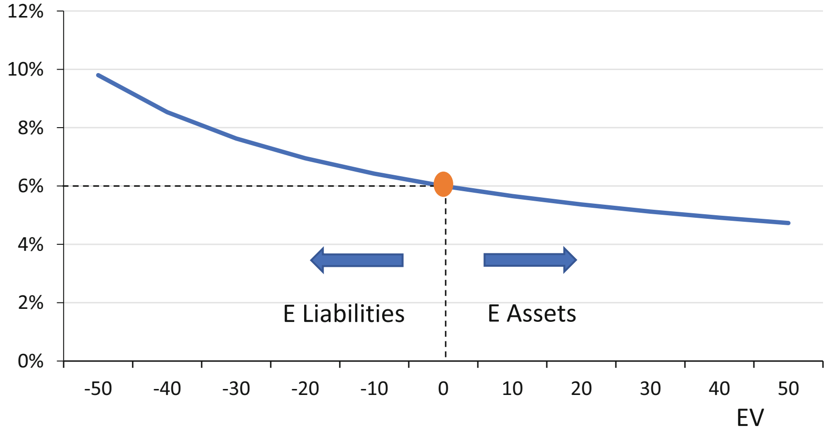

Fig. 13.5 Cost of integrated capital

the cost of integrated capital. And to the right are E assets $EV > 0$ which reduce the cost of integrated capital.

How should we interpret these results? The driving force behind the cost of integrated capital is the fact that the cost of financial capital is higher than the cost of social and environmental capital. The result is that the cost of integrated capital declines with higher amounts of positive social and environmental capital and rises when social and environmental capital fall and go negative. That follows directly from the weighted average formula in Eq. 13.12.

But what does it mean in economic terms? A company with environmental (or social) liabilities has a higher risk profile, reflected in a cost of integrated capital that exceeds its cost of financial capital. The company is basically taking a bet on the future, assuming that it can continue its business model with negative social and environmental externalities. But the company may have to pay for these externalities (i.e., internalisation) or, even worse, new regulations may forbid the company to draw down society's social and environmental capital. The higher cost of integrated capital reflects this risk. By contrast, a company with environmental (or social) assets has a lower risk profile and thus a lower cost of integrated capital, as it offers solutions. When internalisation takes place, that company has a competitive advantage with a future-proof business model (see Chap. 2). The risk to the company's business model is relatively low (i.e. the chance of maintaining the going concern is high), which is reflected in a low cost of integrated capital.

13.4.1 Adjusted Cost of Capital

Our simulation exercise was executed in a static way with constant cost of capital components: $r^{FV} = 6.0\%$, $r^{SV} = 2.2\%$ and $r^{EV} = 2.2\%$. To what extent do the associated risks affect each other? The easy part is that the cost of social and

Table 13.12 Dynamic simulation of cost of integrated capital

FV	SV	EV	IV	β^{SF}	β^{EF}	r^{FV}	r^{SV}	r^{EV}	dynamicr^{IV}	staticr^{IV}
100	0	−50	*50*	0	0.5	7.0%	2.2%	2.2%	*11.7%*	*9.8%*
100	0	−40	*60*	0	0.4	6.8%	2.2%	2.2%	*9.8%*	*8.5%*
100	0	−30	*70*	0	0.3	6.6%	2.2%	2.2%	*8.4%*	*7.6%*
100	0	−20	*80*	0	0.2	6.4%	2.2%	2.2%	*7.4%*	*7.0%*
100	0	−10	*90*	0	0.1	6.2%	2.2%	2.2%	*6.6%*	*6.4%*
100	0	0	*100*	0	0	6.0%	2.2%	2.2%	*6.0%*	*6.0%*
100	0	10	*110*	0	−0.1	5.8%	2.2%	2.2%	*5.5%*	*5.7%*
100	0	20	*120*	0	−0.2	5.6%	2.2%	2.2%	*5.1%*	*5.4%*
100	0	30	*130*	0	−0.3	5.4%	2.2%	2.2%	*4.7%*	*5.1%*
100	0	40	*140*	0	−0.4	5.2%	2.2%	2.2%	*4.4%*	*4.9%*
100	0	50	*150*	0	−0.5	5.1%	2.2%	2.2%	*4.1%*	*4.7%*

This table calculates a dynamic cost of financial capital r_i^{FV} by adding the social and environmental risk premium. We use Eq. (13.8): $r_i = r_f + \beta_i^{MKT} \cdot RP_{MKT} + \beta_i^{SF} \cdot RP_{SF} + \beta_i^{EF} \cdot RP_{EF}$ and assume full equity financing, a risk-free rate of 2%, a market beta of 1, a market risk premium of 4%, a social risk premium of 1.25%, and an environmental risk premium of 1.9%. The factor betas are calculated with Eq. (13.9): $\beta_i^{SF} = -\frac{SV}{FV}$ and $\beta_i^{EF} = -\frac{EV}{FV}$

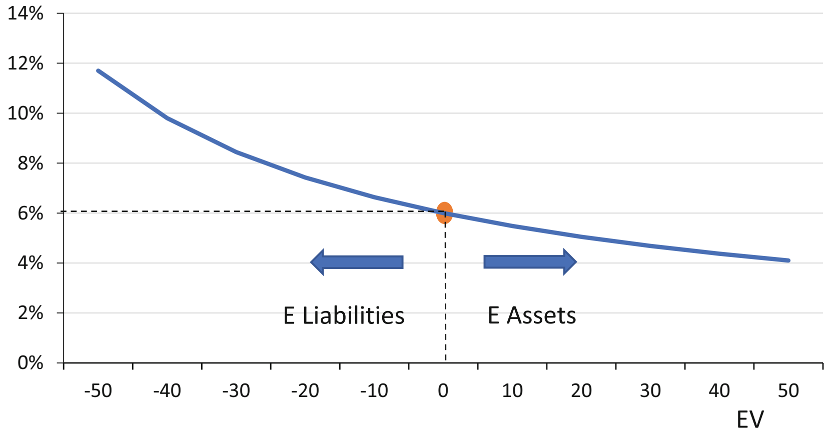

Fig. 13.6 Dynamic cost of integrated capital

environmental capital r^{SV} and r^{EV} remains constant, as explained in Sect. 13.3. But the adjusted cost of financial capital r^{FV} rises with increasing social and environmental risks (proxied by negative values for *SV* and *EV* in Sect. 13.2). So, if anything, the dispersion in the cost of integrated capital widens in a dynamic simulation. The final columns of Table 13.12 compare the results of the dynamic and static r^{IV}. Table 13.12 highlights that social and environmental factors influence the adjusted cost of financial capital r^{FV} in a limited way (ranging from 5 to 7% in our example), while the cost of integrated capital r^{IV} varies from 4 to 12%. Figure 13.6 shows the dynamic cost of integrated capital. The orange focal point of 6%

at $EV = 0$ in Fig. 13.6 is the same as in Fig. 13.5, but the line is steeper than in Fig. 13.5: a higher dynamic cost of integrated capital at negative values of EV and a lower dynamic cost of integrated capital at positive values of EV.

An integrated perspective that includes social and environmental value in the calculations makes a big difference.

13.4.2 Inditex Case Study

We can now calculate the cost of financial capital and the cost of integrated capital for Inditex (see the case study in Chap. 11). Example 13.8 gives the basic data and shows the calculations. The starting point is Inditex's cost of financial capital at 7.8%, as used in the Inditex case study in Chap. 11. Inditex's net social and environmental liabilities of −\$37 bn (= social assets of \$146 bn—environmental liabilities of \$183 bn) cause an uplift of the cost of capital. The first step is from 7.8 to 9.9% on the cost of financial capital, which is mainly caused by Inditex's high sensitivity (beta) to the environmental risk premium. The second step is from 9.9 to 16.6% on the cost of integrated capital. The net social and environmental liabilities increase the cost of integrated capital, as shown in Fig. 13.6.

Inditex's cost of integrated capital of 16.6% is far higher than its cost of financial capital, reflecting Inditex's social liabilities (workers in the supply chain) and environmental liabilities (GHG emissions and other environmental damages). We cannot tell if that is higher compared to the overall market, since we do not (yet) have the integrated value data on other companies.

Example 13.8 Calculating the Cost of Financial and Integrated Capital for Inditex

Problem

From Chap. 11, we know that Inditex has a risk-free rate of 1.5%, a market risk premium of 5%, a beta of 1.21, and a credit risk premium of 1%. From Table 13.7 in this chapter, we know that the social risk premium is 1.25% and the environmental risk premium 1.9%.

For 2021, Inditex had an integrated value of €42 billion. Table 13.13 shows the components of the integrated value (taken from Table 11.18 in Chap. 11). In addition, Inditex had equity of €82 billion and a negative debt of −€3 billion (taken from Table 11.6; debt is negative due to Inditex's large cash position).

Table 13.13 Integrated value of Inditex, in € billions, 2021

IV calculation	Value (Euro billions)
FV (enterprise value)	79
Negative SV	−137
Positive SV	283
Negative EV	−183
IV	*42*

Source: Table 11.18 from Chap. 11

Please calculate Inditex's adjusted cost of financial capital and cost of integrated capital.

Solution

Cost of financial capital

Let's first reproduce Inditex's cost of financial capital. The cost of financial capital is the WACC based on the cost of equity and the cost of debt. Using Eq. 13.1, we get for the cost of equity $r_E = r_f + \beta_i \cdot (E[r_{MKT}] - r_f) = 1.5\ \% + 1.21 * 5\ \% = 7.6\%$. Using Eq. 8.10, the cost of debt is $r_D = r_f + CRP = 1.5\ \% + 1.0\ \% = 2.5\%$. Now we can calculate Inditex's cost of financial capital: $WACC = \frac{E}{V} \cdot r_E + \frac{D}{V} \cdot r_D = \frac{82}{79} * 7.6\% - \frac{3}{79} * 2.5\% = 7.8\%$.

The next step is to calculate the adjusted cost of financial capital. Starting with the adjusted cost of equity component, we need to calculate the betas for social risk and for environmental risk using Eq. 13.9:

$$\beta_i^{SF} = -\frac{SV}{FV} = -\frac{146}{79} = -1.84 \text{ and } \beta_i^{EF} = -\frac{EV}{FV} = -\frac{-183}{79} = 2.31$$

Please note that the positive social value of \$283 bn and the negative social value of −\$137 bn add up to SV of \$146 bn. We use Eq. (13.8) for the adjusted cost of equity:

$$r_E = r_f + \beta_i^{MKT} \cdot RP_{MKT} + \beta_i^{SF} \cdot RP_{SF} + \beta_i^{EF} \cdot RP_{EF} =$$

$$1.5\% + 1.21 * 5\% - 1.84 * 1.25\% + 2.31 * 1.9\% = 9.6\%$$

There is no change in Inditex's cost of debt assumed—at higher debt levels, that might be an unrealistic assumption. Inditex's adjusted cost of financial capital is $WACC = \frac{E}{V} \cdot r_E + \frac{D}{V} \cdot r_D = \frac{82}{79} * 9.6\% - \frac{3}{79} * 2.5\% = 9.9\%$. So Inditex's adjusted cost of financial capital of 9.9% is 2.1% higher than the earlier calculated cost of financial capital of 7.8%.

Cost of integrated capital

We now have all the ingredients to calculate Inditex's cost of integrated capital. Using Eq. 13.12, we get:

$$r_i^{IV} = \frac{FV}{IV} \cdot r_i^{FV} + \frac{SV}{IV} \cdot r^{SV} + \frac{EV}{IV} \cdot r^{EV} =$$

$$\frac{79}{42} \cdot 9.9\% + \frac{146}{42} \cdot 2.2\% + \frac{-183}{42} \cdot 2.2\% = 16.6\%$$

Inditex's net social and environmental liabilities of −\$37 bn (= social assets of \$146 bn—environmental liabilities of \$183 bn) cause an uplift of the cost of capital: from 7.8 to 9.9% on the cost of financial capital and from 9.9 to 16.6% on the cost of integrated capital. ◄

13.4.3 Assets Versus Liabilities

Example 13.9 shows the impact of social and environmental liabilities versus assets for almost identical companies. The presence of liabilities puts a company at risk of increasing the cost of integrated capital. In capital structure terms, the company has higher leverage. By contrast, social and environmental assets improve a company's risk profile (with lower leverage) reducing the cost of integrated capital. We explore the effect of leverage further in Chap. 15 on capital structure. Example 13.9 highlights that even modest differences in social and environmental flows can have a large impact on a company's risk profile. The cost of integrated capital is thus a good indicator of a company's future-proofness or transition preparedness, as discussed in Chap. 2.

Example 13.9 Calculating the Cost of Integrated Capital for Almost Identical Companies

Problem

Let's compare two companies, A and B. They are identical from an FV perspective: both have annual FV flows of 6.4 and a cost of financial capital of 8%. However, company B is superior to company A on both annual SV flows (0.4 vs 0.2) and annual EV flows (0.2 vs −0.4). Both have a cost of social and environmental capital of 2.2%.

What is the integrated value and cost of integrated capital of both companies? Please explain the differences.

Solution

The first step is to transform the annual value flows into present value. We can use Eq. 4.6: $PV = \frac{CF}{r}$. The table below shows the results:

	Company A			Company B		
	Value flows	Cost of capital	Value	Value flows	Cost of capital	Value
FV	6.4	8.0%	80.0	6.4	8.0%	80.0
EV	−0.4	2.2%	−18.2	0.2	2.2%	9.1
SV	0.2	2.2%	9.1	0.4	2.2%	18.2
IV	*6.2*		*70.9*	*7.0*		*107.3*

While the value flows only differ by 13%, the company values differ by 51%. The low cost of social and environmental capital magnifies the differences in social and environmental value.

The second step is to calculate the cost of integrated capital. We can use Eq. 13.12: $r_i^{IV} = \frac{FV}{IV} \cdot r_i^{FV} + \frac{SV}{IV} \cdot r^{SV} + \frac{EV}{IV} \cdot r^{EV}$. The table below shows the results:

	Company A				Company B			
	Value	Value weight	Cost of capital	Weighted CoC	Value	Value weight	Cost of capital	Weighted CoC
FV	80.0	113%	8.0%	9.0%	80.0	75%	8.0%	6.0%
EV	−18.2	−26%	2.2%	−0.6%	9.1	8%	2.2%	0.4%
SV	9.1	13%	2.2%	0.3%	18.2	17%	2.2%	0.2%
IV	*70.9*	*100%*		*8.7%*	*107.3*	*100%*		*6.5%*

The value weights are calculated as: $\frac{FV}{IV}$, $\frac{SV}{IV}$, and $\frac{EV}{IV}$. The final column for each company calculates the cost of integrated capital as weighted cost of financial, social, and environmental capital. Company A's cost of integrated capital of 8.7% is much (220 bps) higher than company B's cost of integrated capital of 6.5%. It is also quite a bit (70 bps) higher than its own cost of financial capital, because of its negative environmental value flows. By contrast, company B has a cost of integrated capital that is much (150 bps) lower than its cost of financial capital—which will be the case for any company with positive SV and EV. In sum, company B has future-proofed its business model producing positive social and environmental flows. ◄

13.5 Conclusions

This chapter investigates the company's cost of capital. It starts with the cost of financial capital r^{FV}, which is the required minimum return on financial capital that is used in investment decisions. One can apply r^{FV} to specific types of financial capital and it is typically expressed in terms of the WACC (weighted average cost of capital) for the company's overall cost of capital; the cost of equity r_E; the cost of debt r_D; or the project cost of capital. Subsequently, the impact of S (social) and E (environmental) risks on the cost of financial capital is considered. That is, to what extent do companies incur additional (or reduced) financial risk from their S and E exposures?

It then addresses the cost of social capital r^{SV} and the cost of environmental capital r^{EV} in their own right. Given their nature, these tend to be much lower than a company's cost of financial capital. The flip side is that the valuation of assets and liabilities on E and S tends to be quite high versus their underlying value flows, as discounting with a low discount rate has a limited impact on value. They are an interesting expression of the claims that nature and society might have on companies.

Finally, r^{FV}, r^{SV}, and r^{EV} are put together to obtain the cost of integrated capital, r^{IV}, which is the return on integrated assets demanded by the company's stakeholders. Interestingly, r^{IV} gives an indication of the overall risk of the company, which can differ substantially from the risk picture that emerges from a purely financial or an ESG integrated perspective. Financial markets correct unsustainable activities only to a limited degree. An integrated perspective is needed to capture the full risk of not operating in a sustainable way.

Key Concepts Used in This Chapter

Adjusted cost of capital includes sustainability (social and environmental factors) in the cost of capital

Asset beta measures the beta (see below) for a company without leverage; it is also called the unlevered beta

Beta measures the sensitivity of a company's stock price to general market movements (with reference to market, social or environmental risk)

Capital Asset Pricing Model (CAPM) is the main asset pricing model in finance explaining the relationship between risk and return

Cost of capital refers to the required return on an investment

Factor beta measures the sensitivity of a company's stock price to specific factors (e.g., the social factor or environmental factor)

Factor portfolio is a portfolio with unit risk exposure to a particular risk factor (market, social or environmental risk) and no risk exposure to other factors

Financial discount rate or *cost of financial capital* is the discount rate used to discount financial capital.

Industry beta measures the asset beta (see above) for an industry

Integrated discount rate or *cost of integrated capital* is the discount rate used to discount integrated capital (or value)

Market index represents an entire stock market and thus tracks the market's changes over time

Market portfolio refers to the portfolio which contains all available assets in a market

Risk refers to the variation of future returns

Risk-free asset is a safe asset, such as government bills or bonds

Risk premium refers the return on a risky asset, such as equities or real estate, minus the return on the risk-free asset,

Security market line plots the expected return against the risk (measured by the beta) of each stock

Social discount rate is the discount rate for social projects and can be used to discount social and environmental capital.

Systematic risk refers to market-wide risk that cannot be diversified in a portfolio

WACC (weighted average cost of capital) is the weighted average of equity capital and debt capital

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14 Capital Market Adaptability, Investor Behaviour, and Impact

Overview

The idea that capital markets are information efficient is the bedrock of modern finance. The efficient markets hypothesis states that stock prices incorporate all relevant information instantaneously. An example is the interest rate announcements of central banks. If the announcement is in line with market expectations, not much happens. An unexpected interest rate rise or decline leads to an immediate stock market response. Similarly, companies make announcements about important events with a potential effect on earnings outside stock market hours, so that all investors have time to digest the implications. The consequence of the efficient markets hypothesis is that investors cannot consistently beat the market.

Investor behaviour is not always fully in line with theoretical predictions. For example, individual investors tend to own a few stocks with which they are familiar, leaving them undiversified. Both individual and professional investors trade too much, leading to high transaction costs without commensurately higher returns. An important anomaly is the existence of bubbles, whereby prices are for a (long) period of time above their 'normal' or fundamental values. Behavioural finance seeks to explain this irrational exuberance.

The mechanism behind efficient markets is that a sufficient number of analysts pay attention to newly arriving information, judge it value relevant, and trade on that information. In that way, the new information gets priced in. But there is evidence that learning takes time and that adaptive markets are a better description than efficient markets. In particular, it seems that analysts have been slow to pick up sustainability-related information. Only after the high-profile Paris climate conference in 2015, have carbon emissions begun to be priced in to some degree. It is not yet clear to what extent other environmental factors, like water scarcity and biodiversity loss, and social factors, like labour practices across the value chain, are reflected in stock prices. The adaptive markets hypothesis states that the degree of market efficiency depends on an evolutionary model of individuals adapting to a changing environment. So, the more analysts start to pay attention to an issue, the more and faster it will be priced in.

D. Schoenmaker, W. Schramade, *Corporate Finance for Long-Term Value*, Springer Texts in Business and Economics, https://doi.org/10.1007/978-3-031-35009-2_14

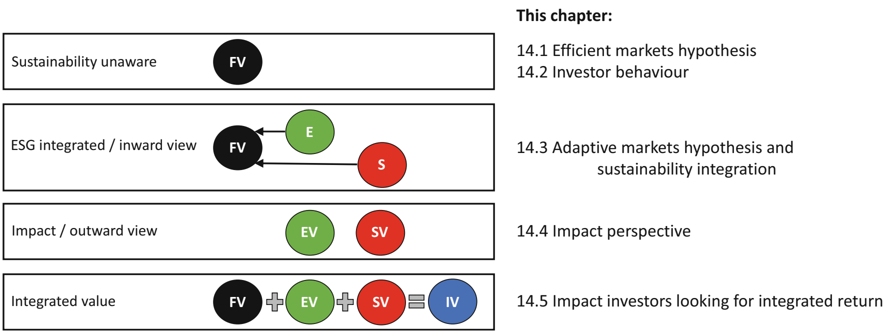


Fig. 14.1 Chapter overview

However, stock prices only reflect the effects of (sustainability-related) information on the financial value of companies. There is no 'market' (yet) for the diffusion of information on the social and environmental value (impact) of companies. New regulations, scientific research, non-governmental organisations (NGOs), and ratings agencies do produce information on companies' social and environmental impact. Implicit markets on impact information and price-setting are evolving: product markets partly reveal consumer preferences for sustainable products; capital markets partly reveal investor preferences for impact investing; and elections partly reveal voter preferences for sustainable policies. These markets can be used to determine the willingness to pay for impact (and thus derive prices for impact). This is all very relevant to companies as well. Chapter 17 explains that reporting regulations are going to require companies to report on their impact alongside their financials. Finally, a new breed of impact investors is emerging. These investors look for financial return (profit) as well as impact and may be willing to sacrifice some part of their financial return for higher impact. See Fig. 14.1 for a chapter overview.

Learning Objectives
After you have studied this chapter, you should be able to:

- explain how information is processed into stock prices
- critically reflect on the information efficiency of markets
- appreciate anomalies in the behaviour of investors
- contrast the efficient markets and adaptive markets hypotheses
- identify the impact perspective and the role of impact investors

14.1 Efficient Markets Hypothesis

Stock prices are one of the most closely followed news items. News bulletins frequently include an update on the change in the Dow Jones index or the leading stock market index in your country. That raises the question of whether stock prices can be predicted: can a pattern or price cycle be discerned? An important premise of finance is that there are no patterns in stock prices according to the efficient markets hypothesis (explained below). Stock price changes are random: tomorrow's stock price has an equal chance of going up or going down (Kendall, 1953). Such a random walk can be generated by tossing a coin: heads—the price goes up; and tails—the price goes down.

Assuming an underlying expected monthly return of 0.5%, stock prices follow a random walk with a positive drift of 0.5% per month. In statistical terms, a *random walk* means that subsequent price changes are independent of each other; just like tossing a coin. Even after 20 times in a row of getting 'heads', the chance of heads in the next toss remains exactly 50% (independent from the previous tosses). So, the pattern of past stock prices does not contain information about tomorrow's stock price.

The premise that stock prices follow a random walk means that stock prices cannot be predicted. Otherwise, investors anticipate price changes and make easy profits. The idea is that competition between investors eliminates profit opportunities. The result is that bonds and stocks are fairly priced. In this line of thinking, an investor can't outperform the market. Market anomalies should not exist because they will immediately be arbitraged away. However, we discuss some exceptions in Sect. 14.2.

Efficient Markets Hypothesis

The idea that investors cannot use information from past stock prices to predict future stock prices means that markets are information efficient. The *efficient markets hypothesis* states that stock prices incorporate all relevant information instantaneously. Eugene Fama (1970) distinguishes three forms of market efficiency:

Weak market efficiency	• Prices reflect all relevant past information
Semi-strong market efficiency	• Prices reflect not only information in past prices, but also all publicly available information (e.g. from Internet and financial press)
Strong market efficiency	• Prices also reflect information gathered through fundamental analysis of the company and the economy

Weak market efficiency is already explained above. Stock prices have to follow a random walk. If not, investors could make a profit from analysing past stock prices (e.g. through technical analysis of stock prices on a chart). But in competitive markets, such profits cannot last and will thus be competed away. The result is that changes in stock prices cannot be predicted. The information in past stock prices is already incorporated in today's stock prices.

The next step is to extend this idea to all publicly available information. This includes information from the financial press (e.g. financial newswires like Reuters and Bloomberg and financial newspapers like the Financial Times) and more broadly from the internet. Again, the semi-strong form of market efficiency states that investors cannot make persistent profits based on this public information, as competition will eliminate these profits. Boxes 14.1 and 14.2 show how important financial information is immediately incorporated in stock prices. Example 14.1 demonstrates how the expected stock price move from a take-over announcement can be calculated.

Box 14.1 Interest Rate Announcements by Central Banks

Interest rates and stock prices are both important for economic growth. When central banks fear that the economy is getting overheated leading to inflation, they will try to slow down the economy and inflation expectations with a rise in interest rates. Such an interest rate rise has a negative impact on future profits and increases the discount factor; both factors reduce stock prices. Interest rates and stock prices are generally speaking negatively correlated.

Thus, interest rate announcements have a major impact on stock prices. Central banks therefore follow a strict protocol on announcing their interest rate policy. The European Central Bank (ECB), for example, has a 6-week schedule for their monetary policy meetings on Thursdays, whereby the press release of the interest rate decision is at 13.45 and the subsequent press-conference of the ECB president at 14.30. The monetary policy meeting dates and announcement times are published well in advance on the ECB website.

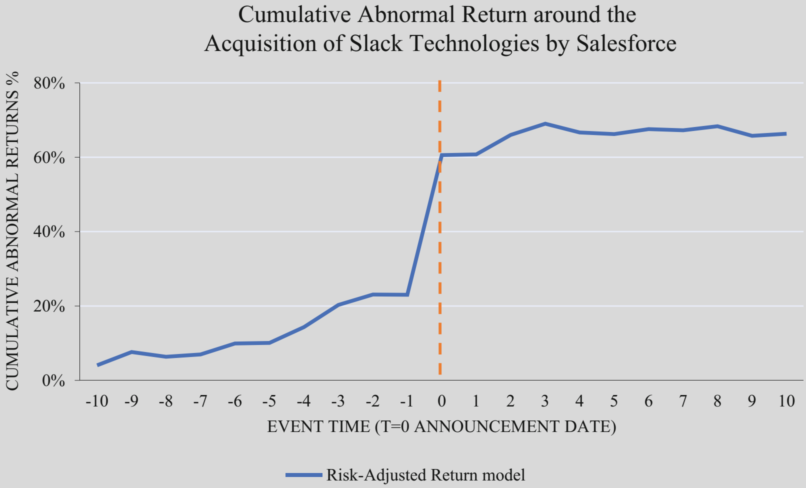
In the run-up to the meeting, the market speculates on the ECB's decision. When the decision is in line with market expectations, the stock market does not move. An unexpected interest rate rise (or decline) leads to an immediate reaction in stock prices, which adjust more or less instantaneously. This adjustment will be paired with some heightened volatility to arrive at the new market equilibrium of expectations. Fierce competition among stock traders ensures that there is limited to no opportunity to gain from the interest rate announcement.

Securities regulations force companies to publish information that can potentially move the stock price (e.g., earnings announcements or takeovers) (a) outside trading hours and (b) as widely as possible (e.g., through a press release). Investors then have time to digest the new information and have equal access to the information.

Moreover, securities regulations forbid spreading rumours (i.e., false information) about companies in order to manipulate the stock price. An investor can easily talk up a company's stock price with favourable rumours, ahead of their planned sale of the company's stock, and vice versa.

Box 14.2 Takeovers and Market Efficiency

On December 1st, 2020, the Cloud computing giant, Salesforce, announced the acquisition of Slack Technologies for $27.7 billion dollars. Salesforce strove to expand their remote work activities via the communication platform Slack. On the announcement date, the stock price of Slack jumped 38%, revealing new information to the market according to the efficient market hypothesis. The share price immediately converged to the bid price, given the fact that Slack shareholders received $26.79 in cash and 0.0776 Salesforce shares. Also, there seems to have been some information leakage prior to the announcement, given that the stock price increased by 22%. The Cumulative Abnormal Return (CAR) shows the deviation of Slack's realised return (on the announcement date) from its expected market return. The expected market return can be calculated with the standard CAPM market model. The figure shows that the total CAR of Slack amounts to 60%. The CAR after the announcement date is close to zero.



Example 14.1 Calculating the Expected Stock Price Change

Problem

Suppose a company with a $50 billion market capitalisation announces the takeover of a smaller competitor. The expected NPV of the takeover is $700 million (this is the NPV for the acquiring company after paying a possible takeover premium; see Chap. 18). If markets are strongly efficient, what will be the stock price effect of the announcement for the acquiring company?

Solution

Strong efficiency implies that the market correctly estimates the NPV of the takeover on its announcement. Therefore, the acquiring company's stock price will rise by 0.7 billion/50 billion = 1.4%. ◄

The final step is to expand market efficiency to all information, including information from fundamental analysis and inside information. Some investment analysts conduct fundamental analysis of companies with a full DCF model, as explained in Chap. 9. The strong form of market efficiency argues that these fundamental analysts cannot outperform the market. This is a very 'strong' statement. It means that there is no added value from fundamental analysis, while this analysis is costly to do. We come back to the role of fundamental analysis (and its cost) in this section and later sections.

Again, securities regulations forbid company insiders to trade on private information. Insider dealing is a criminal offence, although extremely difficult to prove in a criminal court. These rules also prescribe strict procedures for contacts between company management and (fundamental) investors. Company management is not allowed to give stock-price sensitive information to individual investors or small groups of investors. Companies therefore organise analyst calls, which are widely accessible to investors, to update investors on strategy, earnings outlook, etc.

The Paradox in the Efficient Markets Hypothesis: The Need for Active Investors

Interestingly, the efficient markets hypothesis has a contradictory element in it (Grossman & Stiglitz, 1980). Taking its consequences literally, all investors will be passive, as active trading strategies and information acquisition do not pay off in informationally efficient markets. At the same time, we need active investors to acquire and process information to update market prices (the process of price discovery). Information acquisition and processing are costly. So, who will provide this costly service with no benefit?

French (2008) compares the fees, expenses, and trading costs that society pays to invest in the US stock market with an estimate of what would be paid if everyone invested passively. Averaging over 1980–2006, French finds that active investors spend around 70 basis points (0.7%) of the aggregate value of the market each year searching for superior returns. This 70 bp amounts to almost 10% of market returns. However, there is no benefit to this expenditure, as active investors earn by definition the market return on average. Some are lucky and earn a bit more, and some are unlucky and earn a bit less. However, it is impossible to outperform the market on a persistent basis according to the efficient markets hypothesis.

As active investors can 'on average' not increase their return with active trading strategies, they could improve their returns by 70 basis points if they switched to a passive market portfolio. We can observe a move to passive investment strategies by large asset managers, such as BlackRock, Fidelity, and Vanguard. Nevertheless, active investors are needed for price discovery and thus provide a service to society. Price discovery is crucial for markets to play their allocational role: good companies can more easily raise new capital because of higher stock prices, while badly performing companies find it increasingly difficult to raise fresh capital because of declining stock prices and may ultimately disappear in the process of creative destruction (Schumpeter, 1942).

The upshot is that markets can only be close to efficiency, because some (small) profit opportunities are needed for active investors. It is an open question how many active investors are required to keep markets efficient. Further evidence for and against market efficiency is provided in the next section.

14.2 Investor Behaviour

Investor behaviour is not always fully in line with theoretical predictions of capital market efficiency. An important anomaly is the existence of bubbles, whereby prices are for a (long) period of time above their 'normal' or fundamental values. Behavioural finance seeks to explain this irrational exuberance.

14.2.1 Financial Investors and Capital Market Competition

To analyse investor behaviour, we need to know the investor's goal function. The exclusively financially driven investor aims to maximise return and minimise risk. That is exactly what the CAPM is doing. As explained in Chap. 12, the CAPM constructs portfolios of stocks with maximum return given risk. The required return of individual stocks r_i from the CAPM is (Eq. 12.15):

$$\text{Required return} : r_i = r_f + \beta_i \cdot \left(E[r_{Mkt}] - r_f\right) \tag{14.1}$$

Equation 14.1 is the basis for the security market line in Fig. 14.2. Now let's enter investors' expectations about stock return and take the stock of Swiss nutrition company Nestlé as an example. Investors may, for example, expect a higher annual return on Nestlé of say 6.8% (due to good news about the company) than the required return of 4.8% according to the security market line. Figure 14.2 shows this difference between a stock's expected return $E[r_i]$ and required return r_i, which is called a stock's alpha α_i:

$$\text{Alpha} : \alpha_i = E[r_i] - r_i \tag{14.2}$$

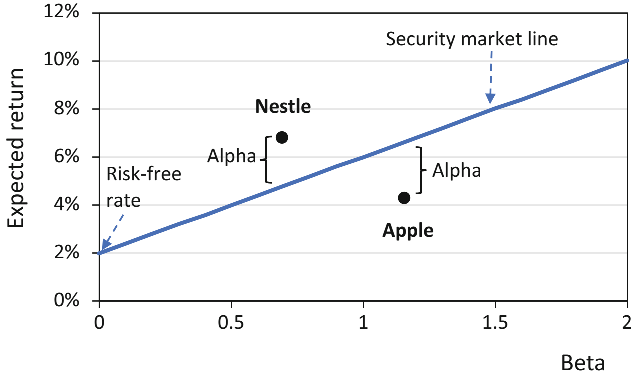


Fig. 14.2 Alpha and the security market line

Alpha is a measure of the active return on an investment and measures the performance of an investment compared with a suitable market index (a real-world proxy for the theoretical security market line). Combining Eqs. 14.1 and 14.2, we can write out the stock's expected return:

$$\text{Expected return}: E[r_i] = \alpha_i + r_f + \beta_i \cdot \left(E[r_{Mkt}] - r_f\right) \tag{14.3}$$

Smart investors see the opportunity of buying Nestlé with an expected return of 6.8%, while its required return (based on its risk profile) is only 4.8%. This trading will drive up Nestlé's stock price until the expected return arrives at 4.8%, back on the security market line. The same will happen to the Apple stock in Fig. 14.2. As Apple's expected return of 4.2% is lower than its required return of 6.3%, investors will sell Apple until the expected return rises to 6.3%. In competitive markets, all stocks are on the security market line with an alpha of zero.

Paradoxically, while the CAPM suggests that all investors passively hold the market portfolio in equilibrium, efficient markets do require the presence of a significant number of active investors who try to beat the market. After all, the mechanism behind efficient markets is that a sufficient number of analysts pay attention to newly arriving information, judge it value relevant, and trade on that information. In that way, the new information gets priced in.

14.2.2 Behavioural Finance

But are all investors acting in line with the expectations of the CAPM model (i.e. investing in the market portfolio)? Behavioural finance looks into deviations from what we might expect from theory. Here, we discuss two major deviations. The first is the *familiarity bias* of individual investors, who tend to invest in a few stocks of companies they are familiar with. These are typically household names, like Apple, Nike, and McDonald's in the USA. In Europe, this is often still country specific: Unilever, Shell, and GlaxoSmithKline in the UK; Volkswagen, Siemens, and Adidas in Germany; Danone, Carrefour, and LVMH in France; and Philips, Heineken, and ASML in the Netherlands.

The familiarity bias often results in portfolios with less than ten stocks. Retail investors may thus fail to diversify their stock portfolio appropriately. This limited diversification (which is not in line with the CAPM) is evidence of irrational investor behaviour. It should be noted that not all retail investors hold portfolios of individual stocks. Well-diversified exchange-traded funds (ETFs) and actively managed mutual funds have become popular among retail (and professional) investors.

Another deviation from theory is *excessive trading*. Following (financially relevant) news, investors may enter into frequent trading of their stocks. Such frequent trading gives rise to high transaction costs, which reduces net investment returns (gross investment returns minus transaction costs). When a broker excessively trades a client's account (beyond the agreed investment objectives), this is called churning, which is forbidden by securities law. Excessive trading is not only done by retail investors, but also by professional investors. The annual stock turnover on the largest stock exchanges is well over 100%, which means that all shares change hands at least once every year (on average). Excessive trading is also not in line with the CAPM and evidence of irrational investor behaviour. In efficient markets, there is no need for frequent (and costly) trading.

14.2.3 Bubbles

In efficient markets, stock prices should trade in line with a company's fundamentals. A company's fundamental value can be estimated with a DCF model, as explained in Chap. 9. A company with good prospects has a higher (fundamental) value than an otherwise similar company with less favourable prospects. CAPM is good at relative pricing of stocks (i.e. relative to each other), but not at absolute pricing (i.e. the height of the stock price).

The pricing of stocks in CAPM is based on homogeneous expectations (see Box 12.2). What happens when investors collectively believe that the outlook is more favourable? Shiller (2000) has coined the term *irrational exuberance* which refers to investor enthusiasm that drives asset prices higher than those assets' fundamentals justify.

A famous example of such irrational exuberance is the dotcom bubble, when investors had high expectations about the internet and valued internet companies at very high prices, even in the absence of profits and clear business models. Figure 14.3 shows the NASDAQ Composite Index, where many of these internet companies were listed. The NASDAQ increased from 750 in early 1995 to 4700 in February 2000, when the dotcom bubble burst. The NASDAQ subsequently fell back to 1170 in September 2002. With hindsight, bubbles are easy to spot, but at the time—when the frenzy takes hold—it may be difficult to identify overvalued companies or sectors. And even if one can identify a bubble, it can still go on for

Fig. 14.3 The dotcom bubble, NASDAQ Composite Index, 1995–2002. Source: Nasdaq

a long time. As Keynes famously said: the market can remain irrational far longer than you can remain liquid.

Shiller developed a cyclically adjusted price-to-earnings ratio (CAPE) as a measure of over- or undervaluation of the market (Siegel, 2016). CAPE is defined as price divided by the average of 10 years of earnings (moving average), adjusted for inflation. The ratio is used to gauge whether a stock, or group of stocks, is undervalued or overvalued. At an average CAPE ratio of 15 for the twentieth century, a high CAPE ratio of 25 indicates overvaluation and is linked to 'irrational exuberance'. Such a high CAPE ratio of 25 happened in 1929 (preceding the Great Depression), in 1999 (preceding the dotcom bubble), and in 2007 (preceding the Global Financial Crisis).

Incentives in the financial system, such as credit ratings paid by the issuers of securities and investment banks paid in fees for developing structured products, can contribute to overtrading and overvaluation of certain companies or products. This happened in the Global Financial Crisis of 2007–2009, when the banking system in the USA and Europe collapsed due to problems in the US housing market. The focal point of the crisis was the unravelling of the Sub-Prime Mortgage market (which was fuelled by rating agencies and investment banks), but the underlying cause was the decline in US house prices.

More general, over- and under-investment in new companies and new technologies is of all ages. There are always some stocks that are trading at very high prices, but these are individual cases. The concept of a bubble is a collective overvaluation of sectors or companies by investors. As discussed, the spotting of bubbles in real time can be difficult. And when spotted, it can still take quite some time before they burst.

14.3 Adaptive Markets Hypothesis and Sustainability Integration

Andrew Lo (2004, 2017) provides an alternative description of markets. His *adaptive markets hypothesis* states that the degree of market efficiency depends on an evolutionary model of individuals adapting to a changing environment:

> Based on evolutionary principles, the Adaptive Markets Hypothesis implies that the degree of market efficiency is related to environmental factors characterising market ecology such as the number of competitors in the market, the magnitude of profit opportunities available, and the adaptability of the market participants.

Unlike the efficient markets hypothesis, the adaptive markets hypothesis allows for:

- path dependencies;
- systematic changes in behaviour; and
- varying risk preferences.

It also means that the current state of markets maximising financial return subject to financial risk only may not last. Changing practices of market participants could result in social and environmental factors being priced in. But it will be an evolutionary process to get there. The speed of the process depends on the number of fundamental analysts covering these factors. The adaptive markets hypothesis can explain why new factors, such as social and environmental risks and opportunities, are not yet fully priced in, because not enough investors are examining these new factors and/or are expecting sustainable material risks to lead to financial effects.

Capital markets still have to adapt to sustainability-related information. The question is how to get sustainability-related information embedded into stock prices. This is the inward perspective as illustrated on the left side of Fig. 14.5 (in Sect. 14.4 below). There is evidence that analysts are slow to pick up sustainability-related information. Only after the high-profile Paris climate conference in 2015 are carbon emissions starting to be priced in. It is not yet clear to what extent other social and environmental factors, like labour practices across the value chain, water scarcity, and biodiversity loss, are reflected in stock prices.

In an adaptive market process, the social and environmental dimensions might become incorporated into investment allocation, as market participants start seeing and pricing their financial relevance. An investment analyst needs to investigate the materiality of social and environmental factors and their impact on an investee company (see Chaps. 2 and 5).

14.3.1 Transition Preparedness

As the UN Sustainable Development Goals are about transition, an investor needs to know how well or ill-prepared an investee company is: can the company's business model be adapted to a sustainable economy? Such preparedness can be assessed at the industry and company level (see Chap. 2). This means that one needs an expert, like a fundamental analyst, to make a judgement call about a company's preparedness.

Another implication of a renewed focus on companies and their preparedness is that the traditional tools do not suffice. Investors have to look at companies through a different lens and go beyond traditional financial statement analysis. Inserting ESG ratings does not measure companies' preparedness for transition, as argued in Box 14.3. Rather, one needs to adopt new tools and data (and often invent them) to really assess the earlier-mentioned transformational challenge and its impact on the company's value. This includes considering social and environmental factors in their own units, investigating governance and behaviour, and assessing their impact on companies' strategies and business models. It is also helpful to apply advanced models like real option analysis to deal with the fundamental uncertainty of transitions (see Chap. 19).

The transition preparedness' assessment requires an in-depth fundamental analysis of companies. Over time, sustainability reporting is expected to increase with new reporting initiatives like the EU Corporate Sustainability Reporting Directive and the International Sustainability Standard Boards, as explained in Chap. 17. With this increased information, markets will adapt and thus become more efficient. Accordingly, ESG ratings are expected to improve and more quant or passive investment strategies may work. Figure 14.4 provides a dynamic picture of the availability of qualitative and quantitative ESG data. The lack of available data is currently very large, but should diminish over time in line with the adaptive markets hypothesis, with pockets of poorly used (and poorly available) data as inefficiencies and opportunities to be exploited. Section 14.2 introduced the concept of alpha—return on active investment exploiting market inefficiencies. Increased attention for, and competition in, gathering socially and environmentally relevant information will reduce alpha to zero.

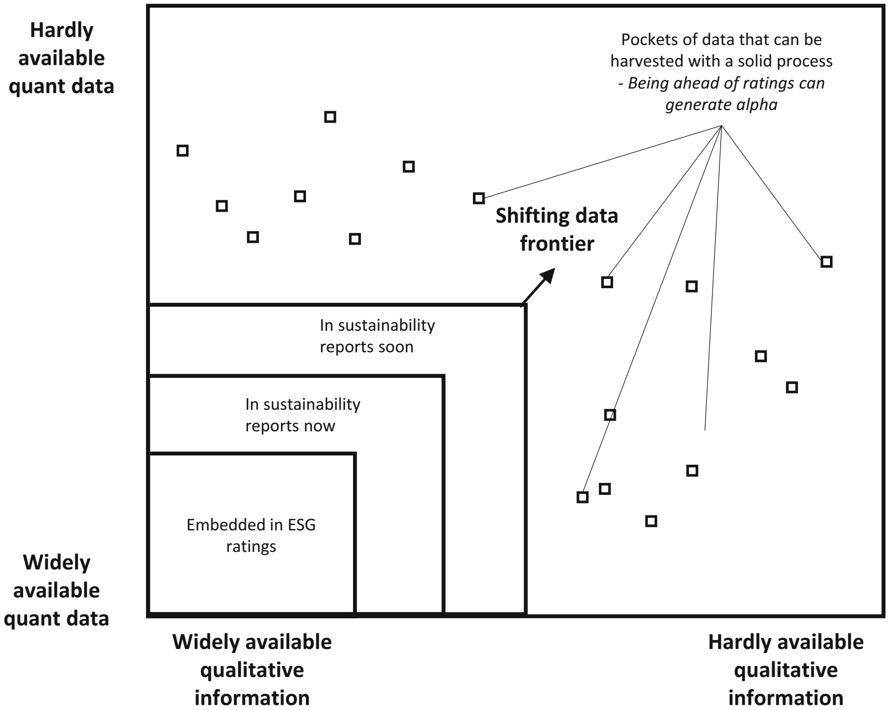


Fig. 14.4 The increasing availability of ESG data

Box 14.3 Limitations of ESG Ratings

To analyse companies' sustainability profiles, ESG ratings have been developed. ESG rating agencies like MSCI, Sustainalytics, Refinitiv (Asset4), and ISS (Oekom) score thousands of companies on several sustainability metrics within the E (environmental), S (social), and G (governance) domains. They provide scores and reports at the company level, to be used by investors with a subscription to their services. Typically, ESG ratings help indicate a company's level of environmental, social, and governance risks. Therefore, it is important to understand that these ratings only indicate a company's inward (risk) impact and don't indicate the outward impact of the company in terms of ESG.

The rating agencies use publicly available information (i.e. from ESG reports) to determine the ratings, but can additionally use non-public information shared privately by the company with the agency to enhance the quality of the ratings. For example, Sustainalytics' ESG Risk Rating can be a 'core' rating, which means it only uses publicly available information; or a

(continued)

Box 14.3 (continued)
'comprehensive' rating, which means it received additional information directly from the company to improve the agency's understanding of the company's internal ESG risk management.

The advantage of these ESG ratings is that they provide investors with a quick approximation of a firm's ESG risk, just like a price-earnings ratio provides investors with a quick view on a firm's valuation (see Chap. 9). The disadvantage of ESG ratings is that they are difficult to compare, since each rating agency uses a methodology which differs in terms of scope and measurement (Berg et al., 2022).

The ESG rating methodology, at least for Sustainalytics and MSCI, contains an Exposure score and a Management score. The Exposure score depends on the operations of a company and its inherent risks (e.g. an oil company has higher exposure to ESG risks than a HR company) and typically cannot be impacted by the company. Therefore, this Exposure score is usually similar for firms operating in the same industry and sector. The Management score is associated with the firm's management of its ESG risks (e.g. for carbon emissions, does it have a decarbonisation strategy?) and can therefore be impacted by the company. This Management score is divided into several ESG issues which are deemed material for the company. This means that companies in different industries will be assessed based on different ESG issues.

Design limitations

The ESG rating methodology leads to a number of limitations by design. First, companies' ESG ratings cannot really be compared unless the company is operating in the same industry and has the same ESG issues (as determined by the rating agency). Second, there is no universally defined framework for deciding which ESG issues are material and how they should be weighted, which means rating agencies can assign different ESG issues for the same company and end up with a completely different rating. Third, as mentioned the rating only takes into account inward impact and not outward impact, which means companies with a lot of negative externalities can still have good ratings if they are (so far) good at protecting themselves from ESG risks.

14.4 Impact Perspective

The adaptive markets hypothesis states that social and environmental risks are increasingly incorporated in stock prices, as more parties in the market pay attention to these risks (top horizontal arrow in Fig. 14.5). That is the inward perspective. But what about the impact of companies on society and nature? This outward or impact perspective on sustainability (bottom horizontal arrow in Fig. 14.5) is not reflected in

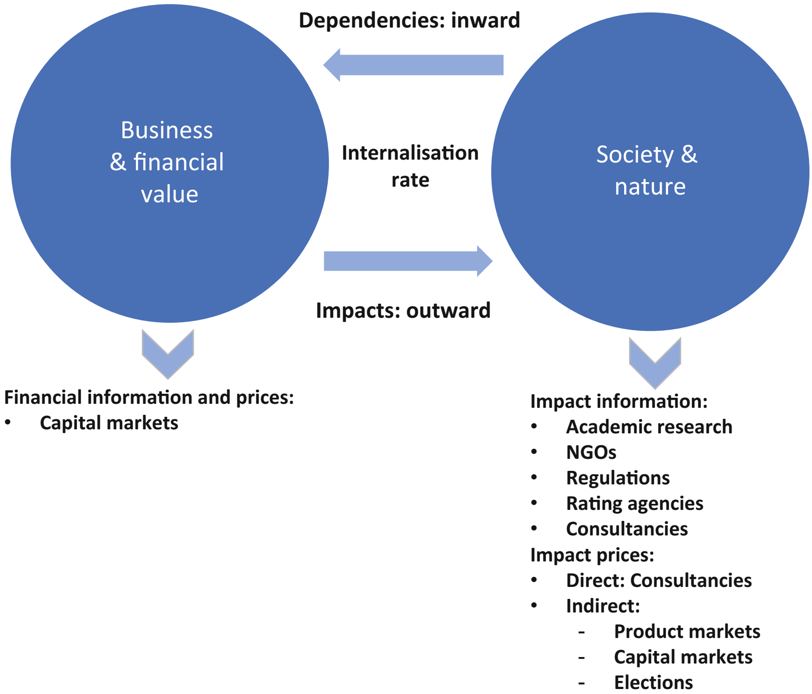


Fig. 14.5 Financial and impact perspectives on information and price formation

stock prices, which represent the financial value of companies. The impact dimension embodies the social and environmental value of companies, separate from financial value. It should be noted that, while these types of value can be calculated independently, they tend to be interdependent (see Chap. 2). This section discusses the main producers of impact information; impact pricing; and impact performance measurement.

14.4.1 Impact Information Producers

Academic research has produced the planetary and social boundaries, introduced in Chap. 1. These overall boundaries show how we can keep the Earth system in a stable and resilient state. The aim is to safeguard Earth's life support systems while ensuring that Earth's benefits, risks, and related responsibilities are equitably shared among people. The Earth Commission, a group of leading scientists, assess the latest science to define a safe and just corridor for people and planet and underpin the development of science-based targets for systems like air, land, water, and biodiversity (Rockström et al., 2021). Although 'safe' and 'just' Earth system targets are interrelated, safe targets refer primarily to a stable Earth system and just targets refer to meeting human needs.

These scientific Earth system targets can be translated into science-based targets for actors, like nations, cities, and companies. While the science-based targets are aligned with scientific evidence, they may involve negotiations based on responsibility and feasibility (Andersen et al., 2021). In our case, this means practical downscaling of global scientific targets to specific science-based targets for sectors and companies. Box 14.4 provides an example of the application of science-based targets to reduce carbon emissions. Science-based targets make use of statistical agencies that produce impact information at country and sector level. Eurostat, the European statistical agency, produces, for example, detailed data on carbon emissions by country and sector.

Box 14.4 Applying Science-Based Targets

There are several alliances of investors, banks, and companies that aim for a net zero carbon 1.5 °C-aligned world. These alliances translate the planetary boundary of 1.5 °C global warming into specific targets for each of these groups. For example, more than 3000 businesses and financial institutions are working with the Science-Based Targets initiative (SBTi) to reduce their emissions in line with climate science. These companies are setting targets for reducing carbon emissions. These targets encompass both near-term targets for the next 5–10 years and long-term targets to achieve net zero by 2040/2050.

For example, in its 2022 annual report, Inditex discusses its 2040 net zero target, and its use of SBTi.

Sources: https://sciencebasedtargets.org/companies-taking-action

Non-governmental organisations (NGOs) are organisations that produce impact information, which is mostly about negative impacts. Amnesty International, for example, publishes overviews of human rights abuses by companies and governments across the world in their annual surveys and specialised reports. Box 14.5 provides an example. In a similar way, the World Wildlife Fund (WWF) is the source for information on company impact on biodiversity loss and the Carbon Disclosure Project (CDP) for company's carbon emissions. In addition to the large well-known NGOs, like Amnesty, WWF, Greenpeace, and Oxfam, there are smaller NGOs. Box 14.6 shows the role of such a smaller NGO in exposing companies and banks linked to deforestation.

Box 14.5 Amnesty International on Oil Spills

In Bodo Creek in Ogoniland, Nigeria, two oil spills (August/December 2008) destroyed thousands of livelihoods. Oil poured from faults in the Trans-Niger Pipeline for weeks, covering the area in a thick slick of oil. Amnesty International and their partner, the Centre for Environment, Human Rights and

(continued)

Box 14.5 (continued)

Development, worked with the community to get the oil company responsible—Shell—to clean up its mess and pay proper compensation. Finally, in December 2014, the Bodo community won a long-awaited victory when Shell paid out an unprecedented £55million in compensation after legal action in the United Kingdom.

Source: https://www.amnesty.org/en/what-we-do/corporate-accountability/

Box 14.6 Global Witness on Deforestation

Agriculture is the main cause of deforestation. Cattle (beef), palm oil, and soy are the most important agricultural commodities contributing to land-use linked to deforestation. Global Witness (2021) has identified the top three companies active in these agricultural commodities:

1. Cargill, the largest agricultural commodity trader of soy and beef, based in the USA;
2. JBS, the leading exporter of beef from South America, based in Brazil;
3. Wilmar, the largest refiner and trader of palm oil, based in Singapore.

While the annual reports of these companies contain statements that most, if not all, of their commodities are deforestation free, the reality is that these companies are major contributors to deforestation. NGOs, like Global Witness, are needed to produce this information. Global Witness (2021) also highlights the role of banks financing these companies. Again, these leading banks have statements on zero-deforestation policies in their annual reports.

Although the impact information produced by NGOs is highly valuable, it also has its limitations. NGOs (rightly) focus their attention on the worst offences, but they do not provide systematic coverage of the universe of listed companies. And only to a certain extent does their data find their way into datasets that *do* have such universal coverage. For example, Bartels and Schramade (2022) point out that human rights data in ESG ratings reports is limited and does not allow investors to make a good assessment of the damage being done, nor of its mitigation.

Reporting regulations are starting to require companies to report on impact information. Chapter 17 discusses these reporting regulations in detail and shows some examples of impact reporting by companies.

Rating agencies are also increasingly becoming producers of impact information. These are the traditional credit rating agencies, which have started to include sustainability into their credit risk analysis (see Chap. 8). And, of course, the ESG rating agencies, discussed in Sect. 14.3. There is a shift from measuring ESG risks (inward) to SDG impacts (outward). Oekom, a leading ESG rating agency, publishes, for example, SDG impact ratings of companies.

While the NGOs are providing broad ranging reports on impacts, rating agencies are starting to use this information in their analysis of specific companies. Moody's has, for example, made an analysis of the reputational risk of deforestation (see Box 14.7).

Box 14.7 Moody's on Reputational Risk of Deforestation

Moody's (2021) notes that the main cause of deforestation is the conversion of forests for agriculture. In their report on Latin American and Caribbean corporates, they list the cattle-raising company, JBS, as one of the main culprits. Moody's argues that deforestation and other climate-related risks can quickly become material to credit quality if societal and regulatory scrutiny intensifies. These concerns include reputational risks and reduced revenue from boycotts and bans. JBS is also one of the main companies identified by Global Witness (Box 14.6). Although Moody's analysis is still an example of risk (the inward perspective), it shows that negative impacts are being highlighted by the rating agencies.

Ratings agencies complement NGOs by processing their data in a more investor friendly format for a wider investment universe. However, they do not yet fulfil their potential of doing it in a systematic way that allows investors to assess the effect on EV and SV. The data are still mostly limited to policies and past actions rather than quantified in units that are building blocks of EV and SV.

So far, we have discussed the production of negative impact information. An even-handed analysis would show the positive as well as the negative impacts of companies. As shown in previous chapters, this can be done—and some companies actually do this. The Big Four accounting firms (Deloitte, KPMG, PwC, and EY) have set up impact measurement divisions in their consultancy wing. Under brands like True Value (KPMG), these impact measurement divisions provide an integrated analysis of a company's value covering financial, social, and environmental value. There are also specialist impact consultants, like Impact Institute. These impact consultants measure impact and apply shadow prices for impact to monetise social and environmental value (see Chaps. 5 and 17).

A good impact analysis meets the following criteria:

- *Holistic*: it covers all material impacts, positive and negative; no cherry-picking;
- *Material*: it focuses on material impacts avoiding distraction by immaterial issues;
- *Comprehensible*: it is written in a concise and accessible way;
- *Assurance*: it is reviewed by a certified audit firm.

As companies have a bias towards reporting good news and omitting bad news ('the good news show'), assurance of impact reports is crucial. Assurance (or audit) is the independent review of company accounts by a certified audit firm. There is already an established tradition of auditing a company's financial reports (see Chap. 17), which should provide clues for auditing a company's impact information.

As stated in Chap. 5, measuring SV or EV takes a three-step process:

1. Determining material S and E issues
2. Quantifying the S and E issues in their own units (Q)
3. Putting a monetary value on those S and E units with shadow prices (SP)

The third step of pricing is discussed in the next sub-section.

14.4.2 Impact Markets and Pricing

Impact prices should reflect the 'true scarcity' of resources or the 'true price' of human right breaches. These impact prices are also called shadow prices, as they don't reflect current market prices but 'shadow' true prices. Consultants, like the Impact Institute, produce regularly updated lists of impact prices (called monetisation factors) for a whole range of social and environmental factors (IEF, 2022). Chapter 5 explains how these monetisation factors can be applied in impact measurement and valuation.

Impact prices translate the science-based targets from Sect. 14.4.1 into actionable inputs for a company's decision-making and reporting. High impact prices, reflecting true scarcity, provide an incentive for companies to explore cheaper alternatives. Renewable energy, for example, is cheaper than fossil fuels, when the shadow carbon price is included in the analysis.

Markets reveal the preferences of their participants. By buying a certain type of product, consumers show their preference for this product and their willingness to pay. We review three 'markets' where participants (partly) pay for impact: product markets (consumers), capital markets (investors), and elections (voters). These markets provide an indirect way to assess impact prices, whereby prices are often still underestimated.

Product markets reveal consumer preferences for sustainable products and services—albeit in a distorted way, since unsustainable products are often not taxed for their negative externalities and are sometimes even subsidised such as in the case of fossil fuels and airline tickets. The transition model in Chap. 2 is built on shifting consumer demand for sustainable products and services. A shift in demand can set into motion the transition from unsustainable to sustainable products in an industry. See the example of the transition from combustion engines to electric cars given in Chap. 2. Product markets can be used to derive the price for social and environmental impact. However, consumers' willingness to pay for impact has so far been limited to a small part of the population (Grant, 2020). Hence, one still needs thorough assessments of hidden costs and true prices such as is done by the Impact Institute.

In capital markets, one can examine investor preferences for impact investing, which aims for social and environmental value creation (impact) alongside financial value creation (profit). Impact investing data provides an indication of preferences for certain types of 'impact-positive' companies. In a similar way, engagement efforts (both on certain topics and on certain sectors) provide an indication of where impact can be improved. A recent trend is to investigate investors' willingness to pay for impact by means of experiments (see Box 14.8): how much financial return are they willing to give up for a certain amount of impact? This is a mechanism to establish a price for impact (in the form of reduced financial performance).

Box 14.8 Willingness to Pay for Impact

Suppose a private investor has a €1000 investment that is expected to yield a 5% annual financial return, i.e., €50 per year. How much of that financial return is the investor willing to give up for impact?

The investor gets the following offer: switch to an investment that yields €10 per year less, but saves 1 tonne of CO_2 per year. The hard part in assessing this offer is its poor comparability: how to trade off a €10 personal financial loss against saving 1 tonne of CO_2 for the public good?

Assuming a €200 CO_2 price per tonne, we can frame the choice much more intuitively: is the investor willing to give up €10 personal financial return for €200 in public return? And where is the cut off? How much public return needs to be generated per euro financial return given up? Let's call this the willingness-to-pay ratio: personal financial return given up/additional public return generated. For example, the investor might want to give up €300 personal financial return for €5000 in additional public return. The willingness-to-pay ratio is then 300/5000 = 0.06. Most likely, this ratio will vary across people, with their present wealth, and with the amount of financial return already given up—i.e. the marginal willingness to pay is probably diminishing.

In the above example, we have assumed that (1) the investor knows the impact of the investment and that (2) the impact is non-negative. Typically, however, an investment's impact is negative. And also typically, such an investor does not know the impact, and finding it out could be an eye-opener.

In a survey among pension fund participants, Bauer et al. (2021) find that two-thirds of participants are willing to invest sustainably, even when they expect sustainable investing to hurt the fund's financial performance. A key reason is participants' strong social preferences.

Another 'market' for impact is elections. In elections, voters reveal their preferences for policies, including sustainability policies (e.g. on carbon tax). Voting for certain parties can enhance, or hinder, support for sustainability policies. Box 14.9 shows how the 2019 elections for the European Parliament are behind the European Green Deal. A counterexample is the 2016 elections for the American president, which led to a (temporary) cancellation of the US participation in the Paris Climate Agreement.

Box 14.9 European Green Deal More Feasible Following Elections
Traditionally, the socialists, Christian democrats, and liberals form the largest parties in the European Parliament. In the 2019 elections, the greens gained more votes and emerged as fourth party. The European Commission invited a majority coalition of socialists, Christian democrats, and greens to support its policy programme. To secure a deal with the greens, the European Commission embarked on an ambitious green policy programme, the European Green Deal.

The overarching aim of the European Green Deal is for the European Union to become the world's first 'climate-neutral bloc' by 2050. In addition to climate, the European Green Deal comprises a circular economy action plan and a farm to fork strategy (for healthy food and nature-positive agriculture).

As the production of impact information is further developed, we expect impact measurement and pricing to be improving over time. This process will be facilitated by requirements for companies to report on sustainability, such as the International Sustainability Standards Board and the EU Corporate Sustainability Reporting Directive (see Chap. 17).

14.4.3 Impact Performance

The planetary and social boundaries in Chap. 1 show the system thresholds within which companies should operate. However, current efforts to improve environmental and social impact are too incremental and fail to take a system approach (Thurm et al., 2018). As a result, we simply do not know whether individual companies are doing enough, or not; nor do we know by how much they are falling short. Instead, one could pursue context-based sustainability, which connects the micro (companies in a certain sector), meso (country), and macro (system) levels to determine individual company contributions. Such a system approach of thresholds and allocations has three steps:

1. *System level*: determining the thresholds that should not be crossed; these thresholds are the planetary and social boundaries;
2. *Country level*: allocating these thresholds to countries on an equal per capita basis; and

3. *Sector level*: allocating resources to sectors and individual companies on a forward-looking basis.

The third and final step indicates a company's normative impact *NI*, which is derived from the planetary and social boundaries. McElroy (2008) developed a footprint method to measure the sustainability performance *SP* of a company:

$$\text{Sustainability performance}: SP_i = \frac{\text{Actual impact}_i}{\text{Normative impact}_i} = \frac{AI_i}{NI_i} \tag{14.4}$$

A company's net actual impact *AI* is the final variable needed to calculate a company's sustainability performance. Chapters 5 and 17 show how a company's social and environmental impact can be measured and reported. Please note that the footprint method works with the original units of a variable (e.g. carbon emissions for climate change and wages for decent work). The *SP* scores work in the following way:

- for environmental impacts: $SP_i \leq 1$ is sustainable; $SP_i > 1$ is unsustainable.
- for social impacts: $SP_i \geq 1$ is sustainable; $SP_i < 1$ is unsustainable.

These opposite signs are consistent with doughnut economy proposed by Kate Raworth (see Chap. 1), which sets maximum values on negative environmental impacts (planetary boundaries) and minimum values on social impacts (social foundations). The *SP* score for environmental impacts means that a company's emissions or water/land use should stay within environmental ceilings $AI_i \leq NI_i$ as $SP_i = \frac{AI_i}{NI_i} \leq 1$ in order to operate in a sustainable way. The *SP* score for social impacts works the other way around: a sustainable company's social outcomes should stay above social foundations $AI_i \geq NI_i$ as $SP_i = \frac{AI_i}{NI_i} \geq 1$.

The innovation of this system approach is that a company's actual impact is measured against its normative impact derived from system thresholds. ESG ratings (see Sect. 14.3) measure at best components of the impact of a company (that is a part of the numerator of Eq. 14.4), but without relation to system thresholds (the denominator). The *SP* indicator puts a company's performance in the appropriate context of the social or environmental system.

In principle, the sustainability performance indicator is static: it measures whether a company currently meets the sustainability threshold. It can be applied in a dynamic way to capture the transition perspective. While a company may currently transgress one or more sustainability thresholds, it can have transition potential. To assess a company's transition potential, you need forward-looking estimates of a company's social and environmental impacts. The new reporting standards require companies to report social and environmental targets, which are subject to a mandatory audit (see Chap. 17). For example, one can map not just a company's current carbon emissions versus its budget, but also its future emissions in the next three decades against its future budgets (see Example 14.2 below). Ideally, future emissions will soon drop below future budgets.

14.4.4 Inditex Case Study

We can use the case study of Inditex, the fast-fashion retailer described in Chap. 11, to illustrate the application of the *SP* indicator to social impacts. Inditex is meeting social foundations at its headquarters and sales outlets, where Inditex pays appropriate salaries to its employees at or above the living wage $SP_{Inditex} \geq 1$. However, Inditex fails to meet social foundations in its supply chain, where it pays salaries below the living wage to factory workers $SP_{Inditex} < 1$. On the environmental side, Inditex exceeds several planetary boundaries $SP_{Inditex} > 1$. On one planetary boundary, namely climate change, Inditex has set science-based targets with a pathway to reach net zero by 2040 (see Box 14.4).

14.4.5 Environmental Impact

Examples 14.2 and 14.3 show how the *SP* indicator can be applied to environmental impacts.

Example 14.2 Carbon Budget

Problem

Current efforts on carbon emission reduction are incremental. Companies can take a system approach towards climate change. Please explain (a) the relevant threshold for climate change based on the 1.5 °C limit, and (b) how this threshold can be allocated to a carbon pathway from 2020 to 2050 for the office of a German company.

You can use the carbon risk real estate monitor (CRREM) methodology for the building sector, which develops pathways to net zero in 2050: https://www.crrem.org/pathways/

Solution

(a) In the 2015 Paris Agreement on climate change, countries reconfirmed the target of limiting the rise in global average temperatures relative to those in the preindustrial world to 2 °C (two degrees Celsius) and to pursue efforts to limit the temperature increase to 1.5 °C. Section 1.1 in Chap. 1 indicates that the global threshold is a remaining carbon budget of 500 giga tonnes (Gt) from 2020 onwards for the 1.5 °C scenario. The CCREM methodology uses a 468 Gt carbon emissions only budget from 2020 to 2050 for the 1.5 °C scenario. Note that the IPCC (500 Gt) and CRREM (468 Gt) figures are slightly different.

(b) This global budget is allocated to the building sector on a global scale. The real estate proportion of the overall carbon budget is 19.5%. This is 91 Gt (= 19.5% * 468 Gt) for 2020 to 2050. The global budget for buildings of 91 Gt CO_2 is allocated to countries based on the anticipated real estate stock (total m^2) in those countries by 2050.

To measure and steer on actual performance of buildings, an emission intensity measure is used of CO_2 per square meter. In 2020 the German intensity was 43 kg CO_2/m^2. For a company in Germany, this results in a decarbonisation pathway for its office, starting at the current intensity in Germany (43 kg CO_2/m^2 in 2020), following a gradual path to 15 kg CO_2/m^2 in 2030, 2 kg CO_2/m^2 in 2040 and 0 kgCO_2/m^2 in 2050.

This calculation requires detailed data (which CRREM has) and detailed calculations (which CRREM provides in an excel sheet). The aim of this example is to show that a global carbon budget can be allocated to a company, following the intermediary steps of a country budget and sector proportions.

Source: The CRREM Downscaling documentation and assessment methodology are used; these are available at https://www.crrem.org/pathways/ ◄

Example 14.3 Company Performance on Land Use

Problem

Current sustainability practices on land use are incremental. Companies can take a system approach towards land-system change. Please explain (a) the relevant threshold for land-system change, and (b) how this threshold can be allocated to individual companies.

Solution

(a) The system threshold for land-system change can be derived from the planetary boundaries framework in Chap. 1. Table 1.1 indicates that the planetary boundary (that is the system threshold) for forested land is 75%, while the current value is 62% and falling.

(b) As the current level is below the system threshold, companies should avoid further deforestation (zero-deforestation). The allocation at industry and company level is thus zero-deforestation. This yields a normative impact on land-use of zero: $NI_i = 0$. Using eq. 14.4 with the environmental ceiling $SP_i = \frac{AI_i}{NI_i} \leq 1$, the actual impact on land-use should be equal or smaller than zero: $AI_i \leq 0$. So, companies should avoid deforestation at a minimum $AI_i = 0$ and could strive for forest or land restoration $AI_i < 0$ (please note that forest restoration $AI_i < 0$ is the opposite of deforestation $AI_i > 0$). ◄

14.5 Impact Investors Looking for Integrated Return

A new breed of impact (or integrated) investors is emerging. This new breed started off as a niche with specialised impact investors, but it is now expanding to mainstream investors. Pension funds, as long-term investors, have started to expand the two-dimensional financial risk-return framework (i.e. the mean-variance framework

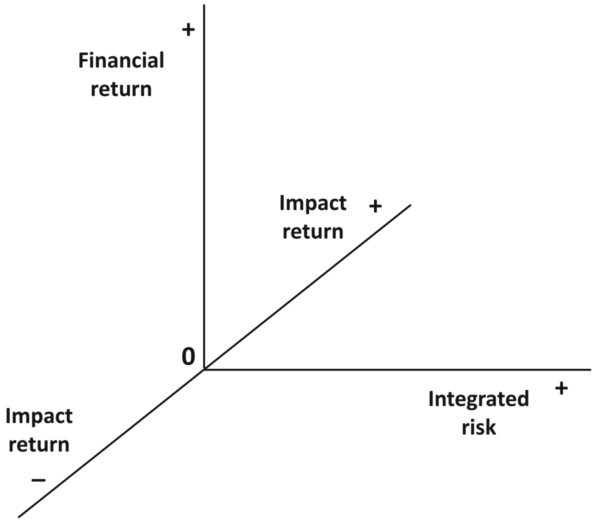


Fig. 14.6 Integrated investing

of the CAPM in Chap. 12) to a three-dimensional risk-return-impact framework of integrated investing (Fig. 14.6). The rationale behind this trend is twofold:

1. *Impact*: long-term investors see positive impact as a creator of long-term value and negative impact as a source of future risk (see Chap. 2);
2. *Responsibility*: institutional investors feel the moral responsibility to invest responsibly and to be accountable to stakeholders (see Chap. 3).

Figure 14.6 shows the three-dimensional nature of the integrated investment framework: (financial) return, (social and environmental) impact, and (integrated) risk. Integrated risk is the risk of having a shortfall in financial return or a shortfall in impact (see Chap. 12 on risk-return analysis).

14.5.1 Impact-Adjusted Return

Impact investors look for financial return (profit) as well as social and environmental impact. Impact-adjusted return r_i^{iar} combines these dimensions: (1) capital gains (on stocks and bonds), dividend and interest; (2) monetised social impact (from Chap. 5); and (3) monetised environmental impact (from Chap. 5) during a given year, divided by invested capital:

Impact-adjusted return: $r_i^{iar} = \frac{capital\ gains + dividend + interest + social\ impact + environmental\ impact}{invested\ capital}$

$$= \frac{\Delta FV + \Delta SV + \Delta EV}{FV} \qquad (14.5)$$

The denominator is invested capital, which is a proxy for the financial value of the company. This reflects the idea that equity and bond investors ‘finance’ the company. This ratio reflects the investors' 'bang for their buck' in the widest sense: what do they get in financial and impact benefits for the capital they invested? As explained in Chaps. 8 and 9, the financial value of the company is the enterprise value. The calculation of the impact-adjusted return is straightforward: just list the three value dimensions at the start of the year and the changes realised during the year. Table 14.1 provides an example of a company that is positive on all three dimensions (multivalue creation): both on starting value and on change during the year (realised profit and impact). As noted in Chap. 2, there are not many companies with such a profile. Table 14.1 calculates the return as △value for each separate value dimension—financial return, social return, environmental return—divided by invested capital. Table 14.1 shows that the impact-adjusted return for this company is 17.5%. The same result is obtained by filling in Eq. 14.5:

$$r_i^{iar} = \frac{\Delta FV + \Delta SV + \Delta EV}{FV} = \frac{2 + 1 + 0.5}{20} = \frac{3.5}{20} = 17.5\%$$

As this company has positive returns on its social and environmental dimensions, its impact-adjusted return (of 17.5%) is higher than its financial return (of 10%).

Table 14.2 shows a more realistic example: company Y with a mixed value creation profile: financially profitable, but still negative social and environmental value dimensions. Company Y's financial return at 10% is higher than its impact-adjusted return at 5.0% (see Panel A of Table 14.2). The company is able to reduce its negative environmental impact to zero, but at a financial cost of 0.5. This action turns the tables: company Y's financial return drops to 7.5%, while its impact-adjusted return improves to 7.5% (Panel B). A financially-minded investor would ask the company not to do the investment. By contrast, an impact investor would ask the company to do the improvement—and perhaps a long-term-oriented financially-minded investor would do so too. In this simplified example, it already becomes

Table 14.1 Company X with multivalue creation

Dimension	Value	△ value	Return
Financial	20	2	10.0%
Social	5	1	20.0%
Environmental	3	0.5	16.7%
Invested capital	*20*	*3.5*	*17.5%*

Note: Invested capital is the financial value

Table 14.2 Company Y with mixed value creation

	Panel A			Panel B		
Dimension	Value	△ value	Return	Value	△ value	Return
Financial	20	2	10.0%	20	1.5	7.5%
Social	−1	0	0.0%	−1	0	0.0%
Environmental	−5	−1	20.0%	−5	0	0.0%
Invested capital	*20*	*1*	*5.0%*	*20*	*1.5*	*7.5%*

Note: Invested capital is the financial value clear that the type of investor matters for companies (see Chap. 3): are companies encouraged to maximise shareholder value or to manage for integrated value?

14.5.2 Inditex Case Study

Example 14.4 calculates the impact-adjusted return for Inditex. It shows that Inditex's impact-adjusted return is 2.9%, well below its financial return of 6.1%. The lower impact-adjusted return reflects the overall negative annual social and environmental value flows of −€2.5 billion, which reduces the annual financial value flow (profit) of €4.8 billion by more than a half to €2.3 billion. So, there is big reduction in return.

Example 14.4 Computing the Impact-Adjusted Return of Inditex

Problem

Please assess Inditex's financial and impact-adjusted return. The data for Inditex are provided in Table 11.18 in Chap. 11.

IV calculation	Value (Euro billions)	Annual value flows (Euro billions)
FV (enterprise value)	79	4.8
Positive SV	283	4.1
Negative SV	−137	−2.9
Negative EV	−183	−3.7
Invested capital	*79*	*2.3*

Solution

Taking the impact-adjusted return formula (Eq. 14.5), we can fill in the components:

$$r_i^{iar} = \frac{capital\ gain + dividend + interest + social\ impact + environmental\ impact}{FV}$$

$$= \frac{4.8 + 1.2 - 3.7}{79} = 2.9\%$$

The numerator takes the annual value flows in financial, social, and environmental value. We take the free cash flows of €4.8 billions (instead of the capital gains, dividend, and interest) for the financial value flows. The social and environmental value flows are also included in the right column. The denominator reflects the invested capital in Inditex of €79 billion in the middle column. The impact-adjusted return is 2.9%.

The financial return is $\frac{4.8}{79} = 6.1\%$. The financial return is higher than the impact-adjusted return. ◄

14.5.3 Integrated Return

Impact-adjusted return changes only the numerator in Eq. 14.5: from financial profit to integrated profit (financial profit and impact) over the measurement period (often a year). Taking financial value for invested capital in the denominator is an intermediate step; this reflects the investor perspective. Another step would be to take integrated value for invested capital in the denominator; this reflects the societal perspective of all stakeholders. We then get integrated return r_i^{ir}:

$$\begin{aligned}\text{Integrated return}: r_i^{ir} \\ &= \frac{\textit{capital gains} + \textit{dividend} + \textit{interest} + \textit{social impact} + \textit{environmental impact}}{\textit{integrated value}} \\ &= \frac{\Delta FV + \Delta SV + \Delta EV}{IV} \qquad (14.6)\end{aligned}$$

The denominator is now integrated value: $IV = FV + SV + EV$. Integrated return reflects thus the overall return from a societal perspective. Once investors get used to the new integrated value measure (used in the denominator), we expect that integrated return comes into vogue. In the meantime, impact investors use mainly impact-adjusted return.

14.5.4 Return on Active Ownership

The integrated return equation can guide impact investors' action. If a company shows low performance (the numerator of Eq. 14.6) and/or has one or more negative value dimensions (the denominator of Eq. 14.6) in comparison with its peers in the same sector, an impact investor can demand a plan from the company to improve. This is called *active ownership:* the use of the rights and position as shareholder ('owner') to influence the activities or behaviour of investee companies.[1] These plans to improve can be seen as transition pathways to restore a shortfall in performance or in a value dimension (see Chap. 2). The required plans can include new investments or hiving off a non-core division to improve the focus (and return) on core assets. If the company is not willing to act or is not improving, investors will increase pressure and may eventually demand removal of management.

Traditionally, financially-minded investors, like hedge funds, have been activist investors when they see (perceived) short-term financial underperformance, lack of focus, or underuse of assets. Having a more long-term orientation, institutional investors typically focus on environmental, social, and governance (ESG) issues in their engagement with companies (see Chap. 3). Active ownership is costly. So to determine the return on active ownership, we need to deduct its cost $cost^{ao}$, as

[1] Unfortunately, superficial engagements are in practice also called active ownership.

investors need to invest time in the engagements themselves, as well as in knowledge of:

1. targeted sectors;
2. relevant transitions affecting these sectors;
3. relevant companies in targeted sectors.

The potential benefit is improved (long-term) financial, social, or environmental value; this boils down to improvement in integrated value that can be attributed to active ownership ΔIV^{ao} (though actual attribution to active ownership actions of individual investors is difficult in practice). The return on active ownership *ROAO* can then be defined as follows:

$$\text{Return on active ownership}: ROAO = \frac{improvement\ IV^{ao} - cost^{ao}}{IV} = \frac{\Delta IV^{ao} - cost^{ao}}{IV} \quad (14.7)$$

There is a need for a balanced approach in active ownership. Otherwise, some (financially driven) investors may want to improve financial performance at the cost of sustainability performance. The attempted takeover of Unilever by Kraft Heinz is a case in point, as highlighted in Chap. 18. And the other way around as well: there are limits to be minded in improving sustainability at the cost of long-term financial value creation. The integrated value measure of Eq. 6.3 $IPV = FV + b \cdot SV + c \cdot EV > 0$ is the appropriate yardstick to assess overall value creation or destruction by activist investors or hostile takeovers. An interesting question is whether active ownership can bring about changes in the real economy. Box 14.10 provides a discussion.

Box 14.10 Transition in the Real Economy: Exogenous or Endogenous?
Active ownership by institutional investors can put pressure on companies to speed up the transition to sustainable business models. If successful on a large scale, investors can thus accelerate the transition to a new sustainable equilibrium in the economy (Kurznack et al., 2021). This would be an endogenously driven change in the economy. Endogenous means from inside the system.

By contrast, existing investing theories, like the CAPM, do not allow for the possibility of endogenous sustainability transitions bringing the economy to a new equilibrium. Investors hold the market portfolio in equilibrium. Shocks to companies' financial, social, or environmental value are assumed to be exogenous, which means from outside the system. Any deviations from the CAPM equilibrium are called investor preferences, leading to ESG investors bidding up the stock price of high ESG companies today. The higher stock price leads in turn to lower expected returns tomorrow as the stock price is ultimately expected to move back to its original price in equilibrium (Pástor et al., 2021).

14.5.5 Impact Investors

Impact investors are a new breed of investors, who made a shift from focusing on financial return only to impact-adjusted return. These impact investors aim for financial return and social and environmental impact. Their behaviour differentiates from exclusively financially oriented investors. Impact investors are looking for ‘impact-positive’ companies with a positive financial return as well (Busch et al., 2021). The Global Impact Investing Network applies the following definition of impact investing:

> Impact investments are investments made with the intention to generate positive, measurable social and environmental impact alongside a financial return. Impact investments can be made in both emerging and developed markets, and target a range of returns from below market to market rate, depending on investors' strategic goals.

Box 14.8 shows experiments to investigate investors’ willingness to pay for impact: how much financial return are they willing to give up for a certain amount of impact? While impact investors started off as niche players (less than 1% of the global AUM (assets under management) in 2016), they are growing very fast at a compound annual growth rate of 45% (see Table 14.3). Pension funds and insurance companies now also allocate parts, albeit very small ones, of their portfolio towards impact investing. Table 14.3 shows that impact investing accounted for 2.3% of global AUM in 2020, while the bulk of sustainable investing is in ESG integrated investing at 33% of global AUM. Remember that impact investing reflects the outward perspective, while ESG integrated investing only takes the inward perspective (see Figs. 14.1 and 14.5). The high compound annual growth of 45% over the last 4 years shows that impact investing is on the rise. For the impact dimension to come to full fruition, market participants need to adapt, as discussed in Sects. 14.3 and 14.4.

Table 14.3 The rise of sustainable investing (2016–2020)

Investment	2016 USD trillions	2020 USD trillions	% of market	Compound annual growth
Global AUM	81.9	98.4		4.7%
Sustainable investing	22.9	35.3	35.9%	11.4%
– ESG integrated	22.4	33.0	33.5%	10.2%
– Impact investing	0.5	2.3	2.3%	44.7%

Source: Global Sustainable Investment Alliance (2021)
Note: The compound annual growth rate measures the compounded growth from 2016 to 2020

14.6 Conclusions

The efficient markets hypothesis states that stock prices incorporate all relevant information instantaneously. And the consequence of the efficient markets hypothesis is that investors cannot consistently beat the market. However, efficient markets do require investors who try to beat the market. After all, the mechanism behind efficient markets is that a sufficient number of analysts pay attention to newly arriving information, judge it value relevant, and trade on that information. In that way, the new information gets priced in. But there is evidence that learning takes time and that adaptive markets are a better description than efficient markets. In particular, it seems that analysts are slow to pick up sustainability-related information. The adaptive markets hypothesis states the degree of market efficiency depends on an evolutionary model of individuals adapting to a changing environment. So, the more analysts start to pay attention to an issue, like carbon emissions or human rights violations, the more and faster its effect on stock prices will be priced in.

The valuation of impact is a different matter. Stock prices only reflect the effects of (sustainability-related) information on the financial value of companies. There is no 'market' yet for the diffusion of information on the social and environmental value (impact) of companies. Academic research and non-governmental organisations (NGOs) play a leading role in producing information on companies' social and environmental impact. Markets on impact information and price-setting are evolving: product markets partly reveal consumer preferences for sustainable products; capital markets partly reveal investor preferences for impact investing; and elections partly reveal voter preferences for sustainable policies. These markets can be used to determine the willingness to pay for impact (and thus derive prices for impact). This is all becoming relevant to companies as well. Chapter 17 indicates that reporting regulations are going to require companies to report on their impact alongside their financials.

Investor behaviour is not always in line with theoretical predictions. Individual investors tend to own a few stocks with which they are familiar, leaving them undiversified. Both individual and professional investors trade too much, leading to high transaction costs without compensating return. An important anomaly is the existence of bubbles, whereby prices are above their 'normal' or fundamental values for a (long) period of time. Behavioural finance seeks to explain this irrational exuberance.

But irrationality is not the only reason why investor behaviour can deviate from theoretical predictions. Investors can have different goals than the exclusively financial one that theory assumes. An increasing number of investors also want impact. This results in different behaviour and the need for different metrics, such as impact-adjusted and integrated returns.

Key Concepts Used in This Chapter

Active ownership is the use of the rights and position as shareholder ('ownership') to influence the activities or behaviour of investee companies

Adaptive markets hypothesis implies that the degree of market efficiency depends on an evolutionary model of individuals adapting to a changing environment

Alpha is a measure of the active return on an investment and measures the performance of an investment compared with a suitable market index

Active investing refers to a portfolio management strategy where the manager makes specific investments instead of investing in the benchmark (see *passive investing*)

Impact refers to a company's social and environmental value; impact can be positive or negative

Assurance (or audit) is the independent review of company accounts by a certified audit firm

Benchmarking in investment is the process of measuring an investment portfolio's performance against a market index

Beta is an indication of a portfolio's (or a stock's) exposure to general market movements

Efficient markets hypothesis states that stock prices incorporate all relevant information and thus on average reflect the long-term fundamental value of the firm

Fundamental analysis is an approach to investing based on obtaining a good understanding of a company's business model and valuation

Impact refers to social and environmental value; impact can be positive or negative

Impact investing (or integrated investing) is an approach to investing that deliberately aims for both social and environmental value creation and financial value creation as well as the measurement of social and environmental value creation

Irrational exuberance refers to investor enthusiasm that drives asset prices higher than those assets' fundamentals justify

Market index represents an entire stock market and thus tracks the market's changes over time

Passive investing is an approach to investing that buys widely diversified portfolios, often made up of entire market indices, and limits the amount of buying and selling, so as to steadily build wealth over time

Performance measure refers to an indicator to measure the success of an investment portfolio on return and risk, often related to a benchmark

Random walk is a stochastic or random process that describes a path that consists of a succession of random steps; stock prices following a random walk means that subsequent price changes are independent of each other and are thus not predictable

Sustainability performance refers to an indicator to measure a company's actual impact in comparison with a company's normative impact, which is derived from planetary and social boundaries

Tracking error is the difference in price behaviour of a portfolio and the price behaviour of a benchmark, reported as a standard deviation percentage difference

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Part V

Corporate Financial Policies

Capital Structure

15

Overview

Capital structure is about the funding side of the company's balance sheet. It's an important topic, enabling a better understanding of a company's risk profile and health. Previous chapters highlighted the need to consider E and S as capital, just like F. That implies that we can and should look at capital structure from the perspective of F, E, and S. In this chapter, we explore how that can be done. We start from *financial capital structure*, which can look like Table 15.1, showing debt, equity, and assets in market values—as opposed to book value balance sheets in accounting. These values can subsequently be expressed in ratios such as debt/assets.

We consider the theories that explain financial capital structure, such as the Modigliani-Miller (MM) theorems, which say that in a perfect world, financial capital structure is irrelevant for financial value (MM1) and that the cost of equity increases with leverage (MM2). Financial capital structure does affect the cost of equity in proportion to risk, and the split in debt and equity value, but it does not change total financial value. From that starting point, several imperfections (e.g., information asymmetries, taxes, bankruptcy costs, agency costs) are considered that try to explain the conditions under which financial capital structure does matter to financial value. Behavioural issues, such as misvaluations and overconfidence, add another layer of complexity.

Subsequently, we consider the capital structures of E and S separately. Companies generate assets and liabilities on E and S, as they do on the financial side. The main difference is that it is typically much less clear how strong the claims against the company are, and to what extent they will materialise in financial terms. However, their presence and size give strong indications of additional risk. For example, a company might destroy more value on E than it creates, meaning that its liabilities exceed its assets on E, and its E equity is therefore negative. This is all the more troublesome if its direct competitors have healthier E capital structures and lower risk of internalisation.

The analysis of the capital structures of E and S allows us to take the next step, namely the construction of an *integrated capital structure*, which is the capital structure of F, E, and S combined, and which may look like Table 15.2.

D. Schoenmaker, W. Schramade, *Corporate Finance for Long-Term Value*, Springer Texts in Business and Economics, https://doi.org/10.1007/978-3-031-35009-2_15

Table 15.1 The market value financial balance sheet

F assets	25	F debt	5
		F equity	20
Total F assets	**25**	**Total F liabilities**	**25**

Table 15.2 The integrated balance sheet

S assets	20	S debt	5
		S equity	15
E assets	15	E debt	25
		E equity	-10
F assets	25	F debt	5
		F equity	20
Total integrated assets	**60**	**Total integrated liabilities**	**60**

This integrated balance sheet offers a richer perspective on the company's assets and liabilities than a balance sheet that is limited to F. In Table 15.2, the integrated capital structure is riskier than the financial capital structure, with higher integrated leverage (as measured by integrated debt/integrated assets = [5 + 25 + 5]/60 = 35/60 = 0.58) than financial leverage (as measured by F debt/F assets = 5/25 = 0.20). As found in Chap. 13 on the cost of integrated capital, liabilities on S and E make the integrated capital structure riskier and raise the cost of integrated capital. See Fig. 15.1 for a chapter overview.

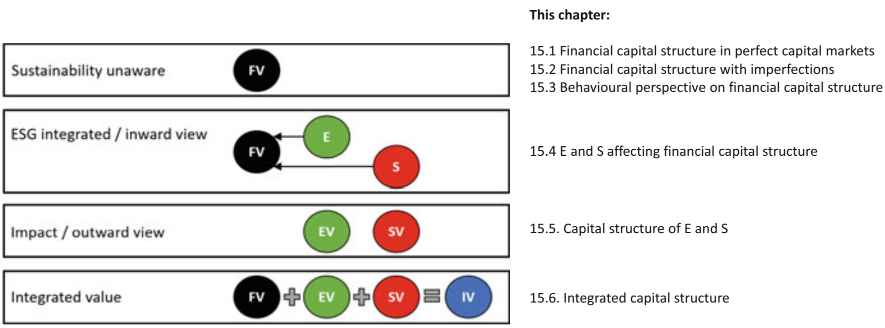

Fig. 15.1 Chapter overview

Learning Objectives
After you have studied this chapter, you should be able to:

- explain the main theories of financial capital structure, and what they say about the relevance of financial capital structure to valuation and the financial cost of capital;
- demonstrate how E and S each have their own capital structure and how they can be interpreted;
- consider capital structure from an integrated perspective and explain what implications that has for assessing company risk;
- do capital structure calculations on all types of capital.

15.1 Financial Capital Structure in Perfect Capital Markets

Financial capital structure is about the funding of the company's business activities. It refers to the distribution of equity, debt, and hybrid securities that a company has outstanding. It is also referred to as leverage:

$$Leverage = \frac{Debt}{Value} = \frac{Debt}{Total\ assets} \tag{15.1}$$

whereby leverage is debt divided by the company's value or total assets. Companies with a high proportion of debt on their balance sheet are said to be highly levered (or leveraged). In Table 15.3, debt, equity, and assets are shown on market value basis for company Keynes Technology. This is important to emphasise: we do not use the book values that are shown in companies' annual reports, but we use the present value of assets, the resulting market value of equity (which is for most listed companies much higher than the book value—with the notable exception of distressed companies, for which the reverse is true) and the market value of debt.

Financial capital structure matters because of its potential impact on valuation (Chaps. 8–10), risk and return (Chap. 12), and cost of capital (Chap. 13). It is typically measured by means of ratios that express the distribution of the types of securities (such as debt/equity or debt/assets) or the ability to bear the interest burden (such as the interest coverage ratio). The main distinction is between debt and equity, but the picture could become blurred by intermediate or hybrid types of capital such as convertible bonds (i.e. corporate bonds that can be exchanged for a predefined number of shares in the issuing company).

Table 15.3 Company Keynes Tech's market value financial balance sheet

F assets	25	F debt	5
		F equity	20
Total F assets	**25**	**Total F liabilities**	**25**

In the example in Table 15.3, the debt-equity ratio is 5/20 = 0.25; and the debt/assets (leverage) ratio is 5/25 = 0.2. At first sight, that seems a moderate level of leverage, but without any further information, it is hard to tell if that is a healthy capital structure. It also depends on the company's ability to service interest payments, which tends to be higher (easier) for a profitable and stable business. However, for a fast-growing company that burns cash, even a low level of debt can be too much. In addition, issues such as tax treatment and management incentives might be relevant in deciding on a company's capital structure. In sum, there are many potential determinants of capital structure.

15.1.1 Theories Explaining Financial Capital Structure in Perfect Capital Markets

Modigliani and Miller (1958) realised that corporate finance in the real world is a complex topic, with many effects potentially in play. So, they decided to tackle the question of optimal capital structure from a very interesting angle: what if we assume a perfect capital market? In a perfect capital market, there are no distortions such as taxes, bankruptcy costs, and information asymmetries. In the absence of such distortions, they asked: does capital structure still matter?

Modigliani and Miller (henceforth MM) postulated that in perfect capital markets, investors are not dependent on the company to decide the level of leverage. Rather, investors could create their own desired level of leverage by buying the company's shares with borrowed funds (homemade leverage). Due to such buying and selling, any price differences based on leverage should disappear. This is the *arbitrage argument*, the foundation for the *law of one price* (see also Chap. 4).

This reasoning resulted in the two MM propositions.

MM proposition 1: in a perfect capital market, the value of the levered company V_L equals the value of the unlevered company V_U.

Another way to express MM1 is the simple formula:

$$V_U = V_L \tag{15.2}$$

The logic behind it is as follows. The total value of a company equals the total market value of the cash flows generated by its assets. That is, in the simplified form of a perpetuity:

$$V_U = \frac{FCF_U}{r_U} \tag{15.3}$$

And in perfect capital markets, the cash flows are not affected by leverage (i.e., $FCF_L = FCF_u$), nor is their risk (i.e., $r_L = r_u$). Hence, V_L should have the same total cash flows and overall cost of capital as V_U, and valuation should not be affected by leverage. However, what does change with leverage is the mix between debt and equity, and the split of cash flows over debt and equity.

$$V_L = \frac{FCF_{equity}}{r_{equity}} + \frac{FCF_{debt}}{r_{debt}} \tag{15.4}$$

Leverage also affects the cost of equity. At 0% debt and 100% equity, r_{equity} equals r_u, but as debt levels rise, r_{equity} needs to go up as well. Since the WACC (see Chap. 13) is unchanged by leverage ($r_L = r_u$), and since debt has a lower cost of capital than WACC, an increasing portion of debt will have to be compensated by a higher cost of equity.

MM proposition 2: the cost of capital of levered equity increases with the company's market value debt-equity ratio.

The MM2 formula:

$$r_{equity} = r_U + \frac{debt}{equity} * (r_U - r_{debt}) \tag{15.5}$$

This follows from:

$$WACC = r_U = \frac{equity}{V_L} * r_{equity} + \frac{debt}{V_L} * r_{debt} \tag{15.6}$$

This can be converted to: $r_U - \frac{debt}{debt+equity} * r_{debt} = \frac{equity}{debt+equity} * r_{equity}$ (please note that $V_L = debt + equity$); and: $r_{equity} = \frac{debt+equity}{equity} * r_U - \frac{debt}{equity} * r_{debt}$; hence: $r_{equity} = r_U + \frac{debt}{equity} * (r_U - r_{debt})$.

MM2 essentially says that r_{equity} rises exponentially with leverage. Let's see how that works in numbers and suppose that company Foodmart's r_U is 7% and r_{debt} is 2% (at least at moderate leverage). Then how does r_{equity} develop as leverage increases? Table 15.4 and Fig. 15.2 illustrate how r_{equity} climbs from 7% at 0% debt (i.e. equal to r_U) to over 10% at 40% debt, still assuming r_{debt} of 2%. Beyond

Table 15.4 Cost of equity with rising leverage at company Foodmart

Equity (as %)	Debt (as %)	r_{equity}	r_{debt}	r_U	Equity/V	Debt/V (leverage)	Debt/equity	WACC
100	0	7.0%	2.0%	7.0%	1	0	0.0	7.0%
90	10	7.6%	2.0%	7.0%	0.9	0.1	0.1	7.0%
80	20	8.3%	2.0%	7.0%	0.8	0.2	0.3	7.0%
70	30	9.1%	2.0%	7.0%	0.7	0.3	0.4	7.0%
60	40	10.3%	2.0%	7.0%	0.6	0.4	0.7	7.0%
50	50	11.9%	2.1%	7.0%	0.5	0.5	1.0	7.0%
40	60	14.1%	2.3%	7.0%	0.4	0.6	1.5	7.0%
30	70	16.8%	2.8%	7.0%	0.3	0.7	2.3	7.0%
20	80	20.2%	3.7%	7.0%	0.2	0.8	4.0	7.0%
10	90	25.0%	5.0%	7.0%	0.1	0.9	9.0	7.0%
0	100	n.a.	7.0%	7.0%	0	1	n.a.	7.0%

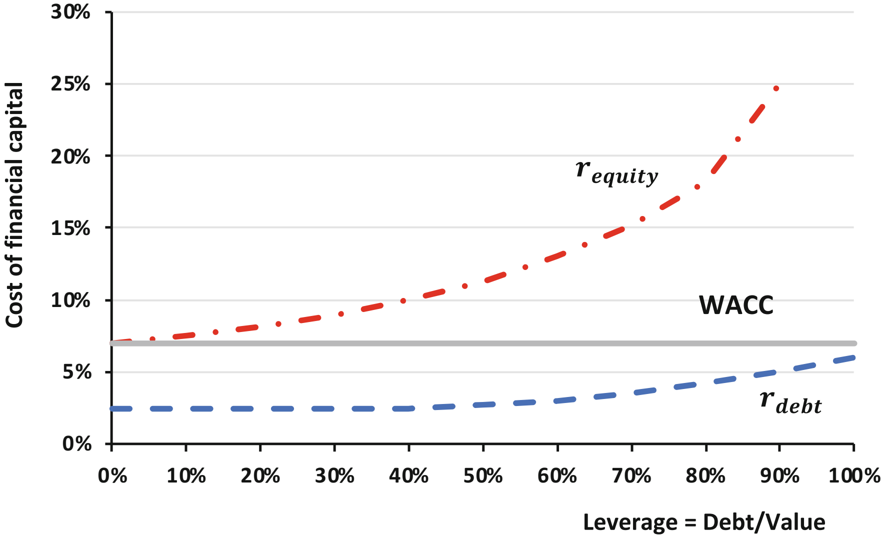

Fig. 15.2 Cost of equity with rising leverage at company M

that point, we assume r_{debt} to rise as well, reflecting serious additional risk. At the extreme, there is 100% debt at r_{debt} of 7%, effectively becoming as risky as equity.

The very high leverage levels might seem farfetched, but they do occur. Such bonds are called junk bonds, as opposed to bonds at low levels of debt, which are rated investment-grade debt (see Chaps. 8 and 13). Example 15.1 shows how one can calculate the WACC.

Example 15.1 Calculating the WACC

Problem

Suppose your manager is creating a DCF model for company Fastfood and asks you to calculate the WACC. Suppose the debt to value (leverage) ratio is 30%, the interest rate is 2%, and the shareholders demand a return of 10%. Calculate the WACC.

Solution

The first step is retrieving the formula to calculate the WACC from Eq. 15.6: $r_U = \frac{equity}{V_L} * r_{equity} + \frac{debt}{V_L} * r_{debt}$ The WACC consists of four elements: the return on equity, the return on debt, the equity ratio, and the debt ratio. Three of these are given and the equity ratio can be determined via 1-debt ratio = 1–0.3 = 0.7.

The WACC of company Fastfood can be calculated as follows 0.7 * 10% + 0.3 * 2% = 7.6%. ◀

However, the above example in Table 15.4 is just a matter of filling in the WACC formula. A more intuitive way is to consider how a company's balance sheet and P&L change with a debt issue, and accordingly its cash flows to equity and cost of

Table 15.5 Company Jevons Motors without leverage

F assets	1,000	F equity	1,000
Total assets	1,000	Total liabilities	1,000

equity. Let's assume the company Jevons Motors has a WACC of 10%; eternal yearly cash flows of 100; 100% equity funding; and 200 shares outstanding. Then using Eq. 15.3 gives: $V_u = FCF_U/r_U$=100/10% = 1000. And the value per share is V_u divided by the number of shares, which is 1000/200 = 5. In the absence of taxes, EPS (earnings per share) equals FCF per share, i.e. 100/200 = 0.5. Jevons Motors's simplified balance sheet can then be constructed as shown in Table 15.5.

Now suppose Jevons Motors issues 400 of debt and pays out the proceeds of 400 as dividends to its shareholders. That means that each shareholder receives a dividend of 2 (= 400 dividend/200 shares). Its balance sheet and capital structure then look like Table 15.6.

At first sight, this looks like a loss for shareholders, but it's not: don't forget that the reduction in the value of their shares exactly equals the dividends they are paid. The debt issue does not affect FCF, WACC (r_U), and the number of shares, as explained in Table 15.7. Of course, there is a change in both F debt (was 0, now 400) and in F equity (was 1000, now 600, so −40%). So, the value per share also drops by

Table 15.6 Jevons Motors with leverage

F assets	1,000	F debt	400
		F equity	600
Total assets	1,000	Total liabilities	1,000

Table 15.7 Jevons Motors with and without leverage (no taxes)

	No debt	With debt
F assets	1000	1000
F equity	1000	600
F debt	0	400
r_U	10%	10%
r_{debt}	na	2%
r_{equity}	10%	15.3%
Free cash flow (FCF)	100	100
Interest	0	8
Cash flow to equity	100	92
Number of shares	200	200
EPS	0.50	0.46
Value per share	5	3

40%, from 5 (= 1000/200) to 3 (= 600/200), equal to the dividends per share of 2. Table 15.7 shows the difference between the situations with and without debt.

The most important change is to the P&L and the cost of equity. With r_{debt} of 2% and F debt of 400, the annual interest payment (cash flow to debt) is 400*0.02 = 8. This reduces the net income and cash flow to equity by 8, from 100 to 92. Hence, EPS = 92/200 = 0.46. So while shareholders sold 40% of the company to the debt holders, their cash flow is reduced by only 8%. This sounds like a free lunch, but it is not, since the cost of equity increases in such a way that the value of equity is reduced by 40% after all. Recall the MM2 formula in Eq. 15.5:

$$r_{equity} = r_U + \frac{debt}{equity} * (r_U - r_{debt})$$

Applying it to this case gives r_{equity}=10% + 400/600*(10%–2%) = 10% + 2/3*8% = 15.3%. This gets us to F equity of 92/0.153 = 600; and a value per share of 0.46/0.153 = 3. This illustrates that the change in capital structure does not mean a change in value (MM1), while it does mean a change in the cost of equity capital (MM2).

Example 15.2 shows how one can calculate the return on equity with leverage.

Example 15.2 Calculating the Return on Equity with Leverage

Problem

The proposition of Modigliani and Miller indicates that the amount of debt doesn't affect the WACC of firm value (MM1). The increase in debt will be reflected in the return on equity (MM2). Suppose the debt ratio is 30%, interest rate is 3%, and the unlevered cost of equity is 8%. Calculate the return on equity with leverage.

Solution

Equation 15.5 can be used to calculate the return on equity:

$$r_{equity} = r_U + \frac{debt}{equity} * (r_U - r_{debt})$$

First, we need to determine the D/E ratio by dividing the debt ratio by the equity ratio, which gives 0.3/(1–0.3) = 0.43. Filling in the equation gives 8% + 0.43 * (8–3%) = 10.15%.

By taking additional leverage, the required return on equity increases from 8 to 10.15%, which makes sense because the equity gets riskier (as debt is repaid before equity in case of default). To compensate for the additional risk, the equity holders demand additional return. ◄

15.2 Financial Capital Structure with Imperfections

The MM propositions show that equity risk increases with leverage (MM2) and that capital structure is irrelevant for value in perfect capital markets (MM1). MM1 shows the *conservation of value principle*: in perfect capital markets, financial transactions do not add or destroy financial value (FV). They just repackage risk, as shown by MM2. In addition, by showing that capital structure is irrelevant in perfect capital markets, the MM propositions implicitly also show that imperfections point the way to what does matter for valuation. Such imperfections that do matter for financial capital structure include:

- *Taxes and bankruptcy costs*—formalised in static trade-off theory;
- *Information asymmetries*—described in pecking order theory.

15.2.1 Static Trade-off Theory: Taxes and Bankruptcy Costs

In MM's perfect capital markets, taxes and bankruptcy costs are absent. But in the real world, taxes do exist and give incentives for investors to prefer higher debt levels. In most tax systems, interest is deductible for corporate tax, which means that debt is effectively subsidised and stimulated. However, the real world also offers a (partial) countervailing effect, which is the cost of bankruptcy. In perfect capital markets companies can go bankrupt at zero cost, i.e. they can reorganise their capital structure (convert debt into equity) without losses on the asset side of the balance sheet. But in the real world, such losses do occur: key employees, suppliers, and clients typically leave the company when in distress, which reduces its FCF and the value of its assets.

Static trade-off theory argues that corporate managers recognise the offsetting effects of tax benefits and bankruptcy costs. This suggests that there is an optimal point or range where the combined effects of tax advantages and bankruptcy costs are most positive, whereby overall cost of capital (WACC) is minimalised. Figure 15.3 illustrates this.

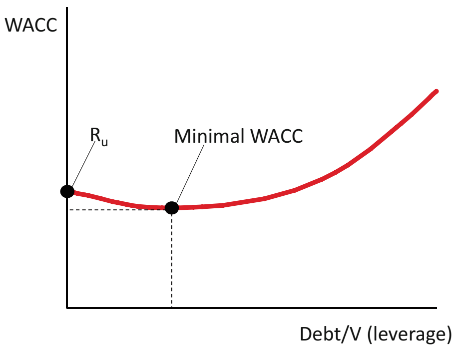

Fig. 15.3 Optimal capital structure in static trade-off theory

15.2.1.1 Taxes

The tax benefits are also known as the *interest tax shield*, which equals the corporate tax rate times the interest payments made:

$$Tax\ shield = \tau_c * interest\ payments = \tau_c * r_{debt} * debt \tag{15.7}$$

Let's illustrate this with the numbers of the previously mentioned company Jevons Motors. Table 15.8 shows the company's simplified P&L for four different situations with/without debt and with/without taxes.

In the first two cases, there are no taxes, and net income and taxes add up to 100. In the last two cases, a corporate tax rate of 25% applies. As a result, the sum of net income and interest payments is reduced to 75 in the third case (the one without debt) and company value V_u is reduced to 750 (= 75/0.1). However, in the fourth case, the sum of net income and interest is 77, producing tax savings or a tax shield of 2 (=25% × 8) for financiers. The reason is that the corporate tax rate is levied on the earnings after the deduction of interest. Hence, it's in the financiers' interest to maximise the tax shield—at least in the absence of bankruptcy costs.

In formulas, the tax shield is typically shown explicitly, as in the after-tax WACC, whereas the bankruptcy costs are not shown. In an adaption of Eq. 15.6, the after-tax WACC is then:

$$\text{After} - \text{tax } WACC = \frac{equity}{V_L} * r_{equity} + \frac{debt}{V_L} * r_{debt} * (1 - \tau_c) \tag{15.8}$$

That means that, versus the pre-tax WACC, the after-tax WACC is reduced by:

$$\frac{debt}{V_L} * r_{debt} * \tau_c \tag{15.9}$$

And since cash flows to financiers also increase, this should result in an increase of the value of the company. In fact, the increase equals the present value of the interest tax shield, i.e. the tax shield discounted by the cost of debt.

Table 15.8 P&L effects of taxes and leverage for Jevons Motors

Debt?	**No debt**	**With debt of 400**	**No debt**	**With debt of 400**
Taxes?	**No taxes**	**No taxes**	**With taxes**	**With taxes**
Cash flow	100	100	100	100
Interest payments (2%)	0	8	0	8
EBIT	100	92	100	92
Corporate tax rate (τ_c)	0%	0%	25%	25%
Taxes paid	0	0	25	23
Net income	100	92	75	69
Net income + interest	100	100	75	77
Tax shield (τ_c x interest)	0	0	0	2

$$\text{PV(interest tax shield)} = \frac{\tau_c * debt * r_{debt}}{r_{debt}} = \tau_c * debt \tag{15.10}$$

Hence, in a world with taxes (and still without bankruptcy costs and other imperfections) MM proposition 1 becomes:

$$V_L = V_U + \tau_c * debt \tag{15.11}$$

and the increase in value of equity equals $\tau_c * debt$, as the advantage goes to the shareholders.

MM proposition 2 is also different with taxes:

$$r_{equity} = r_U + \frac{debt}{equity} * (r_U - r_{debt})(1 - \tau_c) \tag{15.12}$$

So, as in the original MM2, the cost of equity still increases with leverage, but the rise is mitigated by the tax break. Example 15.3 shows how one can calculate the return on equity with corporate tax.

Example 15.3 Calculating the Return on Equity with Corporate Tax

Problem

As discussed, the tax deductibility of interest expenses has an impact on the cost of capital. We build upon Example 15.2 to demonstrate the effect of this interest tax shield. Recall, the D/E ratio is 0.43, interest expense 3%, and unlevered cost of capital is 8%. Assume that the tax rate is 25%. Calculate the return on equity by taking into account the corporate tax.

Solution

The relevant equation is shown in 15.12:

$$r_{equity} = r_U + \frac{debt}{equity} * (r_U - r_{debt})(1 - \tau_c)$$

Simply filling in the formula gives us 8% + 0.43*(8–3%)*(1–25%) = 9.16%. The return on equity without tax shield was 10.15%, while with the tax shield the return on equity drops to 9.16%. The higher firm value benefits the shareholders since they have the residual claim on the company (see Chap. 3 on shareholders as residual claimants of the company). Therefore, the required return on equity drops as a result of the tax shield. ◀

We can apply MM2 to Jevons Motors and observe that the 25% tax rate reduces the unlevered company value to 750, but part of that reduction is reclaimed in the levered case (final column), where the value of assets is 850. This is shown in Table 15.9, which uses the results from Tables 15.7 and 15.8.

After all, MM1 with taxes implies: $V_L = V_U + \tau_c * debt = 750 + 0.25 * 400 = 850$. And equity value then becomes 850–400 = 450. Knowing the value of equity allows us

Table 15.9 Valuation & cost of capital effects of taxes and leverage for Jevons Motors

Debt?	**No debt**	**With debt**	**No debt**	**With debt**
Taxes?	**No taxes**	**No taxes**	**With taxes**	**With taxes**
F assets	1000	1000	750	850
F equity	1000	600	750	450
F debt	0	400	0	400
r_U = pre-tax WACC	10%	10%	10%	10%
After-tax WACC	na	na	10%	8.8%
r_{debt}	na	2%	na	2%
r_{equity}	10%	15.3%	10%	15.3%
Cash flow	100	100	75	77
Interest	0	8	0	8
Cash flow to equity	100	92	75	69
Number of shares	200	200	200	200
EPS	0.5	0.46	0.375	0.345
Value per share	5	3	3.75	2.25

to fill in MM2 with taxes: $r_{equity} = 10\% + \frac{400}{850-400} * (10\% - 2\%)(1-0.25) = 15.3\%$. This is (perhaps surprisingly) exactly the same as in the levered case without taxes: the tax benefit (which lowers r_{equity}) is exactly offset by the higher weight of debt (which raises r_{equity}). The 15.3% r_{equity} also follows from (CF to equity)/equity = 69/450 = 15.3%. And this gives the following after-tax WACC for company X: $\text{After}-\text{tax}\ WACC = \frac{850-400}{850} * 15.3\% + \frac{400}{850} * 2\%(1-0.25) = 8.8\%$.

Given the above calculations, shareholders will be tempted to capture the tax shield by levering up. In fact, this can be (part of) the rationale for takeovers. For example, when Kraft Heinz attempted to take over Unilever, a much bigger company, the idea was to fund the deal with bank debt since Unilever was 'underlevered' anyway (see Chap. 18 on the aborted Kraft Heinz-Unilever takeover). But remember, all of the abovementioned calculations and reasonings are still without bankruptcy costs.

Example 15.4 shows how one can calculate the value of equity with leverage and corporate tax.

Example 15.4 Calculating Equity Value with Leverage and Corporate Tax

Problem

Assume the unlevered value of the company is €5000, the interest rate is 2%, and the tax rate is 20%. The company has debt of €2500. Please calculate the equity value of the company, by taking leverage and corporate tax into account.

Solution

The levered value of a company equals the unlevered equity value + the PV of the interest tax shield given by Eq. 15.11:

$$V_L = V_U + \tau_c * debt$$

First, we need to determine the PV (tax shield) by multiplying the debt with the tax rate. The PV (tax shield) = 2500 * 0.2 = 500. Adding the unlevered value and the PV (tax shield) gives the levered company value 5000 + 500 = 5500. The final step is to calculate the equity value. The levered firm value equals the market value of its debt plus market value of equity. Rewriting the formula gives the levered equity value of 5500–2500 = 3000. The company *creates* €500 (€3000–€2500) in value for its shareholders (but at the expense of other taxpayers) by taking the benefits of the debt tax shield. ◄

15.2.1.2 Bankruptcy Costs and Costs of Financial Distress

As a company's leverage increases, the chance also rises that it cannot meet its debt obligations. And the company is said to be in distress when it's close to being unable to meet its debt obligations. This is typically visible in the worsening of ratios, such as the interest coverage ratio (EBIT/interest payments). For example, with the rise of online retail, many retail companies that operated stores selling books, clothing or electronics got into trouble, resulting in a structural decline of their profit levels. As a result, their debt, which had looked easily serviceable for a long time, became too high for them. Figure 15.4 illustrates this: in year 1, EBIT is close to 400 and interest payments are just above 100. Hence, the interest coverage ratio is well above 3. When management considers year 1 a normal year and does not anticipate the falling EBIT in years 2–5, it feels quite safe at that point in time.

The drop in year 2 will worry management, as the interest coverage ratio falls to 2, but management may still feel this is a temporary setback, especially when year 3 turns out to be better again, though not quite back to 'normal'. However, the sharp drop in EBIT in year 4 should have all alarm bells ringing as the company can just

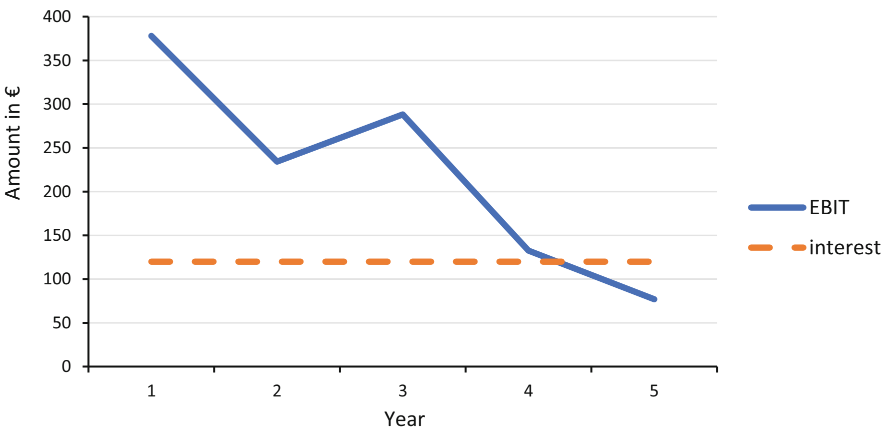

Fig. 15.4 Example of a company getting into financial distress

about pay its interest from EBIT (interest coverage at 1). And in year 5, EBIT even drops below interest payments, with likely negative operational cash flows (also depending on investment levels). The company can then be described as being in distress, and confidence in its ability to service its debt will depend on its cash position and ability to sell assets. If the company is no longer able to service its debt, it will default on it (i.e., fail to make promised interest payments or return of principal) and likely go bankrupt. In that case, the capital structure is 'reorganised' and debt holders become equity holders. If the company's business is deemed no longer viable, it can even be liquidated with assets being sold off. In both stages, the distress stage and the bankruptcy stage that might follow, there are costs to the company that reduce its value: investment opportunities are missed; and suppliers, clients, and employees lose faith in the company and decide to do business elsewhere.

In a perfect capital market, there are no costs to reorganising the company: the equity holders simply hand over ownership and control to the debt holders who become the new shareholders. In reality, however, there are direct and indirect costs of bankruptcy. Direct costs of bankruptcy include fees paid to administrators, accountants, investment bankers, lawyers, and courts. Bankruptcies can take years to unravel, at high costs. The process differs per country since countries have different bankruptcy codes.

Indirect costs of bankruptcy refer to the value loss of missed sales and investments the company could not make as a result of its dire financial situation. Similar types of costs can also occur in the distressed phase and are then called costs of financial distress. They can happen because employees start leaving the company, and suppliers and customers start avoiding the company. Moreover, management may lack the resources or the incentives to make positive NPV investments, especially if those investments also transfer value from equity holders to debt holders or vice versa.

As a result, costs of financial distress and both direct and indirect bankruptcy costs can have a significant impact on company value.

15.2.1.3 Optimal Capital Structure and Trade-off Theory

The imperfections discussed above, taxes and bankruptcy costs, have opposite implications for capital structure: taxes give incentives for higher leverage, whereas bankruptcy costs incentivise managers to reduce leverage. This suggests there might be an optimal capital structure where the overall cost of capital is minimalised as a sizeable tax benefit is obtained without excessive bankruptcy costs (see Fig. 15.3). Hence, the *trade-off theory* predicts that companies' debt ratios move towards a *target capital structure*, which is determined by the balance of tax benefits and bankruptcy/distress costs. This target capital structure depends on the conditions the company is exposed to and is therefore company-specific.

15.2.2 Agency Costs, Information Asymmetries, and Pecking Order

Another issue that might affect capital structure is the presence of *agency costs*. These are the costs resulting from the principal-agent conflict, which is about the tensions between owners/financiers (the principals) and management (the agents), as well as tensions among financiers (debt holders versus shareholders). Managers might have incentives to pursue their own interests at the expense of financiers (or other stakeholders, for that matter), resulting in too much or too little investment. For example, according to Free Cash Flow (FCF) theory, managers of companies with excess FCF (i.e., more cash flow than they can invest in positive NPV projects) will often waste that cash instead of giving it back to shareholders (Jensen, 1986). Such waste may take the form of spending on perks like private jets or a fancy office, i.e. non-productive investment, also known as *overinvestment*. By contrast, heavy debt burdens (called *debt overhang*) may result in managers not doing positive NPV projects because the investments raise the risk of the company not being able to service its debt obligations (Myers, 1977). This is in effect a transfer of value from shareholders (who miss out on the value creation of the positive NPV projects) to debt holders (whose risk is being reduced).

In the conflict of interest between managers and financiers, the former have a key information advantage: managers, by nature of their role, typically know much better what is happening at the company than its financiers and the wider capital markets do. The financiers are aware of this *information asymmetry* and accordingly charge a higher cost of capital for those types of capital where the information asymmetry is more likely to be exploited. This applies first and foremost to equity issues, in which the valuation effects of information asymmetries are largest. A change in the value driver assumptions of investors (see Chap. 2) can affect their valuation a lot. This also applies to a lesser extent to debt issues, but not to cash. From the manager's perspective, this results in a *pecking order*, where they prefer internal finance (i.e. from cash flow and retained earnings, where they don't pay a premium) over external finance (in which financiers charge a higher cost of capital); and external debt over external equity (Fig. 15.5) (Donaldson, 2000; Myers & Majluf, 1984).

In such a context of asymmetric information, the actions of managers can be seen as signals about their beliefs on the value of the company. As Myers and Majluf (1984) argue, when managers issue new equity, in spite of their pecking order

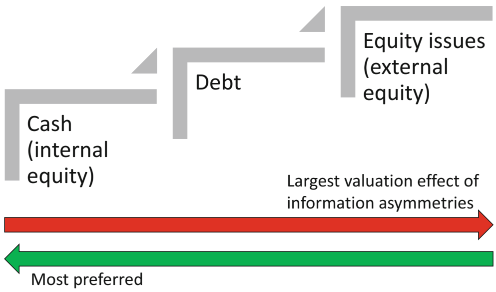

Fig. 15.5 Pecking order of funding choice

preference, they are basically saying that they believe that the company is overvalued. As investors see through this, they will place a lower value on the new equity issue. This also explains why managers issue new equity as a last resort according to the pecking order theory.

Box 15.1 Effect of an Equity Issue with and Without Information Asymmetry

Suppose a company has a market capitalisation of €8 billion, and management announces an equity issue of €2 billion. In the absence of asymmetric information, this means that the new market capitalisation will be €8 billion + €2 billion = €10 billion. On the company's market value balance sheet, €2 billion in cash is added on the left-hand side, and €2 billion in equity is added on the right-hand side. Hence, its market value balance sheet first looks like this:

NPV of assets	8	Market cap	8

And then like this:

NPV of assets	8	Initial market cap	8
Cash	2	New equity raised	2
Assets	10	New market cap	10

However, it is different in the presence of information asymmetries. Then, investors will likely react negatively to the announcement, interpreting the company as overvalued, and the stock price (and market capitalisation) will drop by, in this case, 3%. Hence, on announcement but before the actual issue, the market value balance sheet looks like this:

NPV of assets	8	Initial market cap	7.76
Undervaluation	-0.24		
Assets	7.76	New market cap	7.76

This means that, in order to raise €2 billion, the company needs to issue not 25% additional shares (2/8), but 25.8% additional shares (2/7.76). So, if the number of shares outstanding was 1000, the company will now have to issue 257.7 shares instead of 250 shares. The new shareholders now own 20.5% (257.7/1257.7) of the shares, versus 20% in the case without asymmetric information.

NPV of assets	8	Market cap upon announcement	7.76
Undervaluation	-0.24		
Cash	2	New equity raised	2
Assets	9.76	New market cap	9.76

The new market capitalisation is not €10 billion, but €9.76 billion. More on this in Chap. 16 on payouts and issues.

15.3 Behavioural Perspective on Financial Capital Structure

Surveys among financial practitioners show that the traditional view (i.e. of the abovementioned imperfections) is not the whole story. Corporate financial policies such as capital structure choices are also driven by behavioural issues: those of the managers themselves (internal errors) and those of the markets they operate in (external errors).

15.3.1 Internal Errors

On internal errors, there is evidence that optimistic managers use leverage more aggressively (Malmendier et al., 2011). As they overestimate cash flow (see also Chap. 6 on behavioural biases), managers also overestimate the interest level they can afford to pay; see Fig. 15.6 where the manager's EBIT estimate is higher than the unbiased EBIT estimate.

In addition, optimistic managers tend to think their company's stock is undervalued, which makes them perceive equity issues as costly (Malmendier & Tate, 2005). At the same time, they might think debt is cheap, underestimating how debt (even at low interest rates) raises the cost of equity (see MM2). As a result, optimistic managers are likely to choose higher debt levels than rational managers (Hackbarth, 2008). In fact, empirical research finds that men tend to be more optimistic than women and that female CFOs significantly reduce leverage when taking over from male CFOs (Schopohl et al., 2021).

Table 15.10 illustrates how managers may underestimate leverage if they overvalue their company. In this case, management overvalues the NPV of its assets by 30% (= [338–260]/260), resulting in an overvaluation of equity by 46% (=

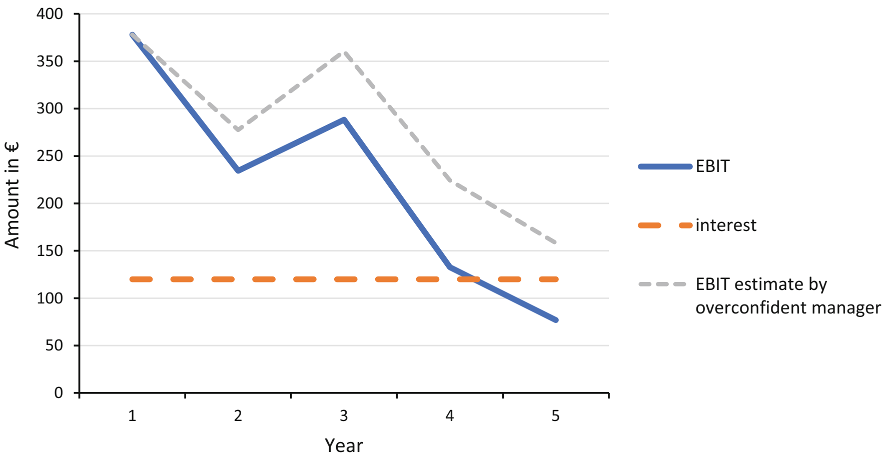

Fig. 15.6 Overoptimistic manager not seeing the company getting into financial distress

Table 15.10 Leverage effect of optimistic management

Fair value			
F assets	260	F debt	90
		F equity	170
Total assets	260	Total liabilities	260
		F debt / F assets	0.35
Management's assessment			
F assets	338	F debt	90
		F equity	248
Total assets	338	Total liabilities	338
		F debt / F assets	0.27

[248–170]/170) and an underestimation of the leverage (F debt/F assets) ratio by 23% (= [0.27–0.35]/0.35).

15.3.2 External Errors

It's not just managers who can act irrationally, but financial market participants as well, which may result in serious undervaluation or overvaluation of company securities. This can also be challenging, for managers who do behave rationally. They need to anticipate market irrationality and its consequences. For example, if your company is significantly undervalued, you will want to avoid issuing equity since it would mean giving away value. Let's again consider the company of Table 15.10, and assume the fair value is the same (top balance sheet of Table 15.10), but now the market is wrong in its assessment of the company: it undervalues the company's assets by 20% (= [260–208]/260) and its debt by 2% (= [90–88.2]/90). As a result, equity falls to 119.8, an undervaluation of 29.5% (= [170–119.8]/170]). This is given in Table 15.11.

The company now has a *perceived leverage* (F debt/F assets) ratio of 0.42, which makes additional debt funding tough. And equity funding is expensive due to its undervaluation. Suppose the company needs 20 of cash for an investment with a PV of 26, hence an NPV of 6. If the company raises that 20 by means of an equity issue, it is effectively giving up 28.4 (= 20/0.295) in shares for 20 in cash; remember that equity is undervalued at 29.5%. This result in an NPV of −8.4 (= 20–28.4), which cancels out the positive NPV of the investment, for an adjusted NPV of −2.4 (= 6–8.4). So, the company will not do the investment. The implication is that (temporarily) irrational markets can result in the absence of funding opportunities for positive NPV projects. This means there are limits to financial flexibility, and managers seem to be aware of this. So, to enhance their financial flexibility,

Table 15.11 Leverage effect of a pessimistic market

Fair value			
F assets	260	F debt	90
		F equity	170
Total assets	260	Total liabilities	260
		F debt / F assets	0.35
Market's assessment			
F assets	208	F debt	88.2
		F equity	119.8
Total assets	208	Total liabilities	208
		F debt / F assets	0.42

managers may keep extra cash for special circumstances and maintain costly credit lines with banks (which can be activated when needed). Managers might have to make their decisions about capital structure and investment jointly rather than separately, as investment might be sensitive to the amount of cash the company has. There is evidence that CFOs try to time the market, for example by issuing debt when they feel interest rates are very low, and try to maintain financial flexibility (Graham & Harvey, 2001).

External and internal errors can of course also happen in tandem and may even reinforce each other. In sum, it seems that capital structure is not so much a conscious decision on having a specific debt/equity ratio, but more the cumulative outcome of a long series of incremental financing decisions. If market timing-motivated decisions are not quickly balanced away, low-leverage firms will tend to be the ones that raise equity when their stock prices are high (Baker & Wurgler, 2002).

15.4 E and S Affecting Financial Capital Structure

Before considering the capital structures of E and S in their own right, let's first explore if S or E risks could make a company's financial capital structure more (or less) risky. The answer is that they can have that effect on financial risk, either through the business model and operations of the company, which can affect interest coverage ratios and project NPVs; or by means of investor perceptions (typically anticipating the former) that affect a company's cost of capital, valuation, and financial capital structure. Managers, in turn, can take these effects into account in their decision-making and adapt capital structure accordingly.

15.4.1 E and S Affecting Financial Capital Structure Through the Business Model and Operations

To see how E and/or S could affect financial capital structure through a company's business model, let's consider the example of an airline. Before internalisation, the company is moderately profitable and its assets are valued at 30, based on the NPV of its expected future cash flows. At a debt burden of 12, this leaves 18 in equity. The upper part of Table 15.12 gives the resulting market value balance sheet. However, the airline's cash flows are generated in a business model that externalises a large amount of environmental costs: the airline emits a lot of CO_2, nitrogen, and other harmful substances. These are not taxed, unlike the emissions of alternative modes of transport. What's more, there is not (yet) a tax on airline ticket prices. All of this leads to a huge E debt that is not yet internalised, but which looms large as a risk for the company, in terms of F as well. This sheds a very different light on the company's current capital structure, as well on its target capital structure, that is deemed optimal. Taking the E risk into account, one probably arrives at a much lower target capital structure.

With internalisation, this risk materialises: the airline industry's subsidies disappear, its costs go up strongly because of carbon taxes, and demand for air travel drops. As a result, both the industry and this particular airline see a drop in volumes and need to shrink their fleets. The resulting losses are partly offset by higher ticket prices and possibly lower levels of competition after restructuring of the industry. The bottom part of Table 15.12 gives the company's market value balance sheet after internalisation. Since this airline is relatively well managed, it is able to survive and

Table 15.12 Market value balance sheet of an airline before and after internalisation

Before internalisation			
F assets	30	F debt	12
		F equity	18
Total assets	30	Total liabilities	30
		F debt / F assets	0.40
After internalisation			
F assets	21	F debt	10.8
		F equity	10.2
Total assets	21	Total liabilities	21
		F debt / F assets	0.51

its loss in NPV is reduced by only 30%, to 21—as opposed to some airlines that fail and see a reduction in value of nearly 100% (i.e. bankruptcy). The reduced asset base jeopardises the company's ability to service its debt, and its probability of default rises. As a result, the value of its debt falls by 10%, to 10.8. Nominally, in terms of book values, debt stays the same, and so do its interest payments, but the market value of debt is reduced by higher risk. Since the company's NPV drops by 9, and its debt falls less, its equity falls from 18 to 10.2 (= 21–10.8). Accordingly, its leverage (F debt/F assets) ratio rises from 0.40 to 0.51.

For the sake of simplicity, we project the effect of the possible removal of airline subsidies as the unfolding of a forward-looking scenario in the bottom panel of Table 15.12. Of course, other scenarios are also possible. As discussed in Chaps. 2 and 12, companies can use scenario analysis with a probability structure surrounding E and S and their costs.

While the company was relatively well managed, it was still ill-prepared for transition risks. If this company had been managed in a more visionary way, it would have anticipated the internalisation of its externalities and prepared accordingly. For example, it could have forged alliances with high-speed rail companies to replace short-haul flights with rail and to connect rail to the more profitable long-haul flights. In addition, the company could have invested more aggressively in fuel savings and the use of alternative fuels. And in doing so, the company would have been able to build a credible transition pathway and a superior reputation with clients.

15.4.2 E and S Affecting Financial Capital Structure Through Investor Perceptions

The above airline example showed how the materialisation of an E risk affected the business model and cash flows, leading to an increase in its leverage ratio. But of course, such E or S risks can also affect capital structure through the cost of capital. In anticipation of a possible internalisation, investors may perceive a heightened financial risk, which results in lower F assets by means of a higher discount rate and/or lower expected cash flows. This diminishes the value of F equity and hence the buffer for F debt. This can result in distress and increased conflicts of interest (agency costs) between debt and equity, as well as financial distress. Chapter 12 shows how E and S risk increase the financial discount rate (see Sect. 12.5).

In practice, the effects of higher cost of capital and lower expected cash flows can of course reinforce each other, but they are separate channels. The lower expected cash flows result from investors attaching higher probabilities to more negative scenarios (often even the first time they consider such negative scenarios). The higher cost of capital results from higher expected variations in outcomes and sensitivity to market returns (higher beta).

15.4.3 E and S Affecting Financial Capital Structure Through Management Action

Ideally, managers see the risks of large E and S externalities, interpret them as additional leverage, and take strategic action. If they have the future of the company and its stakeholders in mind, they will reduce potential E and S liabilities (de-lever) accordingly, for example by replacing harmful processes or products with less harmful or even harmless ones. However, if managers are in it for vested interests (i.e. to maintain negative externalities) or to maximise short-term shareholder value related to their variable pay, they may prefer to lever up (by payouts to shareholders; see Chap. 16) and double down on the risk—thereby endangering the future of the company, while inflicting harm on stakeholders and the environment.

15.4.4 Academic Evidence of E and S Affecting Financial Capital Structure

There is quite some empirical evidence that E risks do indeed have such effects. For example, Ginglinger and Moreau (2022) find that greater climate risk leads to lower leverage in the post-2015 period, i.e. after the Paris agreement. The reduction in leverage related to climate risk is shared between a demand effect (the company's optimal leverage decreases) and a supply effect (bankers and bondholders increase the spreads when lending to companies with the greatest risk). Similarly, Nguyen and Phan (2020) attain that Kyoto protocol ratification in Australia led to a decrease in leverage at heavy carbon emitting firms.

Evidence of S affecting capital structure is more sparse. Chemmanur et al. (2013) show that labour costs limit the use of debt and hence reduce leverage. In addition, Bae et al. (2011) find that companies that treat their employees better have lower leverage. In a similar vein, Ghaly et al. (2015) observe that companies that are more committed to employee well-being tend to hold more cash. And this relation is stronger if human capital is more important to the firm.

15.5 Capital Structure of E and S

Just like FV has a capital structure with debt and equity, so do EV and SV have a capital structure. Their relevance might not be obvious at first sight, but they are an interesting expression of the claims that nature and society might have on companies. They are also important indications of risk. Just consider the Inditex example from Chap. 11, which showed large negative externalities on both E and S. Expressing them in capital structure ratios helps in identifying and understanding the size of the risks involved and allows comparison to other companies.

One could try to express E and S capital structure in their own units. For example, a packaging and forestry company might report 10 million tonnes of CO_2 emitted, creating a liability; 3 million tonnes of CO_2 stored, an asset; and 15 million tonnes of

Table 15.13 Company Keynes Tech's S capital structure

S assets	20	S debt	15
		S equity	5
Total assets	20	Total liabilities	20

Table 15.14 Company Keynes Tech's E capital structure

E assets	15	E debt	25
		E equity	-10
Total assets	15	Total liabilities	15

CO_2 avoided, an asset. However, it would be hard to compare these units: the stored CO_2 is less 'hard' than emitted CO_2, as it can be questioned how long it will be stored. And avoided emissions are relative. So, these numbers cannot be simply added and subtracted. It is also hard to compare them with other companies and across time. Ideally, these flows are expressed in monetary terms (by putting prices on them) and discounted to arrive at values, which can denote a capital structure. Doing this is hard work but it can be done, as shown in impact accounts (see Chap. 17). Tables 15.13 and 15.14 give examples of S and E capital structures, respectively, for our earlier fictional company Keynes Tech (see Sect. 15.1).

One can interpret Keynes Tech's S capital structure as follows: the S assets indicate value creation by the company for society. S assets are not factually owned by society, but they are desirable for society and have the potential for F value creation. Remember from Chap. 4 that society is a company's counterpart on social and environmental value. In contrast, S liabilities (called S debt) indicate value destruction by the company at the cost of society (on a different aspect of S than where the value creation is happening), and hence an infringement on rightsholders, and a potential claim for compensation by society. However, one should be careful in their phrasing, since the value destruction on one aspect of S might be inevitable for value creation on other aspects of S. In addition, in Keynes Tech's case the S assets are larger than the S debt, which means there is net value creation and positive S equity. One can also express the S capital structure in ratios: the S leverage ratio is S debt/S assets = 15/20 = 0.75. This is higher than the typical F leverage ratio.

Let's now have a look at Keynes Tech's E capital structure in Table 15.14, which looks quite different compared to its S capital structure. As was the case for S above, the existence of E assets indicates value creation for society, while E debt indicates value destruction for society. However, Keynes Tech's E assets are smaller than its E debt, so there is net value destruction on E, which is typical for many if not most companies in the current fossil fuels-based economy. In fact, there are likely a lot of companies that have (almost) zero E assets and significant E debt.

There are exceptions that do have E assets in excess of E debt. For example, Danish enzyme maker Novozymes has annual GHG emissions of 0.5 million ton, while saving (avoiding) 60 million tons at their clients (Scope 4), because the company's enzymes reduce energy use in various applications such as transport, baking and washing (see Box 16.6 in Chap. 16). That is a wide margin.

It is useful to express capital structure in ratios, to make it comparable across companies and over time. With the above numbers, Keynes Tech has an E leverage ratio of E debt/E assets = 25/15 = 1.67, which is very high. But for companies with 0 or near 0 E assets, the E leverage ratio goes to infinity. Such high leverage means a high risk for companies to lose their licence to operate (see Introduction of this book). For further context, we will compare the capital structure ratios of E, S, F, and I (integrated) in Sect. 15.6. This is at the core of taking double materiality seriously, as discussed in Chap. 2.

Just like in financial capital structure, one could ask what optimal or healthy levels are in the capital structures of E and S. To be healthy, equity needs to be positive and debt needs to be minimal. But it can be hard to reduce liabilities without also reducing assets and perhaps even killing the business. Hence, a transition pathway is needed. For example, the best speed and order of change also depends on internal capabilities, competitive positions, and pricing incentives (see Chap. 2). To assess this properly, an integrated perspective is needed.

It should be noted that E and S assets and liabilities can be manipulated by management, just like F assets and liabilities. Chapter 5 proposed a materiality test to determine which E and S issues are material (relevant) for the company and should be incorporated in the analysis. Chapter 17 discusses that auditors are starting to include E and S in their audit of company reports. Such audits provide 'reasonable' assurance on the reliability of information in company reports.

15.6 Integrated Capital Structure

Analysing the capital structures of E and S separately allows us to move on to the *integrated capital structure*, which is the capital structure of E, S, and F combined. The integrated capital structure gives a picture of the overall risk of the company, which might differ substantially from the risk picture that emerges from the financial capital structure. For example, in the case of Inditex (see Chap. 11), there is no financial leverage in the company, but a lot of S leverage and especially E leverage. Following Eq. 15.1, we introduce integrated leverage:

$$Integrated\ leverage = \frac{Integrated\ debt}{Integrated\ assets} \tag{15.13}$$

whereby integrated debt is the sum of S, E, and F debt and integrated assets is the sum of S, E, and F assets. Table 15.15 visualises the integrated capital structure of our company Keynes Tech in an integrated balance sheet.

Table 15.15 Company Keynes Tech's integrated balance sheet

S assets	20	S debt	5
		S equity	15
E assets	15	E debt	25
		E equity	-10
F assets	25	F debt	5
		F equity	20
Total integrated assets	**60**	**Total integrated liabilities**	**60**

Let's explore how this works and what it means. First, the asset side of the integrated balance sheet is constructed by including S assets, E assets, and F assets, which add up to I assets (integrated assets).

Second, on the liabilities side, S debt, E debt, and F debt are the starting point, which add up to I debt (integrated debt). S equity, E equity, and F equity then follow from the balance of assets and liabilities for each type of value. In the above example:

- S equity = S assets minus S debt = 20–5 = 15;
- E equity = E assets minus E debt = 15–25 = −10; and
- F equity = F assets minus F debt = 25–5 = 20.

So, for S, E, and F individually, debt and equity add up to assets.

Third, where debt is larger than assets, the equity turns negative. In Table 15.15 this happens for E. This negative E equity remains on the liabilities side of the balance sheet (indicating severe underfunding of E assets).

Fourth, the sum of S equity, E equity, and F equity is I equity (integrated equity), which might have a minus sign. The principle of balanced integrated value (Chap. 6) implies that a company needs to be positive on all three dimensions to be a healthy company.

Fifth, the above observations imply that S, E, and F have both their own capital structures and joint capital structures that can be analysed. For example, by expressing them in ratios. Table 15.16 distinguishes three types of *integrated capital structure ratios*: leverage (debt/assets) ratios; composition of assets ratios (fractions); and composition of debt rations (fractions).

Table 15.16 Integrated capital structure ratios for company K

Leverage ratios		Composition of assets		Composition of debt	
F debt/F assets	0.20	F assets/I assets	0.42	F debt/I debt	0.14
S debt/S assets	0.25	S assets/I assets	0.33	S debt/I debt	0.14
E debt/E assets	1.67	E assets/I assets	0.25	E debt/I debt	0.71
I debt/I assets	0.58	Total	1.00	Total	1.00

When looking at this company from an F perspective, its capital structure looks conservative with a low financial leverage ratio of 0.20; and this also applies to S leverage (0.25). But it is quite different for E leverage. This is visible both in the leverage ratios (1.67 on E vs 0.2–0.25 for F and S) and in the composition of debt ratios (0.71 for E, and 0.14 for S and F), which are high for E debt while having moderate values for F and S. Especially the value of 1.67 for E leverage is high and worrisome. As a result, the integrated leverage (=I debt/I assets) ratio of 0.58 is much higher than the financial leverage (=F debt/F assets) ratio of 0.20.

The economic interpretation is that the company is not treating residual E claimants (i.e. future generations) well, which can hurt them in future court cases (as already seen with Royal Dutch Shell). It's important to use the three types of ratios in relation to each other. For example, the E leverage ratio of 1.67 is worrisome. But in theory, it could also have been the result of very low E assets without having high E debt. The E debt/I debt fraction therefore matters as well. In this case, that one is high, which indicates that E leverage is indeed high and problematic.

The composition of debt ratios show what type of debt represents what portion of total debt. The three of them add up to one. In this example, E debt represents 71% of I debt, whereas the assets ratios are more balanced. Example 15.5 shows how one can calculate integrated capital structure ratios.

Example 15.5 Calculating Integrated Capital Structure Ratios

Problem

You are conducting an analysis on the capital structure ratios of company AZ. Your investment team is a frontrunner in the field of impact investing and therefore assesses the integrated capital ratios. That means that you investigate the F, S, and E leverage ratios separately as well as the integrated leverage ratio. Additionally, you want to know the debt and equity composition in relation to integrated debt and assets.

Use Table 15.17 to calculate the integrated capital structure ratios for company AZ. Briefly discuss the results.

Table 15.17 Integrated balance sheet for company AZ

S assets	30	S debt	40
		S equity	-10
E assets	20	E debt	10
		E equity	10
F assets	40	F debt	20
		F equity	20
Total integrated assets	**90**	**Total integrated liabilities**	**90**

Solution

First, calculate the leverage ratios separately:

F debt/F assets = 20/40 = 0.50
S debt/S assets = 40/30 = 1.33
E debt/E assets = 10/20 = 0.50
I debt/I assets = 70/90 = 0.78

Second, calculate the composition of assets:

F assets/I assets = 40/90 = 0.44
S assets/I assets = 30/90 = 0.33
E assets/I assets = 20/90 = 0.22
Sum of asset fractions = 0.44 + 0.33 + 0.22 = 1.00
Please note the fractions have to add up to 1 exactly. Due to rounding of the fractions, the fractions may add up to 0.99 or 1.01.

Third, calculate the composition of debt:

F debt/I debt = 20/70 = 0.29
S debt/I debt = 40/70 = 0.57
E debt/I debt = 10/70 = 0.14
Sum of debt fractions = 0.29 + 0.57 + 0.14 = 1.00

If the leverage ratio is greater than 1, there is a liability to the claimants, so a negative claim. We see that in the financial and the environmental perspective, the company has a decent capital structure (0.50 both). However, AZ is harming the claimants of S with a high leverage ratio of 1.33. In other words, the company extracts value from society. The integrated leverage ratio of 0.78 is considered to be risky. Moreover, most assets represent financial capital, and most debt relates to societal activities. Via this analysis, you can detect where the strengths and weaknesses of the company lie. Ideally the company would reduce its S debt or alternatively increase S assets to moderate the impact.

Chapter 2 discussed the financial impact: S and E assets can turn into F assets through internalisation, while S and E liabilities can materialise in F liabilities (F debt) through, for example, lawsuits. ◄

Interpretation also depends on a company's context. Ratios of peer companies are an interesting reference. In Table 15.18, packaging company 1 has a low E leverage ratio compared to the average mining company, but a high one compared to other packaging companies, which suggests it is at a competitive disadvantage. In contrast, mining company 1 has a high E leverage ratio compared to the average packaging company, reflecting more serious issues in mining, but it has a low ratio compared to other mining companies, which suggests it is at a competitive advantage. These comparisons show that sector analysis is very important. Market risk calculations in the CAPM are also typically done at the industry level (see industry asset betas in Chap. 13).

Table 15.18 E leverage ratios for two peer groups

Peer group 1	E debt/E assets	Peer group 2	E debt/E assets
Packaging company 1	1.67	Mining company 1	3.41
Packaging company 2	1.22	Mining company 2	7.58
Packaging company 3	1.37	Mining company 3	6.19
Packaging companies average	*1.42*	*Mining companies average*	*5.73*

These ratios also suggest that the mining companies have a higher cost of integrated capital than the packaging companies. More generally, the application of such ratios casts a different light on the US shareholder model in which companies tend to hold high levels of debt to exploit the tax shield. This now looks less sustainable than the European Rhineland model in which companies often hold more liquidity and less debt, which makes them less fragile and more resilient.

15.6.1 Inditex Case Study

We can now calculate the financial and integrated leverage ratios for Inditex. Example 15.6 gives the basic data and shows the calculations. The valuation data from Chap. 11 can be turned into an integrated balance sheet for Inditex. Table 15.20 shows the results.

Example 15.6 Calculating the Leverage Ratios of Inditex

Problem

For 2021, Inditex had an integrated value of €42 billion. Table 15.19 shows the components of the integrated value (taken from Table 11.18 in Chap. 11). In addition, Inditex had an equity value of €82 billion and negative debt of −€3 billion (taken from Table 11.6; debt is negative due to Inditex's large cash position).

Please calculate Inditex's financial leverage ratio and integrated leverage ratio.

Solution

Let's first turn Inditex's value components into an integrated balance sheet. The FV enterprise value represents F assets; negative SV is S debt, positive SV is S assets, and negative EV is E debt. Equity is each time assets minus debt. Table 15.20 provides Inditex's integrated balance sheet for 2021.

We can now calculate the leverage ratios from the integrated balance sheet in Table 15.20. Inditex's financial leverage ratio is F debt/F assets = −3/79 = −4%. Due to its negative F debt position, Inditex has a negative financial leverage ratio. So, Inditex looks very conservatively financed from a financial perspective.

Inditex's integrated leverage ratio is I debt/I assets = (−3 + 137 + 183)/362 = 317/362 = 87%. This is a very high leverage ratio. So, Inditex's leverage looks very risky from an integrated perspective. ◄

Table 15.19 Integrated value of Inditex, in € billions, 2021

IV calculation	Value (euro billions)
FV (enterprise value)	79
Positive SV	283
Negative SV	−137
Negative EV	−183
IV	*42*

Table 15.20 Integrated balance sheet of Inditex, in € billions, 2021

F assets	79	F debt	-3
		F equity	82
S assets	283	S debt	137
		S equity	146
E assets	0	E debt	183
		E equity	-183
Total integrated assets	**362**	**Total integrated liabilities**	**362**

Example 15.6 shows that Inditex's financial leverage ratio is extremely conservative at −4% (the negative number is due to Inditex's negative net debt position). By contrast, Inditex's integrated leverage ratio is very high at 87% and indicates a risky integrated capital structure. So, we get two diametrically opposed messages from the leverage calculations. The high integrated leverage ratio is caused by the high S debt (workers in the supply chain) and the high E debt (carbon emissions and other environmental damages).

Inditex's high integrated leverage ratio raises the question of how to manage leverage from an integrated perspective. A first step for Inditex to address such high leverage is to reduce liabilities. Given that Inditex has no financial liabilities, it can reduce E and S liabilities by lowering carbon emissions and improving working conditions in the supply chain (e.g. paying a living wage, abiding by health & safety standards, and respecting human rights). A second step is to increase equity to finance investment for this transition to a sustainable business model. As explained in Chap. 16, it makes sense to increase investment, while reducing annual dividend payouts.

15.7 Conclusions

Capital structure is an important topic since it helps in understanding a company's risk profile and health. This chapter started with theories that explain financial capital structure, such as the Modigliani-Miller theorems, which say that in a perfect world, financial capital structure is irrelevant for financial value (MM1) and that the cost of equity increases with leverage (MM2). Financial capital structure does affect the cost of equity in proportion to risk, and the split in equity and debt value, but it does not change total financial value. From that starting point, several imperfections (e.g., information asymmetries, taxes, bankruptcy costs, agency costs) were considered that try to explain under what conditions financial capital structure does matter to financial value. Behavioural issues, such as misvaluations and overconfidence, add another layer of complexity.

Subsequently, we looked into the effects of E and S on financial capital structure. Such risks can affect capital structure through changes in the business model that affect the expected cash flows, and hence the valuation of assets and equity versus debt; or through investor perceptions that affect the cost of capital, thereby also changing the valuation of assets and equity versus debt.

We then considered the capital structures of E and S separately. As they do on the financial side, companies also generate assets and liabilities on E and S. The main difference is that it is typically much less clear how strong the claims against the company are and to what extent they will materialise in financial terms. However, their presence and size are strong indicators of additional risk. For example, a company might destroy more value on E than it creates, meaning that its liabilities on E exceed its E assets, and its E equity is negative. This is all the more troublesome if its direct competitors have healthier E capital structures and lower risk of internalisation.

The analysis of the capital structures of E and S allows us to take the next step, namely the construction of an integrated capital structure, which is the capital structure of E, S, and F combined, and an integrated leverage ratio. The integrated balance sheet offers a richer perspective on the company's assets and liabilities than a balance sheet that is limited to F. As found in Chap. 13 on the cost of integrated capital, liabilities on S and E increase the integrated leverage ratio (making the integrated capital structure riskier) and thus raise the cost of integrated capital.

Key Concepts Used in this Chapter

Agency theory describes conflicts of interest between principles and agents

Asset substitution refers to a company's exchange of lower risk investments for higher risk investments

Bankruptcy is a legal proceeding initiated when a person or business is unable to repay outstanding debts or obligations

Capital structure is the combination of debt and equity used by a company to finance its overall operations and growth

Costs of financial distress are due to the company's uncertain financial condition; there are costs to the company that reduce its value, such as investment opportunities that are missed, and suppliers, clients, and employees lose faith in the company and decide to do business elsewhere

Debt overhang theory means that heavy debt burdens may result in managers not doing positive NPV projects because the investments raise the risk of the company not being able to service its debt obligations

Direct bankruptcy costs are the costs of the bankruptcy process itself, such as fees paid to administrators, accountants, investment bankers, lawyers, and courts

Financial distress is a condition in which a company struggles to meet its financial obligations

Free Cash Flow (FCF) theory is the idea that managers of companies with excess FCF (i.e., more cash flow than they can invest in positive NPV projects) will often waste that cash instead of giving it back to shareholders

Financial distress is a condition in which a company struggles to meet its financial obligations

Homemade leverage is the process of recreating an investment in a company with no leverage into the effect of leverage by personal borrowing

Imperfections are limitations that reduce the range of financial contracts that can be signed or honoured

Indirect bankruptcy costs are costs similar to those of distress (see above), but then in the bankruptcy stage

Information asymmetry arises when one party in a transaction is in possession of more information than the other

Integrated capital structure is a capital structure expressed not just in types of financial capital but in types of social and environmental capital as well

Leverage refers to funding with borrowed money

Market value balance sheet is a balance sheet expressed in market value terms instead of book values

Optimal (financial) capital structure refers to the capital structure that minimises the cost of (financial) capital

Pecking order theory posits that managers prefer internal finance (i.e. from cash flow and retained earnings, where they don't pay a premium) over external finance (in which financiers charge a higher cost of capital); and external debt over external equity

Perfect capital markets are capital markets in which there are never any arbitrage opportunities

Static trade-off theory assumes trading off taxes and bankruptcy costs in determining optimal capital structure

Tax shield is a reduction in taxable income achieved through claiming allowable deductions from corporate or income tax such as interest payments

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Myers, S., & Majluf, N. (1984). Corporate financing and investment decisions when firms have information that investors do not have. *Journal of Financial Economics, 13*(2), 187–221.

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Issues and Payouts: Changes in Capital Structure

16

Overview
The previous chapter was about capital structure and its implications for risk. While that chapter mainly discusses given *levels* of capital structure, this chapter focuses on deliberate *changes* in capital structure, i.e. those that do not follow directly from operations and their financial results. Companies can change the composition of their capital structure by adding (issuing) or reducing (paying out) types of funding. And in dire situations they may be forced to restructure and replace debt with equity.

In issues, cash is raised from providers of capital and their claim is increased accordingly. Conversely, payouts refer to those situations in which cash is paid to providers of capital and the value of their claim is reduced accordingly. In the various stages of its development, a company might benefit from different types of capital. In aggregate, more companies are likely to succeed if these channels are wide open in a diverse ecosystem of capital providers. Both issues and payouts compete with alternative uses of corporate cash, such as investments and building cash reserves.

In perfect markets, issues and payouts have no value relevance: the change in cash exactly equals the change in the financiers' claims. However, in practice they may become value relevant due to imperfections such as taxes, information asymmetries, financial distress, and bankruptcy costs.

The impact of environmental (E) and social (S) factors on financial issues and payouts is most obvious through their impact on business models and operations, which in turn affect risk, debt capacity, and cash flows, thereby affecting the degree to which companies can and want to payout cash or issue new capital.

As for issues and payouts of E and S, the question is if they exist at all. After all, issues and payouts concern changes in claims that involve cash transfers, but it is not clear what the equivalent of cash could be in E and S. Even if issues and payouts in E and S do not exist, that shouldn't stop us from having an integrated view on issues and payouts. Given that E and S liabilities affect integrated leverage, they are likely to have implications for integrated payouts. The question then is: how to manage issues and payouts, financial in nature, when managing for long-term value? It calls for caution on payouts in the presence of significant liabilities on E or S (Fig. 16.1).

D. Schoenmaker, W. Schramade, *Corporate Finance for Long-Term Value*, Springer Texts in Business and Economics, https://doi.org/10.1007/978-3-031-35009-2_16

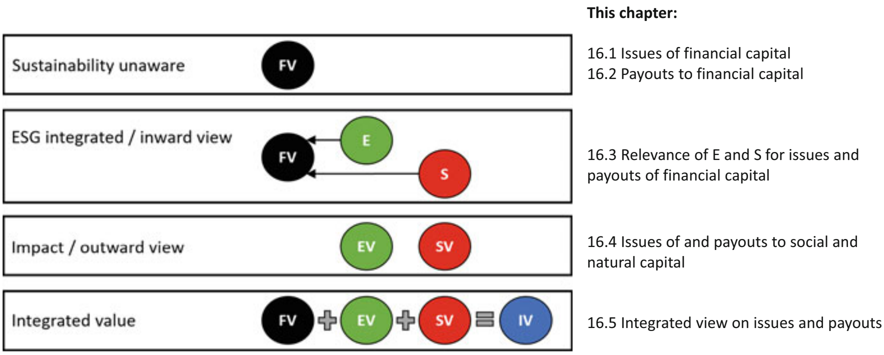


Fig. 16.1 Chapter overview

Learning Objectives
After you have studied this chapter, you should be able to:

- explain how issues and payouts of equity and debt work, what drives them, and how they affect financial capital structure and value
- do basic calculations on the effects of payouts and issues
- demonstrate how E and S can affect a company's payout and issuing policies
- explain the relevance and challenges of issues and payouts from the perspective of integrated value

16.1 Issues of Financial Capital

When companies are in need of extra capital, for example to fund investments, they might issue additional capital, in bonds (debt) or shares (equity). They can sell equity either privately in a so-called private placement or in public equity markets. If the equity issue is the first one in public equity markets, it is called an initial public offering (IPO). An IPO changes the status of the company from a private to a public company, which entails additional reporting requirements and costs. For example, in April 2018 the Swedish music streaming company Spotify went public on the New York Stock Exchange. This allowed Spotify employees to sell some of the (hitherto illiquid) shares they had received as compensation since the company's founding in 2006. It also meant that Spotify had to start disclosing much more information about its financials and operations to the public than it had done previously (see Chap. 17).

While there are over 300 million companies worldwide, only around 40,000 of these companies (0.01%) are stock market listed (source: Statista 2023). Quite a few of those companies also issued shares after listing. Such subsequent equity issues, when the company is already publicly listed, are called seasoned equity offerings (SEOs).

16.1.1 How Issues Work

When companies issue shares or bonds in public markets, they usually do so with the help of a syndicate (group) of investment banks acting as the underwriters or bookrunners of the issue. The underwriters assess the market's (i.e. their clients') appetite for the issue to see what amount of bonds or shares can be issued at what price. On a pre-issue roadshow, the underwriters organise meetings between company management and prospective buyers, and they provide an indicative price range. The company itself publishes a prospectus, which is a document that contains detailed information on the issue. Box 16.1 shows what such a prospectus looks like. The underwriters then sell the shares to the ultimate investors at their own risk by giving a 'firm commitment'. The remaining unsold shares remain on their book. Alternatively, the underwriters can agree to sell as much as possible on a 'best efforts' basis.

Box 16.1 Basic-Fit IPO Prospectus

When fitness club chain Basic-Fit did its IPO on the Amsterdam stock exchange in 2016, it published a 288-page prospectus.[1] The summary page gives an overview of the amount of shares issued; the expected price range; and the investment banks that make up the syndicate:

- Offering of up to 30,666,667 ordinary shares in the capital of Basic-Fit N.V. (the 'Company') with a nominal value of €0.06 each (the 'Ordinary Shares').
- The price of the Offer Shares (the 'Offer Price') is expected to be in the range of €15.00 and €20.00 (inclusive) per Offer Share (the 'Offer Price Range').
- ABN AMRO Bank N.V. ('ABN AMRO') and Morgan Stanley & Co. International Plc ('Morgan Stanley') are acting as joint global coordinators for the Offering (the 'Joint Global Coordinators'), and, together with Barclays Bank PLC ('Barclays'), Deutsche Bank AG, London Branch ('Deutsche Bank'), and ING Bank N.V. ('ING'), as joint bookrunners for the Offering (the 'Joint Bookrunners'). Coöperatieve Rabobank U.A. ('Rabobank'), KBC Securities NV ('KBC'), and NIBC Bank N.V. ('NIBC') are acting as co-lead managers for the Offering (the 'Co-lead Managers'). The Joint Bookrunners and the Co-lead Managers, in their respective capacities, are together also referred to herein as the 'Underwriters'. Lazard is acting as the financial adviser for the Offering (the 'Financial Adviser').

(continued)

[1] Basic-Fit Prospectus, May 2016; https://corporate.basic-fit.com/investors/shareholder-information

Box 16.1 (continued)

The table of contents illustrates the contents of the prospectus:

- Summary
- Risk factors
- Reasons for the offering and use of proceeds
- Dividend and dividend policy
- Capitalisation and indebtedness
- Selected consolidated financial information
- Operating and financial review
- Our industry
- Our business
- Management and employees
- Selling shareholders
- Corporate governance
- The offering
- Plan of distribution
- Selling and transfer restrictions
- Taxation
- Independent auditors

The parts on 'our industry' and 'our business' are important for investors to understand the nature of the company's business model, competitive positions, and value creation process. This allows investors to build informed expectations about the company's value drivers (sales, margins, capital costs) and hence its valuation.

Just like M&A deals (see Chap. 18), issues tend to come in waves: there are often more issues during times of strong stock market performance. These are called hot markets. Conversely, in times of falling stock prices, called cold markets, fewer issues are done.

Some equity issues are done as rights issues. A *rights issue* is essentially an invitation to existing shareholders to purchase additional new shares in the company. The idea is to give current shareholders the first 'right' to buy, so they can avoid dilution of their shares. Rights issues are often done by companies that need new capital fast due to sudden liquidity problems. The existing shareholders get a claim right, i.e. an option (see Chap. 19 for the valuation of options) to buy the new shares at a discount to what new shareholders pay. This claim right is often tradeable.

Issues in Perfect Capital Markets

As discussed in Chap. 15, Modigliani and Miller (1958, MM) showed that capital structure is irrelevant in perfect capital markets. And the same applies to changes in capital structure, such as issues. Assuming perfect capital markets, let's see how an equity issue works in terms of its effect on the market value balance sheet of tech

Table 16.1 The market value balance sheet of AI-lab, in € millions—before an equity issue

F assets	25	F debt	5
		F equity	20
Total F assets	**25**	**Total F liabilities**	**25**

Table 16.2 The market value balance sheet of AI-lab, in € millions—after an equity issue

F assets	35	F debt	5
		F equity	30
Total F assets	**35**	**Total F liabilities**	**35**

company AI-lab. Table 16.1 gives the situation before the equity issue. The company has 5 million shares outstanding.

Now suppose the company does an equity issue, where it raises €10 million in cash for €10 million in equity (at market value, no discount). Since it has 5 million shares outstanding at a value of €20 million, the value per share is €4. To raise €10 million, the company will have to sell 2.5 million shares (=€10 million/4). As a result, the number of shares rises to 7.5 million, F assets (which includes cash) rises by 10 million, and so does F equity. See Table 16.2.

The issue in Table 16.2 is value irrelevant, in that the increase in cash exactly equals the claim of the new shareholders. The stock price remains €4 (=€30 million/7.5 million shares). What *does* change are total capital (assets) and the company's capital structure. Due to the higher amount of equity and assets, and with debt staying the same, the debt/asset ratio (leverage) falls from 0.2 (= 5/25) to 0.14 (= 5/35).

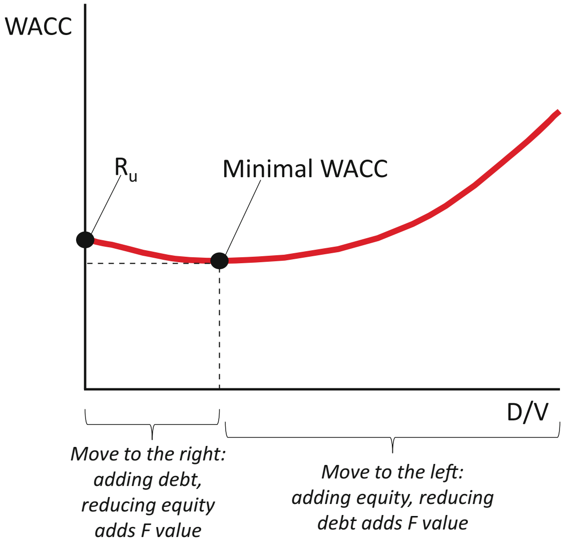
The Costs of Issues in the Presence of Imperfections

The flipside of the MM argument is that capital structure and issues may be value relevant if capital markets are not perfect. Due to the presence of taxes and the tax deductibility of interest payments, adding debt might create financial value, up to a point where bankruptcy and distress costs start to outweigh the tax benefits (see Chap. 15 and Fig. 16.2 below). This suggests a point (or range) for the optimal capital structure. This point is where the WACC (weighted average cost of capital) is the lowest, because a lower WACC increases enterprise value (see Chap. 13).

It depends on one's starting point, then, to determine if it is better to add or reduce debt. And regardless of the starting point, information asymmetries may play a role: investors may assume management to have superior information and to be selling them lemons (i.e. selling stock without revealing company problems or flaws), and hence they may apply a discount to the value of an equity issue.

Let's reconsider the equity issue of our company AI-lab and assume that information asymmetries result in a −3% stock price reaction at announcement of the

Fig. 16.2 Issues and capital structure



issue (see Tables 16.1 and 16.2 for the situation without information asymmetries). Assuming no change in the value of F debt, the −3% means that both F equity and F assets fall by €0.6 million. The percentage drop in F assets is smaller (0.6/25 = 2.4%). With 5 million shares outstanding before the issue, the share price drops to €3.88 (=19.4/5), a fall, of course, of 3% from €4 (Table 16.3).

Again, the company aims to raise €10 million in cash for €10 million in equity. However, since that equity just got valued 3% lower, the company will need to offer more shares to raise that €10 million in cash. The company will have to sell 2.57732 million shares (= 10 million/3.88) instead of 2.5 million. As a result, the number of shares rises to 7.57732 million, F assets (which includes cash) rises by 10 million, and so does F equity. See Table 16.4.

Table 16.3 The market value balance sheet of AI-lab, in € millions—at announcement of the equity issue

F assets	24.4	F debt	5
		F equity	19.4
Total F assets	**24.4**	**Total F liabilities**	**24.4**

Table 16.4 The market value balance sheet of AI-lab, in € millions—at completion of the equity issue

F assets	34.4	F debt	5
		F equity	29.4
Total F assets	**34.4**	**Total F liabilities**	**34.4**

Of course, this example is quite stylised, as the stock price can change (for all kinds of reasons) in the time period between the announcement and the completion of the issue. Moreover, the value of debt may increase, since debt has become less risky due to the equity issue.

The impact of the abovementioned information asymmetries on the value of the company depends on where the company is in Fig. 16.2. If the company is on the left, issuing equity reduces value. If it is on the right, issuing equity may add value. The overall impact depends on the net effect of the benefit of more equity (reducing WACC) and the cost of information asymmetries.

There are other costs of issues as well. For example, there are the direct transaction costs of hiring the investment banks, law firms, and auditors needed to do the issue. And for companies doing their first public issue, there are the additional costs of going public: all of a sudden, the company needs to meet much higher standards of disclosure. The flipside is that the company becomes more visible (including to its customers) because of its stock listing and related disclosures.

Why Do Companies Issue Capital?

Imperfections make issuing capital costly to companies—but they do still issue. Why? There are two obvious reasons why companies issue equity or debt in spite of the costs. First, they may need cash for investments, and the NPV of the investments can be higher than the negative APV (adjusted present value) of the issue. Companies may, in particular, issue stock to fund large acquisitions (see Chap. 18). Second, the owners of a privately owned company (i.e. existing shareholders) may want to (partially) exit their holdings through an IPO. Once the company is listed on the stock market, owners can sell their remaining shareholdings in the stock market.

Roell (1996) listed additional long-term factors for issuing equity:

- *Reduce leverage of the company*: the equity basis is strengthened and leverage is reduced; companies typically do this to rebalance their accounts after high investment and growth;
- *Improve liquidity of shares*: enhanced liquidity reduces the cost of trading stocks;
- *Enhanced company image and publicity*: the publicity surrounding the flotation and the on-going publicity of a listing are seen as a major advantage;
- *Motivate employees and management*: companies can issue stock to management and employees as part of variable pay to align incentives;
- *Exploiting mispricing*: Sect. 16.1.2 discusses behavioural reasons for issues.

The same author also mentioned important disadvantages:

- *High costs of issues*: transaction costs and need for additional disclosure (in the case of an IPO);
- *Loss of control and ownership*: owners/founders of companies may not want to lose decision-making control of their company (and thus prefer bank funding).

Transaction costs and asymmetric information costs can be substantial for issuing equity. Fama and French (2005) argued that these costs are not always high. Issues to employees, rights issues, and acquisitions financed with stock, for example, have lower transaction costs and minor asymmetric information problems.

The Aggregate View: The Role of Issues in Society

There is also a role for issues beyond the individual company level. Ideally, sufficient funding is available to foster companies in going to their next stage of maturity (see Chap. 10). Companies tend to go through several stages of development, at which they have different funding needs. In advanced economies, there is a plethora of funding types for companies at all stages of development. This allows for more complex and advanced networks ('ecosystems') of companies that mutually reinforce each other and society and the local economy. Conversely, if there are gaps in funding, the development of small business (and hence of large business later) can be hampered.

The funnel for stock listings is formed by medium-sized businesses that are typically owned by their founders or by venture capital firms. If a company goes public, it issues equity—an *initial public offering (IPO)*—to obtain external funding. At a later stage, public companies may also issue equity—a *seasoned equity offering (SEO)*—for expansion, exits, or covering losses. But as we learned in Chap. 15, companies' preferred financing method is first retained earnings, then debt and lastly equity, according to the pecking order theory. Yet, more mature companies might generate more cash flows than they need for their investments, and they will do more payouts (see Sect. 16.2) than issues.

In aggregate, in a dynamic and growing economy, most companies are net issuers (i.e. issuing more capital than they payout) and in most years the stock market will on an aggregate basis be a net issuer of equity. In recent decades, however, many developed stock markets have seen negative net issues, suggesting low investment levels.

16.1.2 Behavioural View on Issues

Behavioural issues can also affect issuing activity, both due to internal errors (i.e. by corporate management) and external errors (i.e. by market participants).

Internal Errors

As stated in the earlier chapters, internal errors can occur if management overestimates cash flows or underestimates risk. In terms of capital structure decisions (Chap. 15), this could result in managers levering up by underusing equity. In issues, the effect is likely (but not always) downward: managers that overestimate CF and/or underestimate risk will overvalue their own company and are more likely to judge their company undervalued in the stock market. In that case, they will find issuing equity too costly and might refrain from doing an equity issue.

We can analyse the attractiveness of an issue using the *APV (adjusted present value)* method, which goes beyond the NPV by considering the funding costs of a

Table 16.5 APV of equity issue with internal errors

APV components	20% overvalued by management	10% undervalued by management
Plus: cash in	300	300
Minus: management's valuation of the shares	−360	−270
Minus: transaction costs	−15	−15
Sum: management's perceived APV	*−75*	*15*

transaction. Suppose the manufacturing company ProductCo wants to issue $300 million of new shares at 5% transaction costs. The company is fairly valued by the market (i.e. the company's market value equals its intrinsic value, which is its valuation based on a fair assessment of expected cash flows and cost of capital). What is the management's APV of this issue, if management's valuation of the company's value versus its intrinsic value is (1) 20% overvalued; (2) 10% undervalued? See Table 16.5 for the calculations.

In the case in which management overvalues the company (the typical overconfidence/overoptimism case) by 20%, the APV is negative: management feels it is giving away shares for 300 that are worth 360 (120% of 300) and has to pay transaction costs on top of that. This gives a loss of 75. Conversely, in the much-less-typical case of pessimistic management that undervalues the company by 10%, the APV turns positive. Of course, the transaction costs still come in negatively; but they are offset by a perceived gain in value from selling shares for 300 that are worth only 270 (90% of 300) in management's view.

Please note, however, that this APV calculation might not be complete: management is doing the issue for a reason. It might have an attractive investment project, with a positive NPV. If that NPV is higher than the APV hitherto calculated, the APV turns positive after all. For example, in the case of 20% undervaluation and an APV of −75, management may still do the issue if it allows management to do an investment that (it thinks) has an NPV above 75.

While we show here that managers may underuse equity (because of overvaluation of cash flows and/or underestimation of risk), there are also other behavioural factors at work. Managers in publicly listed companies tend to underuse debt because they opt for a situation without demanding profit targets. High interest payments require sufficiently high profits to meet these payments. So, managers may opt for less disciplining power of debt (see also Sect. 16.2).

External Errors

External errors mean that serious behavioural mistakes are made by the market in aggregate: it may over- or undervalue specific companies, groups of companies or entire market indices. Corporate managers, who might have better information than market participants, can benefit from such misvaluations, for example by issuing equity when their stock is overvalued. And indeed, there is evidence that more companies do stock issues after strong stock performance (e.g. Hovakimian et al., 2001). Corporate executives also admit that they try to time the market: in a survey

Table 16.6 APV of an equity issue with external errors

APV components	20% overvalued by the market	25% undervalued by the market
Plus: cash in	300	300
Minus: intrinsic value of the shares	−250	−400
Minus: transaction costs	−15	−15
Sum: APV	*35*	*−115*

of CFOs, Graham and Harvey (2001) find that CFOs issue equity when they think their stock is overvalued. Prominent historical issuing examples are the 'tronics' boom of the early 1960s (companies with names ending with 'tronics') and internet IPOs of the late 1990s (see Fig. 12.7).

Let's return to our earlier-mentioned company ProductCo that wants to issue \$300 million of shares at 5% transaction costs. Now let's assume that there are no internal errors, but instead external errors, and management is aware of them. What is the APV of this issue, if the market's assessment of the company's value is (1) 20% overvalued; (2) 25% undervalued? See Table 16.6 for the calculations.

In the case where the market overvalues the company by 20%, the APV is positive: management knows it will get 300 for shares that are worth only 250 (=300/1.2), a gain of 50 that is higher than the transaction costs of 15. But in the case of a market that undervalues the company by 25%, the APV turns negative. Then, the company knows it will be selling shares for 300 that are actually worth 400 (=300/0.75), a loss of 100. With the transaction costs of 15 on top of that, the resulting loss is 115.

Again, as in the internal errors case, please note that this APV calculation may not be complete, since there could be an investment project involved that affects the APV.

16.2 Payouts to Financial Capital

In payouts, companies return capital to the financiers; payouts are therefore the opposite of issues. Among payouts on equity, one can distinguish dividends and repurchases (also called buybacks). For companies, payouts are a potential use of free cash flow: an alternative to using free cash flow to invest in new projects, to build cash reserves, or to redeem debt in debt buybacks (see Fig. 16.3). As explained later, investments in new projects can be value creative or value destructive. For investors, payouts in the form of dividends and buybacks are a way to get income from their invested funds.

We start with defining the *payout ratio*, as payouts divided by net income (net profit):

$$Payout\ ratio = \frac{Payouts}{Net\ income} \tag{16.1}$$

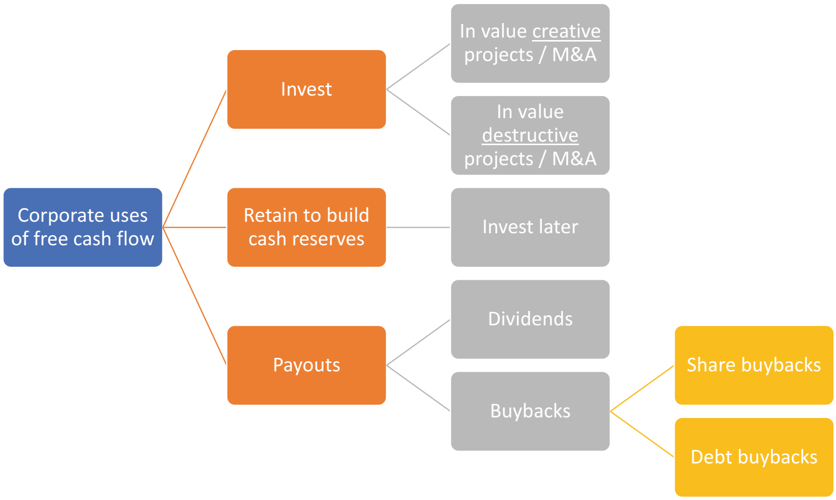


Fig. 16.3 Payouts and other corporate uses of free cash flow

16.2.1 Payouts in Perfect Capital Markets

Why do companies do payouts? Remember that Chap. 15 presented the MM argument about capital structure irrelevance, which rests on investors' homemade dividends. Of course, this applies to dividends themselves as well: investors can create their own dividends by selling shares. Just like there is MM capital structure irrelevance, there is also MM dividend (and repurchases) irrelevance (Miller & Modigliani, 1961): dividend policy and repurchases are irrelevant to company value in perfect capital markets. In a perfect capital market, the dividend payment equals the stock's price drop after the dividend payment, as explained below in Sect. 16.2.3. On the asset side, assets are reduced with the cash amount paid out as dividend. On the liabilities side, equity value is reduced through a drop in the stock price (which is equal to the dividend per share). Leverage (measured as debt to assets) increases, changing the company's capital structure, but that is irrelevant for company value according to MM.

16.2.2 Payouts with Imperfections

Again, just as with capital structure, the potential value relevance of payouts lies in imperfections and behaviour. Non-behavioural potential explanations for payouts include Free Cash Flow theory, signalling, and taxes.

Free Cash Flow Theory

According to Jensen (1986), managers have a tendency to waste Free Cash Flow (FCF) on negative NPV projects and overconsumption of perks, such as corporate

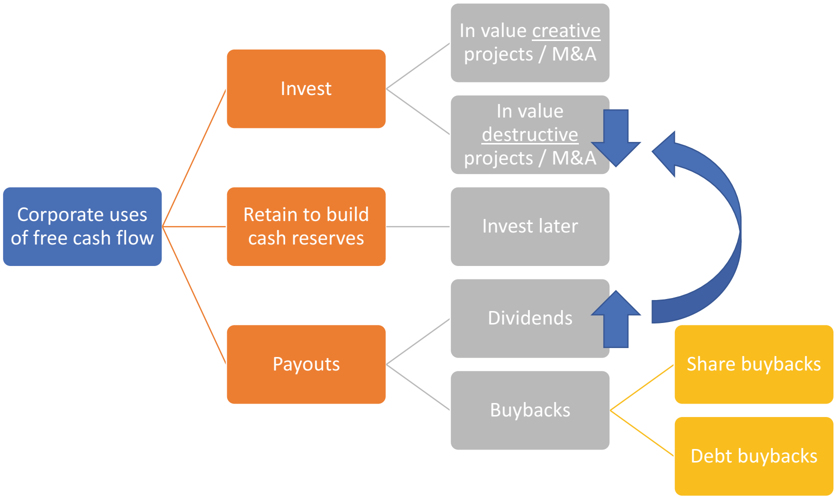


Fig. 16.4 FCF theory: dividends reduce leeway for value destructive investments

jets. To reduce that waste, Jensen argues, one should reduce FCF, and a way to do so is to (self)discipline management with a dividend policy that reduces its leeway to waste cash in value destructive projects or M&A. Figure 16.4, which is an adaptation of Fig. 16.3, illustrates how that works in the context of corporate uses of cash.

But, of course, the counterargument is that it may not only reduce leeway for value destructive investments, but can also hamper value creative investments.

Signalling

Another explanation for the value relevance of payouts lies in their signalling role in alleviating the costs of asymmetric information. Since managers are supposed to have better information about the prospects of the company than outside investors, high and rising dividends effectively signal high company quality, as opposed to low-quality companies that cannot afford to make the signal (Bhattacharya, 1979). Companies may engage in dividend smoothing: they don't link dividends directly to earnings but make sure that they pay a dividend that is at least as high as in the year before. And indeed, as early as seven decades ago, Lintner (1956) found in a survey that companies establish long-run *target payout ratios*. Given these target payout ratios, managers prefer to smooth dividends (i.e. no changes to the existing payout ratio) except when there are good reasons which investors would understand (e.g. a major loss). And the survey by Brav et al. (2005) finds that little has changed.

Smoothing makes dividends less volatile than earnings. Dividend smoothing suggests there is information in dividends: it's an indication of management's expectation of future earnings. After all, the future dividends will have to be paid out of future earnings. In the Brav et al. (2005) survey, 75% of executives see dividends as a conveyor of information.

Signalling also means that dividend cuts are received in a very negative way, with negative stock price reactions, since they are interpreted as a change for the worse in prospective earnings. And indeed, dividend cuts are often the result of disappointing profits, as in the headline of this Fortune article:[2] 'Mining Giant Rio Tinto Scraps Boom Time Dividends as Profits Plunge'. The signal is even stronger if it comes after decades of stable dividends, such as in this CNN article:[3] 'Royal Dutch Shell has slashed its dividend for the first time since World War II after profits were wiped out by a historic collapse in oil demand caused by the coronavirus pandemic'. The article reports an 8% price drop in the Royal Dutch Shell stock price on that day (30 April 2020).

16.2.3 Dividends

Cash dividends are cash payments to shareholders, often on an annual basis, without getting something in return. The number of shares stays the same, but their value drops. In repurchases (also known as buybacks), the company buys back shares from its shareholders. So, cash leaves the company and the number of shares is reduced. Because some investors have to pay income tax on received dividends, share repurchases are often more tax-efficient than cash dividends.

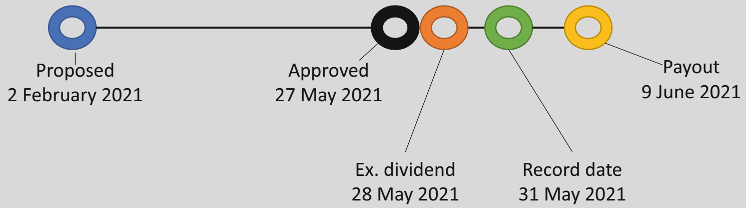
How Do Dividends Work?

A company's board of directors determines the amount and timing of the dividends paid by the company. Box 16.2 shows the timeline of a particular dividend payout by Telenor.

[2] Mining Giant Rio Tinto Scraps Boom Time Dividends as Profits Plunge | Fortune

[3] Shell cuts dividend for first time since World War II | CNN Business

Box 16.2 Timeline of the Telenor 2020 Dividend
Telenor, a Norwegian telecom operator with operations across the globe paid a NOK 5 and a NOK 4 dividend on its 2020 fiscal year. The timeline of the NOK 5 dividend payment is shown below:



The dividend was proposed in February of 2021, i.e., after the closing of the 2020 results. Almost 4 months later, the dividend was approved. The next day, the share went ex-dividend (i.e. the share price drops by the dividend amount). The ex-dividend date is the trading date on (and after) which the dividend is not owed to a new buyer of the stock. The record date, 3 days later, is the cut-off date used to determine which shareholders are entitled to a corporate dividend. Nine days later than that, the dividend was paid to all eligible shareholders.

Source: based on data on the Telenor investor relations website

A dividend payout is typically part of a *dividend policy*, which is the policy of a company to structure its dividends. For example, a company might have the policy of paying 30% of its net income in dividends ('a 30% payout ratio'); or it can have the policy of always paying at least as much dividend as the previous year ('a stable dividend policy'). Such stability can be expressed either in fixed amounts or in fixed payouts (see Box 16.3 on Komatsu for an example of a fixed payout ratio). A dividend policy can be maintained for a very long time: a Nasdaq article[4] gives the examples of PPG, Target, and Sysco, which are 'dividend kings', companies that have increased their dividend payouts for 50 consecutive years.

[4] Dividend Kings; 3 Stocks That Recently Made the Cut | Nasdaq

Box 16.3 Komatsu Dividend Policy

Komatsu (ticker: 6301 JP) is a Japanese machinery company that builds heavy equipment for construction, mining, forestry, and industrial applications. The company has the following stated dividend policy:

> Komatsu is building a sound financial position and enhancing its competitiveness in order to increase its sustainable corporate value. Concerning cash dividends, Komatsu has the policy of continuing stable payment of dividends after comprehensively considering consolidated business results and reviewing future investment plans, cash flows, and the like. Specifically, Komatsu has the policy of maintaining a consolidated payout ratio of 40% or higher.

Source: Komatsu investor relations website.

Let's consider the dividend calculations for fictional Swiss company Pasteur Pharma, for which the market value balance sheet is shown in Table 16.7. Table 16.8 provides further financials that allow for the calculation of the dividend metrics of Pasteur Pharma.

Pasteur Pharma has 3 million shares outstanding, with a per share value of CHF 237 (=CHF 711 million/3 million). The company has a dividend policy of maintaining a 50% payout ratio. In the most recent fiscal year, the company made a profit of CHF 66 million. Hence, it proposes, approves, and pays a dividend of CHF 33 million (=50% × CHF 66 million). The rest of the net profit is retained. Per share, the dividend is CHF 11 (=CHF 33 million/3 million). This gives a dividend yield of 4.6% (=CHF 11/CHF 237).

In comparison with Table 16.7, the results of the dividend payment for Pasteur Pharma's market value balance sheet are a drop in cash of CHF 33 million and, if the stock price reaction exactly equals the dividend payment, a drop of the same size in F

Table 16.7 The market value balance sheet of Pasteur Pharma, in CHF millions—before a dividend payment

F investment projects	760	F debt	112
F cash	63	F equity	711
Total assets	**823**	**Total F liabilities**	**823**

Table 16.8 Dividend calculations for Pasteur Pharma

Number of shares outstanding, millions	3
Value per share, CHF	237
Net profits, CHF millions	66
Payout ratio	50%
Total dividend paid, CHF millions	33
Dividend per share, CHF	11
Dividend yield	4.6%

Table 16.9 Stock split example

	Value before the 15:1 stock split	Value after the 15:1 stock split
Stock market value, € billions	26	26
Number of shares, millions	80	1200
Value per share, €	325	21.67

equity. In the above example, the company has sufficient cash to pay its dividends. However, there are also companies whose cash flows and cash positions are not sufficient to meet their dividend commitments. They will have to cut their dividends or borrow to pay their dividends.

A special dividend is a one-off dividend payment that is not part of a company's dividend policy of recurring dividends. Special dividends are typically paid after a windfall profit or another type of one-off cash flow, such as the disposal of a business unit. For example, in 2017 the UK utility company National Grid Plc had £4 billion in proceeds from the sale of a 61% stake in the UK Gas Distribution business. The company paid out the £4 billion to its shareholders through a £3.2 billion special dividend and the remainder through share buybacks.[5]

Stock Dividend: Not a Real Payout

Companies can also pay dividends in stock instead of shares. For example, a shareholder may receive one additional share for every share already owned. However, this is not really a payout: no cash goes from the company to the shareholders. The only thing that changes is the number of shares outstanding. The total value of the shares stays the same, and the value per share falls. Something similar happens in a stock split, but with more dramatic numbers: instead of each shareholder receiving say one share per 30 shares owned, each share is replaced by say 15.

So, the number of shares rises marginally in a stock dividend (by 3.3% in the case of a 1:30 stock dividend), but dramatically in a stock split (by 1400%, i.e. [15–1]/1 × 100% in the case of a 15:1 stock split). What both cases have in common is that existing shareholders get new shares in proportion to their current holdings, and no cash. Table 16.9 shows the impact of a stock split on the share price and on the number of shares if there is no value effect. The number of shares increases indeed with 1400% from 80 to 1200: 1120 = 80*1400%.

Stock splits are typically undertaken on shares with a high price per share, so as to improve tradability and access for small shareholders. It is not possible to buy fractional shares. For example, in the case of Nintendo's 2022 10-for-1 stock split, retail investors 'had been asking for a split for months to boost liquidity, affordability and reach', according to a Forbes article,[6] and: 'The split reduced the per-share price from around 59,700 yen (about $413) on Wednesday to 6,043 yen (about $41.76) by

[5] See National Grid presentation

[6] 'What Nintendo's Stock Split Means For Investors', Forbes, 30 September 2022

Thursday's close'. Other companies that did stock splits in the early 2020s include Apple, Amazon, Alphabet, and Tesla; all companies with a large increase in market value resulting in high prices per share.

16.2.4 Share Repurchases

Instead of paying dividends, a company can also pay out cash to its shareholders by buying shares in a *share repurchase*—also known as a *share buyback*. There are two ways to do buybacks: open market operations; and tender offers. Since a buyback results in extra demand for the shares, it can drive up the share price.

In open market share repurchases, a company buys back shares in the market. The actual buying is typically done by a specialised investment services provider. See the Bekaert example in Box 16.4.

Box 16.4 Bekaert Share Buyback Programme

Belgian company Bekaert is a producer of steel wires and coatings. In February 2022, in the press release on its 2021 Full Year Results, Bekaert outlined its payouts policy, consisting of an increase in its (fixed) dividend and an open market share buyback programme:

> The Board of Directors seeks to maintain a balanced approach between funding future growth and enhancing shareholders' returns.
>
> - The Board will propose to the Annual General Meeting of Shareholders in May of 2022 a 50% gross dividend increase to €1.50 per share.
> - In addition, the Board has approved a share buyback program of an amount up to € 120 million, to be initiated in the coming weeks. Under the program, Bekaert may repurchase outstanding shares for a maximum consideration up to €120 million, over a period up to twelve months.
>
> The purpose of the program is to reduce the issued share capital of the company. All shares repurchased as part of this arrangement will be cancelled. The program will be conducted under the terms and conditions approved by Bekaert's Extraordinary General Meeting of 13 May 2020. Bekaert will appoint an investment services provider to execute the repurchases of shares in the open market during open and closed periods.

Seven months later, the company issued a press release to give an update on the buyback programme. The update said that company's investment services provider, KeplerCheuvreux, had bought 64,030 shares for €1,883,734 over the 1–7 September period, in the context of the third tranche (part) of €30 million.

In a *tender offer*, shareholders receive an offer that asks them to submit (tender) a portion of their shares within a certain time frame. The offer usually states the number of shares and the price or price range to be paid. For example, in November 2021, Irish mining company Kenmare Resources, listed in London, made a tender offer to purchase up to 13.5% of the company's outstanding shares at £4.17 per share.[7]

Taxes on Dividends & Buybacks

Taxes are generally an argument against dividends and in favour of share repurchases. This is because in most tax regimes, dividends are more heavily taxed than capital gains and repurchases. This tends to favour buybacks over dividends. However, there is a twist: tax rates on dividends and capital gains differ across shareholders, with some (institutional) shareholders, such as pension funds, even being tax-exempt. This allows for dividend capture and tax clienteles. *Dividend capture theory* says that in the absence of transaction costs, investors can trade shares at the time of the dividend so that non-taxed investors receive the dividend. Corporate management can cater to this and optimise its dividend policy for the tax preference of its investor clientele (clientele effects).

Additional Reasons for Buybacks

In addition to the above reasons, companies may also engage in buybacks for lack of investment opportunities or to cover for compensation plans. For example, in June 2022 Dutch medical equipment maker Philips announced it would repurchase up to 3.2 million shares to cover long-term incentive and employee stock purchase plans.[8] Another reason to do buybacks is to boost EPS (earnings per share, which rise as there are less shares outstanding) and hence compensation tied to EPS. The survey by Brav et al. (2005) found that 'Many managers now favor repurchases because they are viewed as being more flexible than dividends and can be used in an attempt to time the equity market or to increase earnings per share. Executives believe that institutions are indifferent between dividends and repurchases and that payouts policies have little impact on their investor clientele'.

Edmans et al. (2022) investigated the long-term consequences of actions induced by vesting equity. In line with Brav et al. (2005), they found that *vesting equity*, which is a short-term compensation measure, is positively linked to the probability of a company repurchasing shares and the amount of shares repurchased. Vesting equity is also associated with more negative long-term returns over 2–3 years following repurchases.

Dividends Versus Share Buybacks

Figure 16.5 shows that share buybacks are most common in the USA, where they account for around 3% of total market capitalisation and bigger than dividend payouts, which are 2% of total market cap in the USA. Next are the European countries with buybacks between 1 and 2% of total market cap. Finally, the Asian-Pacific countries have share buybacks of less than 1% of total market cap. Countries with lower share buybacks typically have higher dividend payouts. Figure 16.5

[7] See Kenmare Resources press release, 16 November 2021

[8] See Philips press release, 13 June 2022

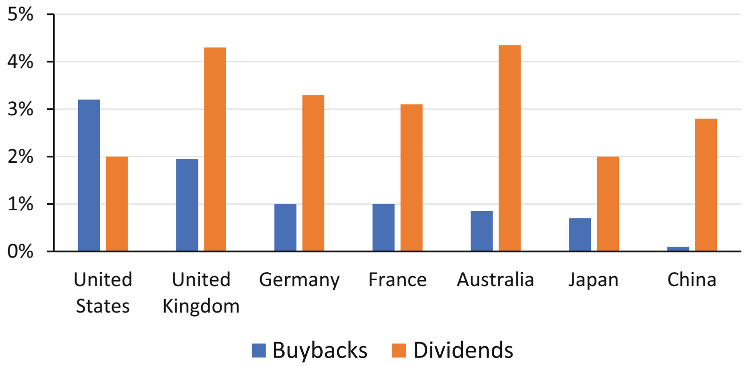


Fig. 16.5 Dividends and share buybacks as a % of total market capitalisation (2018). Source: Adapted from FCLT Global (2020)

reports numbers for the year 2018 (FCLT Global, 2020). Since then, share buybacks have become more popular in Europe as well overtaking dividends in size, like in the USA.

Total payouts (dividends and buybacks) fluctuate between 3 and 6%. So, the key difference between the countries is the composition of payouts (dividends or buybacks) and not the level of payouts.

16.2.5 Behavioural View on Payouts

In Sect. 16.1 we explained how internal errors, i.e. management overestimating CF or underestimating risk, could affect issue activity. Likewise, management could be tempted to pay too-high dividends or do too-big share repurchases as they overestimate future earnings and underestimate risk (e.g. DeAngelo et al., 1996). However, management's overoptimistic view could also result in more investments, which leave less cash on the table for payouts. It's not obvious which effect dominates. At any rate, payout policy under internal errors can give a distorted signal on the company's prospects.

Dividends can also be seen as a reaction to external errors, i.e. irrational market behaviour. According to Shefrin and Statman (1984), a strong rationale for paying dividends lies in catering to three investor needs:

- *Self-control* (Thaler & Shefrin, 1981): the act of exercising control over one's impulses, usually to delay gratification. Dividends make people less reliant on the tough job of self-control in that they make the payouts automatic, so that people do not have to produce the dividends themselves by selling a proportion of their shares on a regular basis;
- *Mental accounting*: this is the segregating of the overall gain or loss into several components, so as to have manageable pieces. A specific case is hedonic editing:

people prefer to experience gains separately rather than together. Dividends help people in their hedonic editing by providing a separate component of gains;

- *Regret avoidance*: people hate to feel regret, which is typically stronger for acts of commission than for acts of omission. This means that people feel more regret over selling shares too early (too cheaply) than for not reinvesting dividends in that same stock.

The need for catering provides the following dividend heuristics (Shefrin, 2007):

- Pay a severe 'penalty' (in the form of damaged trust of investors) for cutting dividends;
- Meet investors' expectations (set according to the company's history and its stability of earnings) about the magnitude and form of payout;
- Do not deviate from competitors;
- Maintain a good credit rating.

Like dividends, repurchases can also be made to benefit from external errors. A survey by Brav et al. (2005) finds that 87% of CFOs admit that they try to time their repurchases to benefit from their company's overvaluation by the market. And the findings of Ikenberry et al. (1995) indicate that repurchasers seem to time successfully. From management's perspective, the value of doing a repurchase can be assessed using an APV analysis. Example 16.1 shows the impact of over- and undervaluation on repurchases.

Example 16.1 Repurchases with over- and Undervaluation

Problem

Suppose a company wants to buy back \$300 million of its own shares at 5% transaction costs. What is the APV of this repurchase, (a) if the company is 20% overvalued by the market; (b) if the company is 30% undervalued by the market?

Solution

Let's first calculate the APV. As in Sect. 16.1, we can make a table to calculate the APV components (see Table 16.6).

Table 16.10 shows an APV of −\$65 million in the case of an overvaluation of 20%. That is a combination of the negative valuation effect of −\$50 million (= −\$300 + S250 million) and the transaction costs of −\$15 million. In the case of

Table 16.10 APV of an equity repurchase with external errors: overvalued vs undervalued

APV components	20% overvalued by the market	25% undervalued by the market
Minus: cash out	−300	−300
Plus: intrinsic value of the shares	250	400
Minus: transaction costs	−15	−15
Sum: APV	*−65*	*85*

undervaluation, the APV is $85 million, which is the sum of an overvaluation of $100 million and transactions costs of −$15 million. The $100 million gain from a company perspective comes at the expense of the shareholders from whom the company is repurchasing the shares. ◄

16.3 Relevance of E and S for Issues and Payouts of Financial Capital

The previous sections discussed the drivers of issues and payouts on financial capital. It is mostly through those drivers that E and S affect issues and payouts on financial capital. As E and S affect business models and operations, they also affect risk, *debt capacity* (that is the amount of debt that the company can sustainably service), and cash flows, thereby affecting the degree to which companies can and want to payout cash or issue new capital.

16.3.1 Internalisation of Risks

There are various ways in which S and E hit issues and payouts. The most obvious way is in the sudden internalisation of E and S risks when they materialise in litigation payments. For example, Bayer made dividend cuts in 2021, after litigation on E issues hit 2020 profits and cash flows. The Bayer litigation costs are discussed in Box 18.3 in Chap. 18. Another example of cutting dividends and adjusting dividend policy is BP after the Deep Horizon oil spill, as discussed in Box 16.5.

Box 16.5 BP Cuts Dividend After Deep Horizon Oil Spill

The example of the Deep Horizon oil spill was mentioned in Chap. 1. One of the consequences of that disaster was that BP had to adapt its financial policies, including a curtailment of its dividend payments. In a press release on 16 June 2010,[9] the company announced that it established a $20 billion claims fund for the Deepwater Horizon spill. Moreover, BP explained how it will fund that $20 billion. Firstly, by drastically reducing investments and increasing divestments:

> To further increase the Company’s available cash resources, the Board intends to implement a significant reduction in organic capital spending and to increase planned divestments to approximately $10bn over the next twelve months.

(continued)

[9] https://www.bp.com/en/global/corporate/news-and-insights/press-releases/bp-establishes-20-billion-claims-fund-for-deepwater-horizon-spill-and-outlines-dividend-decisions.html

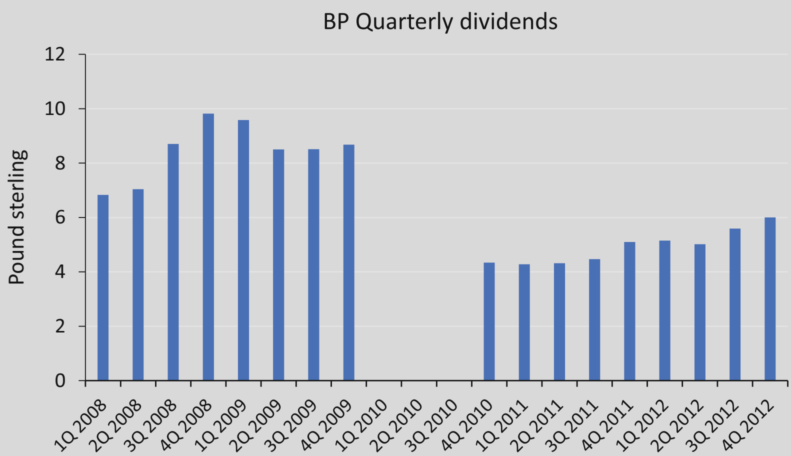
Box 16.5 (continued)

In addition, it says it cuts dividends:

> As a consequence of this agreement, the BP Board has reviewed its dividend policy. Notwithstanding BP's strong financial and asset position, the current circumstances require the Board to be prudent and it has therefore decided to cancel the previously declared first quarter dividend scheduled for payment on 21st June, and that no interim dividends will be declared in respect of the second and third quarters of 2010.

The announcement resulted in a positive stock price reaction, which is atypical. This reflected a relief with the market that there was more clarity on the financial size of the disaster, and the company's realism to react to it.[10]

BP's dividends (in pound sterling per share) over the 5 years surrounding the disaster were as follows:



Dividends resumed in the fourth quarter of 2010, but at a structurally lower level than before the oil spill. The lower dividend payouts constitute a change in BP's dividend policy.

Source dividends: https://www.bp.com/content/dam/bp/business-sites/en/global/corporate/pdfs/investors/bp-cash-dividends-ordinary-shareholders.pdf

A less obvious way for E and S to hit issues and payouts is through internalisation over time. This is similar to the airline example in Chap. 15, where the company's debt capacity was reduced by internalisation of an E liability, which would also reduce the company's sustainable payout ratio. As described in Chap. 2, internalisation can be driven by regulation, technological change, or changing consumer preferences—or a combination thereof. For example, high carbon prices

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[10] 'BP shares up as it bows to US pressure to cut 2010 dividends', Citywire, 17 June 2010

Table 16.11 Cash flow statement of Philtronics—without dividend cut

	2022	2023	2024	2025	2026	2027
Net profit	140	−45	−58	−33	76	187
Depreciation	20	20	22	22	22	22
Capex	−25	−86	−94	−67	−23	−23
FCF	135	−111	−130	−78	75	186
Dividend (fixed)	60	60	60	60	60	60
Payout ratio	43%	−133%	−103%	−182%	79%	32%
Cash position without dividend cut	**247**	**76**	**−114**	**−252**	**−237**	**−111**

Table 16.12 Cash flow statement of Philtronics—with dividend cut

	2022	2023	2024	2025	2026	2027
Net profit	140	−45	−58	−33	76	187
Depreciation	20	20	22	22	22	22
Capex	−25	−86	−94	−67	−23	−23
FCF	135	−111	−130	−78	75	186
Dividend (fixed)	60	0	0	0	0	60
Payout ratio	43%	0%	0%	0%	0%	32%
Cash position with dividend cut	**247**	**136**	**6**	**−72**	**3**	**129**

and other types of climate change mitigation regulation can make certain business models unviable and force companies to invest in new technologies. Higher capex (investment) reduces FCF. Reduced FCF in turn reduces the scope for dividend payments and stock buybacks and increases the need for debt or equity issues. See the example in Table 16.11 of hypothetical company Philtronics whose profits plunge. It takes Philtronics 3 years and heavy capex to rebuild its business model and restore profitability.

In spite of its negative FCF, Philtronics continues to pay its dividend. As a result, its cash position goes negative, and Philtronics will be forced to borrow. Philtronics can also choose to cut its dividend and suspend it until both its FCF and its cash position turn positive—as illustrated in Table 16.12. Both paths are visualised in Fig. 16.6.

Whether the negative cash position is tenable or not will also depend on Philtronics's starting leverage: if it is already quite levered, it might not be able to re-finance. It may be forced to restructure, i.e. shareholders give up power to creditors and debt is swapped for equity.

Effectively, this means that the debt capacity of companies with large negative externalities should be limited. After all, such negative E and S exposures might force companies to go through a painful business model change that requires them to invest more in solutions while profits plunge. This could have happened to carmaker VW, which made heavy investments in electric vehicles (EVs) after the Dieselgate scandal. The Forbes headline at the time (31 January 2022) said: 'VW is making an

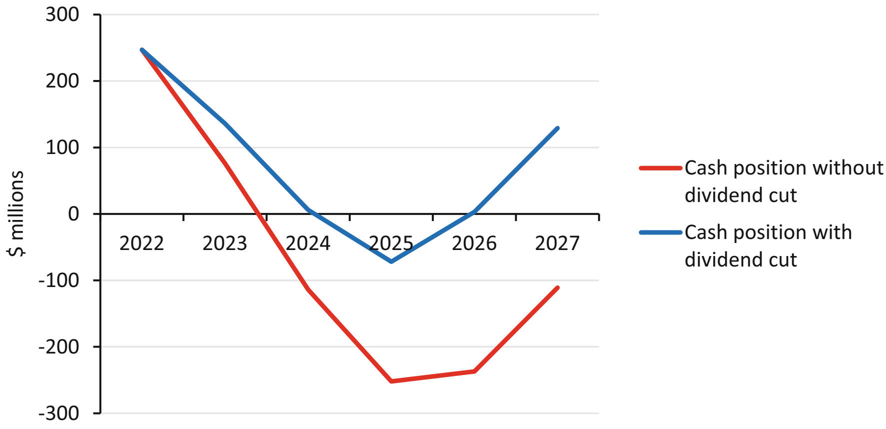

Fig. 16.6 Cash position of Philtronics—with and without dividend cut

$180 billion bet to dominate EVs and catch Tesla'. However, as VW profits did not plunge, it could afford the heavy capex while maintaining its dividends.

As value destruction on E and S puts future cash flows at risk, this should make payouts *less* likely for a prudent and ethical manager. An example with a perverse spin is Unilever, which chose a path of conservative payouts and capital structure, making it a takeover target for Kraft Heinz (see Chap. 18).

However, value destruction on E and S probably makes payouts *more* likely for an imprudent and short-term minded manager who wants to 'milk the cash' and maximise his bonus. Examples of this perverse effect are the US airlines that emerged from Chapter 11 bankruptcy, then used their cash flow to make about $200 billion in stock repurchases before they collapsed during the Covid-19 pandemic, and had to be bailed out.

16.3.2 Internalisation of Opportunities

While E and S risks can affect payouts and increase the need to do issues (to raise fresh funding), E and S opportunities work in the opposite way. A positive contribution to E and S creates value, which is embodied in E and S assets. These assets strengthen a company's capital structure. Furthermore, internalisation of E and S opportunities is likely to increase a company's financial position in the future.

A company example of E assets is the Danish company, Novozymes, which produces bioenergy for low-carbon fuels for the transport sector. The transport sector plays an important role in the energy transition (see Chap. 2), as transport counts for 37% of global CO_2 emissions from end-user sectors (source: IEA). The transport sector is, just like other industries, adopting net zero targets for their carbon emissions. At the same time, carbon taxes are rising to the tune of €100 per tonne of CO_2 in the European Union. So, the demand for low-carbon fuels is likely to increase. Box 16.6 calculates that Novozymes' annual E flows amount to €1.16 billion, compared to an annual profit of €0.40 billion. The expected (partial) internalisation of these E flows will likely strengthen Novozymes' financial position. If that happens, Novozymes can increase its dividend payouts and redeem debt. If needed, Novozymes is also able to issue debt (or equity) to finance expansion of production, given its strong asset position.

Box 16.6 Environmental Assets at Novozymes

Novozymes, a Danish enzyme maker (see Box 9.1), reports that its bioenergy solutions helped the transport sector save 60 million tonnes of CO_2 emissions in 2021 by enabling the production of low-carbon fuels. Novozymes' own CO_2 emissions were only 0.3 million tonnes, which it aims to halve by 2030.

We can calculate Novozymes' net E flows, as sum of E assets (saved client emissions) minus E debt (its own emissions). To be conservative, we attribute 10% saved client emissions to Novozymes. Net E flows are 5.7 million tonnes of CO_2 emissions: 10%*60 million tonnes—0.3 million tonnes. As in Chaps. 5 and 11, we use a shadow carbon price of €204 per ton of CO_2 in 2021. This results in a net annual E flow of €1.16 billion.

Source: The Novozymes Report 2021, available at: https://report2021.novozymes.com/#home

Another example of E assets surprisingly comes from the construction sector. Construction companies are currently using very carbon-intensive cement as a main building material. In contrast, timber, an alternative building material, is carbon-positive because it stores carbon (as trees grow they absorb carbon; when they are used for construction, the carbon is preserved or 'stored'). In the transition to a circular economy (see Chap. 2), construction companies that are ahead in wood construction systems in the building process can financially capitalise on their E assets.

There are also opportunities on S. A company that invests in training its staff thereby creates an S asset. A bottleneck in the transition to electric vehicles is access to sufficient software engineers, as discussed in Chap. 2. Car manufacturers that are ahead in retraining their mechanical engineers (for producing combustion engine vehicles) into software engineers (for producing electric vehicles) are creating an S asset. This S asset may give them a competitive advantage in the transition to electric mobility. This may in turn improve their financial position and enable them to increase dividend payouts and/or redeem debt.

16.3.3 Impact of Governance and Organisational Capital on Payouts

A more subtle impact of S factors on issues and payouts is through governance and the nature of organisational capital and (intangible) assets. Organisational capital represents the knowledge, capabilities, and business processes that integrate human skills with physical capital to enhance organisational efficiency. On governance, Ye et al. (2019) find that higher board gender diversity facilitates better corporate governance and results in higher dividends. Similarly, Chen et al. (2017) find that companies with a larger fraction of female directors have higher dividend payouts. On organisational capital, Hasan and Uddin (2022) find that both the likelihood, and the levels, of cash dividend distribution and share repurchases are significantly higher for firms with more organisational capital.

16.4 Issues of and Payouts to Social and Natural Capital

Whereas the shareholders provide (financial) equity capital, the other stakeholders provide social and natural capital to the company. These other stakeholders include employees, customers, suppliers, and local communities in which the company operates. The broad definition of stakeholders adopted in this book (see Chap. 3) also covers future stakeholders, representing the environment and people not yet born.

Transfers to and from stakeholders are made in the course of companies' operations. Hence, the value of E assets, E liabilities, E equity, and their S equivalents change over time, just like their F equivalents. However, it is not clear whether such transfers also take the form of payouts and issues as described in the previous sections, i.e. happening outside the context of the operations, in explicit and deliberate transactions. Perhaps the restoration of damages can be seen as such, but we are not sure. What is clear is that there is one crucial difference between the financial balance sheet, on the one hand, and the E and S balance sheets, on the other hand: the presence of cash on the F balance sheet that allows for issues and payouts.

Table 16.13 illustrates the role of cash in changes in F debt and F equity, as discussed in the previous sections of this chapter. The general rule is that issues of F debt or equity increase the amount of cash, while payouts on F debt or equity draw down cash. Of course, a company can issue debt to repurchase equity. But even that transaction is conducted through cash holdings, as the issue is typically scheduled ahead of the repurchase.

Table 16.14 illustrates the E balance sheet, which can also be drawn for the S balance sheet. Of course, deliberate changes to the balance sheets of E and S are possible. For example, a company could decide to adopt a much less carbon-intensive production process, thereby drastically reducing its future emissions and hence reducing its E debt. However, this improvement (in the form

Table 16.13 Issues and payouts in the market value financial balance sheet

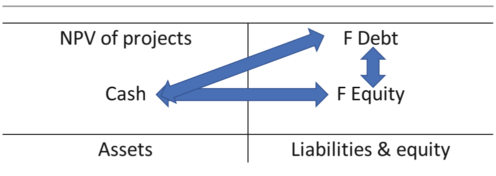

Table 16.14 Absence of the equivalent of cash in the E balance sheet

E assets	E Debt E Equity
Assets	Liabilities & equity

Table 16.15 Changes in the E balance sheet through business model changes

E assets	E Debt ↓ E Equity ↑
Assets	Liabilities & equity

of lower E liabilities) takes place in the company's operations and cannot be considered as a payout (see Table 16.15).

And what about strategic changes, such as selling polluting business units and thereby reducing E debt? This means that those assets are shifted outside the boundaries of the company. However, the E debt still exists and no E payout can be identified. If such a business unit is closed down instead of sold, the E debt to (future) stakeholders does disappear. But still, it is hard to see a payout.

There may not be an E or S equivalent of cash itself, but there are E and S equivalents of cash flows: *value flows* on E and S (see Chap. 5). The value flows are the flows of E and S generated by company's activities. They are the drivers of the E and S assets and liabilities. In sum: business operations determine changes in F value, S value, and E value, which accrue to (or are taken from) relevant stakeholders. Both financial issues and payouts, as discussed in this chapter, are cash transfers with financial stakeholders.

16.5 Integrated View on Issues and Payouts

In Sect. 16.4, we concluded that there do not seem to be payouts and issues on E and S, due to the absence of cash or an equivalent on the balance sheets of E and S. However, there are value flows on E and S; and E and S can affect financial payouts and issues (Sect. 16.3). These insights allow us to build an integrated perspective on payouts and issues. This should help to answer the following question: how to manage financial issues and payouts, when managing for long-term value?

This perspective should help with avoiding highly value destructive payouts that hurt either the company or its stakeholders, or both. Some go even further, Lazonick et al. (2020) argue that stock buybacks are dangerous for the economy and society: 'Stock buybacks made as open-market repurchases make no contribution to the productive capabilities of the firm. Indeed, these distributions to shareholders, which generally come on top of dividends, disrupt the growth dynamic that links the productivity and pay of the labor force. The results are increased income inequity, employment instability, and anaemic productivity'. And: 'When companies do these buybacks, they deprive themselves of the liquidity that might help them cope when sales and profits decline in an economic downturn'.

However, this universally negative verdict on stock buybacks might be too negative. Rather, we would prefer to take an integrated perspective, which allows one to reach a verdict that is better tailored to a specific company and its context. We therefore introduce the *integrated payout ratio*, defined as payouts divided by net integrated income:

$$Integrated\ payout\ ratio = \frac{Payouts}{Net\ integrated\ income} \tag{16.2}$$

The *net integrated income* is a company's integrated profit, which can be derived from its integrated profit & loss account (see Chap. 17). Similar to the financial payout ratio in Eq. 16.1, an integrated payout ratio that (structurally) exceeds 100% indicates payouts to financial stakeholders at the expense of social and environmental stakeholders.

To illustrate how the net integrated income can be calculated, we provide the net flows for each component (E, S, and F) for fictitious company FootPrint (see Table 16.16). The integrated flows statement allows us to calculate an integrated payout ratio.

Table 16.16 Integrated flows statement of company FootPrint

	Positive	Negative	Net	Payouts
E value flows	1	−12	−11	
S value flows	9	−2	7	
F value flows	6	0	6	
Payout				4
Financial payout ratio				**67% (= 4/6)**
Net integrated flows	16	−14	2	
Payout				4
Integrated payout ratio				**200% (= 4/2)**

Company FootPrint has net positive integrated value flows (i.e. net integrated income) that are composed of net positive value flows on S and F, but net negative value flows on E. The negative E flows are clearly the company's main problem. From a purely (and narrowly) financial perspective, FootPrint's payouts of 4 look reasonable since they are below its net profit (net financial income) of 6. This gives a (financial) payout ratio of 67% (= 4/6).

However, from an integrated perspective, the company's payouts look excessive since they are twice as high as its net integrated value flows of 2. The integrated payout ratio is 200% (= 4/2). Moreover, it seems irresponsible to return cash to shareholders if value flows on E or S are highly negative, as they are in FootPrint's case for E (−11 on a net basis).

16.5.1 Integrated Payout Test

The negative E flows make FootPrint's high financial payout (67% of net profit) questionable. Would it not be better for management to cut the dividend and raise investments to fix the net negative E flows? And ideally, this is done in such a way that the business model is changed to become resilient and future fit. This is not an extreme example: many companies have a seemingly reasonable financial payout ratio while consistently destroying value on E and/or S.

Ang and Lambooy (2022) argue that society should not tolerate that. They propose an *integrated payout test*: let payout policy depend not just on the level of financial capital (i.e. driven by financial metrics) but also on a test of the level of social and natural capital. This integrated payout test is based on financial, social, and environmental metrics.

Of course, one could argue that we are still a long way from companies reporting at this level. Nevertheless, auditing rules already require companies to take provisions when they are aware of contingent social or environmental liabilities which can turn into payment for damages (e.g. through court cases). And data on social and environmental liabilities are improving. Investors and other stakeholders can make educated guesses on the sizes of these flows. And internally too, managers could and should do this analysis to determine appropriate payout levels.

16.5.2 Inditex Case Study

We can now calculate the payout ratios for Inditex. Example 16.2 gives the basic data and shows the calculations. While Inditex's financial payout ratio looks quite common at 67%, Inditex's integrated payout ratio is 296%. The high integrated payout ratio, which is well above 100%, indicates that Inditex's large payout to its financial stakeholders is at the expense of other stakeholders, such as workers in its supply chain and future generations.

Example 16.2 Calculating the Payout Ratios of Inditex

Problem

For 2021, Inditex made a net profit of €3.25 billion and paid €2.19 billion in dividends (Inditex Annual Report 2021). Inditex's social and environmental value flows are as follows: positive social flows €4.10 billion; negative social flows −€2.88 billion; and negative environmental flows −€3.73 billion (all numbers from Chap. 11).

Please calculate Inditex's financial payout ratio and its integrated payout ratio.

Solution

Let's first make an overview of Inditex's value flows, like in Table 16.16. Table 16.17 provides the integrated value flows statement of Inditex for 2021.

Table 16.17 shows net integrated flows of \$0.74 billion for 2021. Inditex's financial payout ratio is 67% (= 2.19/3.25) and its integrated payout ratio is 296% (= 2.19/0.74). The integrated payout ratio is far higher than the financial payout ratio, because the net integrated flows are lower than the net profit. ◀

16.5.3 Novozymes Case Study

We can also calculate the payout ratios for Novozymes, introduced in Box 16.6. Table 16.18 provides an overview of the financial and environmental flows, which enable us to calculate the payout ratios. The financial payout ratio is 53%, which is quite common. The integrated payout ratio is very low at 13%, which is caused by the large net E flow. This low integrated payout ratio leaves ample scope for future

Table 16.17 Integrated value flows statement of Inditex, in € billions, 2021

	Flows in € billions	Source calculation
(1) Net profit (F)	3.25	Annual report 2021
(2) Net positive social flows (S+)	4.10	Table 11.17
(3) Net negative social flows (S−)	−2.88	Table 11.16
(4) Net negative environmental flows (E−)	−3.73	Table 11.15
(5) Net integrated flows	**0.74**	**(1)–(4)**
(6) Dividend	2.19	Annual report 2021
(7) Financial payout ratio	**67%**	**(6)/(1)**
(8) Integrated payout ratio	**296%**	**(6)/(5)**

Table 16.18 Integrated value flows statement of Novozymes, in € billions, 2021

	Flows in € billions	Source calculation
(1) Net profit (F)	0.40	Annual report 2021
(2) Net environmental flows (E)	1.16	Box 16.6
(3) Net integrated flows	**1.56**	**(1) + (2)**
(4) Dividend	0.21	Annual report 2021
(5) Financial payout ratio	**53%**	**(4)/(1)**
(6) Integrated payout ratio	**13%**	**(4)/(3)**

payouts. Novozymes thus offers an attractive investment opportunity from an integrated perspective.

16.6 Conclusions

In issues, cash is raised from providers of capital and their claim is increased accordingly. Conversely, payouts refer to those situations in which cash is paid to providers of capital and their claim is reduced accordingly. In the various stages of its development, a company might benefit from different types of capital. In aggregate, more companies are likely to succeed if these channels are wide open in a diverse ecosystem of capital providers. Both issues and payouts compete with alternative uses of corporate cash, such as investments and building cash reserves.

In perfect markets, issues and payouts have no value relevance: the change in cash exactly equals the change in the financiers' claims. However, in practice they may become value relevant due to imperfections such as taxes, information asymmetries, financial distress, and bankruptcy costs.

The impact of E and S on financial issues and payouts is most obvious through their impact on business models and operations, which in turn affect risk, debt capacity, and cash flows, thereby affecting the degree to which companies can and want to payout cash or issue new capital.

As to the issues and payouts of E and S, the question is if they exist at all. After all, issues and payouts concern changes in claims that involve cash transfers, but it is not clear what the equivalent of cash could be in E and S.

Even if issues and payouts in E and S do not exist, that does not need to stop us from having an integrated view on issues and payouts. We develop an integrated payout ratio, which calculates payouts as percentage of integrated value flows. The question then is: how to manage issues and payouts, financial in nature, when managing for long-term value? At the very least, it calls for caution on payouts in the presence of significant liabilities on E or S. An integrated payout ratio over 100% suggests that payouts to financial stakeholders take place at the expense of social and environmental stakeholders.

Key Concepts Used in This Chapter

Adjusted present value (APV) goes beyond the NPV by considering the funding costs of a transaction

*Caterin*g means choosing a dividend policy with the purpose of responding (catering) to investors' psychological or tax needs

Dividends are cash payments to shareholders

Dividend capture theory means that in the absence of transaction costs, investors can trade shares at the time of the dividend so that non-taxed investors receive the dividend

Dividend signalling hypothesis refers to the idea that dividend changes reflect managers' views about the company's future earnings prospects

Dividend yield is dividends as a percentage of equity value

Hedonic editing means that people prefer to experience gains separately rather than together

Integrated payout ratio is payouts (in the form of dividends and/or share buybacks) divided by net integrated income (which combines net social and environmental value flows and net financial income)

IPO is an Initial Public Offering, the first public equity issue of a company

Open market share repurchases mean that a company buys back shares in the market

Payout ratio is payouts (in the form of dividends and/or share buybacks) divided by net income

Rights issue is an invitation to (or 'right' for) existing shareholders to purchase additional new shares in the company

SEO is a Seasoned Equity Offering, a public equity issue of a company that is already stock listed

Share buyback (or share repurchase) refers to a company that pays out cash to its shareholders by buying back shares; there are two ways to do buybacks: open market share repurchases; and tender offers

Share repurchase see share buyback

Special dividend is a one-off dividend payment that is not part of a company's dividend policy of recurring dividends

Stock split is a corporate action in which a company increases the number of its outstanding shares by issuing more shares to current shareholders by the specified ratio (e.g. 15 to 1 split means that each shareholder receives 14 additional shares for each share)

Syndicate is a group of investment banks acting as underwriters or bookrunners of an issue

Tax clientèle effects refer to optimising dividend policy for the tax preference of its investor clientèle

Tender offer refers to a corporate action in which shareholders receive an offer that asks them to submit (tender) a portion of their shares within a certain time frame

Underwriting is the process where an investment bank raises capital for a company from investors in the form of equity or debt securities

Suggested Reading

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17 Reporting and Investor Relations

Overview

Financial reporting serves an important role as a means of communication between corporate management and the company's stakeholders, including investors. Companies issue several financial statements, like a balance sheet, a profit & loss account, and a cash flow statement. **Financial reporting standards ensure comparability of financial statements issued by different companies**. Auditors verify the quality of the provided information, but cannot guarantee that they will always detect misstatements.

Financial statements are primarily based on historical cost and show (see Fig. 17.1 for an overview) financial and manufactured capital, which form a company's tangible assets. Financial reporting faces the challenge of painting a reliable picture of economic reality, which has become increasingly problematic. In the past decades, complexity has increased and intangibles have become a more important part of a company's asset base (see Chap. 2).

This chapter outlines why reporting matters, and how it falls short (see Fig. 17.1 for an overview). It also shows how integrated reporting (combining financial, social, and environmental value) might be an improvement. Integrated reporting is about understanding how an organisation creates integrated value and how its activities affect the capitals (human, social, and natural capitals, next to financial capital) it relies upon for this. Emerging international sustainability reporting standards will spur integrated reporting.

Ultimately, integrated reporting is related to *integrated thinking*, which takes into account the connectivity and interdependencies between the financial, social, and environmental factors that affect an organisation's ability to create integrated value over time. Some form of integrated reporting is already applied by an increasing number of companies, but it is still far from widespread.

Another component of communication is investor relations. The job of a company investor relations department is to provide investors with an accurate account of company affairs. In addition to annual reports, regular analyst presentations and updates are the main tools to update investors. These presentations are increasing including social and environmental information in addition to financial information.

D. Schoenmaker, W. Schramade, *Corporate Finance for Long-Term Value*, Springer Texts in Business and Economics, https://doi.org/10.1007/978-3-031-35009-2_17

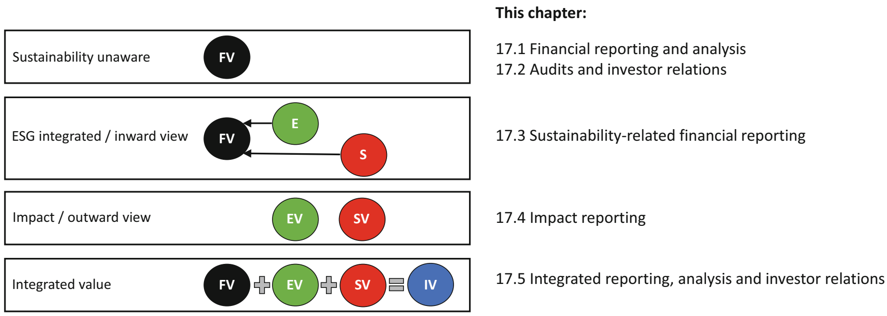


Fig. 17.1 Chapter overview

But investors are slow to ask questions about this new information, as their main focus is still on the financials.

Learning Objectives
After you have studied this chapter, you should be able to:

- assess the benefits and limitations of financial reporting
- analyse financial statements
- critically review the role of auditors
- explain the corporate investor relations function
- assess the emergence and relevance of impact reporting and integrated reporting
- illustrate the characteristics of an integrated report

17.1 Financial Reporting and Analysis

Financial reporting matters and is valuable for communication with the outside world, including modelling by analysts. But it is a struggle for financial reporting to meet the needs of users. Intangibles (see Chap. 2), social value, and environmental value are gaining importance but are rarely shown in financial statements. Regulation tries to address this, but its efforts only affect a subset of companies: all public companies and large private companies. Public companies prepare and publish an annual report, as public companies are listed and traded on the 'public' stock market. Private companies often prepare an annual report as well, but only large private companies need to publish it. In Europe large companies are defined as companies with more than 250 employees and €20 million in assets. As public companies have difficulties resolving information and agency problems between investors and managers, private companies financed by debt and private equity are gaining in importance (Kahle & Stulz, 2017).

17.1.1 Why Report?

As the joint stock corporation gained popularity in the nineteenth and twentieth century, a need arose to report on performance to shareholders. Over the centuries, accounting has become increasingly sophisticated to facilitate better decision-making, external monitoring, and more complex transactions. Generally Accepted Accounting Principles (GAAP) were developed to make reporting across companies more comparable. While GAAP started at the national level, they are currently set at the international level. This is in line with the global scope of many companies and investors. International Financial Reporting Standards (IFRS) are issued by the International Accounting Standards Board (IASB). IFRS is now the international accounting standard. But there is one major exception. The USA does not recognise IFRS and still uses US GAAP. That means that US companies have to prepare their financial reports according to US GAAP issued by the Financial Accounting Standards Board (FASB). The two standards, IFRS and US GAAP, have converged considerably over recent decades.

Eccles and Saltzman (2011) claim that financial reporting has institutional legitimacy, thanks to a variety of factors:

- measurement, reporting, and auditing standards;
- effective enforcement mechanisms, including courts of law for redress of fraud in the financial statements;
- sophisticated internal control and measurement systems; and
- information technologies that enable rapid capture and aggregation of data.

Limits to Financial Reporting

But financial reporting also faces numerous challenges and problems. Figure 17.2 provides an overview. Different user needs make alignment and comparability difficult. Investors tend to be forward-looking, but a significant part of reporting is backward-looking. A board is held accountable for the past but should be prepared for the future. In addition, reporting is focused on manufactured (i.e. physical) and financial assets, not intangibles (see Chap. 2). As Lev (2017) puts it: '*strategic assets are very different from the kinds of assets that are reported by accountants on*

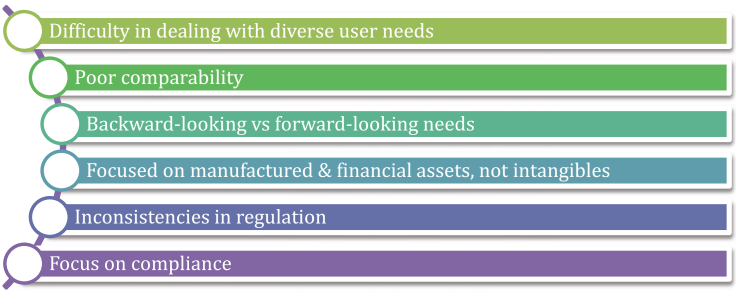


Fig. 17.2 Limits to financial reporting

corporate balance sheets'. Strategic assets are exactly the ones that bring competitive advantage. For example, Microsoft's competitive advantages lie in its patents, its proprietary software and its people. But those are not on Microsoft's balance sheet.

Moreover, there are differences and inconsistencies in reporting, such as different ways for recording items like sales and inventories, while intangibles are sometimes capitalised and reported as assets, but most often not or only partially. This means that important sources of corporate value creation are often not reported. Also, some aspects of reporting are mandatory while others are voluntary. And there are differences in regulation between countries and institutions. Complexity makes it hard to understand reports and often makes them very long.

Eccles and Saltzman (2011) point to the difficulty of finding the most relevant information, the time lag in issuing reports, and the scarcity of information about the risks being taken by the company to create value for shareholders. Moreover, they argue that 'questions about whether a financial report presents a 'true and fair view' of a company cannot be adequately answered, because the reports do not always contain information on nonfinancial performance that can determine a company's long-term financial picture'.

Financial reporting has improved over the past two decades. There is empirical evidence indicating that investors' focus on earning announcements has increased since the 2000s, partly due to increased management guidance, disclosure quality, and analyst activity (Beaver et al., 2020).

From the turn of the century, more and more companies started to publish standalone corporate social responsibility (CSR) reports. Dhaliwal et al. (2011) find that such companies have lower analyst forecast errors, indicating not just better nonfinancial reporting, but better financial reporting as well. Section 17.3 discusses the advance to integrated reporting, which covers financial as well as nonfinancial (i.e. sustainability) information in a single *integrated* report.

Financial reports have become complex and difficult to read. This is partly due to compliance with accounting standards. Nevertheless, financial reporting has a central role in communications with investors and analysts. It is in the interest of a company's management to prepare readable reports. Analysts indicate that the quality of reporting directly influences their opinion of the quality of management.

17.1.2 Financial Statements & Financial Statement Analysis

Financial statements aim to give the user insight into the financial position and performance of a company. They consist of the balance sheet, income statement, cash flow statement, and a statement of changes in equity, which provide past performance information on a company in a standardised format. In addition, financial reports make a segment analysis by business categories and geographical regions to link the financial information more specifically to the company's activities.

A key concept of reporting is materiality. *Materiality* is the degree to which certain issues are important for a company. The need to disclose individual items or groups of items separately depends on the nature and the amount of the item. The

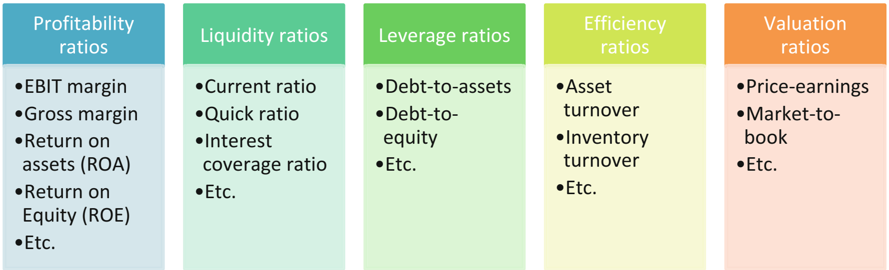


Fig. 17.3 Categories of financial ratios

deciding factor is whether the omission or misstatement could influence the economic decisions that users make on the basis of the financial statements.

Financial reports are meant to be read and analysed by financial analysts and others. *Financial statement analysis* is the process of reviewing and analysing a company's financial statements by external stakeholders, in which they calculate financial ratios to gain insights in the company's ability to generate value.

Internal stakeholders use more detailed internal reports to monitor and improve efficiency and to provide the basis for external reporting. As discussed before, financial statements (almost)[1] only reflect historical information, but they can be useful by discovering trends over the years. The number of total sales in 2020 might not be very informative, but the relative change over the years 2010–2020 indicates whether the company is consistently growing, for example. Figure 17.3 shows five categories of financial ratios: profitability, liquidity, leverage, efficiency, and valuation ratios. These are described in more detail in the Appendix.

In this section, we review companies' main financial statements in turn:

- the balance sheet;
- the income statement, also called the profit & loss (P&L) account;
- the cash flow statement.

For all the three, we briefly summarise their components, discuss their limitations, and show some ratios that help in analysing them.

Balance Sheet

The *balance sheet*, or statement of financial position, lists a company's assets and liabilities. The difference between assets and liabilities is a company's net worth, which is called equity. The balance sheet identity is as follows:

[1] An example would be the forward-looking assessment of value in a purchase price allocation that follows a takeover (see Chap. 18).

$$\text{Assets} = \text{Liabilities} + \text{Equity} \tag{17.1}$$

Assets

Table 17.1 provides the balance sheet of Inditex, the fast-fashion retailer figuring in the case study of Chap. 11. Assets are shown on the left side of the balance sheet. A company's assets are split between long-term assets and current assets. Examples of long-term assets are property, plant and equipment (PPE), investments and intangible assets (e.g. goodwill or R&D as described in Chap. 2).

Please note that intangible assets are intangible resources that are capitalised in the balance sheet; most intangible resources are not capitalised, as there are strict rules for capitalising intangibles to avoid inflating the balance sheet. While purchased R&D in a merger can be capitalised, internal R&D expenses cannot be capitalised and have to be taken in the income statement as expenses (though there are some exceptions, such as development expenditures). The argument is that the value of internal R&D is not tested in the market, while the value of purchased R&D is established in a market transaction.

Current assets represent all the assets of a company that are expected to be sold or used through standard business operations within 1 year. Examples are inventories (goods to be sold), accounts receivable (good and services sold, but not yet paid), and cash held at the bank.

Table 17.1 Inditex balance sheet (2020)

Inditex Group
Consolidated balance sheet
(amounts in millions of euro)

Assets	**2020**	**2019**	**Liabilities and equity**	**2020**	**2019**
Long-term assets	**15,460**	**16,977**	**Long-term liabilities**	**5,529**	**6,136**
- Property, plant and equipment	7,401	8,355	- Long-term debt	3	6
- Investment properties	282	270	- Deferred taxes	396	370
- Intangible assets	6,122	6,660	- Provisions	252	217
- Other long-term assets	1,656	1,692	- Other long-term liabilities	4,879	5,543
Current assets	**10,957**	**11,414**	**Current liabilities**	**6,338**	**7,306**
- Inventories	2,321	2,269	- Short-term debt	11	32
- Accounts receivable	972	954	- Accounts payable	4,747	5,585
- Other current assets	266	3,411	- Other current liabilities	1,579	1,689
- Cash	7,398	4,780	**Equity**	**14,550**	**14,949**
			- Issued share capital	94	94
			- Share premium	20	20
			- Retained earnings	14,703	14,993
			- Other reserves	(267)	(158)
Total assets	**26,418**	**28,391**	**Total liabilities and equity**	**26,418**	**28,391**

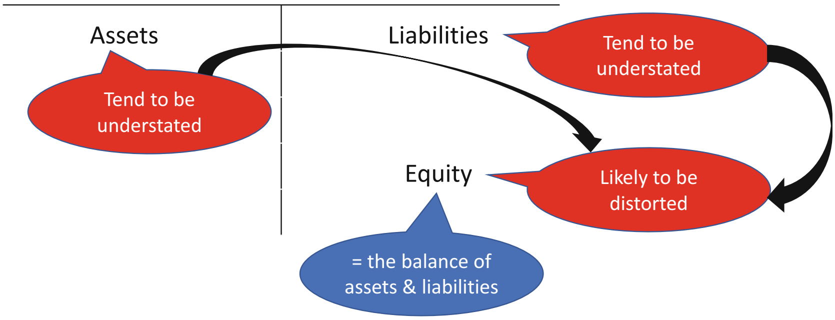


Fig. 17.4 A simplified balance sheet and its distortions

Liabilities
On the right side of the balance sheet, the liabilities are shown. Again, there is a split between long-term and current liabilities. Long-term liabilities include long-term debt with a maturity over 1 year, deferred taxes and provisions. Provisions are funds set aside by a company as assets to pay for anticipated future losses. An example is a provision for pensions. Liabilities can also reflect a company's future service obligations (contract liabilities).

Current liabilities include short-term debt with a maturity of 1 year or less and accounts payable. The difference between a company's current assets and current liabilities is the company's net working capital. The *net working capital* is the capital available in the short term to run the business. It is a measure to gauge a company's short-term health. Net working capital is defined as follows:

$$\text{Net working capital} = \text{Current assets} - \text{Current liabilities} \tag{17.2}$$

Inditex has a positive net working capital of €10,957 − €6338 = €4619 million (or €4.6 billion).

Equity
Equity is the difference between a company's assets and liabilities (see Eq. 17.1). This accounting measure of equity reflects the *book value of equity*.[2] The balance sheet gives an incomplete picture of a company's equity value for various reasons (see Fig. 17.4). First, it is not meant to give the equity value, but to reflect the shareholders' investment in the company. Valuation is up to the shareholders themselves. Second, several assets, like buildings, are at historical cost net of depreciation. The actual current value is likely to be higher. Third, several intangible resources, like brand value, are not capitalised on the balance sheet as intangible assets. Fourth, many valuable assets and liabilities are not on the balance sheet. An important one is human capital, which is both the expertise of the company's

[2]The book value of equity is different from the face or nominal value of shares. The face value of a share is the value per share as stated in the issuing company's charter.

employees and the quality of the company's management. The relationships with customers and suppliers and the damage done to the environment are also not recorded on the balance sheet.

The book value of equity is therefore likely to deviate from the market value of equity. The *market value of equity* is a company's market capitalisation and depends on what investors expect a company's assets to produce (or earn) in the future. Eq. (9.15) from Chap. 9 indicates that the total market value of a company's equity is the number of shares outstanding times the market price per share:

$$\text{Market value of equity} = \text{Shares outstanding} \times \text{Market price per share}$$

$$Equity_0 = \text{Shares outstanding}_0 * P_0 \tag{17.3}$$

Note, however, that this formula describes the calculation of the market value of equity, but not its drivers, which are investors' expectations. Example 17.1 shows the difference between the market and book value.

Example 17.1 Market and Book Value

Problem

Inditex has 3.11 billion shares outstanding. These shares trade at €26.4 on 31 December 2020. What is Inditex's market capitalisation? How does Inditex's market cap compare to its book value of equity in 2020?

Solution

Using Eq. (17.3), Inditex market capitalisation is:

$$Equity_0 = \text{Shares outstanding}_0 * P_0 = 3.11 \text{ billion shares x €}26.4$$
$$= €82.1 \text{ billion.}$$

Inditex's market capitalisation at €82.1 billion is far higher than Inditex's book value of equity at €14.6 billion (taken from Table 14.1). ◀

The market-to-book ratio (also called price-to-book ratio) is a valuation metric used to evaluate a company's current market value relative to its book value:

$$\text{Market} - \text{to} - \text{book ratio} = \frac{\text{Market value of equity}}{\text{Book value of equity}} \tag{17.4}$$

The difference between market value and book value reflects expected abnormal or residual profitability. A market-to-book ratio above one suggests that the company is expected to generate residual profits in the future. In contrast, a value below one indicates a negative residual profit expectation.

Inditex's market-to-book ratio is €82.1 billion/€14.6 billion = 5.62. So, investors are prepared to pay 5.62 times the amount of Inditex's book value per share. The market value is typically higher than the book value of a company's equity, as explained above. So, market-to-book ratios are often larger than one. Nevertheless, underperforming companies or sectors can have a market-to-book ratio below one. An example is the European banking sector after the Global Financial Crisis of 2007–2009 and the European Sovereign Debt Crisis of 2010–2015. In June 2022, European banks were trading at low market-to-book ratios, for example with BNP Paribas at 0.45, Banco Santander at 0.47, and ING at 0.63.[3] Similar to the market-to-book ratio, one could compute leverage ratios (such as in Chap. 15 and in the Appendix to this chapter), including hybrid ratios that combine balance sheet items with items from the income or cash flow statement. An example of such a ratio is the Net Debt/EBITDA ratio, where the numerator consists of balance sheet items (debt minus cash) and the denominator consists of income statement items (operating income plus depreciation and amortisation).

Enterprise Value

As explained in Chap. 9, the enterprise value is the market value of the company's underlying business before financing by equity and debt and separate from any cash holdings. Equation (9.1) provides the enterprise value:

$$\text{Enterprise value} = \text{Market value of equity} + \text{Debt} - \text{Cash}$$

$$V_0 = Equity_0 + Debt_0 - Cash_0 \tag{17.5}$$

The enterprise value of Inditex is €82,104 + €4882 − €7398 = €79,588 million. Debt is long-term debt of €3 million and other long-term liabilities of €4879 million, obtained from Table 17.1. The enterprise value is usually higher than the market value of equity due to large debt holdings. But it is not uncommon for family-controlled companies, like Inditex, to have low debt (only €4882 million in the case of Inditex), as investments are typically financed through retained earnings. The enterprise value (EPV) is also used in valuation ratios (see the Appendix), such as EPV/EBITDA.

Income Statement

The income statement, or profit and loss (P&L) account, lists a company's revenues and expenses (i.e., the costs attributed to the year covered by the P&L). It provides a picture of a company's performance over the past year. Table 17.2 shows Inditex's income statement for 2020. The key metrics are earnings before interest and taxes (EBIT) and net profit. EBIT (also called the operating profit) is defined as follows:

$$\text{EBIT} = \text{Revenues} - \text{Expenses} - \text{Depreciation} \tag{17.6}$$

EBIT measures a company's profitability from its operations before financing and taxes. It is widely used to gauge a company's basic profitability. Its relative version, the EBIT margin (=EBIT/sales), is the favourite metric for comparing the performance of companies within the same industry (see Eq. 17.9 in the Appendix).

[3] Figures are obtained from Yahoo Finance at the end of June 2022.

Table 17.2 Inditex income statement (2020)

Inditex Group **Consolidated income statement** (amounts in millions of euro)	**2020**	**2019**
Sales	20,402	28,286
Cost of sales	(9,013)	(12,479)
Gross profit	**11,390**	**17,806**
Operating expenses	(6,838)	(8,209)
Depreciation and amortisation	(3,045)	(2,826)
Operating profit (EBIT)	**1,507**	**4,772**
Financial results (interest income/expense)	(106)	(91)
Profit before taxes	**1,401**	**4,681**
Corporate tax	(297)	(1,034)
Net profit	**1,104**	**3,647**
Earnings per share	**€ 0.355**	**€ 1.168**

During 2020, Inditex sold goods worth €20,402 million. The total cost of these sales and operating expenses was €9013 + €6838 = €15,851 million. In addition to these out-of-pocket expenses, Inditex deducted €3045 million for the use of fixed assets in the production process. The result is Inditex's EBIT at €1507 million over 2020, and an EBIT margin of 7.4% (=€1507/€20,402), which was well below its long-term average.

Another important metric is net profit:

$$\text{Net profit} = \text{Revenues} - \text{Expenses} - \text{Depreciation} - \text{Interest payments} - \text{Corporate tax} \tag{17.7}$$

The net profit shows the profit net of interest payments and corporate taxes. During 2020, Inditex's interest payments was €106 million due to its low debt (see Table 17.1) and corporate taxes amounted to €297 million. Inditex's net profit is €1104 million over 2020. Net profit is the amount available for shareholders (see Chap. 16 on payouts). The bottom line in Table 17.2 shows Inditex's earnings per share (EPS), which is net profit divided by the number of outstanding shares.

Cash Flow Statement

The balance sheet and income statement are prepared according to accounting standards, like the IFRS. These accounting standards leave room for discretion, as they should. Management can inflate (or deflate) the company's financial position and performance to smooth profit over the years. That is why investors want to see the underlying cash flows which are not sensitive to accounting policies. Or, as popularly put: 'Cash is king'.

Table 17.3 shows an example of a cash flow statement. In the case of Inditex, the cash flow statement indicates that Inditex's cash position improved with €2618

Table 17.3 Inditex cash flow statement (2020)

Inditex Group Consolidated cash flow statement (amounts in millions of euro)	2020	2019
Operating activities		
Net profits	1,401	4,681
Depreciation and amortisation	3,045	2,826
Other non-cash items	(582)	(811)
Cash effect of changes in working capital		
Inventories	93	201
Accounts receivable	34	(10)
Accounts payable	(974)	14
Cash from operating activities	**3,017**	**6,900**
Investment activities		
Capital expenditures	(672)	(1,112)
Acquisitions	(5)	-
Other investment activity	3,191	(1,264)
Cash from investment activities	**2,514**	**(2,377)**
Financing activities		
Sale (or purchase) of stock	-	-
Changes in debt	(23)	(52)
Dividends paid	(1,090)	(2,741)
Other financial activities	(1,673)	(1,836)
Cash from financing activities	**(2,786)**	**(4,629)**
Change in cash and cash equivalents	2,745	(106)
Cash at beginning of the year	4,780	4,866
Effects of exchange rates on cash	(127)	20
Cash at the end of the year	**7,398**	**4,780**

million calculated as the difference between cash at the end of the year €7398 million and cash at the beginning of the year €4780 million. Inditex's income statement shows a profit of €1104 million. The profit is thus underpinned by an even larger cash improvement.

The cash flow statement has three sections:

- Cash from operating activities;
- Cash from investment activities;
- Cash from financing activities.

Major differences between the income statement and the cash flow statement are typically caused by a company's investment and financing activities, and accounting policies. On the investment side, amortisation and depreciation are booked as costs and thus reduce profit. But they do not reduce cash, as the assets have been paid for earlier. By contrast, capital expenditures reduce cash now, but do not yet reduce current profit (only in the future when depreciation starts). At Inditex, depreciation has recently been much higher than capex, which indicates that Inditex is investing less in the future of its business.

The influence of accounting policies is through the line-item amortisation and depreciation. By adjusting accounting policies (for example, increasing depreciation because assets have a shorter lifetime), a company can change its profit (in this example, reducing profit). Another influence is through other non-cash gains/losses (e.g. restructuring costs) and changes in working capital.

On the financing side, major changes in cash can be caused by an increase or decrease in net debt. In contrast, this has only a minor impact on the income statement through increased or reduced interest payments. It should be highlighted that accounting requires management to make many estimates, for example on expected losses and cash flows from intangibles.

17.2 Audits and Investor Relations

This section discusses the auditing of financial statements and investor relations.

17.2.1 Audits

How do we know to what extent a company is truthfully reporting? In accounting, this question is put as follows: do the financial statements give a ‘true and fair’ view of a company’s financial position? Publicly listed companies are required to have their financial statements reviewed or audited by an auditor. An *auditor* is a chartered accountant that is qualified to audit financial statements. Box 17.1 lists the largest accounting firms, the so-called Big Four. There are limits to what auditors can achieve. The auditor’s objectives are to obtain reasonable assurance about whether the financial statements as a whole are free from material misstatement (due to fraud or error) and to issue an auditor’s report that includes the auditor’s opinion.

There are two levels of audit assurance:

- **Reasonable assurance** is a high level of assurance, but is not a guarantee that an audit will always detect a material misstatement when it exists. Misstatements can arise from fraud or error and are considered material if, individually or in the aggregate, they could reasonably be expected to influence the economic decisions of users taken on the basis of these financial statements.
- **Limited assurance** is a lower level of assurance, whereby the auditor collects less, but sufficient, evidence for a negative form of its conclusion: ‘Based on the procedures performed, nothing came to our attention to indicate that the management assertion on XYZ is materially misstated’. The auditor achieves this by performing fewer tests or using smaller sample sizes for the tests performed than those for reasonable assurance.

Reasonable assurance is required for mandatory reporting on the basis of (international) reporting standards, such as IFRS and FASB in the USA. Limited assurance is typically used for voluntary reporting, for example on sustainability risks and opportunities (see Sect. 17.3).

Box 17.1 The Big Four

The Big Four is the nickname for the four largest accounting firms. Until the late twentieth century, the auditing market was dominated by the Big Eight. Strong competition led to a major consolidation with mergers between these firms as well as the 2002 collapse of Arthur Andersen (see below at accounting scandal).

The Big Four are:

- Deloitte;
- EY;
- KPMG;
- PwC.

The auditor evaluates the appropriateness of accounting policies applied and the reasonableness of accounting estimates made by a company's directors. A key element is the auditor's judgement on the appropriateness of the directors' use of the going concern principle. The *going concern principle* assumes that during and beyond the next reporting period a company will complete its current plans, use its existing assets, and continue to meet its financial obligations. If the auditor concludes that a material uncertainty about the going concern basis exists, the auditor is required to draw attention in their report to the related disclosures in the financial statements or, if such disclosures are inadequate, to modify their opinion (see below).

The auditor's opinion is the main instrument for an auditor to inform financial statement users about his findings. It also gives him power towards a company's directors, when directors are dressing up financial statements to make them look better or are not providing the auditor with sufficient information to form an opinion. A modified audit opinion is taken very badly by financial markets. It often triggers a strong decline of the company's stock price and could even lead to a temporary trading suspension of the company's stock until the company provides further clarification and information.

During the audit, the auditor needs to obtain sufficient audit evidence about a company's financial position to form an opinion. There are three categories for an auditor's opinion:

- An **unmodified opinion** is expressed when the auditor is able to conclude that the financial statements give a 'true and fair' view of the company's financial position and comply in all material respects with the applicable financial reporting framework;
- A **modified opinion** can be given in two ways:

– A **qualified** opinion is given when misstatements are material but not pervasive to the financial statements;
– An **adverse** opinion is given when the auditor concludes that misstatements, individually or in the aggregate, are both material and pervasive to the financial statements.

Sometimes the auditor does not sign off the financial statements at all. For example, KPMG refused to sign off the 2021 financial results of German real estate group Adler, 'in a rare move that pushes the embattled group into an ever deeper crisis', the FT reported.[4]

Accounting Scandals

As explained above, auditors cannot guarantee the reliability of financial statements. They can at most provide reasonable assurance about the 'true and fair' view of a company's financial position. A big accounting scandal involved Enron, an energy company based in Houston, Texas. The collapse of Enron in 2001, the largest corporate bankruptcy at the time in American history, involved the use of accounting loopholes, special purpose entities, and poor financial reporting (see Box 3.1). In that way, management (i.e. the CEO and the CFO) of the energy company was able to hide billions of dollars in debt from failed deals and projects. These practices inflated Enron's accounts and performance.

Another big accounting scandal concerned Wirecard, a payment processor and financial services provider based in Munich, Germany. The company was part of the DAX index (the German stock market index). Allegations of accounting malpractices culminated in 2019 when the Financial Times published whistleblower complaints and internal documents. In June 2020, Wirecard filed for insolvency after revealing that €1.9 billion was missing, and the arrest of its CEO. Questions were raised about regulatory failure of the German supervisor, BaFin, and possible malpractice of Wirecard's long-time auditor EY.

The bankruptcy of Enron led to the closure of its accountant, Arthur Andersen. The US Securities and Exchange Commission (SEC) started an investigation of Enron's collapse. Arthur Andersen was found guilty of illegally destroying documents (i.e. putting them in the shredder) relevant to the SEC investigation. The SEC revoked Arthur Andersen's licence to audit public companies and effectively closed the auditing firm.

As a consequence of the Enron scandal, the Sarbanes–Oxley Act was passed by US Congress to expand the accuracy of financial reporting for public companies. This Act contained standards for external auditor independence as well as standards for executive management to take individual responsibility for the accuracy and completeness of company financial reports. On the latter, the company's principal officers—typically the CEO and the CFO—have to sign the company financial

[4] 'KPMG refuses audit opinion on embattled real estate group Adler', Financial Times, 29 April 2022.

reports, approving the integrity of the reports. In Europe, EU Directives were adopted that achieve similar goals of auditor independence and management responsibility.

Evolution of the Auditor's Role

The Sarbanes-Oxley Act also started a global movement to put more emphasis on the role of the auditors themselves. Across all major jurisdictions, auditors are now regulated and supervised. The expansion of financial reporting to integrated reporting (discussed in Sects. 17.3–17.5) can significantly expand the role of the auditor, as the expanded reporting standards are subject to mandatory reporting.

17.2.2 Investor Relations

The investor relations (IR) department within a company is tasked with keeping current and prospective investors informed about the company's financials, strategy, operations, etc., so that investors can make well-informed investment decisions and hold company management accountable for its performance. The investor relations department typically reports to the CFO. At small companies, there is often no formal investor relations department and the function is then filled by the CFO.

Investor relations is involved in publishing the annual report, quarterly or semi-annual reports and other externally oriented material. It organises meetings with investors in which presentation material is used, which is subsequently published on the company's IR website. For example, the CEO, CFO, or head of IR might go on a roadshow to visit investors in several countries. In addition, IR might organise conference calls on the quarterly or annual results. These are often mainly addressed to sell-side analysts, which are not the investors themselves, but advisors to institutional investors (the buy-side). Figure 17.5 provides an overview of the points typically covered in IR presentations.

For example, BMW starts its December 2022 investor presentation with a slide (Fig. 17.6) that asks and answers the question: why invest in BMW? In this 70-page

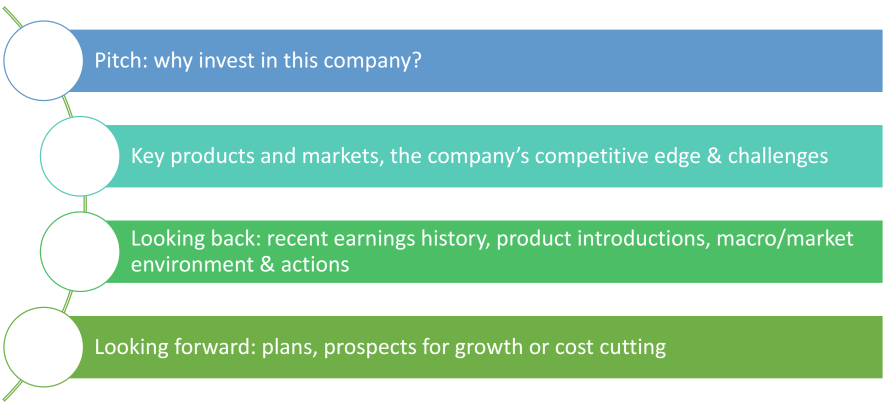


Fig. 17.5 Typical points made in an IR presentation

Fig. 17.6 BMW investor presentation slide. Source: Adapted from BMW investor relations presentation

presentation, BMW goes on to discuss its strategy (slides 3–5); its approach to sustainability (slides 6–10); its transformation to becoming a producer of electric vehicles (slides 11–28); digitalisation (slides 29–37); and financial performance (rest of the deck), including sales by segment and geography, market shares, and financial policy (e.g. payout policy, capex).

17.3 Sustainability-Related Financial Reporting

Companies started to issue corporate social responsibility reports in the 1990s. However, these stand-alone reports were mainly read by stakeholders, such as employees, governments, and NGOs, while investors kept focusing on the company's financial reports. More recently, sustainability is entering financial reports.

This section discusses the inclusion of social and environmental factors that affect financial risks. This single materiality dimension looks at the effect of social and environmental risks on financial and enterprise value and still has an investor focus (the inward view, see Fig. 17.9 below). Section 17.4 analyses impact reporting, which looks at the impact of the company on society and nature and has a stakeholder focus (the outward view).

17.3.1 IFRS Sustainability Standards

Sustainability reporting itself is in transition. Several voluntary reporting initiatives, such as the Task Force on Climate-related Financial Disclosures (TCFD, 2017), the Sustainability Accounting Standards Board (SASB), and Integrated Reporting (<IR>), were consolidated in the International Sustainability Standards Board, a new body of the IFRS, in 2021. Figure 17.7 shows that the IFRS now has two bodies: the International Accounting Standards Board (IASB) and the new International Sustainability Standards Board (ISSB).

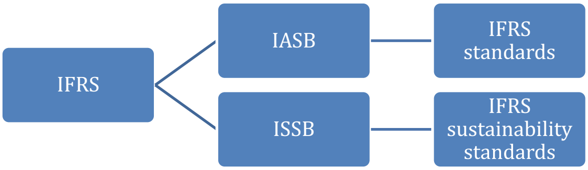


Fig. 17.7 IFRS bodies and standards

Just like the IFRS standards (see Sect. 17.1), the new IFRS sustainability standards are mandatory, part of financial reports and subject to audit control. The IFRS focus remains on informing investors. The IFRS sustainability standards contain disclosure requirements for sustainability information relevant for the company's financial value—the single materiality dimension.

IFRS has issued 2 standards in 2023:

1. **IFRS S1** General Requirements for Disclosure of Sustainability-related Financial Information (general sustainability standard)
2. **IFRS S2** Climate-related Disclosures (climate standard)

IFRS S1

The first standard (IFRS S1) sets the general framework for disclosure of sustainability risks and opportunities related to the company's financial value. Subsequent standards provide more detailed requirements on specific topics. Unsurprisingly, the first specific standard (IFRS S2) relates to climate disclosures.

The general sustainability standard (IFRS S1) requires that a company shall provide disclosures about:

(a) **governance**—the governance procedures the company uses to monitor and manage sustainability risks and opportunities;
(b) **strategy**—the approach for addressing material sustainability risks and opportunities that could affect the company's strategy and business model over the short, medium, and long term;
(c) **risk management**—the processes the company used to identify, assess, and manage sustainability risks; and
(d) **metrics and targets**—information used to assess, manage, and monitor the company's performance in relation to sustainability risks and opportunities over time.

Interestingly, the required disclosures go beyond providing the relevant metrics and targets. In line with the set-up of this book, the governance (Chap. 3), strategy (Chap. 2), and risk management (Chap. 12) of sustainability risks and opportunities must be incorporated in the new disclosures. The general sustainability standard requires the disclosure of sustainability-related risks and opportunities over the short, medium, and long term. This fosters thinking, and hopefully acting, in terms of long-term value creation. Box 17.2 explains how IFRS defines sustainability topics.

Box 17.2 Disclosure of Sustainability Topics: Taking Industry Context into Account

IFRS builds on the industry-based SASB Standards. With a focus on how sustainability affects value creation, the SASB Standards vary by industry, based on the different sustainability risks and opportunities within an industry. The SASB Standards identify the subset of environmental, social, and governance issues most relevant to financial performance and enterprise value for 77 industries.[5]

To highlight the differentiation across industries, we give three examples of material topics in an industry. The third example shows that some industries have more material sustainability topics than other industries.

Industry (77 in total, 3 given here)	Material topics identified per industry
Apparel, accessories, & footwear	• Management of chemicals in products • Environmental impacts in the supply chain • Labour conditions in the supply chain • Raw materials sourcing
Hotels and lodging	• Energy management • Water management • Ecological impacts • Labour practices (including average hourly wage) • Climate change adaptation
Materials & mining	• GHG emissions • Air quality • Energy management • Water management • Waste & hazardous materials management • Biodiversity impacts • Human rights (including those of indigenous people) • Community relations • Labour relations • Workforce health & safety • Business ethics • Tailings storage facilities management

IFRS S2

The IFRS S2 climate-related disclosures standard follows the same format of IFRS S1 (governance, strategy, risk management, and metrics/targets), but goes one step further with more detailed requirements for the disclosure of several climate topics (see Fig. 17.8). These topics are discussed throughout this book, such as Scope 1, 2, and 3 GHG emissions in Chap. 5, scenario analysis in Chap. 12, shadow or internal carbon prices in Chap. 5, and management remuneration linked to climate targets in

[5] https://www.ifrs.org/issued-standards/sasb-standards/

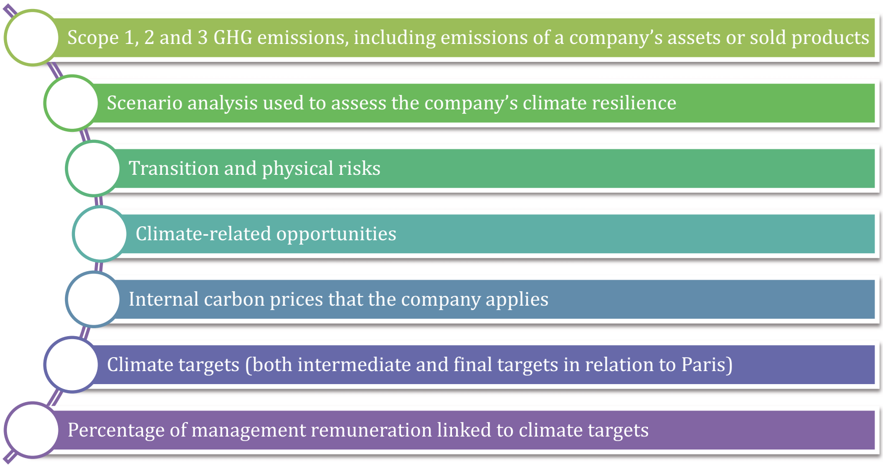


Fig. 17.8 Climate-related disclosure requirements in IFRS S2

Chap. 3. The good news is that companies have to disclose information on these topics.

On the targets, companies have to report in relation to the planetary boundary of climate change: is a company aligned with the 1.5 °C or 2 °C global warming limit of the Paris Agreement, or is a company aligned with a 3 °C limit?

These detailed requirements allow investors and other stakeholders to make a thorough assessment of a company's weaknesses and strengths on climate. Box 17.3 provides an example of disclosure on a company's strategy for stranded assets. These are assets that are 'stranded' due to unanticipated or premature write-downs (e.g. a coal-powered steel factory becomes stranded when the use of coal is prohibited or becomes too expensive due to a high carbon tax; see Chap. 2). The detailed requirements will allow for a better calculation of the company's environmental value by outsiders, which was hitherto very hard to do. Remember the difficulties we experienced in finding the Scope 3 GHG emissions for Inditex in Chap. 11.

Box 17.3 Strategy for Stranded Assets

The strategy section of IFRS S2 has detailed requirements for disclosing information about the effects of material climate-related risks and opportunities on a company's strategy and business model, including its transition plans. It covers, for example, information on legacy assets, which this book calls stranded assets. This information on legacy assets must include strategies to manage carbon-energy-intensive and water-intensive operations and to decommission carbon-energy-intensive and water-intensive assets.

Current efforts to report on social and environmental topics are already labelled as ‘integrated reporting’ by the industry. Section 17.3.2 provides a frontrunner example of such ‘integrated reporting’ by AkzoNobel. Nevertheless, it is still investor focused. Real integrated reporting (Sect. 17.5) focuses on all stakeholders (including investors) and is based on double materiality: financial materiality (effect on financial value) and impact materiality (impact on society and nature).

17.3.2 Sustainability Reporting Company Case Study

AkzoNobel, a large Dutch paints and coatings manufacturer, provides an example of voluntary reporting on social and environmental topics in its annual report. Under the headings People, Planet and Paint, AkzoNobel provides detailed numerical information on material topics, including some targets for 2025. The external auditor has given limited assurance (see Sect. 17.2) on most of the reported topics. Table 17.4 shows AkzoNobel’s sustainability performance summary. In line with best practice, AkzoNobel does provide information not only on its own operations, but also on its contractors in the supply chain and its products. In this way, investors (and other stakeholders) can analyse the sustainability risks and opportunities of AkzoNobel’s business model.

Table 17.4 AkzoNobel Sustainability Performance (Annual Report, 2021)

People	Unit	2017	2019	2021	Ambition 2025
Employees					
Organisational health score	score	-	61	72	Top quartile 75
Female executives	%	19	18	22	30
People, process and product safety					
Fatalities employees	number	0	2	1	
Injury rate employees	/200k hours	0.20	0.24	0.21	
Lost time injury rate employees	/200k hours	0.06	0.08	0.11	
Occupational illness rate employees	/200k hours	0.011	0.003	0.003	
Fatalities contractors	number	1	0	0	
Injury rate contractors	/200k hours	0.12	0.19	0.12	
Lost time injury rate contractors	/200k	0.06	0.09	0.08	
Life-changing injuries	number	2	3	2	
Health, Safety & Environment					
Management and reassurance audits	number	32	32	29	
AkzoNobel Cares					**2020-2025**
Community people trained	number	2,863	4,078	11,193	35,000
Projects	number	224	225	182	1,000

(continued)

Table 17.4 (continued)

Planet	Unit	2017	2019	2021	Ambition 2025
Energy use and emissions					
Energy use	1000TJ	6.39	6.02	6.33	Top quartile 75
- per ton of production	GJ/ton	1.88	1.88	1.89	-30% versus 2018
Renewable energy (own operations)	%	30	31	37	
Renewable electric. (own operations)	%	37	37	45	100
GHG emissions – Scope 1	kiloton	69.66	58.29	64.51	
- per ton of production	kg/ton	20.53	18.18	19.27	
GHG emissions – Scope 2	kiloton	237.8	183.1	172.1	
- per ton of production	kg/ton	70.11	57.13	51.40	
Resource efficiency					
Total waste	kiloton	77	67	67	
- per ton of production	kg/ton	22.77	21.00	19.87	
Total waste - circular	%	51	55	59	100
Total reusable waste	kiloton	37	34	35	
Total non-reusable waste	kiloton	40	33	31	
Hazardous waste total	kiloton	33	29	31	
Hazardous waste non-reusable	kiloton	16	14	17	
Hazardous waste to landfill	kiloton	0.60	0.45	0.11	
Resource efficiency (continued)					
Fresh water use	million m^3	9.62	8.05	9.56	
- per ton of production	m^3/ton	2.84	2.51	2.86	
Fresh water consumption	million m^3			1.27	
- per ton of production	m^3/ton			0.38	
Supplier management					
Suppliers in sustainability program	% of baseline	-	65	84	
Business Partner Code of Conduct	% of spend	97	98	99	

(continued)

Table 17.4 (continued)

Paint	Unit	2017	2019	2021	Ambition 2025
Sustainable product portfolio					
Sustainable solutions	% of revenue	21	22	39	>50
Value chain emission					
Cradle-to-grave carbon footprint (Scope 1, 2 and 3)	million tons	-	13.8	14.7	
Scope 3 upstream	million tons	-	6.3	6.8	
Scope 3 downstream	million tons	-	7.3	7.7	

Source: AkzoNobel, Annual Report 2021.

The information is industry-specific with a focus on work health and safety, gender diversity, and community training on the social side and carbon emissions, waste, and freshwater usage on the environmental side. AkzoNobel also shows to which extent its products contribute to sustainable solutions: 39% in 2021 with more than 50% as target for 2025. On the one hand, this information is relevant to assess how future-proof AkzoNobel's business model is. On the other hand, it is also vague and hard to compare with other companies, since there are no standards for contributing to sustainable solutions.

In line with best practice, AkzoNobel reports absolute carbon emissions and relative carbon emissions (per ton of production). Scope 1 and 2 emissions amount to 0.237 million tons, while Scope 3 emissions form the bulk of AkzoNobel's emissions with 14.7 million tons: 98% of total emissions (see Chap. 5 on Scope 1, 2, and 3 emissions). The historical pattern shows that AkzoNobel's absolute emissions are still increasing from 13.8 million tons in 2019 to 14.7 million tons in 2021. So, AkzoNobel has some work to do to reduce its carbon emissions by 55% in 2030 and to net zero in 2050 (the commonly used targets in Europe). The two indicators, sustainable solutions and Scope 3 emissions, give opposite signals. This is a typical topic for investor relations. Analysts could ask the company to explain the improvement in sustainable solutions, while carbon emissions (a key indicator of sustainability) are still rising.

While AkzoNobel's reporting is advanced, it still does not give sufficient information to assess the company's value creation and destruction for society and nature—just like in the case of Inditex, discussed in Chap. 11. AkzoNobel is still able to select the topics on which it reports; human rights breaches are, for example, absent in its sustainability performance report.

17.4 Impact Reporting

Before discussing impact reporting frameworks, this section highlights convergence in reporting on social and environmental issues.

17.4.1 Convergence in Reporting

Whereas sustainability-related financial reporting in Sect. 17.3 takes the *inward perspective* (how does E and S affect company value?), impact reporting adopts the *outward perspective* (how does the company affect E and S?). Figure 17.9 (reproduced from Chap. 2) illustrates the concept of *double materiality* with financial materiality (inward) and impact materiality (outward).

At the time of writing (2023), there are multiple voluntary sustainability reporting frameworks (mentioned in Sect. 17.3 and in this section). Convergence towards mandatory reporting is very welcome to enable comparability. In terms of actually reported metrics by companies, we observe a convergence of the underlying social and environmental factors used for financial and impact materiality, mostly because outward issues are increasingly seen as inwardly relevant as well. This is good news in itself, and it reduces the reporting burden for companies that are subject to multiple reporting regimes.

The *inward focus*, which looks at sustainability topics relevant for the financial value of the company, is rapidly expanding because of increased internalisation of social and environmental factors by companies. An emerging example is biodiversity loss, which has always been a key indicator for nature and is now entering company sustainability-related financial reporting (Kennedy et al., 2023). Other examples include work health & safety and living wage.

Figure 17.10 shows the expanded list of material factors for the inward perspective. Some topics remain on the fringe, such as human rights. NGOs, like Amnesty International, have been campaigning for human rights since the 1960s (outward perspective), but companies have until now refused to report on human right

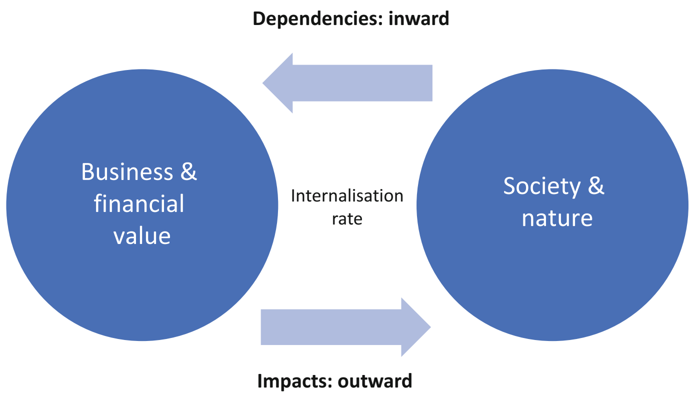


Fig. 17.9 Double materiality of social and environmental factors

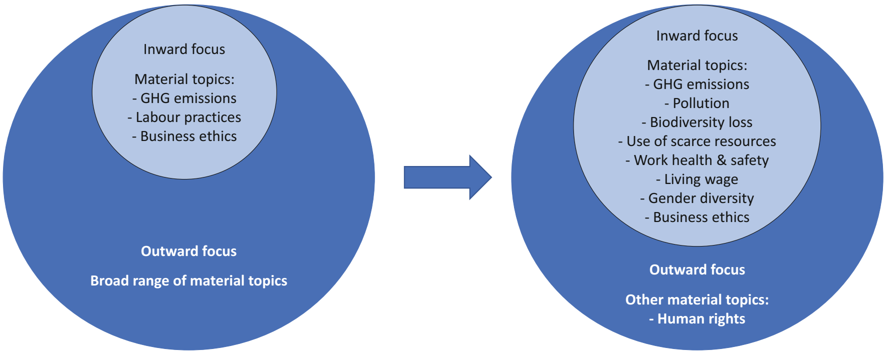


Fig. 17.10 Expanding list of material topics under inward perspective

violations in the supply chain (inward perspective). Such company reporting would, of course, raise awkward questions about why companies continue to let these violations happen in the first place. That highlights the need for mandatory reporting on these topics.

Where the IFRS Sustainability Standards are based on single materiality (inward focus), the European Sustainability Reporting Standards (ESRS) adopt double materiality combining the inward and outward focus. Box 17.4 provides an overview of the European standards.

Box 17.4 European Sustainability Reporting Standards (ESRS)

The Corporate Sustainability Reporting Directive (CSRD) introduces European Sustainability Reporting Standards (ESRS) for disclosure of a company's sustainability performance. These standards go two steps further than the IFRS Sustainability Standards. First, they are based on double materiality—both the financial and impact materiality. Second, they are far more detailed. Whereas IFRS has so far published only one topical sustainability standard on climate (see Sect. 17.4), the CSRD has a whole range of topical sustainability standards on environmental, social, and governance topics. Each of these topical standards contains detailed disclosure

(continued)

Box 17.4 (continued)
requirements. The ESRS require limited assurance for the first years of implementation (starting in 2024/2025) and reasonable assurance thereafter.

Overview European Sustainability Reporting Standards (ESRS)

Cross-cutting standards	
ESRS 1	General requirements
ESRS 2	General disclosures (governance, strategy, risk management, and metrics and targets)
Topical standards—environment	
ESRS E1	Climate change
ESRS E2	Pollution
ESRS E3	Water and marine resources
ESRS E4	Biodiversity and ecosystems
ESRS E5	Resource use and circular economy
Topical standards—Social	
ESRS S1	Own workforce
ESRS S2	Workers in the value chain
ESRS S3	Affected communities
ESRS S4	Consumers and end-users
Topical standards—Governance	
ESRS G1	Business conduct

17.4.2 Impact Reporting Frameworks

The IFRS Sustainability Standards and the ESRS require companies to disclose much needed information on material sustainability topics. The final step of Impact Measurement and Valuation translates the social and environmental metrics (Q) in value or capitals by monetising them with valuation factors or shadow prices (SP), as explained below. Please note that this is not the same definition of impact as typically used in impact investing, where impact also implies intentionality and additionality. See, for example, the impact investing definition of the Global Impact Investing Network in Sect. 14.5 of Chap. 14.

Impact reporting is a recent phenomenon. The major emerging impact reporting frameworks, which are all voluntary, include:

- **Integrated Capitals Assessments** written by the Capitals Coalition, formed by uniting the Natural Capital Coalition and the Social and Human Capitals Coalition;

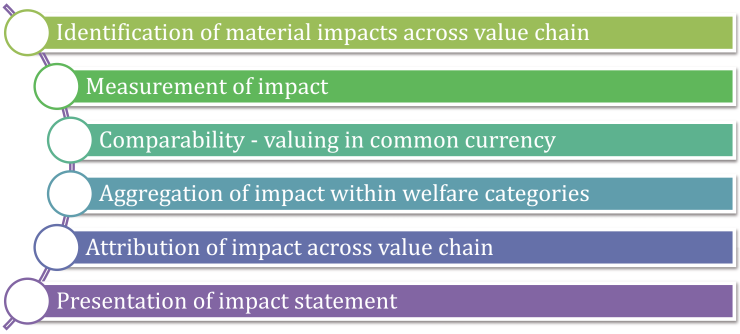


Fig. 17.11 Basics of impact reporting

- **Impact-Weighted Accounts Framework (IWAF)** written by the Impact Economy Foundation with experts from Harvard Business School, Singapore Management University, Rotterdam School of Management and Impact Institute;
- **Value Balancing Alliance (VBA)** written by an association consisting of more than 25 international companies and the big four audit firms.

These frameworks have a similar set-up, but differ in core principles, dimensions of impact and level of detail. We explain the basics of impact reporting in Fig. 17.11, following the Impact-Weighted Accounts Framework (IWAF) (Impact Economy Foundation, 2022). Impact-Weighted Accounts contain impact information for the calculation of SV and EV for stakeholders. Impact frameworks make use of four capitals: financial, social, human, and natural capital. Financial capital forms the financial value (FV), social and human capitals are combined in the social value (SV), and natural capital is the environmental value (EV).[6]

Material Impacts

The first step is the identification of impacts that are material for stakeholders, which include investors, employees, suppliers, customers, local communities, nature and future generations. The impacts reflect current and future value enjoyed by stakeholders and are based on welfare considerations. Welfare does include not only the current and future well-being of stakeholders, but also the effects of guaranteeing or non-guaranteeing of stakeholder rights (see Box 5.1 in Chap. 5 on the rightsholders approach). Value chain responsibility means that a company is accountable for the consequences of its own activities (direct impacts) and those of its suppliers and customers (indirect impacts).

[6]The International Integrated Reporting Council distinguished earlier six capitals: manufactured capital (which is part of financial value) and intellectual capital (which contributes to each of the three value components).

Whereas financial reporting takes an *investor's/financier's perspective* (did a company increase (profit) or decrease (loss) its financial value over last year's period), impact reporting takes a *stakeholder perspective* (what is the impact of a company's activities on its stakeholders?; did a company create value for its stakeholders?). An example of value creation (positive impact) is where customers give up financial value (payment for the product) and receive a product (manufactured capital) that represents a larger value for them. Another example of value creation refers to employees, who give up their time (representing a value in human capital) and receive salaries (financial capital) as well as, potentially, well-being from work and future career benefits due to training and work experience (human capital). An example of value reduction (negative impact) is where stakeholders are worse off due to a company's activities (e.g. pollution reducing natural capital). These examples sound quite abstract. Table 17.5 below provides a company case study showing the company's positive and negative impacts across the six capitals.

Measurement

Measuring the size of impacts is done with respect to a basis or reference. The Greenhouse Gas Protocol, for example, simply measures a company's carbon emissions (Scope 1, 2, or 3). Technically, these emissions are then compared to a no-activity reference. In the case of wages, the reference point is a living wage (see Chap. 5). Let's take the example of a fast fashion company using a foreign garment factory. If this garment factory pays its employees \$1 an hour and the living wage of the country in which the factory operates is \$1.40, there is an underpayment of \$0.40. The number of hours times the underpayment of \$0.40 per hour is then the negative social impact (negative social value). As we have seen in the case of Inditex (Chap. 11), it can be difficult in practice to measure the number of hours in Inditex's supplying garment factories, and the actual wage paid by these factories.

Monetisation for Comparability

An important step for impact reporting is *monetising* (putting a shadow price, SP, on) the social and environmental factors (quantities, Q) to derive the social and environmental value (Q*SP). The valuation factors (shadow prices) reflect the true price of social and environmental factors (see Chap. 5). The reported impact in terms of SV and EV can then be compared to FV. In addition, this allows for comparing impact reports over time and between companies. As a result, monetisation facilitates integrated valuation and investment decision-making (see Chaps. 5–9 and 18).

Aggregation with Caution

An impact assessment can add up to multiple impacts. Aggregation is then needed to keep an overview. At the same time, aggregation across welfare categories should be avoided. Otherwise, pollution (violating the rights of certain stakeholders) can be offset by creating employment (well-being of employees). So aggregation should only be done within welfare categories (see Table 5.4 for material social and environmental welfare categories), and while remaining conscious of the elements being aggregated.

Attribution
Double counting of impact should be avoided. The direct impact of one company (e.g. a supplier) can be the indirect impact of another company in the same value chain. Attribution distributes shares of the impact to each of the stakeholders in the value chain (see Chap. 5). The company case study below shows how attribution works in practice.

Impact Statements: So Far Only Integrated P&Ls
Impact statements can follow the format of financial statements in Sect. 17.1. The impact or integrated P&L presents a company's value creation and reduction across the six capitals during the year analysed. Until now, companies that do impact reporting have only published an overview of the past year's positive and negative impacts. The company case study below shows such an integrated P&L statement.

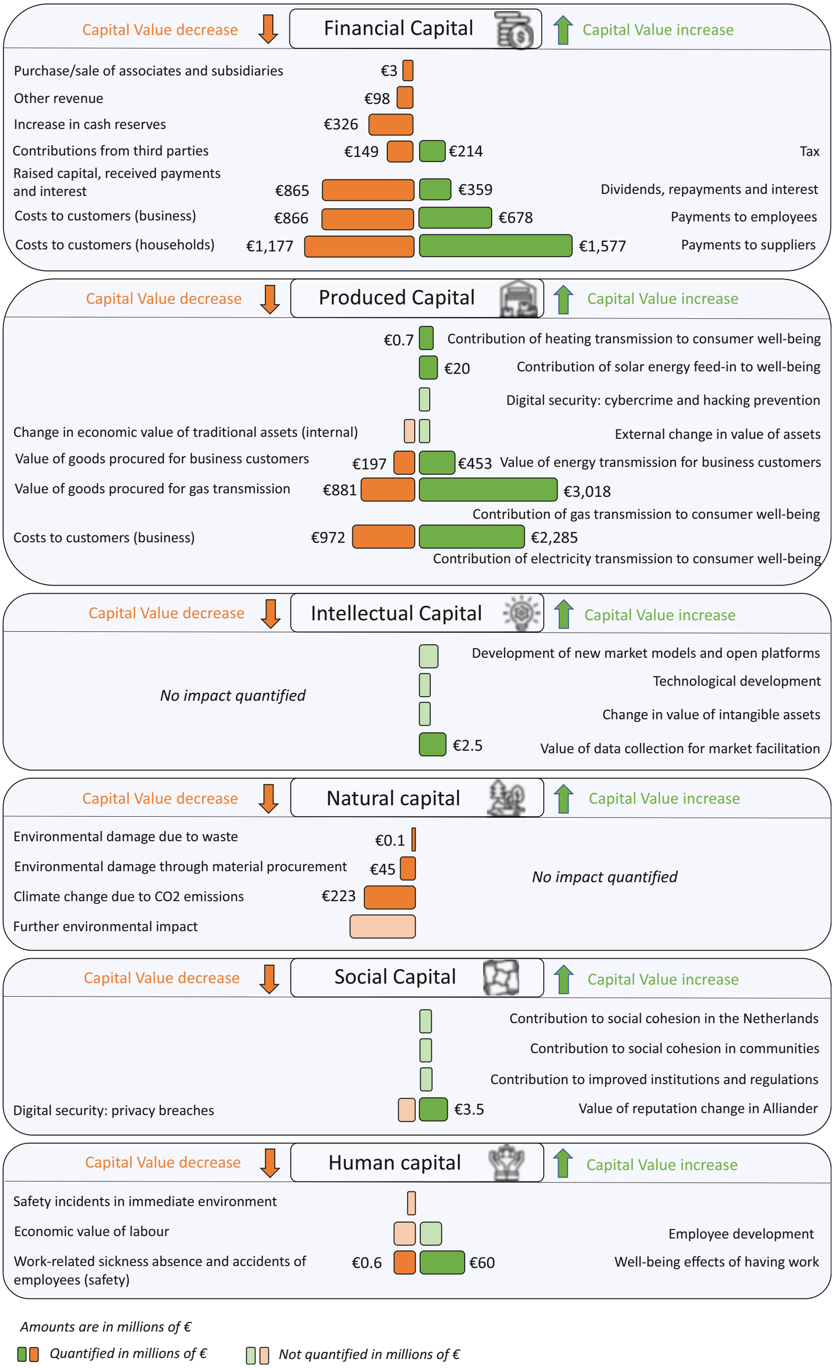
No Impact Balance Sheets Yet
The impact balance sheet records a company's assets and liabilities at year end. These assets and liabilities affect a company's ability to create integrated value for its stakeholders and its responsibility towards its stakeholders. An impact balance sheet thus contains forward-looking elements, while a financial balance sheet records assets and liabilities at historical value which is backward-looking. Section 17.5 discusses the difficulties in producing an integrated balance sheet, which combines financial, social, and environmental assets and liabilities.

Impact Performance
Summing up, material social and environmental factors are inputs for impact reporting. To assess a company's impact performance, the social and environmental factors need to be placed in context. Does the company stay within social and planetary boundaries? Chap. 14 introduces the *footprint method*, which translates the social and planetary boundaries into social minimum levels and environmental ceilings at company level (Sect. 14.4.3). The questions are then (1) whether a company is paying a living wage across its supply chain and respecting human rights and (2) whether a company's GHG emissions are on a downward trajectory in line with the Paris global warming limit of 1.5 °C.

17.4.3 Impact Reporting Company Case Study

Impact reporting is quite challenging for companies. The complexity of the impact data creates process complexity for the organisation. As the Impact Institute (2019, p. 9) puts it: 'An organisation typically has to undergo a phased process in order to ultimately be able to manage its impact in a manner that fits its purpose and goals. This process is referred to as the *impact journey* and can take several years. An

Table 17.5 Alliander's impact statement (Annual Report, 2021)



Note: Amounts are in € millions; quantified; not quantified
Source: Adapted from Annual Report 2021, Alliander

impact journey typically starts with small-scale internal reporting, then evolves to a state in which thinking about impact is central in the organisation'.

We take the impact report of Alliander, a Dutch electricity and gas grid operator, as an example. The distribution of energy through its networks makes a positive contribution to the economic development of regions and stakeholders. Alliander participates in alliances to use common standards for its impact reporting. The Dutch network operators, for example, agreed to use a common carbon price for impact measurement to make their performance on carbon emissions comparable. The network operators apply a progressively increasing carbon price over time; the shadow carbon price for 2021 was €157.

Table 17.5 shows an excerpt from Alliander's impact report over 2021. We highlight the main items of the impact report. Remember that impact is considered from the perspective of the company's stakeholders. So, the payment of salaries to employees is an increase in financial value for employees. Alliander's employees received €678 million in salaries over 2021. Equity and debt holders received €359 in dividends, repayments, and interests, while Alliander raised capital to the amount of €865 million. Business and household customers had to pay €866 and €1177 million, respectively, for the energy transmission.

Energy distribution and transmission form Alliander's manufactured capital. Alliander's share in value for consumers amounted to €5.3 billion (€3.0 billion for gas transmission and €2.3 billion for electricity transmission) and for business customers to €453 million in 2021. This value is measured as increase in consumers' well-being due to the use of energy. Well-being is calculated on the basis of paid value and consumer surplus (the extra amount that customers are in theory prepared to pay on top of the price for a product). Value of goods procured reflects the value produced by Alliander's suppliers.

Natural capital depletion is a major concern for operators in the energy industry. Alliander aims to limit the negative impact of its use of materials (€45 million in 2021) by using recycled materials. The most important negative impact is carbon emissions, which amounted to €223 million in 2021, up from €218 million in 2020. This is largely due to the increase in the number of cold days (more usage of gas for heating) and the higher carbon price in 2021. A fall in carbon intensity per kWh due to a cleaner energy mix reduced the effect of the increase somewhat. The main contributor to carbon emissions is network and leakage losses, which arise during the transmission of electricity and gas. Alliander's carbon strategy is to reduce network losses and to offset remaining network losses by generating additional renewable energy.

Measuring social impact is work in progress. Alliander reported an increased value of its reputation of €3.5 million in 2021. Alliander's contribution to social cohesion was not quantified. On human capital, well-being effects of having work amounted to €60 million, while work-related sickness and accidents was €0.6 million in 2021.

Next, Alliander's impact statement contains backward-looking data on Alliander's impact, similar to the backward-looking information in financial statements. It would be good for users to include forward-looking information on the business model, strategy, and sustainability policy, including targets and pathways or milestones to reach these targets. The new European Sustainability Reporting Standards require companies to report their targets (see ESRS 2 in Box 17.4).

In sum, Alliander's impact report provides an overview of its main impacts: the well-being benefits of gas and electricity distribution for its customers on the positive side and the depletion of natural resources on the negative side. This impact report highlights the external focus: it shows the impact on society and the environment (outward view) rather than the impact on the company (inward view). As impact reporting is not (yet) mandatory, the auditor provided limited assurance on Alliander's impact report.

17.5 Integrated Reporting, Analysis, and Investor Relations

The final step is to bring a company's financial statements (FV) and impact report (SV and EV) together in an integrated report.

17.5.1 Integrated Statements

The aim of integrated reporting is to provide stakeholders with reliable and comparable company information on material financial, social, and environmental factors. This should allow them to make a good estimate of FV, SV, and EV. Figure 17.12 shows the access to company information: internal management information systems contain a wealth of internal management information, of which only a small subset is externally reported; and these externally reported data are just a subset of the total body of externally available data about the company's performance, since they are complemented by data from NGOs, researchers, regulators, external consultants, etc.

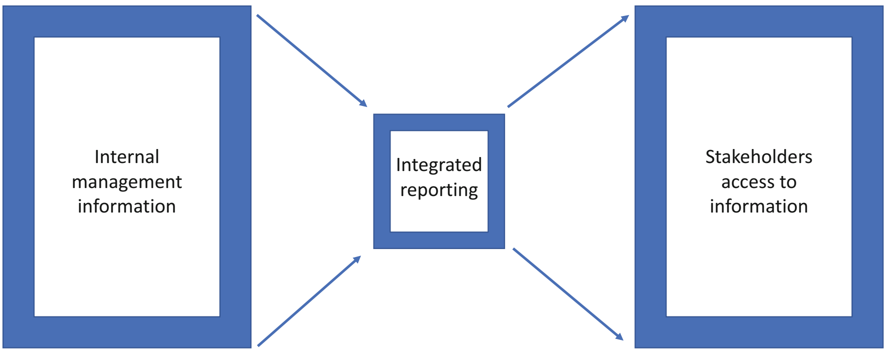


Fig. 17.12 Access to company information

Traditionally, these internal management information systems are focused on financial information, providing detailed information on the financials of the operations and products/services. Companies are increasingly formulating key performance indicators (KPIs) for social and environmental factors. Examples are Net Promoter Score for customers, Employee Satisfaction or Engagement Score for employees, Carbon Emissions or Energy Savings for climate and Circular Use of Materials or Waste for circularity. These KPIs are included in management information systems and are thus becoming part of the monthly or quarterly management reports for the executive and non-executive board. Advanced companies also measure the impact on social, human, and natural capital, like Alliander in Sect. 17.4.

A subset of the available management information goes into the integrated report in the standardised format according to international reporting standards (see Fig. 17.12). Sections 17.3 and 17.4 show the evolution of international sustainability reporting standards, indicating what new information on social and environmental factors can be expected in integrated reports. Reporting standards promote the comparability of companies' integrated reports, while mandatory audits improve the reliability of the provided information in integrated reports. Nevertheless, some of the impact information has still low verifiability and thus low reliability. In contrast, a key benefit of financial reporting is comparability, reliability, and verifiability of the financial information (see Sect. 17.1).

Stakeholders make their own assessment of a company's integrated value profile using the integrated report as well as other external sources. These other sources include analyst reports, suppliers, competitors, NGOs, consultants, rating agencies, academic work on science-based targets, and shadow prices to calculate impact, as explained in Chap. 14.

Producing Integrated Statements

It is quite a challenge for companies to produce integrated statements. While accounting records past transactions in company financial statements (backward-looking), finance tries to assess the effect of future events (forward-looking). This distinction is less of a problem for the integrated profit & loss (IP&L) statement. The IP&L shows what happened last year and registers the revenues, expenditures, and impacts over this period. The main challenge is multiyear items: revaluations of assets (because of higher or lower expected future cash flows from an asset) and reorganisations (which make a company more cost-efficient in the future). Revaluations and reorganisation costs are often taken as extraordinary items in the P&L. The separate classification of these gains and losses reflects their unusual and infrequent nature. Several companies already publish an IP&L: ABN AMRO bank, Solvay, Holcim, Novartis, and Volvo. Table 17.5 shows the IP&L from the grid operator, Alliander. It combines the financial, social, and environmental flows over 2021 in an integrated impact statement.

Compiling an integrated balance sheet is more challenging. There is a big tension between the historical value or cost price of assets and the forward-looking earning power of assets. There are a few shortcuts. Marketable assets can be marked-to-market, reflecting the market value (forward-looking earning power) rather than the historical value. Another example is the Mindestwert principle in German accounting, which takes the lowest (‘mindest’) of the historical and market value (‘wert’). Next, some assets, such as intangible resources (see Sect. 17.1 and Chap. 2), are not captured as intangible assets in the balance sheet, but are crucial for a company’s business (and success).

The question is how to incorporate S and E factors in the balance sheet. Should a company report past (realised) carbon emissions or future (expected) carbon emissions based on a company’s business model in its balance sheet, or both? Well-accepted accounting concepts can provide guidance to certain important choices in integrated reporting. For example, accounting for liabilities focuses on ‘future obligations arising from past events’ (e.g. from forbidden cartel agreements). Applying the same concepts and approaches to integrated reporting could help answer questions on reporting on past and future carbon emissions.

At any rate, key financial (F), social (S), and environmental (E) factors should be in the integrated balance sheet. This enables auditors to review the accounting balance sheet and investors to compile a market value-based balance sheet. Although the feasibility of such an integrated balance sheet is low in the short-term, separate impact reporting on the current period in the IP&L is an intermediate step.

The aim of integrated reporting is to inform stakeholders (including shareholders and debt holders) to allow them to form a balanced opinion on the ‘value’ of the company. We are not quite there yet. As a result, the integrated valuation case study of Inditex in Chap. 11 was inevitably going to be an imprecise assessment, as material information on S and E was lacking in Inditex’s financial report. We had to fill in this lack of information with assumptions.

In sum, integrated reporting is work in progress. It is also a mindset. Integrated reporting facilitates integrated thinking (Oliver et al., 2016; Eccles & Krzus, 2014), which takes into account the connectivity and interdependencies between the factors that affect an organisation’s ability to create integrated value over time; it combines the financial, social, and environmental dimensions. Churet and Eccles (2014) interpret integrated reporting (admittedly referring to the regular, less ambitious meaning than that outlined above, but it still applies) as a proxy for management quality:

> Companies that are able to articulate the relevance of sustainability issues to their long-term business success are likely to be those that are best equipped to address these issues internally. We therefore consider integrated reporting to be a useful proxy for the overall quality of management, which increasingly involves managing intangible assets while also taking account of any negative effects (or “externalities”) on the environment and society.
>
> Integrated thinking also implies an ability to find an optimal balance between managing short-term business imperatives and on-going value creation.

Finally, the financial statement analysis in Sect. 17.1 can be expanded to an integrated statement analysis. Integrated return (as alternative to return on assets) and the integrated leverage ratio (as alternative to the financial debt-to-assets ratio) are introduced in Eqs. (17.22 & 17.23) in the Appendix. These integrated ratios provide an integrated picture of a company’s performance.

17.5.2 Integrated Audits and Investor Relations

A challenge is that some of the information in integrated reports cannot yet be fully certified by auditors, as there is lack of relevant auditor skills and international standards are still in the process of being adopted. Auditors play an important role in the assurance of integrated reports. In the examples of impact reporting in Sects. 17.3 and 17.4, the auditor provided limited assurance. The European Sustainability Reporting Standards (ESRS) require limited assurance for the first years of implementation (starting in 2024/2025) and reasonable assurance thereafter (see Box 17.4).

The training of auditors is a big challenge. Several institutes, like the Impact Institute, are setting up executive training programmes for impact reporting. Further, auditing integrated statements is more costly than auditing financial statements. Companies will only pay for assurance (limited or reasonable) of impact information, if it is mandatory or valued by the companies themselves. Moreover, auditing requires verifiability, which places boundaries on impact reporting. Nevertheless, advances in impact measurement and valuation have expanded the scope of impact measurement and reporting, as explained in Chap. 5.

Section 17.2 described the role of IR (investor relations) as widely practiced. Integrated IR means that the IR role is expanded to inform investors on the company's value creation on E, S, and F. Figure 17.13 provides an overview of the messaging by an integrated IR department.

So, instead of just describing the profit potential of a new product, the company would emphasise how it creates value on E and S as well. For example, the product might be reducing CO_2 emissions by a certain amount or improving the quality of life for a significant amount of people. These sources of E and S value creation may or may not help or hurt financial prospects in the short and/or long run, as discussed in Chap. 2. To convey that kind of information, companies could show tables like in Table 17.6.

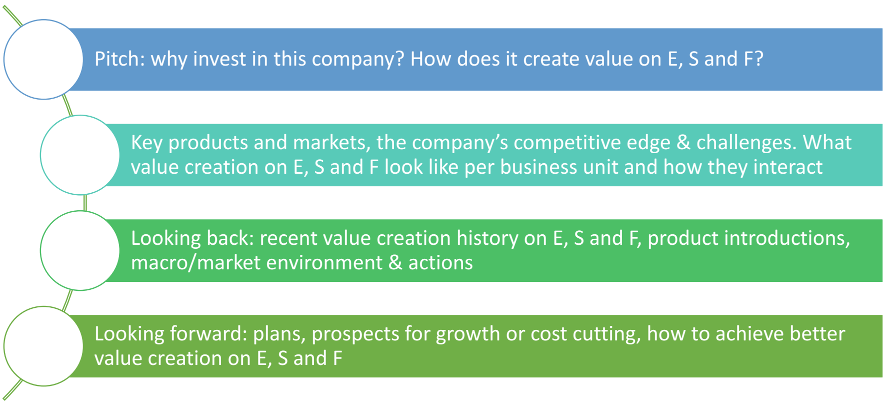


Fig. 17.13 Typical points made in an integrated IR presentation

Table 17.6 Business unit level analysis of F, S, and E

	BU1	BU2	BU3	Overall
F Size by • Sales • Invested capital Return on invested capital EBIT margin Sales growth				
S Annual health benefits in additional life years Well-being of employment Damages in human rights violations Etc.				
E GHG emissions GHG emissions avoided Contribution to biodiversity losses Contribution to biodiversity restoration Waste generation Etc.				

This would allow analysts to make calculations, add their own assumptions, and then add it all up to arrive at value creation per business unit (BU), on F, S, E, and totals. Of course, IR should explain the underlying processes, including the action being undertaken to improve the value creation profile. See also the IR example presented on Inditex at the end of Chap. 11.

17.6 Conclusions

Financial reporting serves an important role as a means of communication between corporate management and the company's stakeholders, including investors. Companies issue several financial statements, like a balance sheet, a profit & loss account, and a cash flow statement. These financial statements are based on book values and show financial and manufactured capital, which form a company's tangible assets. Financial reporting faces the challenge of painting a reliable picture of economic reality, which has become increasingly problematic. In the past decades, complexity has increased and intangibles have become a more important part of a company's asset base (see Chap. 2).

This chapter outlines why reporting matters (promoting comparability and verifiability of company information) and how it falls short. It also shows how impact reporting can inform stakeholders about social and environmental factors. The chapter provides some company examples of impact statements. Integrated reporting—which combines financial and impact statements—is about understanding how an organisation creates integrated value and how its activities affect the capitals (intellectual, human, social, and natural capitals, next to financial and manufactured capital) it relies upon for this.

Ultimately, integrated reporting facilitates integrated thinking, which takes into account the connectivity and interdependencies between the financial, social, and environmental factors that affect an organisation's ability to create integrated value over time. Some form of integrated reporting is applied by an increasing number of companies, but it is still far from widespread.

Another component of communication is investor relations. The job of companies' investor relations department is to provide investors with an accurate account of company affairs. In addition to annual reports, regular analyst presentations and updates are the main tools to update investors. These presentations are expanding to social and environmental information in addition to financial information. But investors are slow to ask questions about this new information as their main focus is still on the financials.

Key Concepts Used in this Chapter

Accounting is the process of keeping financial accounts

Aggregation refers to combining data to provide an overview

Assurance (or audit) is the independent review of company accounts by a certified auditor

Attribution of impact distributes shares of an impact to each of the stakeholders in the value chain

Auditor is a chartered accountant that is qualified to audit financial statements

Balance sheet is a statement of the assets, liabilities, and equity capital of an organisation

Book value of equity is an accounting measure of equity. It is measured as the difference between a company's assets and liabilities.

Efficiency ratios evaluate a company's ability to generate income with its resources

Financial reporting is the process of producing reports that disclose an organisation's financial status

Financial statement analysis is the process of reviewing and analysing a company's financial statements by external stakeholders, in which they calculate financial ratios to gain insights in the company's ability to generate value

Going concern principle assumes that during and beyond the next reporting period a company will complete its current plans, use its existing assets, and continue to meet its financial obligations

Impact reflects changes that affect the welfare of a company's stakeholders; companies create or destroy value for society through their impact

Intangibles are assets or resources that are not physical in nature; examples are human capital, goodwill, brand recognition, and intellectual property, such as patents, trademarks, and copyrights

Integrated reporting integrates financial, social, and environmental metrics and refers to concise communication about how an organisation's strategy, governance, performance, and prospects, in the context of its external environment, lead to the creation of value over the short, medium, and long term

Integrated thinking refers to taking into account the connectivity and interdependencies between the factors that affect an organisation's ability to create value over time; it combines the financial, social, and environmental dimensions

Investor relations informs current and prospective investors about the company's financials, strategy, and operations

Leverage ratios show how the business operations are financed and provide an indication of the company's solvency

Limited assurance is a lower level of audit assurance than reasonable assurance (see below), whereby the auditor collects less evidence but sufficient for a negative form of its conclusion: 'nothing came to our attention to indicate that the management assertion on XYZ is materially misstated'

Liquidity ratios reflect the ability to meet the company's short-term debt obligations

Market value of equity reflects a company's market capitalisation. It depends on what investors expect a company's assets to produce (or earn) in the future

Market Value ratios can be used to determine how valuable a company is

Materiality indicates relevant and significant information and refers to the degree to which certain information is important for a company

Net working capital is the capital available in the short term to run the business. It is calculated as the difference between a company's current assets and current liabilities.

Profitability ratios are meant to reflect a company's ability to generate profits

Reasonable assurance is a high level of audit assurance, but is not a guarantee that an audit will always detect a material misstatement (due to fraud or error) when it exists

Six capitals are the types of capital distinguished by the International Integrated Reporting Council, namely financial, manufactured, intellectual, social (and relationship), human and natural capital

Valuation ratios are based on a company's market value and show how valuable a company is

Appendix: Financial and Integrated Ratios

This Appendix provides more detail on five categories of financial ratios discussed in Sect. 17.1: profitability, liquidity, leverage, efficiency and valuation ratios. Section 17.5 moves from financial statement to integrated statement analysis. Equations (17.21, 17.22 & 17.23) show how financial ratios can be expanded to integrated ratios.

Profitability Ratios

Profitability ratios measure the company's ability to generate profits. The gross margin and operating margin ratios are measured in relation to a company's total sales. The *gross margin* measures how much profit a company makes after subtracting cost of sales from total sales.

$$Gross\ Margin = \frac{Gross\ profit}{Total\ sales} \tag{17.8}$$

In 2020, Inditex's gross margin is 55.8% = 11,390/20,402 (numbers are taken from Inditex's income statement in Table 17.2). It is useful to compare the profitability ratios with industry peers to evaluate where the company outperforms or underperforms. If the average industry gross margin is 61%, then Inditex overpays for its cost of sales, resulting in a competitive disadvantage. The next step is the *operating margin* (also called EBIT margin), which measures a company's profitability after subtracting operating expenses and depreciation from the gross profit.

$$Operating\ Margin = \frac{Operating\ income\ (EBIT)}{Total\ sales} \tag{17.9}$$

Inditex's operating margin is 7.4% = 1507/20,402 in 2020. In 2019, Inditex's operating margin was 16.6%, so it is important to investigate the cause of this strong drop. It appears that this drop is due to the Covid-19 pandemic, which started in 2020.

Next, the *return on assets* (ROA) reflects a company's ability to generate income for equity and debt investors employing its assets.[7]

$$Return\ on\ Assets\ (ROA) = \frac{Net\ profit + interest\ expense}{Total\ assets} \tag{17.10}$$

Inditex' ROA is 4.6% = (1104 + 106)/26,418 in 2020 (numbers taken from Tables 17.1 and 17.2). This means that every €1 in assets converts into €0.046 net income for equity and debt investors. The *return on equity* (ROE) is important to shareholders because it shows how much net profit is realised with their shareholder equity.

$$Return\ on\ Equity\ (ROE) = \frac{Net\ profit}{Total\ equity} \tag{17.11}$$

Inditex's ROE is 7.6% = 1104/14,550 = 7.6%. A potential downside of using ROA or ROE is the sensitivity of profits for extraordinary events or windfalls. Moreover, a high ROE can be achieved by taking excessive debts. In such a case, ROE provides a misleading image when considered as a stand-alone ratio. ROE should therefore be judged together with a company's leverage.

Liquidity Ratios

Liquidity refers to the company's ability of meeting its short-term debt obligations. Does the company have enough liquid assets to pay the bills in the upcoming months? Liquidity and solvency are frequently used interchangeably, while they substantially differ from each other. Liquidity is based on the financial health within one year, while solvency reflects the capability to meet long-term debts and financial obligations. The *current ratio* is measured as current assets divided by current liabilities and shows short-term liquidity.

$$Current\ Ratio = \frac{Current\ assets}{Current\ liabilites} \tag{17.12}$$

The current ratio is closely related to net working capital, explained in Sect. 17.1. The difference is that net working capital is calculated by subtracting current liabilities from current assets, and the current ratio by dividing the two. The main benefit from the current ratio is that is shows the relation of current assets to the liabilities, rather than an absolute number. Inditex' current ratio is 1.73 = 10,957/

[7] For ease of exposition, we use total assets at the end of the year. Strictly speaking, we should take average total assets during the year, which is the average of total assets at the beginning and the end of the year.

6338 (numbers taken from Table 17.1), indicating that for every €1 current liability, there is €1.73 available in current assets, which is considered positive.

The *quick ratio* excludes the inventory from the current asset because in some cases, the inventory is not as liquid as cash or accounts receivable for example.

$$Quick\ Ratio = \frac{Current\ assets - Inventory}{Current\ liabilites} \tag{17.13}$$

The quick ratio of Inditex is 1.36 = (10,957 − 2321)/6338, suggesting sufficient liquidity. Finally, the *interest coverage ratio* reflects a company's ability to pay the interest on its debt.

$$Interest\ Coverage\ Ratio = \frac{Operating\ income\ (EBIT)}{Interest\ expense} \tag{17.14}$$

To guarantee liquidity, the operating income should be a multiple of the interest expense, usually more than 1.5 times. For simplicity, we assume that the interest expense equals the financial results on the income statement (Table 17.2). Inditex's interest coverage ratio is then 14.2 = 1507/106. This high number suggests a very healthy liquidity.

Leverage Ratios

Leverage ratios are an indicator of a company's solvency. These ratios show the proportion of debt used to finance the assets employed in the business operations. A frequently used leverage ratio is the *debt ratio*, which is calculated as (current liabilities + long-term liabilities) divided by total assets, and strongly varies across sectors.

$$Debt\ Ratio = \frac{Current\ liabilities + long\ term\ liabilities}{Total\ assets} \tag{17.15}$$

Inditex' debt ratio is 44.9% = (6338 + 5529)/26,418 in 2020, which is relatively comparable for the retail industry. Debt ratios vary across sectors. In Europe, the average Air Transport company has a debt ratio of 74.6%, while the average Electronics company only has a debt ratio of 30.5% (Damodaran, 2022).[8] A low debt ratio means better coverage of debt by assets for debt holders in financial distress, hence a better solvency. But it can also indicate an inefficient capital allocation, according to the free cash flow theory (see Chap. 15). Leverage should be considered in conjunction with a company's risk profile. The more volatile a company's business, the lower the leverage. High-tech companies with a high industry asset beta of more than one (see Fig. 13.4) are typically equity financed with little debt (low leverage). And vice versa: utilities with stable cash flow patterns (industry asset beta of a half) typically have a high leverage.

[8] See: 10 Sept 2022, https://pages.stern.nyu.edu/~adamodar/

Next, the *debt-to-equity ratio* shows the distribution between debt and equity.

$$Debt\ to\ Equity\ Ratio = \frac{Total\ debt}{Total\ equity} \tag{17.16}$$

In 2020, Inditex's debt to equity (D/E) ratio is 81.6% = (6338 + 5529)/14,550. A D/E ratio lower than 1 implies that every €1 in debt is backed by at least €1 in equity, which is assumed to be safe.

Efficiency Ratios

Analysts use efficiency ratios to evaluate a company's ability to generate income with its resources. The commonly used efficiency ratios are asset turnover ratio and the inventory turnover. The *asset turnover ratio* measures the efficiency of using assets to produce sales.

$$Asset\ Turnover\ Ratio = \frac{Sales}{Total\ assets} \tag{17.17}$$

Inditex's asset turnover ratio is 77.2% = 20,402/26,418. A high asset turnover ratio signals efficient allocation of assets, which depends on the sector. The *inventory turnover ratio* shows how many times the company sold its inventory during a year.

$$Inventory\ Turnover\ Ratio = \frac{Annual\ cost\ of\ sales}{Inventory} \tag{17.18}$$

The clothing retail industry tends to have a high inventory turnover ratio since every few months, a new collection is being distributed. The inventory turnover also relates to the liquidity ratios, because a high ratio reflects a liquid inventory. In such a case, analysts prefer to use the current ratio over the quick ratio. Inditex' inventory turnover ratio is 3.9 = 9013/2321, which is quite high.

Valuation Ratios

Finally, analysts use valuation ratios to determine how valuable a company is. These valuation ratios are based on a company's market value. These ratios tell not only external investors whether the stock is a good buy but also internal teams whether the company is generating enough value per share. *Earnings per share* (EPS) is the dominant metric to reflect the profitability of a publicly-traded company. EPS shows how much profit can be attributed to one share. Inditex' EPS is already given in Table 17.2 and is calculated by net profit (earnings)/number of shares outstanding = 1104/3109.86 = €0.355. EPS is frequently used for the stock's valuation.

The *P/E ratio* (price-earnings ratio) measures how valuable the company is relative to its EPS. In other words, how much do investors need to pay for €1 of earnings; it is therefore often called the earnings multiple. Via the multiple analysis, analysts compare the P/E to the industry peers to determine whether the stock is over- or under-valued. As explained in Sect. 9.3 of Chap. 9, the relationship for the stock price *P* is as follows:

$$P = EPS * \frac{P}{E} \tag{17.19}$$

At the end of 2020, Inditex' P/E ratio was 74.4 = 26.4/0.355. This means that investors pay 74.4 times the earnings to buy a stock, which seems very high. In 2019, the P/E ratio was just 27.6 = 32.25/1.168. The higher P/E ratio in 2020 is due to far lower earnings as a result of the Covid-19 pandemic in 2020. Fluctuating earnings highlight a major limitation of using multiples. It doesn't tell anything about a company's long-term earnings potential or earnings growth. A strong increasing EPS could justify a high P/E ratio. Another shortcoming is that the earnings multiple doesn't capture the debt financing effect properly. Increasing debt reduces EPS via interest expenses but could have a positive impact on the future earnings if the additional debt is invested properly.

Finally, the *market-to-book ratio* evaluates the market value of equity in comparison with the book value of equity derived from the balance sheet.

$$Market\ to\ Book\ Ratio = \frac{Total\ market\ value\ of\ equity}{Total\ book\ value\ of\ equity} \tag{17.20}$$

The market value (market capitalisation) is determined by multiplying the stock price with the number of outstanding shares (see Eq. 17.3). It shows how investors value the company. The book value reflects the amount what's left on paper after selling all assets (at book value) and repaying the liabilities. At 31st December 2020, the market value of Inditex was €82.1 billion = 26.4 * 3.1 billion shares (see Example 17.1). And the book value equals the equity on the balance sheet €14.5 billion (see Table 17.1). Hence, Inditex's market-to-book ratio is 5.66 = 82.1/14.5. A typical ratio would lie between 1 and 2. As Example 17.1 already indicated, Inditex's market-to-book ratio Inditex is fairly high.

Integrated Ratios

Sect. 17.5 expands the financial statement analysis from Sect. 17.1 to integrated statement analysis. In Chap. 14, we introduced *impact-adjusted return* as alternative to financial return on assets (Eq. 17.10), reflecting the financial return and social and environmental impact. Following Eq. (14.5), the impact-adjusted return is calculated by dividing the sum of ΔFV, ΔSV and ΔEV by the financial value FV.

$$Impact - adjusted\ return = \frac{\Delta FV + \Delta SV + \Delta EV}{FV} \tag{17.21}$$

Investors can use impact-adjusted return on assets to assess the effect of a company on society as whole. A reforestation company could struggle to make money but can still have a high integrated return because of its positive environmental impact. Example 14.4 in Chap. 14 calculates the impact-adjusted return of Inditex, as follows:

$$\frac{\Delta FV + \Delta SV + \Delta EV}{FV} = \frac{4.8 + 1.2 - 3.7}{79} = 2.9\%$$

To compare, the financial return of Inditex is:

$$\frac{\Delta FV}{FV} = \frac{4.8}{79} = 6.1\%$$

Impact-adjusted return changes only the numerator in Eq. (17.21): from financial profit to integrated profit (financial profit and impact). Taking financial value in the denominator is an intermediate step; this reflects the investor perspective. Another step would be to take integrated value (defined as $IV = FV + SV + EV$) in the denominator; this reflects the societal perspective of all stakeholders. We then get integrated return:

$$Integrated\ Return = \frac{\Delta FV + \Delta SV + \Delta EV}{IV} \tag{17.22}$$

Next, Chap. 15 discusses the importance of integrated statements where E and S are explicitly valued. The *integrated leverage ratio* gives an integrated picture of the company's capital structure and the implications when analysts focus on integrated value instead of solely financial. Following Sect. 15.6, we define the integrated leverage ratio as follows:

$$Integrated\ leverage = \frac{Integrated\ debt}{Integrated\ assets} \tag{17.23}$$

The integrated debt is the sum of F, S and E debt, while integrated assets sum F, S and E assets (see Sect. 15.6). Example 15.6 calculates the integrated leverage of Inditex as follows:

$$\frac{Integrated\ debt}{Integrated\ assets} = \frac{317}{362} = 87\%$$

Again to compare, the financial leverage of Inditex is:

$$\frac{F\ debt}{F\ assets} = \frac{-3}{79} = -4\%$$

The integrated leverage ratio shows that Inditex is riskier than the financial statements reflect.

Suggested Reading

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Mergers and Acquisitions 18

Overview

While Chaps. 6 and 7 discussed corporate investments in general, this chapter focuses on a special type of investment: mergers and acquisitions (M&A). M&A are very large investments in which a company absorbs another company, which can dramatically change the profile of a company's assets.

M&A deals can be done for several reasons, some are more rational and valid than others. Less valid motives include diversification and deals done for the sake of boosting earnings per share (EPS). Value creation is often more likely if there are synergies between the companies involved. M&A deals tend to come in waves, with clustering in industries and driven partly by market valuations.

Just as in any other investment decision, the financial sanity of M&A activity can be assessed with the NPV method. However, the numbers tend to be much bigger than in ordinary capex decisions, hence the stakes are bigger as well. This makes behavioural issues even more problematic, as they can result in very large overvaluation, overinvestment, and value destruction. And indeed, massive value destruction in a small number of very large M&A deals is well documented.

E and S issues can also affect the risk and valuation of M&A deals. If not properly understood and considered, E and S issues can have similar effects as the abovementioned behavioural issues and reduce the company's financial value. A notorious example is Bayer's acquisition of Monsanto, which resulted in over $10 billion in litigation costs on health issues due to Monsanto's glyphosate product Roundup. Ideally, such skeletons in the closet are uncovered in the due diligence of the target company ahead of the M&A transaction, which should focus not only on F issues but also on S and E issues.

While the effects of E and S issues on M&A valuation are increasingly understood, scarce academic attention is given to the valuation of E and S in their own right in M&A deals. An M&A deal can be massively value destructive on E or S, which might justify blocking the deal. For example, the source of a takeover's financial success can lie in business practices that involve increased pollution, negative health effects, and exploitation of workers and consumers.

D. Schoenmaker, W. Schramade, *Corporate Finance for Long-Term Value*, Springer Texts in Business and Economics, https://doi.org/10.1007/978-3-031-35009-2_18

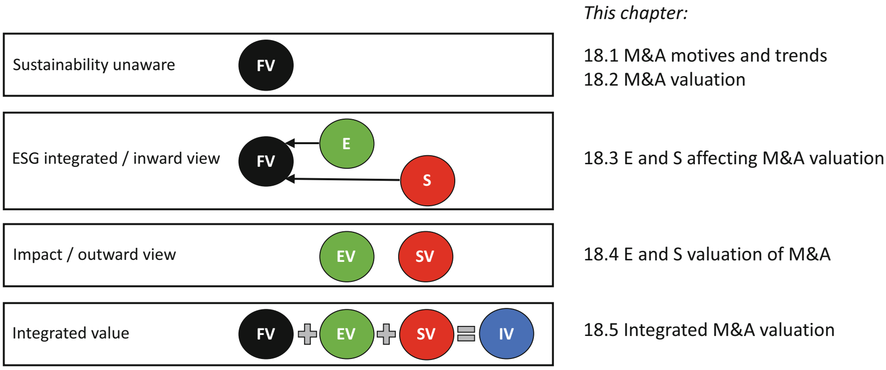

Fig. 18.1 Chapter overview

An integrated perspective on M&A valuation is therefore needed. In particular for large M&A deals, an integrated value test should be required. This implies that a takeover or merger would only go ahead if and when the integrated value of the combined companies is higher than the integrated value of the stand-alone companies. The aborted takeover attempt of Unilever by Kraft Heinz would not have passed the integrated value test. While the merged combination might have improved short-term financial value (passing the financial test), the integrated value would have declined as Kraft Heinz planned to reduce the sustainability (E and S) efforts of Unilever (failing the integrated value test). See Fig. 18.1 for a chapter overview.

Learning Objectives
After you have studied this chapter, you should be able to:

- analyse the typical motives for M&A transactions—and to what extent they make sense,
- do a simplified calculation of M&A value in terms of F, S, and E,
- judge an M&A deal on its merits in a wide sense, i.e. considering its value creation on F, S, and E,
- analyse the interactions between F, S, and E in M&A, as well as behavioural influences.

18.1 M&A Basics, Motives, and Trends

In this chapter, we use the term M&A (mergers and acquisitions) as a general term for all kinds of deals in which companies or parts of companies are bought and sold. In a *takeover* or *acquisition*, one company buys another company and it is typically quite clear who is the buyer and who is the seller. But in a *merger*, it is supposed that companies of roughly equal size together decide to continue as one company, without a clear buyer or seller. But note that sometimes a deal may be *called* a merger for political reasons, whereas it is quite clear who is the senior party and who is the junior; and/or who is the buyer and who is the seller. The buyer is called the *bidder* during the bidding process and called the *acquirer* if the deal happens. The company that is sold is called the target during bidding and becomes the acquired company once the deal is done.

Companies are not bought and sold overnight. Rather, a *bidding process* takes months and is preceded by screening activities aimed at identifying the most suitable targets and doing initial valuations. During the bidding process, a *due diligence* is carried out in which the bidder (or its deal consultant) scrutinises the target's accounts under strict non-disclosure agreements. Bids can be *friendly*, i.e. with the consent of the target's management, or *hostile*, where such consent is lacking. In the latter case, a bid becomes more difficult, but it can still succeed. If all tests are passed, the actual bid is made, and the target company's shareholders decide on the outcome. But even with their approval, the deal can still be stopped by regulators if it is deemed to be anti-competitive or contrary to national interests. For example, in August 2020 the UK government blocked the takeover of electronic design company Pulsic by a Hong Kong rival over national security concerns.[1] Companies themselves can also apply *takeover defences*, such as poison pills, differential voting rights, multiple layers of shareholdings, or golden parachutes. This chapter will not dive further into the topics of M&A regulation and M&A tactics.

The seller can be the acquired company itself (i.e. its shareholders), but it can also be a parent company that sells a business unit. In that case, the business unit being sold is called a *divestiture*. In the case of a *spin-off*, the business unit is not sold to another company, but set up as an independent company. Typically, the parent company gives up control over the business unit by distributing the business unit's shares to the parent's shareholders. But in some cases, a parent company partly sells a subsidiary, but retains control of it. This is called an *equity carve-out*, split-off IPO, or partial spin-off. Box 18.1 provides an example of an equity carve-out.

Box 18.1 Equity Carve-Out Example: The IPO of Porsche AG

A recent example of an equity carve-out is Porsche AG, the luxury car maker, which did an IPO in September 2022. With a valuation of €75 billion it was the largest European IPO in two decades. However, its frame as an IPO leaves out part of the picture, namely that Porsche AG is floated by and remains under control of parent company Volkswagen AG and by Porsche SE, the holding company of the Piëch and Porsche families. In the IPO, only preferred Porsche AG shares, carrying no voting rights, were sold. The point of this partial IPO is to make the value of Porsche AG more visible within Volkswagen AG, which

(continued)

[1] "Kwarteng blocks takeover of Pulsic by Hong Kong rival over security concerns", The Guardian, 1 8 August 2022.

Box 18.1 (continued)
is not that much more valuable, at just over €80 billion. An investor was quoted saying: ‘Porsche was and is the pearl in the Volkswagen Group. The IPO has now made it very, very transparent what value the market brings to Porsche’.[2]

18.1.1 Market Reactions to M&A

The market’s assessment of a potential M&A transaction is expressed in the stock price reactions of the target and the bidder (provided that they are both listed), which reflects a mix of (1) the value creation for shareholders and (2) the likelihood that the transaction will happen. Hence, the stock price reaction is seen as the criterion for success and researchers have studied stock price reactions to proposed M&A transaction to learn about M&A. There is also evidence (Kau et al., 2008) that managers to some extent listen to the market in M&A. For example, they are more likely to cancel takeovers when the market reacts unfavourably to the related announcement and they listen more if more of their shares are held by large blockholders (i.e. owners of a large block of a company’s shares), and when their CEOs have higher pay-performance sensitivities.

18.1.2 Types of M&A by Business Activity

An often-used way to classify M&A is by how the bidder and the target relate to each other in terms of their business activity:

- *horizontal* (same line of business),
- *vertical* (different parts of the same value chain),
- *conglomerate* (unrelated business).

Let us take the perspective of a pharmaceutical company as the acquirer. If it acquires another pharma company with a similar product portfolio, i.e. a direct competitor, this is a *horizontal takeover*. If it acquires a supplier, such as an ingredients company, or a client, such as a managed care organisation, this constitutes a *vertical takeover*. Finally, if it acquires an unrelated business, such as an advertising agency or a bank, this is a *conglomerate takeover*. However, the distinctions are not always that neat. What if the company takes over a pharmaceutical company that is not a direct competitor, or only a competitor in certain markets, then what is the boundary between a horizontal and a conglomerate takeover? The

[2] Porsche races higher after landmark $72 billion listing | Reuters.

right criterion is then probably the amount of synergies (see below): high in case of a horizontal takeover, and insignificant in case of a conglomerate takeover.

Empirical research results suggest that the success or failure of M&A depends very much on the circumstances. For example, Mulherin and Boone (2000) find that announcement effects of both acquisitions and divestitures in the 1990s are positive on average, i.e. they tend to increase shareholder wealth. Moreover, the wealth effects for both acquisitions and divestitures are directly related to the relative size of the event. 'The symmetric, positive wealth effects for acquisitions and divestitures are consistent with a synergistic explanation for both forms of restructuring and are inconsistent with non-synergistic models based on entrenchment, empire building and hubris'.

18.1.3 Motives

M&A deals can be done for several reasons, some of which are deemed more valid than others. The search for synergies is typically deemed a valid reason, whereas cheap funding and increased EPS (earnings per share) are seen as poor reasons. Protection of the existing business model by diversification is another invalid reason, as the investor can achieve this by themselves through a portfolio strategy. In addition, irrational managers can rationalise poor M&A decisions.

Synergies mean that the cooperation of two organisations provides better results (higher sales, lower costs, lower risk) than the mere sum of their parts. There are several potential sources of synergies:

- economies of scale: as production volumes go up, unit costs tend to fall due to learning effects and the recovery of fixed costs;
- economies of scope: combining similar products tends to give positive spill-over effects;
- vertical integration: acquiring other parts of the value chain (i.e., upstream from suppliers or downstream from clients) can allow for streamlining of production and lower costs or higher sales;
- industry consolidation: by reducing competition, a larger part of the consumer surplus is taken. But of course, this is to the detriment of consumers and society at large (see Philippon, 2019); and,
- transition: acquiring companies with advanced sustainability (E and/or S) capabilities can accelerate the transition (see Sects. 18.3, 18.4, 18.5).

An example of economies of scope is the $63 billion takeover of the agri-chemical company Monsanto by the chemical company Bayer in 2018. However, this deal ended up with large losses instead of the projected synergies (see Box 18.3). An example of industry consolidation is the $68.7 billion takeover of Activision Blizzard, a video game company, by Microsoft in 2022. Finally, the DSM–Firmenich merger in 2022 provides an example of transition (see Box 18.4).

M&A deals involve estimating synergies before actually executing them. So, their potential is not always achieved. Moreover, they can be achieved at the cost of others. This applies in particular to industry consolidation, which may result in higher prices because of reduced competition. We will return to this in Sect. 18.4.

M&A deals can also be done for poor reasons, such as diversification; increasing earnings per share (see the case of Kraft Heinz-Unilever in the Appendix); or lowering financing costs. In research on serial acquirers, Renneboog and Vansteenkiste (2019) find that related or focused acquisitions outperform unrelated or diversifying acquisitions.

In addition, such poor reasons for M&A deals can also be behaviourally driven (see Sect. 18.2). Examples are:

- escalation of commitment: if there is already much time and efforts invested, it often becomes mentally hard to stop a process;
- when operating in the domain of losses: Shefrin (2018) provides the example of Hewlett-Packard in 2001. The company had missed its Q4 2001 earnings target; had provided guidance for lower future earnings; and had unsuccessfully sought to buy accounting firm PwC. As a result, Hewlett-Packard's management was psychologically operating in the domain of losses. This likely contributed to its overvaluation of takeover target Compaq.
- overoptimistic managers: overconfident CEOs overestimate their ability to generate returns. As a result, they overpay for target companies and undertake value-destroying mergers (Malmendier and Tate, 2008). Overconfident and overoptimistic CEOs are also 65% more likely to complete an acquisition; and,
- serial acquisition: some companies are serial acquirers and acquire multiple companies per year. Renneboog and Vansteenkiste (2019) find that serial acquisition performance declines deal by deal, mainly driven by CEO overconfidence (related to the previous reason).

18.1.4 M&A Advisory

During an M&A process, both the bidder (acquirer) and the seller (target) hire advisory partners, also known as buy-side and sell-side mandates. Typically, an investment bank acts as the primary contact person for the sellers and bidders throughout the entire process, whereby each selling or bidding company hires its own investment bank advisor. When the seller is the initiator, the seller's investment bank supports the company in preparing the to-be-sold equity, before pitching to prospective bidders. Similarly, when the bidder is the initiator, the bidder's investment bank supports the company in selecting potential targets. Additionally, investment banks support with valuations and negotiations.

Various specialists are hired to conduct a due diligence of the target. Financial experts normalise and evaluate the target's earnings and financial statements (see Chap. 17). Operational specialists evaluate the different value drivers of the target, e.g. an industry specialist analyses its production network. Finally, lawyers review critical company contracts and prepare the non-disclosure agreements and the purchase agreement.

18.1.5 M&A Waves

M&A activity comes in waves, as illustrated by Fig. 18.2. These M&A waves are linked to the state of the economy. During an upswing of the economy, M&A activity increases followed by a sharp decline when the downturn sets in. Figure 18.2 shows this around the internet bubble (bursting in the early 2000s) and the Global Financial Crisis (starting with the fall of Lehmann Brothers in 2008).

Mulherin and Boone (2000) find significant industry clustering in both acquisitions and divestitures related to synergies (economic motives) and hubris (personal motives). An example is the acquisition of internet companies during the internet bubble in the late 1990s. Cross-border M&A also cluster by industry and time (Xu, 2017). Late deals exhibit better performance than early deals within a merger wave, which suggests learning.

Intuitively, this response to market conditions makes sense. During a recession, management attention is diverted to more urgent matters, such as sustaining the business model. Funding acquisitions becomes more expensive, as interest costs typically rise to reflect the market risk, while equity issues are costly for existing shareholders. As the company's market capitalisation tends to fall during a recession, an equity issuance causes greater dilution of existing shareholder's ownership. Lastly, valuations (of the targets also) tend to fall, because the discount rates used to compute the present value of a company's equity increase with market risk (see Chap. 9).

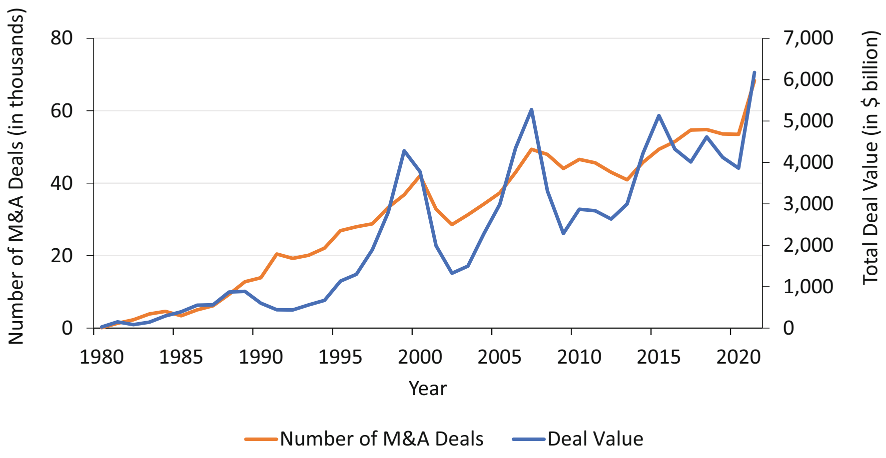

Fig. 18.2 Global M&A activity between 1980 and 2021. Source: Data obtained from Refinitiv Eikon Deal Screener

18.2 M&A Valuation

In Sect. 18.1, we identified synergies as the main criterion for M&A success. But in finance terms the criterion is the same as in any investment decision: what is the NPV? Of course, the two criteria are linked: the larger the synergies, the bigger the NPV tends to be. But there are other drivers as well, such as the price demanded by the seller, who might be aware of the size of the synergies. Koller et al. (2020) define the value creation as follows:

$$\begin{aligned}\text{value created for acquirer} &= \text{value received} - \text{price paid} \\ &= (\text{standalone value of the target} + \text{value of performance improvements}) \\ &\quad - (\text{market value of the target} + \text{acquisition premium})\end{aligned} \tag{18.1}$$

Figure 18.3 summarises the components of the acquirer's value creation.

The *stand-alone value* of the target is management's assessment, which does not need to equal the market value (and may be either higher or lower). The *value of performance improvements* relates to the measures that the acquirer intends to take, for example cost cutting or using new market channels. These are often referred to as synergies.

The *acquisition premium* is the price paid by the acquirer on top of the market value of the target. This premium is driven by expectations (the size of the expected synergies; 'normal' acquisition premia) and behaviour (hubris of the bidder or overvaluation by the management of the target, or by its core shareholders).

We can of course express the terms from Fig. 18.3 in numbers. The following information is given: the market value of the target is $585 million, which is a 10% undervaluation of its intrinsic value at $650 million; synergies are estimated at 15% of intrinsic value, which is $97.5 million (= 15% * $650 million). There are two scenarios for the sellers' demanded acquisition premium on the target's market value: 20% and 30%. Then what is the value creation for the acquirer in both scenarios? Table 18.1 gives the calculations.

In both scenarios, the *intrinsic value* (i.e. the fundamental value based on a serious DCF analysis) is $650 million +15% of $650 million = $747.5 million.

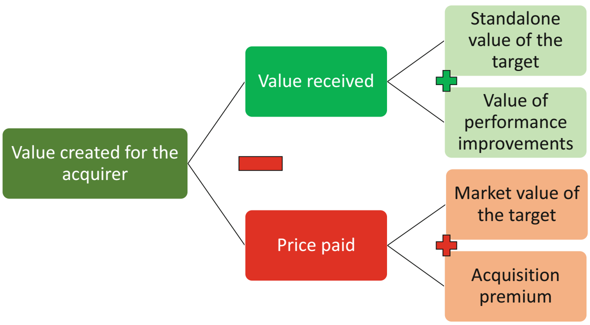

Fig. 18.3 Value creation for the acquirer

Table 18.1 M&A valuation example

Value component	Value, $ millions at a 20% takeover premium	Value, $ millions at a 30% takeover premium
Stand-alone intrinsic value of the target	650	650
+ Value of performance improvements	97.5	97.5
= Value received (1)	747.5	747.5
Market value of the target	585	585
+ Acquisition premium	117	175.5
= Price paid (2)	702	760.5
Value created for acquirer (1)–(2)	**45.5**	**−13**

The difference is in the price paid, driven by the acquisition premium of $117 million (20% of $585 million) versus $175.5 million (30% of $585 million). Table 18.1 shows the value created for the acquirer. In the case of a 20% takeover premium, the value created for the acquirer is $45.5 million (= $747.5 million–$702 million). In the case of a 30% takeover premium, the value created is –$13 million (= $747.5 million–$760.5 million).

This example still leaves open where these valuations come from, or how the acquisition is financed (cash or stock financed). M&A valuations may, just like regular company valuations, be based on multiples or the discounted cash flow (DCF) model (see Chap. 9). Multiples valuation is a relative valuation, whereby a stock value (or more generally, an asset's value) is derived from the given (market) value of another comparable stock. The DCF model is an *absolute valuation method*, whereby the free cash flows available to investors (equity and debt holders) are discounted. The valuation can be split into value drivers: sales growth, EBIT margin, and cost of capital.

The tough part about M&A valuation is making assumptions about the value drivers. Management's assumptions are not known to the outside world. That makes it hard to assess how rational management's assumptions are. For example, in its 2014 takeover of WhatsApp, Facebook (now Meta) paid $19 billion for a company with just $20 million in annual revenue. As a Forbes article[3] put it: 'That's not enough to justify a $19 billion price tag, so Facebook is almost certainly looking at other ways the messaging service could make money'. In sum, it is very hard to tell in particular cases if companies make the correct assessment. However, there is strong evidence that they often do not make a rational assessment. Example 18.1 asks you to calculate the value creation in a M&A deal in the car industry.

[3] 'Facebook Closes $19 billion WhatsApp deal', Forbes, 6 October 2014.

Example 18.1 Value Creation in M&A

Problem

Assume a hypothetical acquisition in the car industry, where German car manufacturer Volkswagen decides to acquire the smaller, Swedish car manufacturer Volvo. As of the closing date, Volvo's equity was trading at a market cap of €37.6 bn. By integrating Volvo into its wider company, synergies of €4.5 bn are projected, while Volkswagen assumes Volvo to be worth 10% more than its current trading value.

Assume that Volkswagen is willing to pay a €2 bn premium, how much value is created?

What would be the highest acquisition premium at which Volkswagen still creates value?

Solution

Firstly, we compute the stand-alone value, from the acquirer's point of view:

$$Standalone\ Value = Trading\ value * \% = \text{€}37.6\ \text{bn} * 1.1 = \text{€}41.4\ \text{bn}.$$

Using Eq. (18.1), we can calculate the value creation:

$$\begin{aligned} Value\ creation &= (standalone\ value + value\ of\ synergies) - \\ &\quad (market\ value + acquisition\ premium) \\ &= (\text{€}41.4 + \text{€}4.5) - (\text{€}37.6 + \text{€}2) = \text{€}6.3\ \text{bn} \end{aligned}$$

By re-arranging the above equation, we can find the break-even point for value generation:

$$(\text{€}41.4 + \text{€}4.5\ ) - (\text{€}37.6 + acquisition\ premium^{max}) = 0$$

$$acquisition\ premium^{max} = \text{€}8.3\ \text{bn}$$

Just to check—the maximum acquisition premium of €8.3 bn is composed of the 10% higher valuation by VW of Volvo of €3.8 bn (=€41.4 bn – €37.6 bn) and the projected synergies of €4.5 bn. So, Volkswagen has scope to increase the initial acquisition premium of €2 bn during the bidding. In practice, instead of making a public offer, VW would probably approach Volvo's controlling shareholder to make a deal.

18.2.1 Financing M&A Deals

The acquirer needs to finance the M&A deal. The acquiring company can pay the price for the target company in cash, in stock or with a combination of both. Taken from Eq. (18.1), the price paid is as follows:

$$\text{price paid} = \text{market value of the target} + \text{acquisition premium} \qquad (18.2)$$

The cash financed M&A deal is straightforward. The acquirer offers the original share price plus the acquisition premium in cash to the target's shareholders. Assuming that our target company in Table 18.1 has 100 million shares outstanding and offers a 20% takeover premium, the acquirer's cash offer is $7.02 per share, adding up to $702 million (=$7.02 * 100 million shares). This cash offer is a combination of the original share price (before the takeover announcement) of $5.85 and an acquisition premium of $1.17 (20% of the original share price).

Many mergers and acquisitions are paid wholly or partly in the acquirer's stock. Let's assume that the acquirer also has 100 million shares outstanding at $10 per share. To pay the takeover in stock, the acquirer has to offer 70.2 million shares (=$702 million/ $10). The target stockholders receive a fraction x of the combined companies:

$$x = \frac{new\ shares}{new + old\ shares} \tag{18.3}$$

In our example, the target stockholders receive a fraction of $0.4125 = \frac{70.2}{70.2+100}$ of the combined companies.

Is the stock offer equivalent to the cash offer? Assuming that the acquirer's stock is priced at its intrinsic value (i.e. no over- or undervaluation), the value of the combined companies is $1747.5 million, which is the sum of the acquirer's intrinsic value ($1000 million), the target's intrinsic value ($650 million), and the performance improvements ($97.5 million). The target stockholders receive $720.8 million (=0.4125 * $1747.5 million). The value of the stock offer is $18.8 million more than the cash offer of $702 million. Why is that? The explanation is that in stock payments, what you see is not what you get.

In a stock offer, the effective price of the merger or takeover is affected by the M&A gains or losses. Whereas target stockholders get a fixed price (i.e. cash) in a cash offer, they share in the post-merger gains or losses if stock is offered. Let's do the calculation. The merger gain is $45.5 million in our example in Table 18.1. The target stockholders obtain 0.4125 * $45.5 million = $18.8 million of the merger gain. This is exactly the difference between the stock offer and cash offer, as calculated above. Example 18.2 shows the calculation of a cash and stock-financed M&A deal. This is quite a demanding exercise requiring several steps in the calculation.

Payment in stock mitigates the undervaluation and overvaluation of both companies (see below on behavioural issues). In the case of overvaluation of the target (e.g. because of a hidden liability), the target and acquirer stockholders share in the losses. Similarly, in the case of undervaluation, the target and acquirer stockholders share in the gains.

Example 18.2 Cash and Stock-Financed M&A

Problem

An aerospace company takes over an aircraft engine manufacturer in a vertical takeover. The aerospace company makes a combined offer in cash and stock. Assume the target currently has 300 million shares outstanding, which are trading at €26.3 per share. Additionally, an acquisition premium of 12.5% is to be paid. The acquirer currently has €1.2 billion in liquid, freely available funds, which it intends to use for the acquisition.

1. How many new shares does the aerospace company need to issue if its own equity is trading at €75 per share?
2. If the acquirer has 500 million shares outstanding and expects €2.5 billion in synergies, how much does the combined cash and stock offer exceed a pure cash offer?

Solution

For question (1), we first compute the price paid by the acquirer, using Eq. (18.2).

$$Price\ paid = 300\text{ mn} * €26.3 * (1 + 12.5\%) = €\ 8.9\text{ bn}$$

Next, we can compute the number of new shares issued.

$$Shares\ issued = \frac{€8.9\text{ bn} - €1.2\text{ bn}}{€75} = 102.35\text{ million}$$

For question (2), we compute first the value of the two types of offers.

$$Value_{Cash\ Offer} = €8.9\text{ bn}$$

The next step is to calculate the value per share of the combined company. That is the combined company value, which is the stand-alone market value of both companies plus the expected synergies, divided by the new number of shares.

$$Value\ per\ share_{Combined\ company} = \frac{Combined\ company\ value}{Number\ of\ shares} =$$

$$\frac{(500\text{ mn} * €75) + (300\text{ mn} * €26.3) + €2.5\text{bn}}{500\text{ mn} + 102.35\text{ mn}} = \frac{€47.9\text{ bn}}{602.35\text{ mn}} = €79.5$$

We are now able to calculate the value of the cash and stock offer.

(continued)

Example 18.2 (continued)

$$Value_{Cash\ and\ Stock\ Offer} = €1.2\ \text{bn} + (€79.5 * 102.35\ \text{mn}) = €9.35\ \text{bn}$$

As you can see, the combined offer of €9.35 bn exceeds the pure cash offer, which is worth €8.9bn. The excess amount of €0.45 bn can be explained by the participation in the predicted synergies. We can check this extra amount for the aircraft engine maker's shareholders:

$$number\ of\ shares\ received * price\ differential =$$

$$102.35\ \text{mn} * (€79.5 - €75) = €0.45\ \text{bn}$$

18.2.2 Behavioural Issues in M&A Valuation

As discussed previously, behavioural issues can be internal (errors by management) or external (errors by the market). In internal errors, managers overvalue their own company, the target, or the synergies. Companies can make several such behavioural mistakes when doing M&A. For example, before they make their bid, they can overestimate the aforementioned synergies or underestimate the risks involved, such as the cultural risks of integrating two organisations with different habits. In a bidding context, management can succumb to the winner's curse: winning an auction or bidding contest by overpaying. This can be aggravated by hubris, a special case of winner's curse, caused by overconfidence (Roll, 1986).

In external errors, the market overvalues the target or the bidder (who might be paying in its own shares). Such misvaluation can dramatically change M&A incentives. This is very nicely shown in the Shleifer and Vishny (2003) model, which assumes that: (1) acquirers are overvalued; and (2) the motive for acquisitions is to preserve some of the temporary overvaluation for long-run shareholders—that is, the goal is not primarily to realise synergies.

The empirical predictions of the model are as follows:

- Managers' perceptions of mispricing drive acquisition probabilities;
- Method of payment matters: predicts that cash acquirers earn positive long-run returns versus negative for stock acquirers since the latter are likely to be overvalued. There are varying pecking orders:
  - for the acquirers who regard themself undervalued: preference for paying cash;
  - for the acquirers who regard themself overvalued: preference for paying in stock;
- Market-level mispricing proxies and merger volume are positively correlated, i.e. higher M&A volumes in overvalued markets. This is confirmed by Dong et al. (2006).

The Shleifer and Vishny (2003) model is the external errors' mirror image of Roll's (1986) hubris theory of M&A, which is based on internal errors. It is consistent with the findings by Moeller et al. (2005) that large M&A losses are concentrated in a small number of very large deals. Box 18.2 provides the example of the $182 billion Time Warner takeover by AOL.

Of course, one could ask why not do an outright equity issue to realise the overvaluation? First, a stock-financed takeover more effectively hides the underlying market timing motive from investors. Second, inertia (i.e. tendency to do nothing) plays a role: equity issues require investor action whether to buy the new stocks or not, while M&A doesn't require specific action. Of course, investors do need to approve the takeover if the acquiring company issues a large amount of new stock in the deal. The US stock exchanges, such as NYSE and NASDAQ, require, for example, shareholder approval when a company issues more than 20% of its stock in a M&A deal.

Box 18.2 AOL's Takeover of Time Warner

In 2000, America Online (AOL) paid $165 billion in AOL stock and acquired $17 billion of Time Warner debt in one of the biggest M&A deals in history. The aim was to create a digital media powerhouse. The market capitalisation before the announcement was $185 billion for AOL and $84 billion for Time Warner. This looked like an almost 100% takeover premium (paying $165 billion in AOL stock for $84 billion of Time Warner stock), but AOL stock was vastly overvalued at the peak of the dot-com bubble in 2000. There were indications for AOL's overvaluation at the time:

- AOL had zero residual income;
- Internal memos indicate that AOL's CEO Steve Case thought that dot-com stocks, including AOL, were overpriced and that he sought to exploit this overpricing; and
- Time Warner's investor relations admitted that AOL was 'basically an elaborate spin machine'.

Time Warner did not recognise AOL's overvaluation, as Time Warner's CEO Gerald Levin trusted market prices. In the year after the deal, AOL Time Warner experienced a $99 billion write down. The combined market capitalisation fell from its peak of almost $250 billion in 2000 to less than $50 billion in 2002. This dramatic loss in value of 80% stemmed partly from false expectations about forecasted earnings growth of 30%.

Source: Shefrin (2018)

It can also be the other way around, namely that the bidder is undervalued or perceives itself to be undervalued. This effectively discourages the bidder to make the offer in stock. Say the price of the target is $13 billion, and the bidder perceives itself to be undervalued by 20%, then it feels it is paying 25% more: $16.25 billion (= $13 billion/[1–0.2]).

18.2.3 Hedge Fund Activism

There are market participants who specialise in hostile M&A activity. These are activist hedge funds, which have a highly concentrated portfolio of holdings in companies that they want to shake up. Their stakes are not necessarily large as a percentage of a target company's overall capital. For example, The Children's Investment (TCI) succeeded in breaking up ABN AMRO bank in three pieces sold to Royal Bank of Scotland, Fortis, and Santander with just 1% of the shares, by writing an aggressive letter and amassing a coalition of partners in 2007.

There is academic evidence that an activist approach can work. Boyson et al. (2017) find that shareholder value creation from hedge fund activism occurs primarily by influencing takeover outcomes for targeted firms. Even failed bids lead to improvements in operating performance, financial policy, and positive long-term abnormal returns at targets of activism, which suggests that activism enhances value. Brav et al. (2018) find that companies targeted by activists improve their innovation efficiency over the five-year period following hedge fund intervention. Despite a tightening in research and development (R&D) expenditures, target firms increase innovation output, as measured by both patent counts and citations, with stronger effects among firms with more diversified innovation portfolios.

18.3 E and S Affecting M&A Valuation

Thus far, we have left E and S out of the equation, but they can have very material effects on M&A deals and their valuation.

18.3.1 E and S Effects on M&A Before Valuation

Managers can see E and S issues as drivers of risks and opportunities in their product markets (see Chap. 2). In terms of risks, they can perceive certain assets as being too risky operationally or bringing reputation risks, which can result in management teams shying away from specific M&A deals in the first place. Opportunities can also drive strategic preferences in M&A deals, such as the desire to acquire sustainability skills or to buy renewable energy assets. Take energy companies Ørsted and Neste for example, who transformed their product portfolios by selling fossil fuel assets and buying renewables assets.

This also means that companies can become targets because of their sustainability skills. Gomes (2019) finds that companies with higher CSR scores are more likely to be acquisition targets. And sustainability skills are also associated with buyer success: Deng et al. (2013) find that mergers by high CSR acquirers take less time to complete and are less likely to fail than mergers by low CSR acquirers. This fits with the observations of Polman and Winston (2021) who argue that a sustainability-driven culture drives M&A preferences of takeover targets: Unilever acquired many mission-driven and founder-led firms that only wanted to be taken over by Unilever, not by its peers, because of its values.

Moreover, Arouri et al. (2019) find that during 2004–2016, arbitrage spreads (a measure of deal uncertainty) are negatively associated with acquirers' CSR. So, a stronger CSR profile of the bidder means higher probability of closing the deal. Weaker players try to avoid this by seeking environments with lower societal pressure: Bose et al. (2021) find that high carbon emitting acquirers are more likely to buy firms in countries with low GDP; and they also tend to buy firms in countries with weak environmental or governance standards.

18.3.2 E and S Effects on M&A Valuation

As we saw in the previous chapters, E and S can affect the value drivers and hence the attractiveness of M&A deals. For example, as low-carbon energy assets benefit from upcoming regulation and likely higher future carbon prices, they tend to have better expected cash flows and lower risk than otherwise identical energy assets with higher carbon intensities. This is likely to drive up the bid prices of utilities companies with low-carbon intensities versus those with high carbon intensities. Gomes and Marsat (2018) study the impact of CSR performance on acquisition premiums. Although CSR performance is an imperfect measure of E and S value, they do find a positive link between targets' overall CSR performance and acquisition premiums and a positive link between targets' environmental performance and acquisition premiums. Their findings are less pronounced for targets' social performance, which turn out to only impact acquisition premiums in cross-border deals. In addition, Deng et al. (2013) find that compared with low CSR acquirers, high CSR acquirers realise higher merger announcement returns.

18.3.3 E and S Effects on Post-Deal Performance

E and S can also have impact on post-deal performance. Deng et al. (2013) find that compared with low CSR acquirers, high CSR acquirers realise larger increases in post-merger long-term operating performance. They also realise positive long-term stock returns, suggesting that the market does not fully value the benefits of CSR immediately as part of the positive stock returns are obtained only in the long run.

The underestimation of E and S effects can be extremely costly. A major example is the takeover of Monsanto by Bayer (see Box 18.3). Health issues related to one of Monsanto's key products, Roundup, led to numerous lawsuits culminating in a multi-billion settlement. That shows the importance of not only checking the financial accounts in the due diligence during the bidding process (see Sect. 18.1), but also examining relevant E and S issues.

Box 18.3 Health Issues Destroy Value in Bayer's Takeover of Monsanto

Bayer, the German pharma and biotechnology company, announced the takeover of the agri-chemical company Monsanto in 2016 with the intention to become a global leader in life science. The final cash offer amounted to $63 billion. After settling antitrust concerns, the deal was completed in 2018. Soon after finishing the deal, the first lawsuits on Monsanto's Roundup weed killer started, internalising the negative health issues.[4]

Roundup was popular with farmers, as it increased crop yield by killing weed. Glyphosate is a chemical ingredient of Roundup. A 2015 report from the World Health Organisation's International Agency for Research on Cancer showed that there was 'sufficient evidence' that glyphosate causes cancer in animals as well as damaging effects on human cells. As of September 2022, Monsanto has settled over 100,000 Roundup lawsuits worth over $10 billion. Over 30,000 lawsuits are still pending.[5] Bayer cut its dividend to zero in 2021 after litigation on health issues hit 2020 cash flows and profits (see Chap. 16). In 2022, Bayer resumed dividend payouts.

The market capitalisation of Bayer was $83 billion and that of Monsanto was $45 billion at the time of the announcement. The acquisition premium amounted to $18 billion (=$63 billion − $45 billion) or 40% of Monsanto's pre-announcement market value. Bayer expected annual cost and sales synergies of $1.5 billion. In its bid announcement, Bayer did not give an estimate of potential health liabilities, suggesting that they were not considered.

Bayer financed the deal with new equity of $7 billion, combined with asset sales, cash drawdown, and new debt. At the time of writing (December 2022), Bayer's market capitalisation was $55 billion, well below its original market cap of $90 billion (= $83 billion + $7 billion). The Bayer-Monsanto deal is an example of very negative S impact on M&A value, although the drop in market capitalisation cannot be fully attributed to the lawsuit ($10 billion).

Going forward, pesticides, such as Roundup, are increasingly banned by governments in the transition to healthy food and regenerative agriculture (see Chap. 2).

[4] https://www.wsj.com/articles/how-bayer-monsanto-became-one-of-the-worst-corporate-dealsin-12-charts-11567001577

[5] Roundup Lawsuit Update September 2022 | Average Roundup Settlement Per Person (torhoermanlaw.com).

18.3.4 E and S Driven M&A Activism

The past years have seen the emergence of sustainability-driven activism by hedge funds.[6] For example, Jana Partners partnered with CalSTRS in 2018 to pressure Apple's board to address the potential negative effects of iPhone use on children. Trian Partners has pushed companies including GE, DuPont, and Danone to promote workplace diversity, adopt supplier codes of conduct, and reduce emissions and waste. Some hedge funds went further and put companies under pressure to do E and S driven M&A deals. For example, Bluebell asked Glencore to separate its coal mines.[7] And Third Point called for a breakup of Shell.[8]

This is a positive development, and possibly the start of a break with the past. Looking at the past, DesJardine and Durand (2020) found that hedge fund activism between 2000 and 2016 yielded benefits that were shareholder-centric and short-lived, with immediate increases in market value and profitability, coming at a mid- to long-term cost to other stakeholders, captured by decreases in operating cash flow, investment spending, and social performance.

18.4 E and S Valuation of M&A

The previous sections discussed M&A from the perspective of financial capital. But E and S in M&A can be valued in their own right. That is important, since the potential for S and E value destruction in M&A is massive, but hitherto typically remains invisible. There is, of course, also potential for S and E value creation through M&A.

Grullon et al. (2019) find that since the late 1990s, over 75% of US industries have experienced an increase in concentration levels. Moreover, firms in industries with the largest increases in product market concentration show higher profit margins and more profitable M&A deals. At the same time, they find no evidence for a significant increase in operational efficiency. Taken together, their results suggest that market power is becoming an important source of value, reducing consumer surplus (see also Philippon, 2019). It has not been documented to what extent M&A might be motivated by the extraction of financial value at the expense of S and E (facilitated by market power).

Incumbent firms may acquire innovative targets solely to discontinue the target's innovation projects and pre-empt future competition. Cunningham et al. (2021) call such acquisitions '*killer acquisitions*'. Using pharmaceutical industry data, they show that acquired drug projects are less likely to be developed when they overlap with the acquirer's existing product portfolio, especially when the acquirer's market

[6] Hedge fund activists pivot to ESG, Institutional Investor, 23 January 2020.

[7] Activist investor Bluebell adds pressure on Glencore to fix coal unit, Bloomberg, 8 June 2022.

[8] Third Point's Loeb praises Shell moves, sticks by calls for breakup, Reuters, 7 May 2022.

Table 18.2 SV valuation example in M&A

	Bidder, pre-deal	Target, pre-deal	Synergies	Total
SV^{+}	14	23	−3	34
SV^{-}	−27	−3	−12	−42
SV	**−13**	**20**	**−15**	**−8**

Table 18.3 EV valuation example in M&A

	Bidder, pre-deal	Target, pre-deal	Synergies	Total
EV^{+}	0	0	0	0
EV^{-}	−52	−18	−7	−77
EV	**−52**	**−18**	**−7**	**−77**

power is large because of weak competition or distant patent expiration. Conservative estimates indicate that 5% to 7% of pharma acquisitions are killer acquisitions.

To determine the E and S valuation effects of M&A, one needs to calculate the pre-deal EV and SV of the target and the bidder; and EV and SV of the resulting combination—and hence its synergies. These can be valued, following the same logic as in Chaps. 5, 6, 9, and 10. Tables 18.2 and 18.3 give the example of a deal in which SV^{+}, SV^{-}, and EV^{-} deteriorate as a result of the deal, likely because the bidder imposes its exploitative business model and lower standards on the target. Please note that the superscript + and − stands for positive and negative values, respectively. The loss of SV and EV in synergies is substantial: −15 on SV and −7 on EV in Tables 18.2 and 18.3. This is also what likely would have happened if Kraft Heinz had succeeded in taking over Unilever. See the appendix to this chapter for the case study on that failed deal, including detailed calculations of SV and EV.

Of course, it could also be the other way round. The bidder can use the target's capabilities to improve the E and S profile of the combined company. That is likely to result in positive synergies on SV and EV. The outcome thus depends very much on the bidder's strategy on sustainability.

18.5 Integrated M&A valuation

Once we know the M&A valuation effects on EV and SV, we can also determine the integrated value (IV) of an M&A deal. Remember that $IV = FV + SV + EV$, whereby SV and EV can be split in positive and negative values, denoted by the superscript + and -, respectively. Table 18.4 shows the IV of the deal from the example in Tables 18.2 and 18.3. The financial synergies (7) are offset by the negative social (−15) and environmental (−7) synergies, resulting in overall negative synergies (−15).

This deal is value destructive on EV, SV, and IV. It would fail the integrated takeover test presented in Sect. 18.5.3. This highlights that E and S should also

Table 18.4 IV example in M&A–low E&S quality bidder

	Bidder	Target	Synergies	Total
FV	126	38	7	171
SV^+	14	23	−3	34
SV^-	−27	−3	−12	−42
EV^-	−52	−18	−7	−77
IV	**61**	**40**	**−15**	**86**

Table 18.5 IV example in M&A–high E&S quality bidder

	Bidder	Target	Synergies	Total
FV	108	38	3	149
SV^+	79	23	4	106
SV^-	−5	−3	1	−7
EV^-	−25	−18	7	−36
IV	**157**	**40**	**15**	**212**

become part of data rooms, due diligence, and reporting. The picture could look quite differently with a high E&S quality bidder, as shown in Table 18.5.

In this case, the financial synergies are lower (3), but the high E&S quality bidder also realises positive social (5) and environmental (7) synergies. The high-quality bidder thus manages to improve the overall value creation profile of the combined company by 15, an objective presented in Chap. 2.

18.5.1 Kraft Heinz–Unilever Case Study

Let's illustrate our examples with a company case study. In the Appendix, we present the attempted takeover of Unilever by Kraft Heinz in 2017. Kraft Heinz is an example of a low E&S quality bidder, which applied the standard financial analysis of synergies. Kraft Heinz's strategy was to maximise shareholder value, measured by EPS (earnings per share). Using EPS multiples, Kraft Heinz estimated the financial value of the synergies to be €46 billion. Table 18.6 presents this financial result in the first columns; the numbers are taken from Table 18.8 in the Appendix.

By contrast, an IPV analysis of the synergies based on a DCF model showed a very different result. The final columns of Table 18.6 present the financial, social, and environmental value creation; numbers are taken from Table 18.12 in the

Table 18.6 Synergies for Kraft Heinz–Unilever takeover (in € billions)

Financial analysis based on EPS		IPV analysis based on DCF	
Value	Synergies	Value	Synergies
FV	46	FV	−11
		SV	−38
		EV	−13
FV	**46**	**IPV**	**−63**

Appendix. The synergies were estimated at the time to be negative on all three dimensions: financial, social, and environmental value.

So, the estimated synergies depend very much on how the valuation analysis is conducted. There are two main reasons for the differences. First, the IPV analysis includes not just financial value but all three value dimensions. Second, the financial analysis was based on Kraft Heinz's EPS maximisation strategy: achieving sales growth while cutting costs. Moreover, Kraft Heinz assumed that sales growth could be maintained (i.e. extrapolating these growth numbers to the future) delivering positive financial value, which appeared not to be the case a few years later. In contrast, the IPV analysis was based on Unilever's long-term financial value drivers, which would decline due to diminished attention for social and environmental factors (because of the cost cutting).

18.5.2 IPV Criterion

Ideally, M&A deals result in an improvement in SV and EV, or at least not in a deterioration in SV and EV. However, as long as *NPV of FV* > 0 is the main criterion to judge the soundness of an M&A deal, the change in SV and EV is more likely to be negative than positive. In Chap. 6 (Eq. 6.3), we introduced the *IPV* (integrated present value) criterion for new investments:

$$IPV = FV + b \cdot SV + c \cdot EV > 0 \tag{18.3}$$

whereby $b \geq 0$ denotes the weighting of SV; and $c \geq 0$ denotes the weighting of EV. In the context of the models of Chap. 5 and 6, the incidence of M&A deals that do improve SV and/or EV is likely to increase with:

- SV and EV being measured or at least seen;
- lower discount rates on SV and EV (see Chap. 13);
- higher values for the parameters b and c to weight SV and EV.

In this way, applying the IPV criterion to M&A deals can improve the value profile of the company across the three value dimensions. The stylistic examples in Tables 18.2, 18.3, 18.4, 18.5 show the effects on the individual value dimensions: FV, SV, and EV. In reality, the three value dimensions interact. DSM is an example of a company that actively managed the three dimensions in an integrated way (though not using those labels). By improving SV and EV through internal investments and external M&A (see Box 18.4), DSM improved its long-term FV.

Box 18.4 DSM's Transition

DSM (Dutch State Mines) was established by the Dutch government to mine coal reserves, as its name suggests. When the coal mines were closed in the 1970s, the Dutch government helped out in the transformation of DSM into a base chemicals company. The government did not want to protect the coal mining jobs, but wanted to maintain employment (an important S issue) in the southern part of the Netherlands.

Since the 1990s, during which the company was fully privatised, DSM has transformed itself again, selling almost all of its commodity chemicals activities (to reduce exposure to negative E factors) and becoming a global science-based company for nutrition and health through a string of M&A deals[9]:

- acquisition of Martek in 2011—adding a new nutrition growth platform focused on polyunsaturated fatty acids;
- acquisition of Fortitech in 2012 to strengthen its human nutrition business;
- acquisition of Tortuga, the Brazilian market leader in organic trace minerals for animal nutrition and health, in 2013;
- acquisition of SRF Ltd.'s Specialty Materials business in India in 2019;
- acquisition of Erber Group, a company specialised in animal nutrition & health businesses, and Human Milk Oligosaccharides (HMO), a leading supplier of human milk for early life nutrition applications, in 2020;
- merger with Firmenich, a Swiss manufacturer of flavours and fragrances for the food and beverage industry, in 2022.

The DSM–Firmenich merger combines the health and nutrition divisions of DSM and the taste and perfume divisions of Firmenich. This latest merger completed the transition of DSM into a global leader in nutrition, beauty, and wellbeing.

18.5.3 Integrated Takeover Test

Implicit awareness of SV and EV is rising, but not yet safeguarded. The aftermath of the aborted takeover of Unilever by Kraft Heinz generated a debate on the 'protection' of companies steering on integrated value against the aggressive bids of shareholder-driven companies. Without protection, financial considerations (F) would always dominate social and environmental considerations (S + E). This would imply a bias towards the shareholder model (see Chap. 3). General defences against takeovers, such as certified shares, dual class shares, pyramiding or priority

[9] https://www.dsm.com/engineering-materials/en_US/connect/long-history.html

shares with friendly shareholders, can reduce market discipline on the management, which in turn might decrease the stock price of the company, without necessarily protecting against value extraction.

De Adelhart Toorop et al. (2017) propose a *societal cost-benefit test for takeovers*, which includes financial, social, and environmental factors. This is akin to an integrated takeover test. It is the responsibility of the management of both the acquiring and target company to conduct this test to obtain the integrated value of the joint companies. Similar to the way that an investment bank decides whether the terms of an M&A deal are fair, an independent advisor would give a fairness opinion on the outcome of the integrated takeover test. A Commercial Division of the Court or a Take-Over Panel (as in the United Kingdom) would only approve a takeover or merger if and when this integrated takeover test showed an improvement in the integrated value for society (in comparison with the integrated value of the stand-alone companies)—and ideally an improvement in the value of all its components. When necessary the Court or Panel could appoint experts to re-calculate the integrated takeover test.

It should be acknowledged that conducting such an integrated takeover test is administratively cumbersome and requires detailed information. With advances in integrated reporting this information will become more readily available, as highlighted in Chap. 17.

18.5.4 Integrated View on M&A Activism

One could also apply the integrated lens (with or without a formal integrated takeover test) to judge M&A activism. M&A activism is typically justified by claims of value creation (in the form of 'synergies'). But the key question is whether that value creation benefits all stakeholders (i.e., FV, SV, and EV all rise, or at least none of them fall), which is real or integrated value creation; or whether it is only value creation for (some) of the claimants of FV, coming at the expense of other stakeholders (i.e. SV and/or EV destroyed), which should be labelled value extraction instead of value creation (Mazzucato, 2018). It would be helpful if this distinction would already be made by managers, analysts, regulators, and reporters. Figure 18.4 illustrates this key question of value creation versus value extraction.

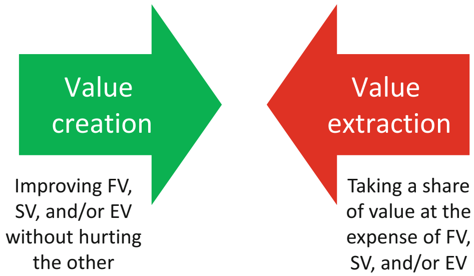

Fig. 18.4 Value creation versus value extraction in M&A

18.6 Conclusions

M&A are very large investments in which a company absorbs another company, which can dramatically change the profile of a company's assets. M&A deals can be done for several reasons, some are more rational and valid than others. Less valid motives include diversification and deals done for the sake of boosting earnings per share (EPS). Value creation is often more likely if there are synergies between the companies involved. M&A deals tend to come in waves, with clustering in industries and partly driven by market valuations.

Just as in any other investment decision, the financial sanity of M&A activity can be assessed with the NPV method. However, the numbers tend to be much bigger than in ordinary capex decisions, hence the stakes are bigger as well. This makes behavioural issues even more problematic, as they can result in very large overvaluation, overinvestment, and value destruction. And indeed, massive value destruction in a small number of very large M&A deals is well documented.

E and S issues can also affect the risk and valuation of M&A deals. If not properly understood and considered, E and S issues can have similar effects as the abovementioned behavioural issues, and reduce the company's financial value. A notorious example is Bayer's acquisition of Monsanto, which resulted in over $10 billion in litigation costs on health issues due to Monsanto's glyphosate product Roundup.

While the effects of E and S issues on M&A valuation are increasingly understood, scarce academic attention is given to the valuation of E and S in their own right in M&A deals. An M&A deal can be massively value destructive on E or S, which might justify blocking the deal. For example, the source of a takeover's financial success can lie in business practices that involve increased pollution, negative health effects, and exploitation of workers and consumers. In contrast, M&A deals can also be used to acquire S and E capabilities, accelerating a company's sustainability transition.

Therefore, an integrated perspective on M&A valuation is needed. In particular for large M&A deals, an integrated value test should be required. This implies that a takeover or merger would only go ahead if and when the integrated value of the combined companies is higher than the integrated value of the stand-alone companies. The DSM-Firmenich merger, which created a global nutrition and health company out of a chemicals company, would likely have passed the integrated value test. But the aborted takeover attempt of Unilever by Kraft Heinz would not have passed the integrated value test. While the merged combination might have improved short-term financial value (passing the NPV test), the integrated value would have declined as Kraft Heinz planned to reduce the sustainability (E and S) efforts of Unilever (failing the integrated value test).

Key Concepts Used in this Chapter

Acquirer is the company that buys another company in an M&A deal

Acquired company is the company that is bought by another company in an M&A deal

Acquisition is the situation in which one company buys another company; it is typically quite clear who is the buyer and who is the seller
Acquisition premium is the price paid in excess of the market price before the bid
Bidder is the company that tries to buy another company in an attempted M&A deal
Buyer is the company that buys another company in an M&A deal
Conglomerate M&A is an M&A among companies in unrelated businesses
Due diligence is an investigation carried out by the bidder (or its deal consultant) into the target's accounts under strict non-disclosure agreements
Economies of scale means that as production volumes go up, unit costs tend to fall due to learning effects and the recovery of fixed costs
Economies of scope means that combining similar products tends to give positive spill-over effects
Horizontal M&A is an M&A among companies in the same line of business
Industry consolidation refers to M&A deals that reduce competition, taking a larger part of the consumer surplus (by the consolidated companies)
Integrated takeover test is a test which measures whether the integrated value of the combined companies is improved in comparison with the integrated value of the stand-alone companies
M&A refers to mergers and acquisitions and is used as a general term for all kinds of deals in which companies or parts of companies are bought and sold
Merger refers to the situation in which companies of roughly equal size together decide to continue as one company, without a clear buyer or seller
Synergies refer to the benefits from combining two companies
Takeover see acquisition
Takeover premium is the price paid in excess of the market price before the bid
Target is the company that is targeted to be bought by another company in an M&A deal
Value creation refers to an increase in environmental value (EV), social value (SV), and financial value (FV)
Value extraction refers to an increase in financial value (FV) at the expense of environmental value (EV) and/or social value (SV)
Value of performance improvements relate to the measures that the acquirer intends to take, for example cost cutting or using new market channels; these are often referred to as synergies
Vertical M&A is an M&A among companies in different stages of the same value chain

Appendix: Kraft Heinz-Unilever Case Study

The attempted takeover of Unilever by Kraft Heinz in 2017 is particularly interesting because it represents a clash between two visions on value creation. Kraft Heinz represented the typical short-term financial optimiser of shareholder value; and Unilever the showpiece of enlightened shareholder value that recognises that, to

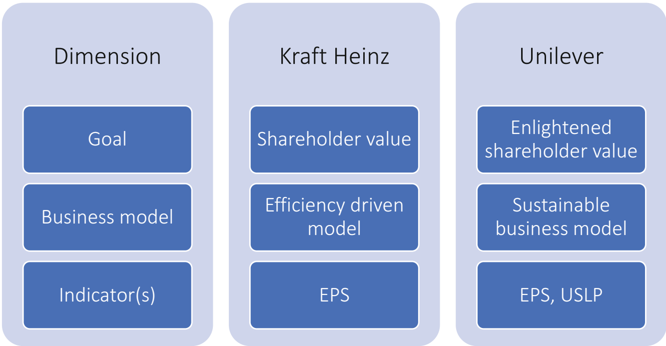

Fig. 18.5 Profile of the companies. Note: EPS is earnings per share; USLP is Unilever Sustainable Living Plan

obtain good long-term financial outcomes, other types of value need to be managed as well (see Fig. 18.5).

Kraft Heinz was the result of the merger of Kraft and Heinz and listed by 3G in 2015. 3G is a Brazilian private equity house infamous for its efficiency squeeze model based on zero-based budgeting. Zero-based budgeting means that all expenses must be justified and approved for each new period, regardless of how much money has previously been budgeted to any given line item. ZBB was also applied at previous targets of 3G, like Anheuser-Busch, resulting in very high margins, because of cost savings.

For many investors, Kraft Heinz looked like the epitome of efficiency and shareholder value creation, with even legendary investor Warren Buffett involved. Kraft Heinz's valuation was high, but its portfolio consisted of old-fashioned products and had little Emerging Markets exposure.

By contrast, Unilever did have an innovative product portfolio and a very high Emerging Markets exposure. It was also the favourite of proponents of a more social model (prosocial shareholders), with the Unilever Sustainable Living Plan (USLP) and a CEO who was vocal on social issues. But its margins were lower, and to the conventional investors, Unilever looked like the laggard that wasted money on fancy sustainability projects—behaviour begging to be 'disciplined' in the spirit of Jensen's (1986) free cash flow hypothesis. So, some investors were complaining about inefficiency. And then the bid came.

Not surprisingly, the announcement of the bid sparked a lot of debate: does the more profitable and less social company have the right to acquire the more social company? Conventional investors said yes, and prosocial shareholders said no—but lacked the means to back that up by protecting Unilever—as even their own portfolio managers are incentivised to maximise financial returns in the short run.

Unilever rejected the bid, saying that it 'fundamentally undervalues Unilever', and: 'Unilever rejected the proposal as it sees no merit, either financial or strategic, for Unilever's shareholders. Unilever does not see the basis for any further discussions'. And many of Unilever's top shareholders said that the bid drastically undervalued the company's assets. Unilever's CEO, Paul Polman played the game well, effectively forcing Kraft Heinz to come out with a bid much earlier than planned. That bid was too low and easily rejected. Three years later, it is Kraft Heinz that is in trouble while Unilever continues to flourish. Kraft Heinz suffered from falling margins and sales as well as an accounting scandal. Its stock price collapsed from just under \$100 at the time of the bid, to well below \$30 in 2020. However, it should be emphasised that Unilever's successful rejection of the bid was not a foregone conclusion, and it came at a price: to avoid another bid 6 months later (the regulatory window), the company felt it needed to keep the share price above €50, and it was forced to take measures such as cost cutting, disposals, and share buybacks.

Available and Missing Numbers in Kraft-Heinz' Failed Takeover Attempt of Unilever

The enlightened shareholders were basically saying that there was positive value in Unilever's model, which would have been destroyed if the takeover had happened. But they lacked the numbers to show that, and the mandate to act on it. In this section, we try to fill in those missing numbers, before discussing potential action in the next section. We value the bid from four perspectives:

1. short-term shareholder value;
2. long-term shareholder value;
3. social value; and
4. environmental value.

Short-term shareholder value

Kraft Heinz had a growth strategy based on maximising earnings per share. We use the multiples formula from Chap. 9 (Eq. 9.17) for calculating the components of the stock price P_0:

$$P_0 = EPS_0 * \frac{P}{E} \tag{18.4}$$

whereby EPS_0 is the earnings per share and P/E the price-earnings ratio. Table 18.7 derives the earnings per share and multiples underlying the initial stock price: $P_{Unilever} = €1.90 * 20.8 = €39.5$ and the target stock price: $P_{Unilever} = €3.01 * 22 = €66.3$.

Before the bid, Unilever's stock price drifted around €39–40. Allegedly, 3G and Warren Buffett thought they could create \$50 billion in shareholder value by taking over Unilever and raising its EBIT margins from 15% towards the levels of Kraft Heinz (26% in 2017). They would do that by using zero-based budgeting and cutting as much cost as possible, including spending on marketing and on the USLP. This would raise 2017 EPS from €1.9 to €3.0. A key assumption was apparently that the

Table 18.7 Kraft Heinz' path to short-term value creation

Item	Value
Unilever 2016 EBIT margins (1)	15%
KH EBIT margin target for 2017 (2)	26%
% of the margin gap to be closed (3)	80%
New Unilever margin under KH management (4) = (1) + [(2)–(1)]*(3)	24%
Improvement to be made (5) = (4)/(1) - 1	59%
Unilever 2016 EPS GAAP (6)	1.81
Unilever 2017 expected EPS (7)	1.90
Unilever stock price before the bid (8)	39.5
2017 Trading PE (9) = (8)/(7)	20.8
Unilever EPS potential after KH measures (10) = (7)*[1 + (5)]	3.01
New 'right' PE multiple to trade on (11)	22
Price at 'right' PE multiple (12) = (10)*(11)	66.3

Source: Derived by the authors based on company financials and news items

Table 18.8 Kraft Heinz' short-term value creation

Short-term value creation based on EPS	Equity value per share	Market capitalisation € billions
Stock price before the bid	€ 39.5	€ 68
Kraft Heinz bid price	€ 47.0	€ 81
Likely value to Kraft Heinz	€ 66.3	€ 114
Short-term value creation	**€ 26.8**	**€ 46**

price-earnings multiple would rise to 22 as a more profitable company should fetch a higher multiple.[10] The stock price would move to €66.3 (22*€3.0), an increase of €27 or 70%. That would imply a market value of €114 billion (€66.3*1.715 billion shares) versus €68 billion (€39.5*1.715 billion shares) previously; hence, short-term value creation of €46 billion, or almost $50 billion (see Table 18.8 and Fig. 18.6). These numbers look very impressive. But they are also very simplistic, as they require some implicit assumptions to hold. First and foremost, it implies that profitability permanently moves to a much higher level, while holding all else equal, i.e. growth remains the same, and the cost of capital remains the same. That is not realistic: the cuts in spending on marketing and the USLP are bound to result in a loss of sales growth.

[10] More profitable firms deserve a higher multiple due to the compounding effect of higher cash flows.

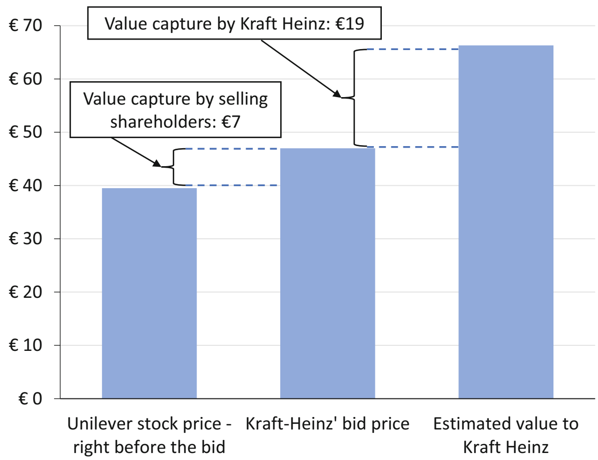

Fig. 18.6 Short-term value capture per share

Long-term Shareholder Value

The long-term shareholder value can be measured by the DCF model. Taking Eq. (9.12) from Chap. 9, we can calculate the enterprise value V_0 as follows:

$$V_0 = \frac{FCF_1}{(1 + WACC)} + \frac{FCF_2}{(1 + WACC)^2} + \ldots + \frac{FCF_N + TV_N}{(1 + WACC)^N} \tag{18.5}$$

where *WACC* represents the weighted average cost of capital, *FCF* the free cash flow, and TV_N the terminal value at $t = N$. The underlying value drivers of the free cash flows (and the terminal value) are sales and margins. The cost of capital *WACC* is the third value driver (see Sect. 9.4 in Chap. 9).

We consider long-term value creation by comparing the DCF value of Unilever in a stand-alone scenario with the DCF of Unilever within Kraft Heinz. For the bid to be long-term value creative, the latter DCF value should be higher, but we find the opposite. In the stand-alone DCF, we assume a rise in margins to 16% driven by management's current program, and 4% sales growth for the years to come. The cost of capital is 7.4%. While there is a positive relation between sales growth and margins due to economies of scale, there is also a trade-off between margins and growth: by investing in sustainability and its brands, Unilever's margins are lower than they could have been, but they help keep sales growth higher. We make the following Value Driver Adjustments (VDAs, see Chap. 9): due to its USLP, margins are probably 300 bps lower than they could have been, and sales growth is probably 200 bps higher than that of a similar company without USLP. Inserting these assumptions in otherwise identical DCF models of Unilever, Table 18.9 shows an 8% higher fair value (€64.7) in the case with the USLP than in the case without USLP (€60.2). See the book's website (available at www.rsm.nl/corporatefinanceforlongtermvalue) for the DCF model used.

Table 18.9 Value driver adjustments for the USLP

	Sales growth	EBIT margins	WACC	Fair value
Unilever excl. USLP	2%	19%	7.4%	€60.2
USLP effect	+200 bps	−300 bps	–	+€4.5
Unilever incl. USLP	4%	16%	7.4%	€64.7

Note that the resulting fair values are over 50% higher than the stock price of €40. This means the market took a dim view of management's ability to realise those value drivers. And the €64.7 price target may look excessively optimistic. The DCF calculation suggests it is not. First, the value driver assumptions are plausible given Unilever's positioning. Second, the DCF outcome was not the most optimistic out there: some analysts had price targets of well over €70 and many of Unilever's top shareholders said that the bid drastically undervalued the company's assets. Third, Kraft Heinz's value drivers were much more aggressive than Unilever's (see below). Fourth, deriving the market implied value drivers suggests that the market was mainly extrapolating recent weaker performance. We can estimate the market implied value drivers by starting from our €64.7 and adjusting each value driver. Assuming sales growth of 2.5% instead of 4% takes €13 off the stock price. This is consistent with analysts' scepticism on Unilever's sales growth following a period of currency fluctuations in emerging markets. Next, assuming margins to stay at 14% (i.e. extrapolating the 2015 level) instead of rising to 16%, takes another €8 off the stock price. Finally, using a WACC of 7.9% instead of 7.4% brings down the stock price another €4, to arrive at €39.6.

The next question is how Unilever's stand-alone value compares to long-term value within Kraft Heinz. In the case of Unilever within Kraft Heinz, we assume margins to temporarily rise much higher to 24%, but then to drop back down to 18%, which is still higher than in the stand-alone scenario. But crucially, we expect sales growth to slow dramatically in the within Kraft Heinz scenario because of reduced marketing and sustainability spending. See Figs. 18.7 and 18.8. Although we should be careful with reasoning with hindsight, this was soon borne out by Kraft Heinz's own value driver performance, which had plummeting margins and negative sales growth—while Unilever kept up its value driver performance.

As a result, the DCF value is higher in the stand-alone scenario (€64.7) than in the within Kraft Heinz scenario (€58.4). Note that the latter is below the value of €66.3 envisaged by 3G and Warren Buffett, as they simplistically and conveniently assumed sales growth to stay the same. Clearly, a longer horizon brings a different perspective here. And this is even without considering internalisation scenarios, i.e. scenarios in which the company would have to pay up for the negative externalities it creates. These would be much higher in the within Kraft Heinz scenario than in the stand-alone scenario, as we will see in the following sections on societal value. Also, we did not make adjustments to the cost of capital in case of a within Kraft Heinz scenario, but in hindsight an upward (i.e. value reducing)

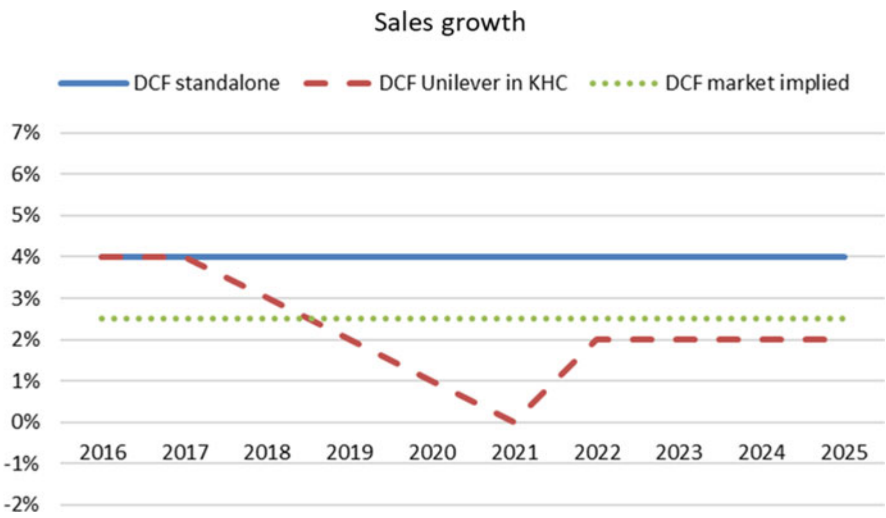

Fig. 18.7 Unilever sales growth within Kraft Heinz versus stand-alone and market implied

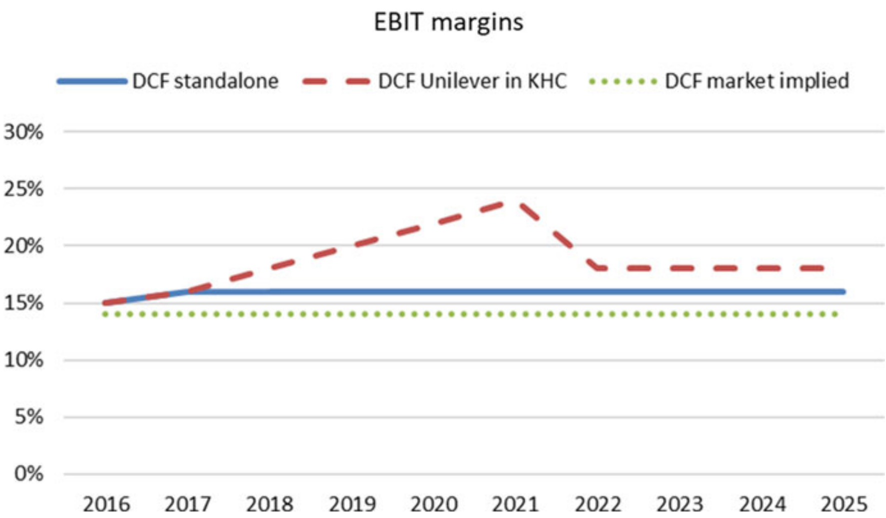

Fig. 18.8 Unilever margins within Kraft Heinz versus stand-alone and market implied

adjustment seems plausible. Given Kraft Heinz' poor societal record, hidden liabilities are likely. The long-term value differences are visualised in Fig. 18.9.

Of course, one could argue that the stand-alone value is too high (or too low), depending on the assumptions used. The same applies to the DCF value of Unilever within Kraft Heinz. Whether the DCF valuation estimate is correct cannot be established. In the end, a valuation is a reasoned opinion. For the sake of the

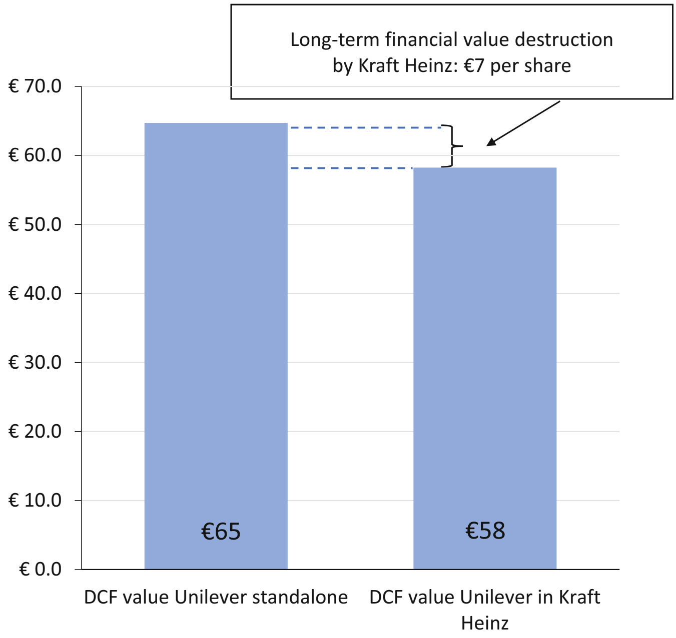

Fig. 18.9 Long-term shareholder value

argument, it does not even matter: the point is that such calculations should be done in the first place to make comparisons that are typically not made.

Social Value

For the calculation of the social and environmental value, we focus on material social and environmental issues (see Chap. 5). If anything, this leads to an undervaluation of these values. Given its ZBB program, we would expect Kraft Heinz to make spending cuts in both Unilever's own workforce and in its sourcing. In the hunt for bargains, the latter would necessarily involve relaxation of labour rights demands in the supply chain as well as reduced enforcement thereof. This would eliminate much of the work done by Unilever on improving working conditions in its major supply chains.

Table 18.10 summarises our assumptions and the resulting estimated value losses for both employees and people in the supply chain. The latter would account for the bigger loss—while per person losses may be lower, this concerns much more people than the employee effect. Unilever had 169,000 people directly employed. The value of employment can be measured in life satisfaction points. We assume a deterioration in working conditions and salaries of one life satisfaction points of €2250 (2017 prices derived from Table 11.11). In the supply chain, Unilever had 1.5 million farmers. Adding other workers, we assume three million people in the supply chain. The average living wage gap was €3000 (source: Impact Institute). We assume that

Table 18.10 Social value loss

Stakeholders	Employees	People in the supply chain
Nature of the value creation/destruction	Change in working conditions and salaries	Change in (1) social programmes on sanitation, women empowerment, etc. (2) working conditions and salaries at suppliers
Crude assumptions	Deterioration in working conditions and salaries equivalent to a loss of €2250 per employee per year for next 15 years	3 million people in and near the Unilever supply chain to suffer a loss in value of €1500 per person per year for next 15 years; attribution factor of 0.5
Volume unit	People	People
Number (thousands)	169	3000
Value per unit per year (in €)	−2250	−750
Annual value creation, € billions	−0.4	−2.3
Social discount rate of 2.2%, with employee growth at 2% per year	2.2%	2.2%
PV of value creation, € billions	−5	−33
PV of value creation, € per share	−3	−19

Kraft Heinz would operate at the average, while Unilever had halved the living wage gap. The attribution factor for the supply chain is 0.5 (see Chap. 5).

The appropriate discount rate for social value is the social discount rate of 2.2% (see Chap. 12). Finally, we assume these differences to last for 15 years, as Kraft Heinz will at some point be forced to adhere to international labour standards.

Admittedly, these estimates are mere guesses—the best we can do given the state of reporting on these topics. Therefore, the numbers should be used with caution: they could be much higher or lower. Still, it is safe to assume that the sign is correct: stakeholders would suffer a value loss on S if Unilever were taken over by Kraft Heinz. Table 18.10 estimates the social value loss at €22 per share.

Environmental Value

For E, we can do the same kind of analysis as for S, but of course with different indicators. We could try to estimate Unilever's impact on all of the nine planetary boundaries (see Chap. 1). However, for the sake of simplicity, we only consider GHG emissions. Unilever's 2018 CO_2 equivalent footprint was 61 million tonnes, achieved on a programme aimed at emissions reductions. Kraft Heinz does not have reduction targets (or even reporting) on GHG, so we estimate future emissions of Unilever within Kraft Heinz to be 10% higher. This means an additional 6.1 million tonnes per annum (i.e. ignoring the mutually offsetting effects of sales growth and

Table 18.11 Environmental value–GHG emissions

Stakeholder	Current and future generations
Nature of the value creation/destruction	Change in GHG emissions. Unilever's 2018 CO_2 equivalent footprint was 61 million tonnes.
Crude assumptions	In the absence of reduction targets at Kraft Heinz, future emissions for the next 15 years are estimated to be 10% higher at €137 carbon price.
Volume unit	CO_2 equivalent
Number (thousands)	6100
Value per unit per year (in €)	−137
Annual value creation, € billions	−0.8
Social discount rate of 2.2%, with shadow carbon price growing at 3.5% per year	2.2%
PV of value creation, € billions	−13
PV of value creation, € per share	−8

efficiencies). That amount can be monetised by using a carbon price, for which we take the 2017 shadow price of €137 (source: True Price). True Price's shadow carbon price grows at 3.5% per year. Again, we assume the difference to last for 15 years, as Kraft Heinz will at some point also be forced to reduce carbon emissions. Table 18.11 estimates the environmental value loss at €8 per share.

Again, it should be stressed that this is done in the absence of critical data: Kraft Heinz does not even report its emissions. Moreover, this is just carbon. It does not include the likely massive effects on biodiversity (palm oil, plastics), nitrogen cycles, or other planetary boundaries. Also, this is value destruction of the within Kraft Heinz case versus Unilever stand-alone—i.e. the value destruction on top of that already being effected by Unilever. In fact, a company with serious externalities needs to have a transition path towards elimination of those externalities—which Unilever is trying to develop, and Kraft Heinz is not.

Total Long-term Value Destruction

The materiality (or lack thereof) of the social and environmental dimensions is highly context specific. It varies per industry, and also within industries, depending on the nature of the industry, the specific company's business model and local conditions (see Chaps. 2 and 5). Hence, the KPIs used will differ across companies. Still, one can estimate financial, social, and environmental value or the change therein, which we present in Table 18.12 and Fig. 18.10.

We arrive at €36.5 value destruction per share, or 56% of the long-term value per share of €64.7. Of course, this number should be interpreted with caution: critical numbers are missing, so there is a wide confidence interval. Moreover, one could disagree with the assumptions applied in our analysis. This means that the size could change, in both directions—as argued, we did not take into account aspects of S and E that were also likely to give value destruction. While sizes could be debated, the negative signs on S and E would not disappear.

Table 18.12 Unilever's long-term value creation (in € billions)

Long-term value creation based on DCF	Equity value per share	Equity value € billions
DCF value Unilever stand-alone	€ 64.7	€ 111
DCF value Unilever in Kraft Heinz	€ 58.2	€ 100
Financial value creation	–€ 6.5	–€ 11
Social value creation	–€ 22.2	–€ 38
Environmental value creation	–€ 7.8	–€ 13
Long-term value creation	**–€ 36.5**	**–€ 63**

Note: The equity value is obtained by multiplying the equity value per share with the number of outstanding shares, which is 1.715 billion shares. For example, the long-term value creation is -€63 billion (=€36.5*1.715 billion shares). Please note that numbers do not add up exactly due to rounding

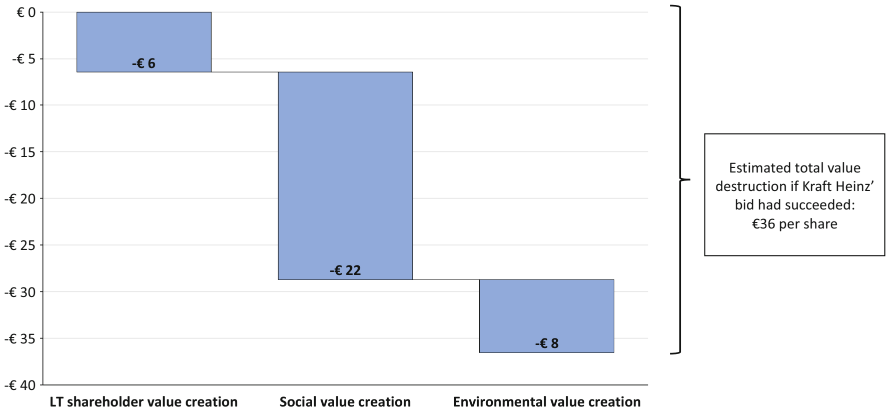

Fig. 18.10 Integrated value creation (destruction) per share

It is also striking that all components are in the same direction: the takeover would have resulted in value destruction on F, S, and E—only short-term F based on EPS would have gone up (provided that investors believed Kraft Heinz' financial engineering for at least a while). Of course, we could also have found a value creation profile that was negative on S and E, but positive on long-term F. In that case, narrow fiduciary duty would have obliged Unilever's board to support the takeover bid. This illustrates the importance of the integrated takeover test, introduced in Sect. 18.5. This test would fail in the Kraft Heinz-Unilever case, not allowing the takeover to proceed. The integrated value destruction of €36.5 per share, which amounts to €63 billion in equity value, could not be compensated by potential synergies.

Conclusions and Recommendations

The analysis of Kraft Heinz's attempted takeover of Unilever illustrates that social and environmental value destruction in M&A can be massive. Such value destruction typically remains invisible, because it is not a common practice to consider it, let alone to analyse it. Those who want to do such analysis run into an information problem: the needed data is typically not reported. As described in Chap. 17, corporate reporting is expected to evolve in such a way that it allows users to estimate social and environmental value in a better way.

Next, incentive structures are such that the bid could have succeeded, with a few people better off (short-term financial gain) at the expense of all others. Such value destruction could be avoided by changing corporate legal and taxation structures, as well as business education.

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Options

19

Overview
Financial options are contracts that give the owner the right to buy (in the case of a call option) or sell (in the case of a put option) a security at a pre-specified price (the exercise price). The owner has a long position in the option. By contrast, the seller or writer of the option has a short position in the option; this is the opposite position of the buyer. The seller has to exercise the contract if the buyer wants to do so. The flexibility is on the side of the buyer, but the seller is compensated with a premium paid by the buyer. Sophisticated models have been developed to determine the value of options.

Options are interesting since they offer an alternative way of tying payoffs to (future) situations, also outside of contractual settings. In that case, they are called real options. A real option is an economically valuable right to make or else abandon some choice that is available to the managers of a company, exemplifying the value of flexibility. Real options come in various types, such as the option to delay, the option to expand, and the option to abandon. They can be applied in valuation and in investment decisions, including M&A.

One can analyse many situations as combinations of options, using concepts such as put-call parity, which also allows for the interpretation of capital structure in terms of options. Moreover, one can visualise both financial options and real options with decision trees and payoff graphs for a better intuitive grasp of situations.

Real options on F can have E or S drivers: payoff in terms of F, but with E or S as the underlying values. For example, a CO_2 price or a methane tax could bring a real option in-the-money by increasing its PV of cash flows. In the extreme, the underlying value of E or S can determine if a certain product or business is in or out of business. An example of a real option is the ability to easily scale up renewable energy production capacity.

But there are also real options on E and S themselves, i.e. with the payoffs in terms of E and S, and possibly the underlying values as well. For example, a company's activities might engender the option to improve or worsen biodiversity. And often, there is interaction between F options and S or E options, which can come

D. Schoenmaker, W. Schramade, *Corporate Finance for Long-Term Value*, Springer Texts in Business and Economics, https://doi.org/10.1007/978-3-031-35009-2_19

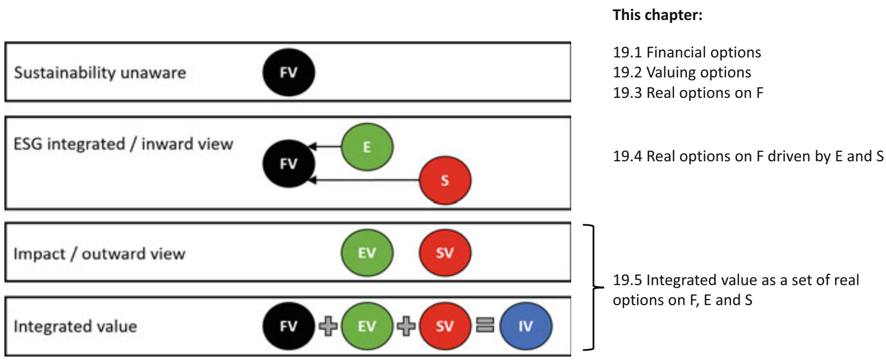


Fig. 19.1 Chapter overview

at each other's expense. In fact, companies are short a lot of options against society, but awareness of it is low. An airline can, for example, save on the maintenance of its airplanes. Against the annual cost savings, the airline creates a contingent liability in the form of increased likelihood of an accident. These interactions between F, S, and E options call for an integrated view on options, or even integrated value expressed in real options, which helps make these options and their trade-offs more explicit. See Fig. 19.1 for a chapter overview.

Learning Objectives
After you have studied this chapter, you should be able to:

- Demonstrate the basics of financial options.
- Recognise and analyse real options.
- Indicate how E and S can affect F options.
- Take an integrated value perspective on a company, expressed as a set of options.

19.1 Financial Options

Financial options are option contracts that give their owners the right to sell or buy a security from the writer of the contract at a specified price. That specified price is the exercise price or strike price. The two parties to the contract have opposite positions: the buyer (owner) is long the option and has a right (not the obligation) to buy or sell; and the seller (the party who writes the contract) is short and has the obligation to fulfil the contract, if the buyer decides to enforce the contract and exercise their right to buy or sell. The owner pays a price for the option to the seller, known as an option premium.

Box 19.1 A Very Short History of Option Contracts

The first option contract on record was set up by the Greek philosopher Thales of Miletus around 600 BC. Expecting a strong olive harvest in the coming summer, Thales bought the right to rent all olive presses in the vicinity (a call option). When summer came, there was a heavy demand for olive presses and Thales exercised his right to rent cheaply. Having cornered the market, he could rent out the olive presses at high prices to become rich overnight.

Option contracts became a regular part of financial markets much later. Contracts with option features were used on the Antwerp bourse in the sixteenth century. And in the seventeenth-century Amsterdam, options on tulip bulbs were an important part of the tulip mania of the 1630s and the subsequent collapse of the Dutch economy. This gave options contracts their reputation as a speculative investment. Admittedly, it is hard to distinguish from the outside if investors use options for hedging or for speculation—the latter tends to be the case if the option is not combined with exposure to the underlying asset. This is especially risky when writing options without owning the underlying asset.

Option markets really took off in the 1970s with opening of the Chicago Board Options Exchange and the development of formal option pricing models. Hitherto, option pricing had been based purely on intuition. But even with formal option pricing models, disasters continue to happen. In fact, one could argue that the academic models gave a false sense of security, resulting in hubris on the part of their users. For example, in 1998, the hedge fund Long-Term Capital Management went bust in dramatic fashion due to events that were not even possible according to their models. This was all the more dramatic since it was run by, amongst others, Myron Scholes and Robert Merton, the Nobel prize winners and inventors of the Merton-Scholes option pricing model. This should have been a warning, but in the financial crisis of 2008–2009 too, options (and other contingent claims like credit default swaps) were a large part of the problem.

Options come in two main types: calls and puts. A call option gives the owner the right to buy a security, whereas a put option gives the owner the right to sell a security. The underlying security can be anything, such as a company's stock, an exchange rate, or a commodity. Another distinction is between the so-called American and European options (so-called because both types are used globally): American options allow the owner to exercise the option at any time, whereas European options can only be exercised at the expiration date. This typically makes a European option less valuable than an American option with otherwise same terms.

19.1.1 Call Option: Long

Let's consider the example of a call option on a bushel of wheat, with an exercise price of \$10. Figure 19.2 shows the payoff structure at maturity of this call option.

The underlying value is the price of a bushel of wheat. The exercise price of \$10 means that the payoff is \$0 for every price (of a bushel of wheat) below \$10. For every price above \$10, the payoff is the price minus the exercise price. So, at \$10.70, the payoff is \$10.70–\$10 = \$0.70.

The formula for the value of a long position in a call at expiration is:

$$C = \max(S - K, 0) \tag{19.1}$$

With S = the underlying value, and K = strike or exercise price.

At the time of writing in October 2022, wheat was traded for \$9.66 per bushel. And it was about \$12 at the start of the Russian invasion of Ukraine in February 2022. We can use these prices to see what the payoff would be. At a price of \$9.66 per bushel, $C = \max(S - K, 0) = \max(\$9.66 – \$10, \$0) = 0$, if the option were to expire at that point in time. As the price of the underlying value is below the strike price, the call is said to be *out-of-the-money*. However, that does not mean that the value of the call is 0, unless it is at expiration. The longer the maturity of the call, ceteris paribus, the higher the probability that the underlying value will at some time exceed the strike price (and be *in-the-money*), and the higher its value. And since it has value, investors will be willing to pay a price for it, called a premium (which in a well-functioning market equals the consensus view).

Let's suppose the premium that the owner has paid is \$0.40 (we'll get back to the drivers of that premium later on). Then the profit net of the premium is as follows: C-premium = max(S-K-premium,-premium) = max(\$9.66–\$10-\$0.4,-\$0.4) = −\$ 0.4. The payoff structure in Fig. 19.2 does not include the premium paid, but the profit diagram in Fig. 19.3 does include the premium.

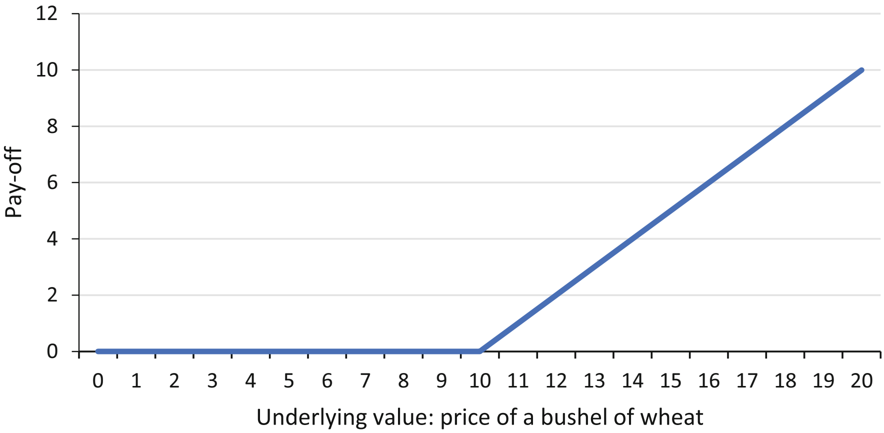


Fig. 19.2 Payoff structure of a call option on a bushel of wheat, excluding the premium

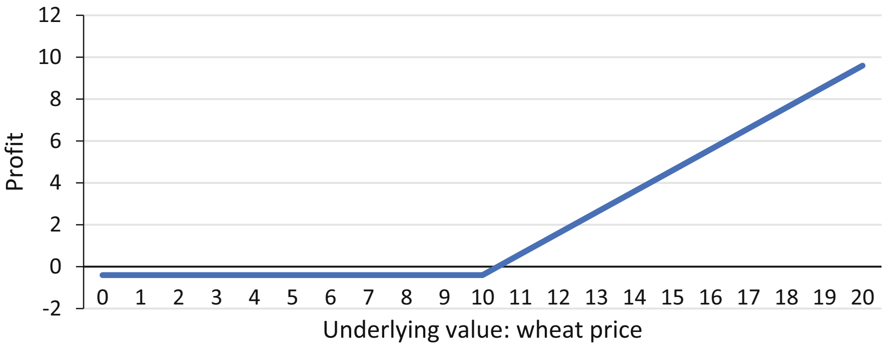


Fig. 19.3 Profit diagram of a call option on a bushel of wheat, including the premium

Note that the payoff line has shifted below 0, and the break-even point is now at \$10.40, where the underlying value equals the sum of the exercise price and the premium. Note that this does not mean that premiums are fixed: they move with the price of the underlying security. However, the buyer pays the premium to the seller at the time both parties enter into the contract, at which time the premium payment is fixed.

At a price per bushel of \$10, the price of the underlying value exactly equals the strike price. The call option is then said to be *at-the-money*. C = max(S-K,0) = max (\$10–\$10,\$0) = \$0 (this is the intrinsic value of the option without the premium). But again, before maturity the call option's value will be positive to reflect the probability that it will be in-the-money later on. At a price of \$12, C = max (S-K,0) = max(\$12–\$10,\$0) = \$2. The option has a positive probability of ending up well in-the-money.

19.1.2 Call Option: Short

All of the above represent the perspective of the owner of the call, who has a long position. The seller, who writes the call, has the exact opposite payoff profile, as shown in Fig. 19.4. The payoff diagram shows that the losses can become very large when the wheat price increases.

The payoff of the written call at expiration can be expressed as follows:

$$-C = -\max(S - K, 0) \tag{19.2}$$

At a price per bushel of \$9.66, there is no payoff, since the price is below the strike price: -C = -max(\$9.66–\$10,\$0) = \$0. But at a price of \$12, the call is in-the-money, and negative value for the writer of the option: -C = -max(\$12–\$10,\$0) = −\$2. Again, this is without the premium paid. Since this is the same contract as the long call example, we should use the same \$0.40 premium. But now it works the other way: the writer of the call receives the premium as a compensation

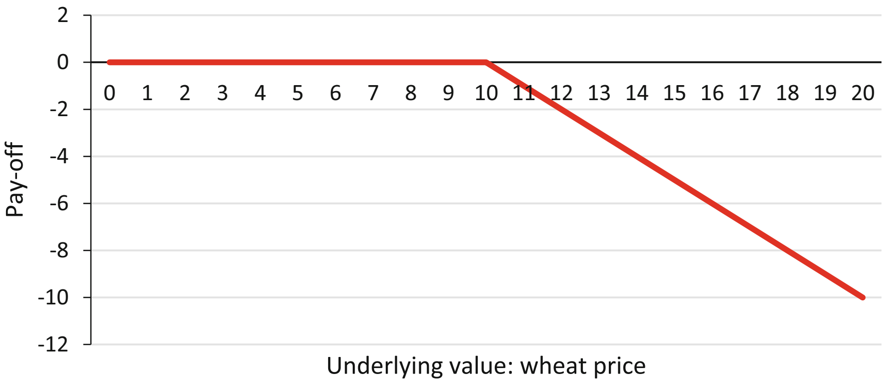


Fig. 19.4 Payoff structure of a written call option on a bushel of wheat, excluding the premium

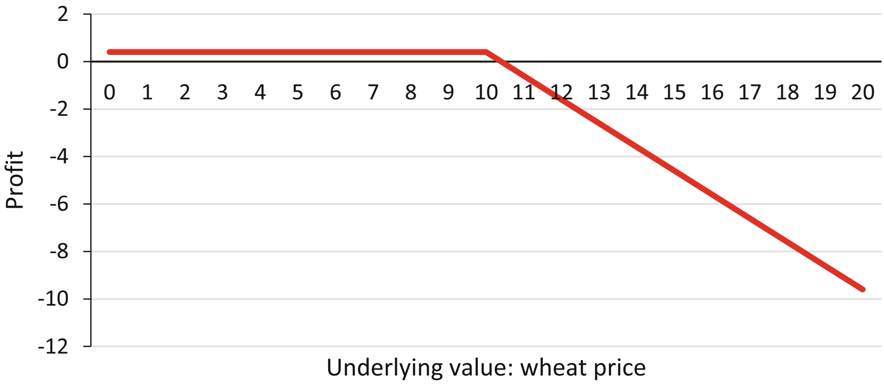


Fig. 19.5 Profit diagram of a written call option on a bushel of wheat, including the premium

for writing the call. Hence, the line that is flat below the exercise price moves from \$0 to \$0.4 in Fig. 19.5.

Example 19.1 provides a problem to get familiar with calculating the value of a call option with premium.

Example 19.1 Calculating the Value of a Call Option with Premium
Problem

Investors expect share prices for Tech companies to rise in the next 6 months, so they decide to purchase a 6-month call option for an ETF (Exchange-Traded Fund) covering the biggest Tech companies. This ETF is worth \$80 today, the strike price for the call option is \$90 and the premium for this call option is \$5. What is the value and net profit of the call option if the

(continued)

Example 19.1 (continued)
ETF is worth \$80, \$100, or \$120 in 6 months? And at what ETF price does the call option break even?

Solution

Using Eq. (19.1), the value of the call option at an ETF price of \$80 is $C = \max(S - K, 0) = \max(\$80 - \$90, \$0) = \$0$ and the net profit is $\$0 - \$5 = -\$5$. At \$100, the value of the call option is $\max(\$100 - \$90, \$0) = \$10$ and net profit is $\$10 - \$5 = \$5$. At \$120, the value of the call option is max $(\$120 - \$90, \$0) = \$30$ and net profit is $\$30 - \$5 = \$25$.

The call option breaks even when the value of the call option equals the option premium, thus $\max(S - \$90, \$0) =$ \$5 which leads to an underlying value S of \$95.

19.1.3 Put Option: Long

As mentioned above, a put option gives the owner the right to sell a security. Let's again consider the example of an option on a bushel of wheat, again with an exercise price of \$10. But this time it's a put instead of a call. Figure 19.6 shows the payoff structure of this wheat put option for its owner.

The formula for the value of a long position in a put at expiration is:

$$P = \max(K - S, 0) \tag{19.3}$$

The exercise price of \$10 means that the payoff is \$0 for every price (of a bushel of wheat) above \$10. For every price below \$10, the payoff is the exercise price minus the price of wheat. So, at a wheat price of \$4, the payoff is \$10–\$4 = \$6.

As in the case of a call, a premium is paid. But we will skip discussion of the put premium here.

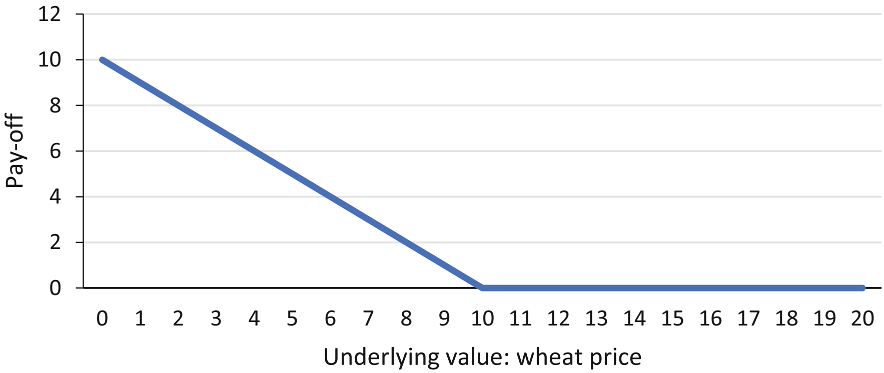


Fig. 19.6 Payoff structure of a put option on a bushel of wheat, excluding the premium

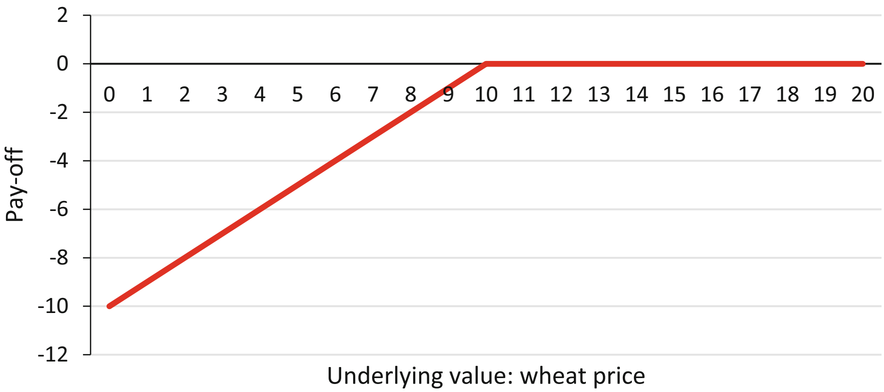


Fig. 19.7 Payoff structure of a written put option on a bushel of wheat, excluding the premium

19.1.4 Put Option: Short

The seller, who writes the put, has the exact opposite payoff profile versus that of the buyer. This is shown in Fig. 19.7. At outcomes below the exercise price, the seller makes a loss, which can become quite significant at high volumes (i.e., many puts written) and at lower wheat prices (i.e., a bigger gap between price and exercise price to cover). Such losses may be neutralised by offsetting underlying positions, as we will see in the combined exposures below. But the losses can be dramatic in case of uncovered puts, i.e. without offsetting underlying exposures. The losses can be even worse for short calls. Figure 19.5 shows that these losses are not limited. For short put options, the downside is limited to the exercise price (which the writer has to pay to the owner of the put option).

The payoff of the written put at expiration can be expressed as follows:

$$-P = -\max(K - S, 0) \tag{19.4}$$

At a price per bushel of \$9.66, the payoff is −\$0.34 at maturity: -P = -max(\$10–\$9.66,\$0) = −\$0.34. But at a price of \$12, the put is out-of-money, and there is no payoff for the writer of the option: -P = -max(\$10–\$12, \$0) = \$0. Example 19.2 provides an exercise for the valuation of a short put option.

Example 19.2 Calculating the Value of a Short Put Option
Problem

A commodity trader is confident that oil prices will continue to rise in the following 3 months and therefore decides to write 3-month put options for oil. The current price is \$30 per barrel of oil, and the trader sets the strike price at \$25 with a premium of \$2.50. What is the value and net profit of the trader

(continued)

Example 19.2 (continued)
when the oil price reaches \$20, \$25, or \$30 in 3 months? And below what price will the trader make a loss?

Solution

Using Eq. (19.4), the payoff for the writer of the short put option at an oil price of \$20 is $-P = -\max(K - S, 0) = -\max(\$25 - \$20, \$0) = -\$5$. The oil trader is the writer of the option and thus receives the premium for the option. The trader's profit is $-\$5 + \$2.50 = -\$2.50$. The payoff at \$25 is $-\max(\$25 - \$25, \$0) = \$0$ and the profit is $\$0 + \$2.50 = \$2.50$. At \$30, the payoff is $-\max(\$25 - \$30, \$0) = \$0$ and the profit is $\$0 + \$2.50 = \$2.50$.

The trader will break even when $-\max(\$25 - S, \$0) = -\$2.50$ (the loss on the written put option equals the received premium), so at an oil price S of \$22.50. When the oil price drops below \$22.50, the trader will make a loss.

19.1.5 Combinations of Options & Hedging

The above payoffs were on a stand-alone basis, but in practice people can have composite exposures. And they may use options to hedge their exposures. Hedging is a strategy that tries to limit financial risk. For example, a farmer who has an upcoming wheat harvest will have a profit that depends on the wheat price, such as shown on the left-hand side of Fig. 19.8: since his costs are \$5 per bushel, his profit per bushel will equal the wheat price minus \$5. At any price below \$5 he will be making a loss. However, by buying the put option described in Fig. 19.6 with an exercise price of \$10, the farmer gets protection against potential losses. His payoff is his profitability before hedging (S-\$5) plus the put's payoff (max[K-S,0]) minus the put's premium, so: (S-\$5) + max(\$10-S,0)-\$0.4. This means he obtains a profit of \$4.6 at all wheat prices below \$10. You can check the profit of \$4.6: the farmer receives \$10 as exercise price, has a cost of \$5, and pays a premium of \$0.4. Only if the wheat price goes above \$10, does his profit rise proportionately with the wheat price, but he will still be making \$0.4 per bushel less than in the case without hedging. This looks like a great deal: the put offers full protection on the downside

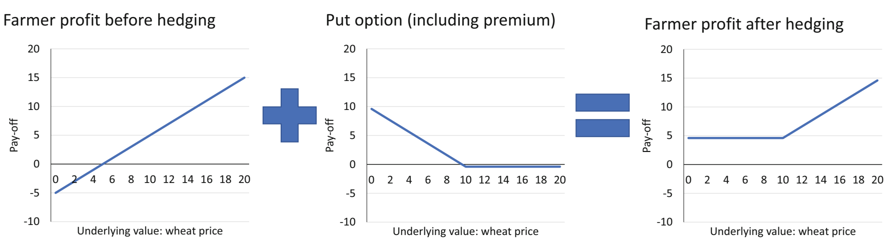


Fig. 19.8 Farmer profit before and after hedging with a put

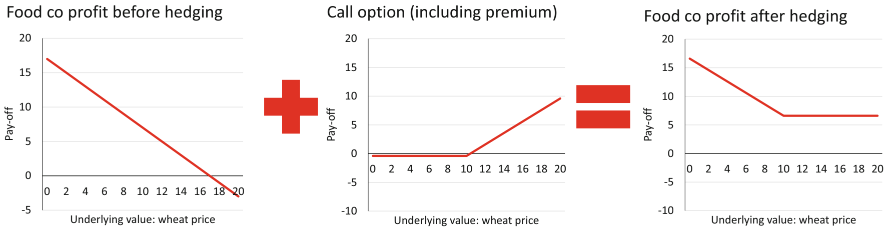


Fig. 19.9 A food production company's profit before and after hedging with a call

against limited cost on the upside. So perhaps, the option is too cheap at $0.40? That depends on the chance of the wheat price ending up below $10.

Whether to buy the put, and with what strike price, is not the only decision to make. The farmer also needs to decide on the volume: how many bushels does he expect to harvest? And for how many does he need protection?

A producer of packaged food faces an (almost) opposite exposure. The price per bushel hurts its profits since the food company needs to buy wheat for its production: profit per bushel is $17-S. Therefore, it might want to buy a call to protect against price rises. Figure 19.9 describes the company's exposures before and after adding the call. As a result of this protection, the company's payoff is now its original profit formula ($17-S) plus the call including its premium (max[S-$10,$0]-$0.4). So, for example, at a wheat price of $4 per bushel, its payoff is ($17–$4) + (max[$4–$10,$0]-$0.4) = $13 + $0–$0.4 = $12.6. And at wheat prices of $10 and higher, its profits are locked in at $6.60: all the losses on the original profit formula are offset by equal gains on the call. Note however that just like for the farmer, the company's full exposure is not this simple, since it will also be determined by its production volumes—which are probably more predictable than the farmer's harvest. Hence, for a full analysis, one should not only look at payoffs per unit (the price component), but at total payoffs including units (price times volume).

Example 19.3 provides an example of a steelmaker who hedges the price of iron. Iron is an important input to the steelmaker's production process and the iron price can fluctuate.

Example 19.3 Calculating the Profit of a Steelmaker After Hedging

Problem

A manufacturer of steel products needs to buy iron as inputs for its production process and wants to protect itself from rising iron prices by buying a call option. The steelmaker's profit formula is: $50-S, where S is the price of iron, and the call option uses a strike price of $20 with a premium of $4. What is the steelmaker's profit when the price of iron is $10? And what is the maximum profit the steelmaker can earn when the iron price exceeds the strike price?

(continued)

Example 19.3 (continued)

Solution

Using the steelmaker's profit formula in combination with the long call formula (Eq. 19.1), the steelmaker's profit is (\$50 − S) + max ($S - K, \$0$) − premium = (\$50 − \$10) + max ($\$10 - \$20, \$0) - \$4 = \$40 + \$0 - \$4 = \$36$.

The maximum profit the steelmaker can earn when the iron price equals or exceeds the strike price ($S = K =$ \$20) is (\$50 − \$20) + max ($\$20 - \$20, \$0) - \$4 = \$30 + \$0 - \$4 = \$26$. To check this you can use the situation where the iron price is higher, for example \$40, and calculate the profit: (\$50 − \$40) + max ($\$40 - \$20, \$0) - \$4 = \$10 + \$20 - \$4 = \$26$. So, the maximum profit for the steelmaker is $\$26$ when $S \geq \$20$.

19.1.6 Put-Call Parity

If you take another look at Figs. 19.8 and 19.9, you might notice that the farmer's resulting exposure (third graph in Fig. 19.8) looks a lot like the call option used by the producer (second graph in Fig. 19.9), but simply at a higher level. And likewise, the producer's resulting exposure (third graph in Fig. 19.9) looks very much like the put option used by the farmer (second graph in Fig. 19.8), but again at a higher level. In fact, one could argue that the farmer's payoff on the portfolio containing the underlying value (in this case wheat) plus a put is essentially a call plus a bond (riskless debt with a fixed payoff) and that the company's payoff on the portfolio containing a negative exposure to the underlying value and a call is a put plus a bond. Please note that the size of the bond equals the present value of the exercise price: $B = PV(K)$. This was \$10 in Figs. 19.8 and 19.9. One can make different combinations to arrive at the same result. This can be expressed in put-call parity:

$$S + P = B + C \tag{19.5}$$

That is, the combined payoffs of the underlying value S and the put P are equal to the combined payoffs of a bond B and a call C. Figure 19.10 visualises these relationships.

19.1.7 Capital Structure Expressed in Options

One can view capital structure (Chap. 15) in terms of options as well. As we will show, equity can be seen as a call option on the company's assets (Merton, 1974); and corporate debt is effectively riskless debt minus a put on the company's assets.

Equity as a Call Option on the Company's Assets

Let's take the market balance sheet of Table 19.1 as an example.

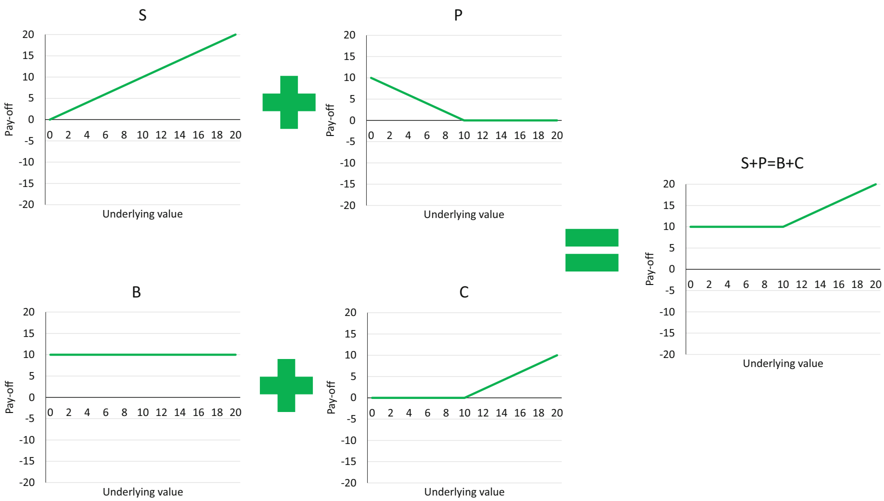


Fig. 19.10 Put-call parity expressed in payoff structures

Table 19.1 Market value balance sheet

NPV of projects	20	Debt	5
		Equity	15
Total assets	**20**	**Total liabilities**	**20**

The above values are given as static numbers, but in reality they can fluctuate over time as expected cash flows and/or discount rates change and affect the NPV of projects (estimated at market value). The NPV of projects is the driver of the value of assets and the value of equity. If the NPV of projects falls below 5, equity value goes to 0. For all values above 5, the value of equity moves proportionately with the NPV of projects. Therefore, one can regard the equity as a call option on the company's assets, whereby the exercise price is the face value of debt[1] (in this case 5). See Fig. 19.11.

Remember the formula for the value of a call option at maturity:

$$C = \max(S - K, 0) \tag{19.6}$$

Then:

$$\textit{Equity as a call} = \max(\textit{Assets} - \textit{Debt}, 0) \tag{19.7}$$

Thinking in terms of options provides a dynamic perspective on value, recognising that the current value of equity may be 15, but that the leverage means

[1] The exercise price is the face value of debt. We assume here that debt is riskless, so that the market value of debt is equal to the face value.

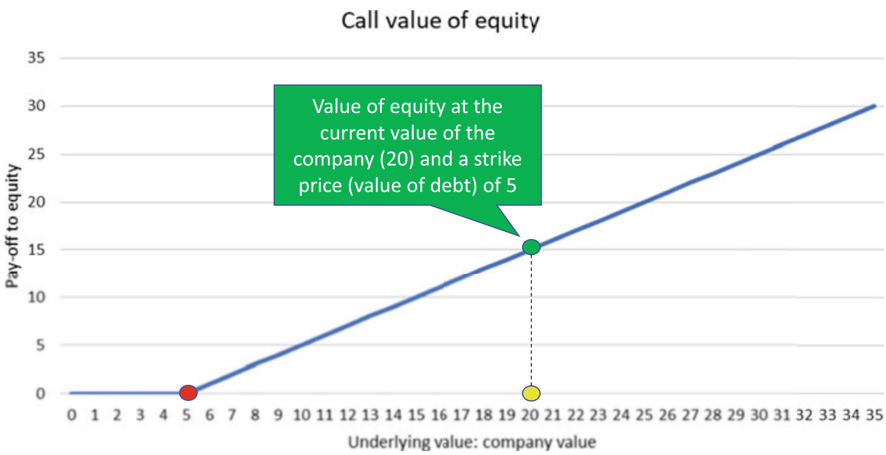


Fig. 19.11 Equity value expressed as a call option on company value

that the equity value is extra sensitive to changes in asset value. Figure 19.11 shows that the equity holders (stockholders) get the full potential of the upside and have limited their losses on the downside (they can at most lose their invested capital of 15 due to limited liability). Equity holders thus favour risky projects with an equal up- and downside risk profile. Volatility of the underlying value (in this case the company's assets) increases the value of a call option (see Fig. 19.22 on drivers of option prices below).

Corporate Debt as Riskless Debt Minus a Put on the Company's Assets
Now that we know that equity can be expressed in options, it follows from put-call parity that corporate debt can also be expressed in terms of options. After all from Eq. 19.5, we have:

$$S + P = B + C \tag{19.8}$$

where S = assets; P = put on assets; B = riskless debt; C = call on assets. Hence, assets can be expressed as:

$$Assets = S = B - P + C \tag{19.9}$$

Figure 19.12 illustrates this relationship. Assets is equal to riskless debt minus a put option on assets plus a call option on assets.

From Chap. 15 on capital structure, we know that assets are financed by equity and debt. This company debt is risky, because a company can fail. Assets can thus be expressed as follows:

$$Assets = Risky\ debt + Equity \tag{19.10}$$

where from Eq. (19.7), we can express equity as follows:

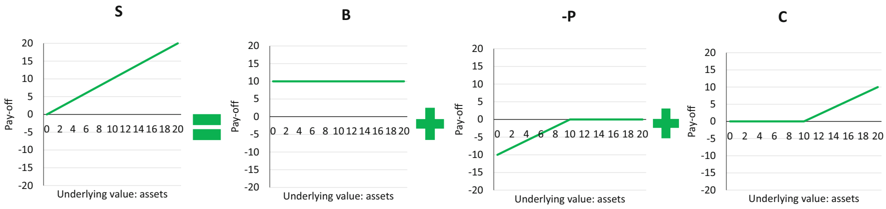


Fig. 19.12 Assets expressed in put-call parity terms

$$Equity = C \tag{19.11}$$

Rewriting Eq. (19.10), we can derive risky debt as follows:

$$Risky\ debt = Assets - Equity = (B - P + C) - C = B - P \tag{19.12}$$

Equation 19.12 implies that risky debt is essentially riskless debt minus a put on assets, i.e. riskless debt plus a written put on the company's assets (remember a written put is a short position in a put). Figure 19.13 illustrates the payoff structure of risky debt. Again, the value of the put option increases with volatility of the company's assets (Fig. 19.22 below). So debt holders try to avoid risk, whereas equity holders love risk to a certain extent. Banks and bondholders therefore use loan and bond covenants, which restrict the company's ability to take on risk.

Example 19.4 asks you to calculate the value of risky debt.

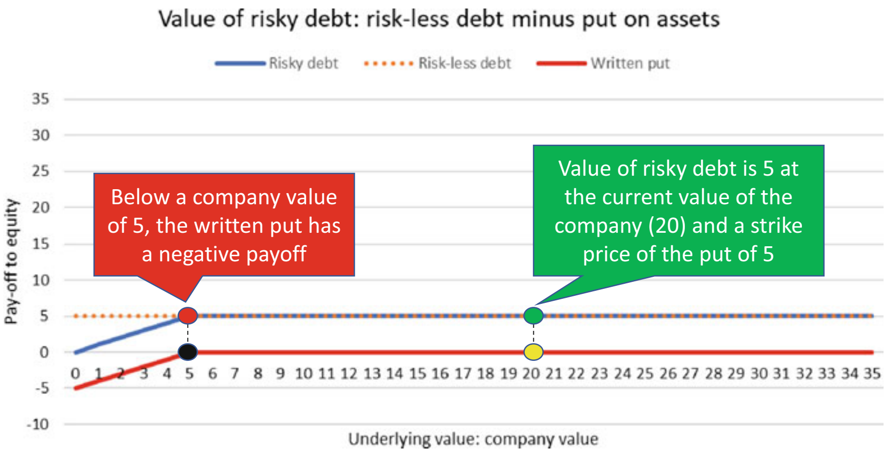


Fig. 19.13 Risky-debt value expressed as riskless debt minus a put on company value

Example 19.4 Calculating the Value of Risky Debt

Problem

The market value of Pharma's assets is $100 million. The face value of its debt is $40 million. A put option on Pharma's assets with a strike price of $40 million trades at $0.5 million. What is the current value of Pharma's risky debt? And what is the value of Pharma's equity?

Solution

The face value of debt is the nominal value of debt. It represents the value of riskless debt B (with no default risk). Using Eq. (19.12), the value of Pharma's risky debt is $B - P = \$40 - \$0.5 = \$39.5$ million. Next, using Eq. (19.10), the value of Pharma's equity is $Equity = Assets - Risky\ debt = \$100 - \$39.5 = \$60.5$ million.

The written put is worth $0.5 million. This amount is added to the equity holders' value at the expense of bondholders.

19.1.8 Option Quotations

Options are most commonly traded on stocks. 3M is a US conglomerate company that is well known for its Post-It and Scotch Tape products. Table 19.2 gives quotations for options on 3M stock with expiration in January 2025, priced as of Mid-October 2022, when the price of the stock was $113.49. Table 19.2 shows three strike prices (in reality, many more are available): one much below the stock price, one very close to the stock price, and one much above the stock price. We need some terminology to understand the option quotations in Table 19.2:

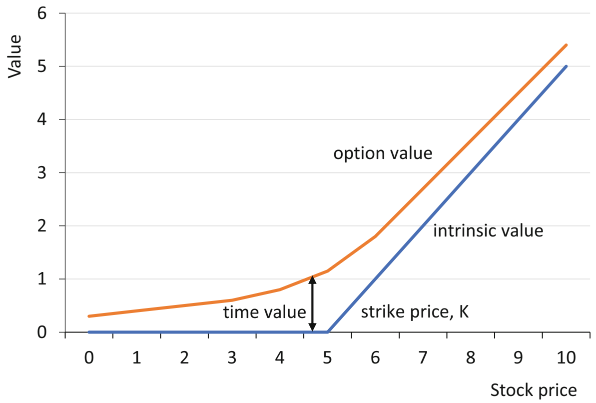
- The **strike price** of an option is a fixed price at which the owner of the option can buy (in the case of a call), or sell (in the case of a put), the underlying security (or commodity);
- The **bid price** is the price at which market makers (see Box 8.2 on the role of market makers) are willing to buy the option;
- The **ask price** is the price at which market makers are willing to sell the option;

Table 19.2 Quotations for options on 3M stock, per October 2022 with expiration in January 2025

Strike*	C or P	Bid*	Ask*	Open interest
60	C	53.50	55.55	0
	P	2.97	3.90	20
110	C	20.50	21.75	17
	P	16.90	18.00	64
160	C	5.65	6.45	25
	P	49.15	50.70	2

Notes: *Prices in US dollar. The current stock price is $113.49

Fig. 19.14 Option value before expiration at time t



- **Open interest** refers to the number of options or future contracts that are held by traders and investors in active positions. These positions have been opened, but have not been closed out, expired, or exercised.

With a strike price of \$60, the call is very much in-the-money. The payoff would be: $C = \max\ [S - K, \$0] = \$113.45 - \$60 = \$53.45$, if the option on 3M stock were exercised today. This is called the *intrinsic value* of the call option (see Fig. 19.14). The option premium—the average of bid and ask—is \$54.52, which is \$1.07 higher. This is called the *time value* of the call option. It is the amount an investor is willing to pay for an option above its intrinsic value and reflects hope that the option's value increases before expiration due to a favourable change in 3M's price (see Fig. 19.14).

Conversely, at that strike price of \$60, the put is very much out-of-the-money if 3M stock hits \$110 at maturity, since $\max(K - S, 0) = \max\ (\$60 - \$110, \$0) = \$0$. Hence, the much lower option premium of \$3.44 (=(\$2.97 + \$3.90)/2) on the put than on the call. The put premium reflects only the time value, since the intrinsic value is zero for this particular put option.

At a strike price of \$160, the reverse holds: the put is very much in-the-money ($\max[K - S, 0] = \max\ [\$160 - \$110, \$0) = \$50$), with a price around \$50; and the call is out-of-the-money ($\max[\$110 - \$160, \$0] = \$0$), and a price (or premium) around \$6, reflecting a small but serious chance that 3M's stock price goes over \$160 in the next 3.25 years.

At a strike price of \$110, there is only a small gap between the strike price and the share price of \$3.45. However, the prices of the puts and calls are much higher, reflecting the possibility that the share price will go much higher or much lower than the strike price during the lifetimes of the options.

As discussed, Fig. 19.14 illustrates the option value (also called option premium or option price) as the sum of the intrinsic value and the time value:

$$Option\ value = intrinsic\ value + time\ value \tag{19.13}$$

Example 19.5 gives an exercise to calculate the value of stock options.

Example 19.5 Calculating the Value of Stock Options

Problem

The price of the S&P 500 Index in March 2023 is around $4000. The quotations for options on S&P 500 Index stock, per March 2023, with expiration in December 2025, are given in the table below. Calculate the premium, the intrinsic value, and the time value of each call and put option for the given strike price.

Strike	C or P	Bid	Ask
3600	C	882.10	942.40
	P	266.90	281.90
3800	C	776.90	800.60
	P	320.10	336.60
4000	C	657.90	682.40
	P	380.20	397.30
4200	C	547.00	569.30
	P	447.60	471.82
4400	C	443.80	466.70
	P	523.10	542.00

Solution

The option premium (or option value) is the average of the bid and the ask. The price of the S&P Index is $S = \$4{,}000$. The premium, the intrinsic value, and the time value of each call and put option are calculated in the table below. The time value is relatively large, which reflects the long maturity (2 years and 9 months) of the options and the volatility of the S&P index.

Strike (K)	C or P	Premium	Intrinsic value	Time value
Calculation		(Bid + Ask)/2	$C = max\,(S - K, 0)$ $P = max\,(K - S, 0)$	Premium – Intrinsic value
3600	C	912.25	400	512.25
	P	274.4	0	274.4
3800	C	788.75	200	588.75
	P	328.35	0	328.35
4000	C	670.15	0	670.15
	P	388.75	0	388.75
4200	C	558.15	0	558.15
	P	459.71	200	259.71
4400	C	455.25	0	455.25
	P	532.55	400	132.55

19.2 Valuing Options

So far, we have described what the payoffs of certain options are. The non-linear nature of these payoffs makes valuation of options difficult. The standard discounted cash flow (DCF) model is difficult to use. But models have been developed that derive the value of an option.

Options are priced using no-arbitrage principles. This is most easily explained using the put-call parity (static arbitrage), introduced in Sect. 19.1. In order to use the put-call parity, you need a correctly priced put to price a call, and that is not always available. Therefore, we need to resort to a different approach that uses a dynamic trading strategy over multiple periods. The idea is still the same. We design a trading strategy that exactly replicates the option payoffs. This strategy should be self-financing such that we do not need to add or withdraw money at intermediate time points. This way, we can price the option at time 0 as the required starting capital for this dynamic trading strategy. The dynamic trading strategy is used in the binomial option pricing model, which can be extended to the well-known Black-Scholes option pricing model.

19.2.1 The Binomial Option Pricing Model

The binomial option pricing model (Cox et al., 1979; Rendleman, 1979) prices options by making the simplistic assumption that at the end of the next period, the underlying value has only two possible values. The two-state single period model values a call option by building a replicating portfolio, which is a portfolio of other securities that has the same value as the option in one period. As they have the same payoffs, the law of one price (see Box 4.1) tells us that the call and the replicating portfolio of stocks and bonds should have the same value.

A Call in the Binomial Model

The example in Fig. 19.15 shows how that works in a binomial tree, a timeline with two branches per date that show alternative possible events. The starting point is a call with a strike price of $K = \$10$ on a stock with a value of $S = \$10$. The decision tree shows two possible values for the stock in the next period: $S_u = \$12$ in the up state u, and $S_d = \$8$ in the down state d. This results in values for the call of $C_u = \$2$ in the up state and $C_d = \$0$ in the down state. During the same period, the riskless bond B gives a return of $r_f = 3\%$.

The question then is: how to replicate the call with (parts of) a stock and (parts of) a bond? The idea is to buy stock in such proportions that they give exactly the same payoffs as the call, i.e. \$2 in the up state and \$0 in the down state. The bought stock (long position) is financed by selling bonds (short position). The first step is to determine the option delta (or hedge ratio), which is the number of stocks needed to replicate or hedge the call. The option delta Δ is defined as follows:

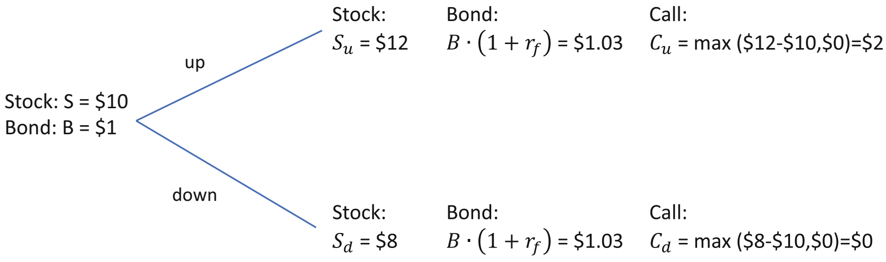


Fig. 19.15 Binomial tree for a call

$$\Delta = \frac{\text{spread of possible option prices}}{\text{spread of possible stock prices}} = \frac{C_u - C_d}{S_u - S_d} \tag{19.14}$$

The intuition of Eq. 19.14 is as follows. One is 'hedged', when the following identity holds at t = 1: Δ x spread of possible stock prices = spread of possible option prices. In our example of Fig. 19.15, the option delta is $\Delta = \frac{\$2 - \$0}{\$12 - \$8} = 0.5$.

The second step is to determine the number of bonds needed to finance the stock position. We are working with a replicating portfolio, which means that the payoff on the stocks and bonds replicates the payoff on the call option. This replication, for one time period later, is for the up state $C_u = \Delta \cdot S_u - (1 + r_f) \cdot B$, and for the down state $C_d = \Delta \cdot S_d - (1 + r_f) \cdot B$. Note that we have to increase the bonds with the paid interest r_f over one period. A single bond is valued at $B = \$1$ in Fig. 19.15. Rearranging, we can derive the number of bonds B:

$$B = \frac{\Delta \cdot S_u - C_u}{1 + r_f} \tag{19.15}$$

Filling in, we get for the up state $B = (0.5 \cdot \$12 - \$2)/1.03 = \$3.8835$. As the replication should work in the same way for the two states, we can check for the down state $B = (\Delta \cdot S_d - C_d)/(1 + r_f) = (0.5 \cdot \$8 - \$0)/1.03 = \$3.8835$. They are the same!

The final step is to determine the price of the call. Again, we can use the replicating portfolio. The price of the call option in the binomial model is as follows:

$$\text{Value of call} = [\text{delta} \times \text{stock price}] - [\text{bonds}]$$

$$C = \Delta \cdot S - B \tag{19.16}$$

Now, we are ready to calculate the value of the call option today, using the stock price S and bond price B at t = 0, one period before the final payoff at t = 1. Using Eq. 19.16, we get $C = 0.5 \cdot \$10 - \$3.8835 = \$1.1165$.

Table 19.3 provides a final check that the no-arbitrage principles work. At each point in time (t = 0 and t = 1) and for each scenario (up and down), the value of the replicating portfolio equals the value of the call.

Table 19.3 Call equals replicating portfolio in each scenario

	Period t = 0	Period t = 1	
Instrument	Up	Down	
Replicating portfolio	$\Delta \cdot S - B=$ 0.5*\$10 - \$3.8835 = \$1.1165	$\Delta \cdot S_u - (1 + r_f) \cdot B=$ 0.5*\$12 – (1.03) *\$3.8835 = \$6 - \$4 = \$2	$\Delta \cdot S_d - (1 + r_f) \cdot B=$ 0.5*\$8 – (1.03) *\$3.8835 = \$4 - \$4 = \$0
Call	$C = \$1.1165$	$C = \$2$	$C = \$0$

A Put in the Binomial Model

The calculation of the put price occurs in a similar way. The starting point is a put with similar prices: a strike price of $K = \$10$ on a stock with a value of $S = \$10$. The decision tree in Fig. 19.16 is similar to Fig. 19.15, except for the put: the values for the put of $P_u = \$0$ in the up state and $P_d = \$2$ in the down state.

Building on Eq. 19.14, the option delta Δ is defined as follows:

$$\Delta = \frac{\text{spread of possible option prices}}{\text{spread of possible stock prices}} = \frac{P_u - P_d}{S_u - S_d} \tag{19.17}$$

Whereas one needs a positive number of stocks to hedge a call option (the stock and call option both increase with a rising stock price), the option delta is negative for a put (the put option decreases with a rising stock price). So, in our example of Fig. 19.16, the option delta is $\Delta = \frac{\$0 - \$2}{\$12 - \$8} = -0.5$, which means that one has to sell stocks to hedge a put option. The replicating portfolio has thus a short position in stocks and a long position in bonds. This replication is for the up state $P_u = \Delta \cdot S_u + (1 + r_f) \cdot B$ and for the down state $P_d = \Delta \cdot S_d + (1 + r_f) \cdot B$. Rearranging these equations, the number of bonds B is:

$$B = \frac{-\Delta \cdot S_u + P_u}{1 + r_f} \tag{19.18}$$

Filling in, we get for the up state $B = (-(-0.5) \cdot \$12 + \$0)/1.03 = \$5.8252$. We leave it to the reader to check that the number of bonds is the same for the down state. The price of the put option in the binomial model is as follows:

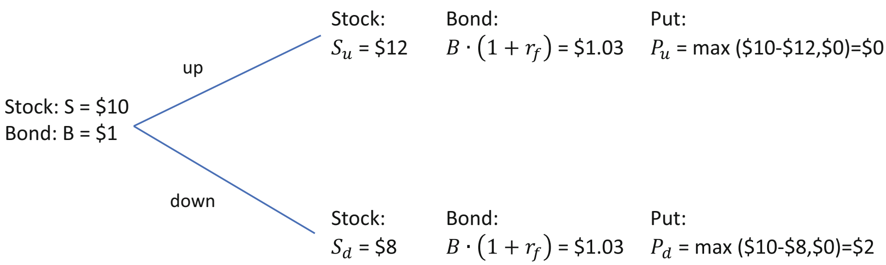


Fig. 19.16 Binomial tree for a put

$$\text{Value of put} = [\text{delta x stock price}] + [\text{bonds}]$$

$$P = \Delta \cdot S + B \tag{19.19}$$

We can calculate the value of the put: $P = -0.5 \cdot \$10 + \$5.8252 = \$0.8252$. We are now able to calculate the value of a call option and that of a put option with the binomial option pricing model. Box 19.2 checks our calculations with the put-call parity. Next, Example 19.6 gives you the opportunity to calculate the value of a call option with the binomial model.

Box 19.2 Put-Call Parity in the Binomial Pricing Model

We can use put-call parity to check the calculations for the prices of the call and put options in Figs. 19.15 and 19.16. The put-call parity from Eq. 19.5 is:

$$S + P = PV(K) + C$$

We can check the put-call parity directly by putting the relevant prices in: $\$10 + \$0.8252 = (\$10/1.03) + \$1.1165 = \$10.8252$. It holds!

We can also check the formula in an analytical way. Filling in the put and call option formulas of Eqs. 19.19 and 19.16, we get: $S + \Delta_p \cdot S + B_p = PV(K) + \Delta_c \cdot S - B_c$. Rearranging, we obtain: $S + B_p + B_c = (\Delta_c - \Delta_p) \cdot S + PV(K)$. This means for the stocks that $1 = (\Delta_c - \Delta_p)$. This holds in our example: $0.5 - -0.5 = 1$. Next, for the bonds: $B_p + B_c = PV(K)$. Again, this holds $\$5.8252 + \$3.8835 = \$10/1.03 = \$9.7087$.

Example 19.6 Calculating the Value of a Call Option with the Binomial Model

Problem

A stock has a current value of \$40 and two possible values for the next period, namely \$36 and \$46. In addition, the risk-free rate equals 2%. What is the value of a call option calculated using the binomial model?

Solution

To calculate the value of the call option, you first need to determine the delta and number of bonds. The delta is calculated using Eq. 19.14. In this case, the delta is $\Delta = \frac{C_u - C_d}{S_u - S_d} = \frac{\$6 - \$0}{\$46 - \$36} = 0.6$. The number of bonds is calculated using Eq. 19.15. We first calculate the up-state values as follows: $B = \frac{\Delta \cdot S_u - C_u}{1 + r_f} = \frac{0.6 \cdot \$46 - \$6}{1.02} = \$21.18$. Next, we calculate the down-state values: $B = \frac{\Delta \cdot S_d - C_d}{1 + r_f} = \frac{0.6 \cdot \$36 - \$0}{1.02} = \$21.18$, which is the same as for the up-state values. Lastly, the value of the call option can be determined using Eq. 19.16: $C = \Delta \cdot S - B = 0.6 \cdot \$40 - \$21.18 = \$2.82$.

19.2.2 Multiperiod Binomial Model

The formula for the option delta Δ can be interpreted as the sensitivity of the option's value to changes in the stock price at each point in time. Let's expand our one period binomial tree in Fig. 19.15 for a call to a two-period binomial tree. Figure 19.17 shows that in the up state at \$12 at t = 1, the stock can go up again to \$14 in t = 2. It can also go down to \$10. In the down state at \$8 at t = 1, the stock can go up to \$10 at t − 2 (the same as the down movement of the up state) or go down to \$6.

We can value the call option in the multiperiod binomial tree by working backwards from the end at t = 2. Let's start with the situation that the stock price has gone up to \$12 at t = 1. Figure 19.18 shows the payoffs for the stock and the call. Remember that the exercise price of the call is \$10. This results in values for the call of $C_u = \$4$ in the up state with a stock price of $S_u = \$14$, and $C_d = \$0$ in the down state with a stock price of $S_d = \$10$. Using eq. 19.14, we can calculate the delta Δ:

$$\Delta = \frac{C_u - C_d}{S_u - S_d} = \frac{\$4 - \$0}{\$14 - \$10} = 1$$

The next step is to calculate the number of bonds needed to finance the stock position. Using Eq. 19.15, we can derive the number of bonds B:

$$B = \frac{\Delta \cdot S_u - C_u}{1 + r_f} = \frac{1 \cdot \$14 - \$4}{1.03} = \$9.709$$

The final step is to derive the value of the call option at t = 1. Using Eq. 19.16, the price of the call option C is:

Fig. 19.17 Two-period binomial tree for a call

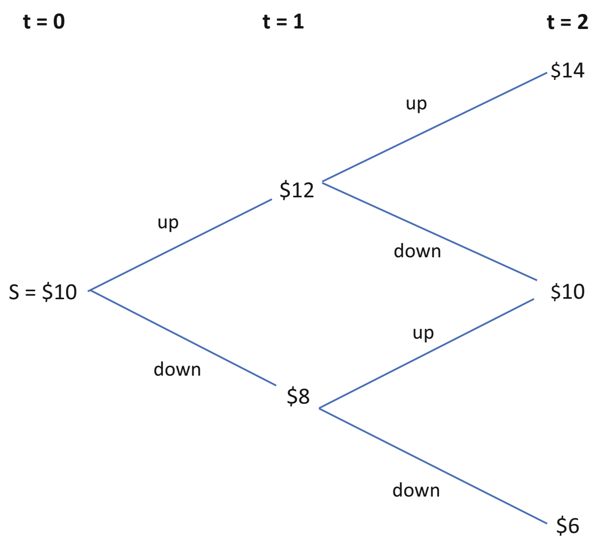


Fig. 19.18 Value of call option in up state at t = 1

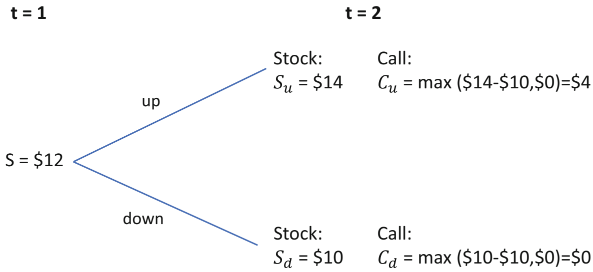
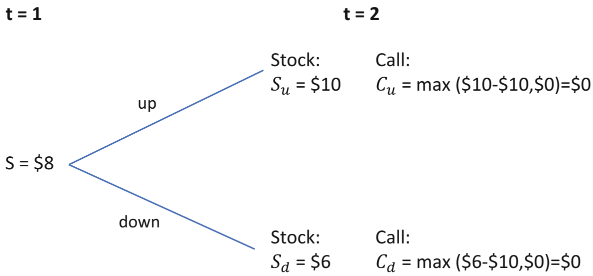


Fig. 19.19 Value of call option in down state at t = 1



$$C = \Delta \cdot S - B = 1 \cdot \$12 - \$9.709 = \$2.291$$

So, the value of the call option in the up state at t = 1 is $2.291.

We can repeat the same exercise for the down state. Figure 19.19 shows that the payoff on the call is $0 in the up and down state at t = 2. A call with zero payoffs in the future also has zero value today. So, the value of the call option in the down state at t = 1 is $0. To check this, we can also calculate the delta

$$\Delta = \frac{C_u - C_d}{S_u - S_d} = \frac{\$0 - \$0}{\$10 - \$6} = 0$$

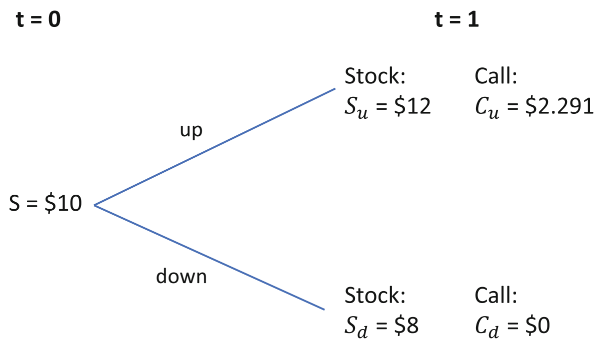
The delta is also zero, so we need zero stocks to hedge this position.

The final step is calculating the value of the call option at t = 0 in Fig. 19.20. As discussed before, the option delta—which is the number of stocks needed to hedge the call option—has to be recalculated at each point in time when the stock or call data change. Although Fig. 19.20 and Fig. 19.15 look almost the same, there is a small difference. The payoff on the original call option in the one-period model in Fig. 19.15 is $2 at t = 1 and that on the new call option is $2.291 in the two-period model in Fig. 19.20 at t = 1. Using Eq. 19.14, the delta Δ is:

$$\Delta = \frac{C_u - C_d}{S_u - S_d} = \frac{\$2.291 - \$0}{\$12 - \$8} = 0.573$$

Using Eq. 19.15, the number of bonds B needed to finance the stock position is:

Fig. 19.20 Value of call option at t = 0



$$B = \frac{\Delta \cdot S_u - C_u}{1 + r_f} = \frac{0.573 \cdot \$12 - \$2.291}{1.03} = \$4.449$$

Using Eq. 19.16, the price of the call option C at t = 0 is:

$$C = \Delta \cdot S - B = 0.573 \cdot \$10 - \$4.449 = \$1.279$$

So, the value of the call option at t = 0 is $1.279, which is slightly higher than the one-period call with a value of $1.1165.

We can refine the tree by cutting the maturity of the call option in ever smaller increments. As a result, the return distribution at t = T (maturity) starts to approximate the real returns distribution ever better. There is also the limiting case in which the time to maturity is cut off into infinitely many increments that are each infinitely small. This gives the Black-Scholes option pricing model, which is in continuous time.

19.2.3 The Black-Scholes Option Pricing Model

The Black-Scholes option pricing model (Black & Scholes, 1973) was developed independently and before the binomial model. But it is related to the binomial option pricing model and can be derived from it (see, for example, Hull, 2014). The Black-Scholes formula for the price of a European call on a non-dividend paying stock follows the set-up of the binominal model in Eq. 19.16:

$$\text{Value of call} = [\text{delta} \times \text{stock price}] - [\text{bonds}]$$

$$C = N(d_1) \cdot S - N(d_2) \cdot PV(K) \tag{19.20}$$

where

S is the current price of the underlying stock.

$PV(K)$ is the present value (and price) of a risk-free zero-coupon bond that pays K on the expiration date of the option discounted at the risk-free rate.

K is the exercise price.
$N(d)$ is the cumulative normal probability distribution, i.e. the probability that a normally distributed variable is less than or equal to d

$$d_1 = \frac{\ln[S/PV(K)]}{\sigma\sqrt{\mathrm{T}}} + \frac{\sigma\sqrt{\mathrm{T}}}{2}$$

$$d_2 = d_1 - \sigma\sqrt{\mathrm{T}}$$

σ is annual volatility (standard deviation) of the stock's returns.
T refers to the number of years until expiration.

Let's discuss the features of the Black-Scholes formula. First, the stock price S plays an important role in option pricing. As stock prices cannot fall below zero, the left side of the stock price is limited. But stock prices can increase to very high numbers, though the chance of that happening is small. The lognormal function (denoted by ln in Eq. 19.20) is therefore used for the stock price.

The next step is to interpret the cumulative normal distribution $N(d)$, which is illustrated in Fig. 19.21. This is the probability that a randomly distributed variable will be less than d: the shaded area left of d in Fig. 19.21. $N(d_1)$ is the option delta, which we introduced earlier. If d_1 is large, then $N(d_1)$ is close to one. In economic terms, this means that the stock price S is large relative to the present value of the exercise price $PV(K)$. The call option is then very much in-the-money and one needs almost a full stock to hedge the fluctuations of the call option (i.e. the option delta is close to one). If d_1 is zero, then $N(d_1)$ is 0.5. Figure 19.21 shows that half of the probabilities are in that case to the left.

$N(d_2)$ is the normal distribution corresponding to the probability that the call option will be exercised at expiration (remember the Black-Scholes formulas are used for European call and put options, which can only be exercised at expiration). An easy way to calculate $N(d)$ is to use the excel function NORMSDIST(d).

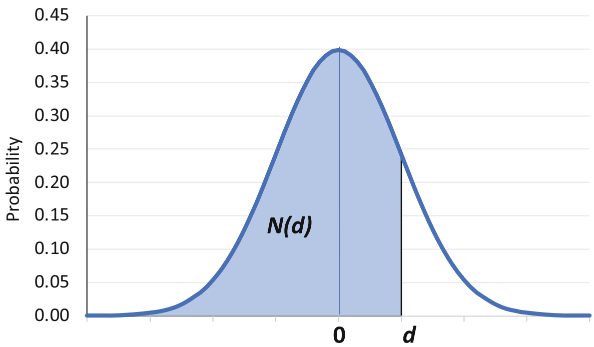


Fig. 19.21 Cumulative normal distribution

Finally, the volatility of the underlying stock σ is an essential variable of the Black-Scholes formula. Options are useful to protect or 'hedge' the owner of stocks against volatile stock prices, as discussed in Sect. 19.1. Without volatility in the underlying value, there is little use for options.

Example 19.7 calculates the value of the 3M call option with the Black-Scholes model.

Example 19.7 Calculating the Value of a Call Option with the Black-Scholes Model

Problem

We use the values of the 3M call option with exercise price of $110 from Table 19.2. Next, we take a given volatility of 25%, a risk-free rate of 2.5%, and 2.25 years to maturity. What is the option delta, the number of bonds needed and the value of the call option?

Solution

The value of the call can be determined using eq. 19.20. In order to fill in the complete formula, the option delta and the number of bonds need to be determined first. To determine the option delta, the present value of the exercise price is need. For the exercise price of $110, the present value is $PV(K) = \frac{\$110}{(1.025)^{2.25}} = \$104.06$.

Next, d_1 and d_2 are calculated as follows:

$$d_1 = \frac{\ln[S/PV(K)]}{\sigma\sqrt{T}} + \frac{\sigma\sqrt{T}}{2} = \frac{\ln\left[\frac{\$113.49}{\$104.06}\right]}{0.25\sqrt{2.25}} + \frac{0.25\sqrt{2.25}}{2} = 0.4189$$

$$d_2 = d_1 - \sigma\sqrt{T} = 0.4189 - 0.25\sqrt{2.25} = 0.0439$$

The option delta is the normal distribution of d_1, which leads to $N(0.4189) = 0.662$. The number of bonds is calculated by multiplying the normal distribution of d_2 with the present value of the exercise price, so $N(0.0439) \cdot \$104.06 = 0.518 \cdot \$104.06 = \$53.85$. Now that all the variables for the calculation of the call option are calculated, inserting them into Eq. 19.20 gives:

$$C = N(d_1) \cdot S - N(d_2) \cdot PV(K) = 0.662 \cdot \$113.49 - 0.518 \cdot \$104.06 = \$21.32$$

To check our calculation, we can compare the option value with the option premium in Table 19.2, which is $\frac{\text{bid}+\text{ask}}{2} = \frac{\$20.50+\$21.75}{2} = \$21.13$. This shows that our option value of $21.32 is close to the option premium of $21.13 quoted in the market.

Using the put-call parity from Eq. 19.5, we can show the put as follows:

$$P = C - S + PV(K) \tag{19.21}$$

We can now insert the Black-Scholes formula of Eq. 19.20 for the call C and rearrange. This gives us the Black-Scholes formula for the price of a European put on a non-dividend paying stock:

$$P = [1 - N(d_2)] \cdot PV(K) - [1 - N(d_1)] \cdot S \tag{19.22}$$

Interestingly, only a very limited number of input parameters are needed to price the Black-Scholes call and put options. For example, we don't need to know the expected return on the stock (which is already in the current stock price). In Sect. 19.2.4, we review the drivers on option prices.

Dividend Paying Stocks

The Black-Scholes formulas are derived for non-dividend paying stocks. They can easily be adjusted for dividend paying stocks. The European call option holder has no rights to any dividends paid out prior to expiration. We can just deduct the present value of these missed dividends $PV(Div)$ from the stock price S:

$$S^* = S - PV(Div) \tag{19.23}$$

The adjusted stock price S^* in place of S can then be used in the Black-Scholes formulas.

Implied Volatility

While most parameters are easy to calculate, the volatility of the stock price σ is more difficult to calculate. The most direct way is to calculate a stock's volatility from historical stock prices (see Chap. 12). But traders sometimes take a shortcut by deriving a stock's volatility from the current market prices of traded options. By filling out all other parameters and the market price of the option, the volatility can be obtained. Estimating a stock's volatility that is implied by an option's market price is called implied volatility.

Risk of Options

What are the risks of options? We can derive the risk of an option from the underlying replicating portfolio. In the case of a call option, the portfolio is long in stocks and short in bonds. From Eq. 13.7 in Chap. 13, we know that the beta of the option β_{option} is a weighted average of the beta of the stock and the bond:

$$\beta_{option} = \frac{\Delta \cdot S}{\Delta \cdot S + B} \cdot \beta_{stock} + \frac{B}{\Delta \cdot S + B} \cdot \beta_{bond} \tag{19.24}$$

Given that the bond is risk-less, its beta is $\beta_{bond} = 0$. Let's calculate the beta of the 3M call option in Table 19.2. From Example 19.7, we know that $\Delta \cdot S = 0.662$ * \$113.49 = \$75.13 and $B = 0.518$ * \$104.06 = \$53.85. Remember that for a call option, the delta Δ is positive and the bond financing B is negative. 3M's stock beta is $\beta_{3M} = 1$. The beta of the option is $\beta_{option} = \Delta S/(\Delta S + B) \cdot \beta_{stock} = \$75.13/(\$75.13 - \$53.85) * 1 = 3.53$. The beta of the 3M call option (3.53) is far higher than the beta of the stock (1) and thus riskier than the stock itself. This can be explained by the fact that a call option is basically a leveraged position in the stock, as the replicating portfolio finances the stock with borrowing.

Please note that the option beta β_{option} changes at each point in time. After all, you have a dynamic trading strategy in which delta Δ changes at each point in time. While the beta of a call is positive, the beta of a put is typically negative reflecting the short position in stocks.

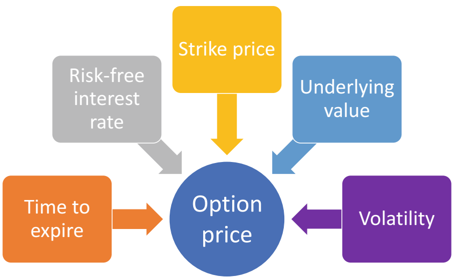
19.2.4 Drivers of Option Prices

The Black-Scholes formulas reveal the drivers of option prices, which are summarised in Fig. 19.22.

Two out of these five drivers have the same sign for (long positions in) calls and puts: the time to expiration (+) and volatility (+). After all, the longer the option runs, and the higher its volatility, the bigger the chance that it will become in-the-money. The probability of really large swings increases, since there is little downside to a swing to one side and a lot of upside to the swing to the other side. Just imagine the reverse: an out-of-the-money call (or put) option with a very short time to expiration and a very low volatility—its price will likely be low.

The other three drivers have opposing signs for (long positions in) calls and puts, of which one has a negative sign for calls and a positive sign for puts: the strike price. The intuition on the strike price already followed from the discussion in Sect. 19.1: the higher the strike price, the lower the expected payoff on a call. This brings us to the two drivers that have positive signs for calls and negative signs for puts: the risk-free rate and the underlying value. The underlying value was already discussed in Sect. 19.1: the higher the underlying value, the higher the expected payoff on a call. And a higher risk-free rate lowers the PV of the strike (or exercise) price, which is

Fig. 19.22 Drivers of option prices



positive for the call price and negative for the put price. Table 19.4 summarises the effect of drivers on call and put options.

Table 19.4 Effect of drivers on (long positions in) call and put options

Driver	Call option	Put option
Underlying value	+	–
Volatility	+	+
Strike price	–	+
Time to expiration	+	+
Risk-free interest rate	+	–

19.3 Real Options on F

A real option is the opportunity to make a particular business decision. In contrast to financial options, they are not exchange traded, and there is no formal option contract, and no clear counterparty. Otherwise, they have the same characteristics, namely with a payoff that depends on factors such as the underlying value and a strike price on that underlying value. Being long in real options provides valuable flexibility to exercise an opportunity, whereas being short in real options (which may happen unknowingly) can be very risky and value destructive.

This section discusses what real options look like, how they arise, and what they mean in terms of financial value. In subsequent sections, we discuss how E and S affect such real options on F (Sect. 19.4); real options on E and S themselves (Sect. 19.5); and how real options on E, F, and S relate to each other in integrated value (Sect. 19.5). We note at the outset that you typically cannot price real options by no-arbitrage principles as we did in the previous sections, since these real options are not redundant. This means you cannot make a replicating portfolio to price real options.

19.3.1 Applications of Real Options

Many corporate assets, particularly growth opportunities, can be viewed as call options (Myers, 1977). The value of such 'real options' depends on discretionary future investment by the firm. These options can be used in valuation and (corporate) investment decisions, including M&A. For example, suppose a company has developed a technology to make battery materials for electric vehicles that replaces polluting metals with lignin (wood). As almost always, the initial problem is the higher cost of the new technology versus existing alternatives. The company now effectively has a put option on the production costs of lignin-based battery materials (which need to go down to be competitive), where the exercise price is the production costs of traditional metals-based battery materials products (which are lower, but may rise). When the production costs of lignin-based battery materials go down, the put option comes in-the-money.

This is just one example, but there are many more. See Fig. 19.23 for a classification of more often occurring types. These options are very important for

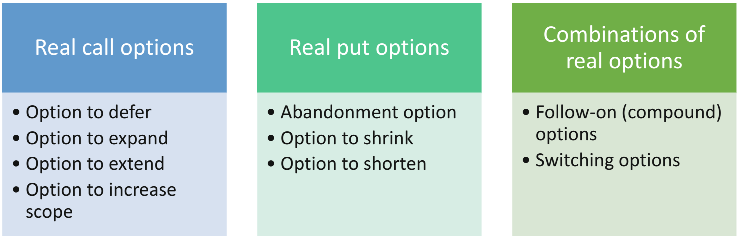


Fig. 19.23 Classification of real options

companies. In fact, one could argue that corporate strategy is all about options. As Luehrman (1998) puts it: 'In financial terms, a business strategy is much more like a series of options than a series of static cash flows'. One could also view high risk companies as options, for example in a venture capital portfolio, where two-thirds of investments tend to lose money and most of the returns come from just a few blockbusters (see Chap. 10). Typical examples include biotech R&D investments, where most don't pay off, but some pay off massively; and mining exploration, which gives the option to build a mine, and which is exercised if the price of the mined material is sufficiently high.

To stress the strategy angle, Box 19.3 shows how Shell created a put option to cancel refinery construction ahead of the oil crisis in the 1970s. This put option appeared to be very valuable when the oil crisis hit.

Box 19.3 Put option on Refinery Capacity

Oil company Shell is one of the first companies to do long-term scenario analysis (see Chap. 2). The business model of oil companies can be affected by several political and economic trends. Shell's scenario analysis in the early 1970s showed the possibility of reduced oil supply from the Middle East. And importantly, Shell acted on this knowledge by putting a clause in its contracts with refinery constructors to delay or cancel the building of refineries. They could do this at negligible costs. When the oil crisis hit in the 1970s, Shell exercised this put option by cancelling the building of new refineries, as these would be idle given the reduced oil supply.

Shell saved a lot of money by exercising its put option, while other oil companies had to keep on building refinery capacity (without business for these refineries), since they did not have the flexibility to delay construction.

The lesson from this case study is that it is important to put scenario analysis into strategic action. Once a company becomes aware of undesirable scenario outcomes, it should act on it as part of its strategy to navigate away from these possible outcomes.

Source: De Ruijter (2014).

19.3.2 Types of Real Options

Koller et al. (2020) provide a classification of real options (see Fig. 19.23):

- The **option to defer** (a call): the flexibility to wait and do the same action later (e.g., a product introduction), when conditions (the underlying value) are better;
- The **abandonment option** (put): the option to stop an operation, for example to shut down a plant at a cost (the exercise price) to avoid much higher on-going costs (negative exposure to the underlying value);
- The **follow-on (compound) option** (a series of options on options): for example, the ability to launch a new product, for which the experience of previous products is a prerequisite;
- The **option to expand** (call) **or contract** (put): flexibility in the size of the operations, for example to operate a mine or factory at larger (call) or smaller (put) volumes per unit of time;
- The **option to extend** (call) **or shorten** (put): the flexibility to adapt the lifetime of an operation, i.e. to operate for longer (call) or shorter (put);
- The **option to increase scope** (call): the flexibility to add other operations, such as new products, new features, or new markets to existing operations;
- **Switching options** (a portfolio of call and put options): flexibility to choose between different operations; for example, to increase the production of a product in high demand at the expense of another product that is less in demand.

The drivers of real options follow from the drivers of financial options and are summarised in Fig. 19.24. A key point is that uncertainty—measured as volatility of cash flows—enhances the flexibility value (though it may also reduce future cash flows). Real options are about creating flexibility to change course in future circumstances. In this future, the cash flows of the existing course of action

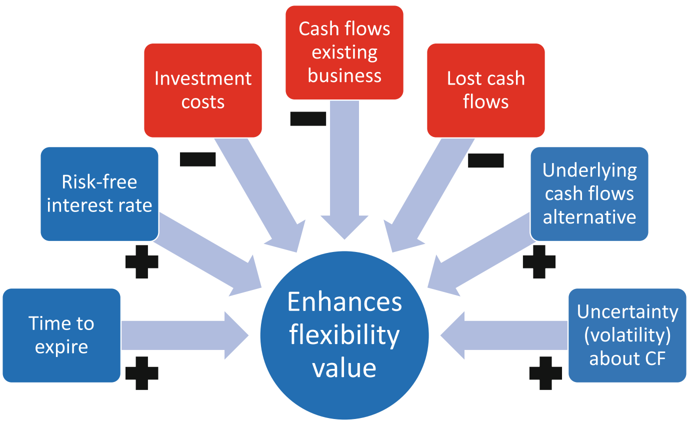


Fig. 19.24 Drivers of real option value. Note: The drivers of a real call option are shown. Source: Adapted from Koller et al. (2020)

(e.g. the incumbent product or technology) and/or the alternative course of action (e.g. a new product or technology) may change.

But these real options are typically not costless. Investment is often necessary to create the option and can thus be seen as a premium paid for the option. There may also be lost cash flows from an option to defer; the company could, for example, have increased sales today if it had not deferred the launch of a new product.

19.3.3 Real Options to Deal with Uncertainty

Companies can use real option analysis when faced with fundamental uncertainty, if not only the outcome, but also the probability distribution governing the outcome, is unknown. If the probability distribution is known, scenario analysis can be used (see Sect. 12.8 in Chap. 12). If the probability distribution is unknown, real options can be used to structure the challenge for the company and prepare decisions in the future.

Let's illustrate this with an example. In the energy transition, it is not (yet) clear which renewable energy source (wind, solar or hydrogen) is the most profitable and will emerge as the 'winning' technology. A company can prepare itself by making (small) investments in the various technologies. The company is then ready for expansion when it becomes clear which type of renewable is the most profitable. The option premium is then the upfront investment and the real options are the option to expand (in the winning technology) and to switch (from the non-winning technologies). As shown below, real option analysis works backwards. It starts with possible outcomes (in our example, possible renewable technologies) and then defines the options in the intermediate period (choice to expand/switch) and at the start (decision to do initial investment).

19.3.4 Using Decision Tree Analysis for Real Options

Real options can be analysed using decision trees that are reminiscent of the multiperiod option pricing model. A decision tree is a graphical representation of future decisions under uncertainty. Figure 19.25 gives the example of a decision tree regarding the investment in a mine. A decision tree is different from a binomial tree, in which the branches of the tree represent uncertainty that cannot be controlled: the nodes are only information nodes (uncertainty out of control of the decision maker; in red in Fig. 19.25). A decision tree also has decision nodes (in blue in Fig. 19.25).

The investment in the mine (a cash flow of -\$2500 million) at $t = 0$ effectively buys the company an exposure to metal prices, with a payoff of \$5500 million if prices rise; and a \$800 million payoff if prices fall at $t = 2$. Note that the investment in the mine is NOT a call anymore at $t = 1$ once the mine has been built at $t = 0$. The call lies before that at $t = 0$: the choice to build it or not; and before that at $t = -1$ (outside Fig. 19.25): the choice to do the exploration or not. Table 19.5 shows the (expected) payoffs and how they add up. Please note that Table 19.5 starts from the

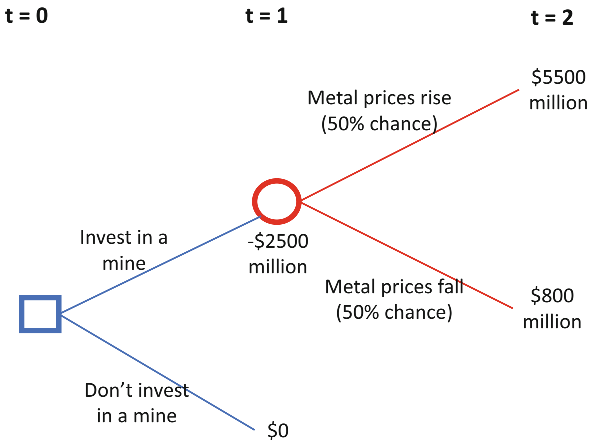


Fig. 19.25 Decision tree example

Table 19.5 Expected value in the decision tree example ($ million)

Scenario	Payoff (1)	Probability (2)	Expected payoff (3)	Previous payoff (4)	Total payoff (5)	Total expected payoff (6)
Calculation			(1)*(2)		(1) + (4)	(5)*(2)
Metal prices rise	5500	50%	2750	−2500	3000	1500
Metal prices fall	800	50%	400	-2500	−1700	−850
Total		100%	3150			650

right side of the decision tree and then works backwards. Table 19.5 shows a total expected payoff of $650 million, suggesting that the company should invest in the mine. Example 19.8 shows how one can calculate the expected value with a decision tree.

In reality it is of course more complicated, with a continuum of possible prices, and significant differences between small and large price rises. One can construct decision trees that better reflect that complexity by adding more branches. Up to a point, that can improve the quality of decision-making information.

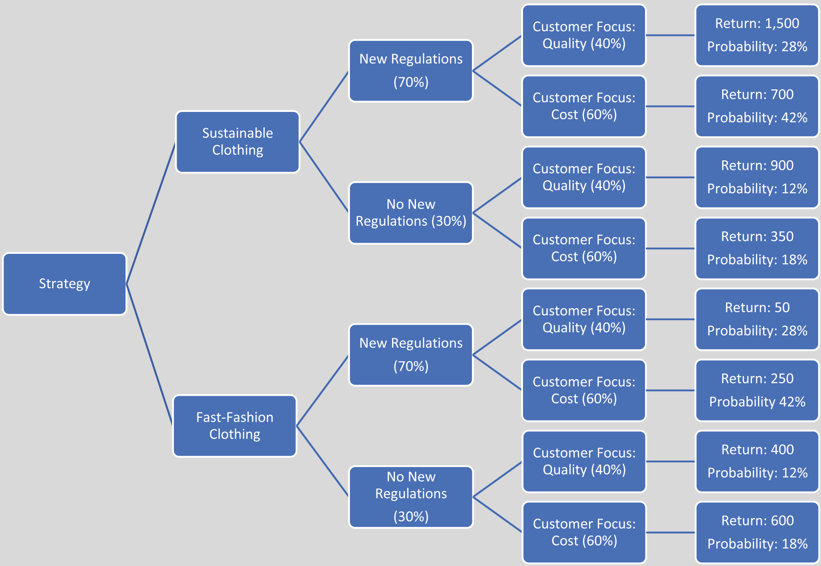
Example 19.8 Calculating Expected Value with a Decision Tree

Problem

A fast-fashion clothing brand currently is considering selling sustainable clothing (higher durability, better quality, and organic materials). Key external factors that help determine the success of this strategy are new regulations (requiring sustainable clothing) and customer preferences (cost or quality). The decision tree showing the possible scenarios and associated returns and

(continued)

Example 19.8 (continued)
probabilities is shown below. The company assumes a 70% chance of new regulations and 40% chance of customers focusing on quality. The company also faces investment costs of 500 should they decide to implement the sustainable clothing strategy. What is the expected value of both strategies? And which should the company therefore decide to implement?



Solution

The table below is filled in backwards with the payoff (1) and probability (2) from the final column of the decision tree at $t = 2$. This provides the expected payoff (3) at $t = 1$. Next, the company faces the investment cost (4) at $t = 0$. The total payoff (5) is then (1) + (4). Finally, the total expected payoff (6) can be calculated.

As illustrated in the table below, the total expected payoff of the sustainable clothing strategy (385) is higher than the fast-fashion strategy (275). The company should therefore implement the sustainable clothing strategy. Looking at the numbers, the payoff when the company chooses the sustainable clothing strategy under the scenario of new regulation and customers prefer quality is by far the highest (280) and is the main reason why the strategy is

(continued)

Example 19.8 (continued)
preferred. In this example, it 'pays off' for the fast-fashion company to anticipate new regulations and consumer preferences by investing in a sustainable clothing strategy.

Strategy	Scenario: New Regulation	Scenario: Customer Focus	Payoff (1)	Probability (2)	Expected payoff (3)	Previous payoff (4)	Total payoff (5)	Total expected payoff (6)
Calculation					(1)*(2)		(1) + (4)	(5)*(2)
Sustainable	Yes	Quality	1500	28%	420	500	1000	280
Sustainable	Yes	Cost	700	42%	294	500	200	84
Sustainable	No	Quality	900	12%	108	500	400	48
Sustainable	No	Cost	350	18%	63	500	−150	−27
Total				100%	885			385
Fast-Fashion	Yes	Quality	50	28%	14	0	50	14
Fast-Fashion	Yes	Cost	250	42%	105	0	250	105
Fast-Fashion	No	Quality	400	12%	48	0	400	48
Fast-Fashion	No	Cost	600	18%	108	0	600	108
Total				100%	275			275

19.3.5 Corporate Use of Real Options

In corporate practice, the use of real options is not as widespread as academics had imagined. Managers tend to favour DCF analysis in capex decisions, or simpler but flawed alternatives, such as the payback criterion—see Chaps. 6 and 7 for a discussion. Triantis and Borison (2001) identify three main corporate uses of real options:

- as a strategic way of thinking—for example as input into an M&A process, but with little quantification or formality;
- as an analytical valuation tool—for example in commodities, where financial options are available for the underlying exposures; and
- as an organisation-wide process for evaluating, monitoring, and managing capital investments—this is rare, except in companies where technology and R&D make it crucial to identify and manage potential sources of flexibility.

Often, managers are not even aware of the options they have, since these options are not explicitly presented as such ('opaque framing') and are thus not identified in the first place. Moreover, they may suffer from behavioural biases, such as excessive optimism or overconfidence, which cause them to refrain from using real option techniques—they simply don't see the need. That is a pity, because real option techniques can mitigate managers' tendencies to invest fully in projects which could turn out to be unsuccessful. They can, for example, do a small upfront investment creating an option to expand. At the next stage, they can scale up when the project is successful or abandon when the project is unsuccessful.

A different and more cynical perspective is taken by Nassim Taleb (2012) in his book Antifragile. He argues that there are many cases in life, not just in corporate life, where people chase the upside while shifting the risk to others—they receive the option premium and leave the downside to fall on others. Outside of corporate life, examples include politicians who make dangerous claims and decisions that help them win elections, but which come at a high price to the health and wealth of the ordinary public. In corporate life, it can be managers who take cost-cutting measures at the expense of client safety, which helps them to boost EPS in the short run, while costing lives in the medium term. See the Boeing example in Chap. 3. Such shortcuts in safety are essentially written puts, in which every year the premium is earned (by means of cost savings and higher EPS) until one year a massive bill comes in.

19.4 Real Options on F Driven by E and S

The real options described in Sect. 19.3 can have E or S drivers. This section describes real options on F driven by E and S, that is with environmental and/or social externalities as the drivers of the underlying value and payoff in terms of F. We consider calls and puts in pairs of long and short positions.

19.4.1 Real Call Positions Driven by E and S

How to think about real call options driven by E and S? On the long side, such a call results from grasping E and S opportunities. On the short side are the incumbents that are currently destroying value on E or S, whereas some competitors grasp E and S opportunities. Table 19.6 provides an overview of these real call options on E, long and short. To be concrete, we discuss Table 19.6 in terms of introducing a new low-carbon technology (or product) versus keeping the incumbent high-carbon technology. Think of the advent of electric vehicles in the car industry versus the

Table 19.6 E and S drivers of real call options on F

		Long call	Short call
Underlying value	Size of the positive externality of the new technology relative to the old technology	+	–
	CFs new technology	+	–
Strike price	CFs incumbent technology	–	+
Volatility	Transition tensions	+	–
Time to expiration	Economic life of the incumbent technology	+	–
Risk-free interest rate	PV of the incumbent technology (strike price)	+	–

incumbent internal combustion engine. But it applies more generally: a new course of action versus an existing course of action.

Long Call

In the case of the long call, the intrinsic value of the real option increases with the size of the positive externality (opportunity). After all, the larger the potential reduction in value destruction, the higher the value of the new technology for society. In contrast, the value of the short call decreases with the size of the negative externality (risk of incumbent technology). It becomes thus riskier (i.e. less valuable) for the company to offload sustainability risks to society.

The intrinsic value of the real call option increases with the attractiveness (e.g., low cost or ease of application) of the new technology (it becomes cheaper to switch to the new technology) and decreases with the attractiveness of the incumbent technology (the hurdle for switching is higher). This is a story about competitiveness of the new versus the incumbent technology. As the new technology becomes competitive, the value of the long call goes up and might come in-the-money, while that of the short call falls.

The volatility is captured by transition tensions that increase the likelihood and speed of internalisation of the externality. Note that the time value of a long call increases with uncertainty or volatility (see Table 19.4). As the company with the incumbent technology has a short call, it loses from higher volatility.

The time to expiration is related to the economic life of the incumbent technology. As long as the old technology is viable, the long call on the new technology remains in place. In contrast, the written call on the incumbent technology loses value when the old technology is eventually phased out (because it is at the end of its lifetime and needs to be replaced). If the risk-free interest rate increases, the present value (PV) of the incumbent technology decreases, which increases the value of the long call (as discussed above).

It is quite difficult to put numbers on the option value parameters of such a call driven by E or S. Still, real options driven by E and S are insightful. The long call helps companies to prepare for transition at low cost, even if they are not convinced about the transition happening in the short run. The preparation investment (call premium) gives the company an opportunity to switch to the new technology when that becomes competitive. In option terms, the value of that opportunity increases when transition tensions and/or the size of the externality increase.

Let's illustrate the long call with an example. As explained in Box 2.2 in Chap. 2, the food chemical and nutrition company DSM has developed the product Bovaer, which reduces methane emissions of cows. As we do not know the real numbers, we use fictional numbers for illustrative purposes here. The development cost of Bovaer is the option premium at €4 per unit product. The strike price of the call is the production cost of Bovaer at €5 per unit product. The underlying value on the x-axis is the tax on methane emissions. Figure 19.26 shows the profit diagram of this call option. DSM will start producing and selling Bovaer (i.e. exercising the call option) as soon as the methane tax exceeds the strike price. That is at a methane tax of €5 for saved methane emissions per unit product. At that price, DSM covers the production

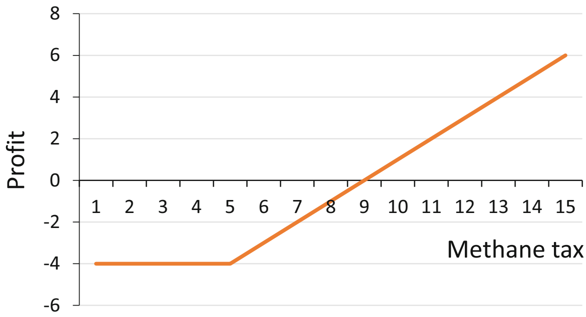


Fig. 19.26 Profit diagram for DSM's product Bovaer

cost of $5 per unit. DSM will break even at a methane tax of €9 (earning back the development cost and the production cost). The Bovaer product becomes more profitable as the methane tax continues to rise.

Short Call

Valuing the short call also incentivises companies to prepare for the future. When transition tensions and/or the size of the externality increase, the risk of doing nothing increases, as witnessed by the lower value of the short call. Companies are then pushed to consider strategies to avoid this risk by phasing out the incumbent technology (and thus getting into transition). Negative externalities are thus an indicator for the need for transition. In both the long call and the short call case, real option analysis incentivises companies to prepare for transition with transition tensions and the size of externalities as powerful indicators.

Separately, increased competitiveness of the new technology relative to the old technology reduces the societal cost of transition. Such increased competitiveness might result from falling costs of the new technology or from rising costs of the incumbent technology. For example, a prospective CO_2 price or a methane tax could bring a real option in-the-money by decreasing the PV of the cash flows of the incumbent technology (which bears the methane price). And uncertainty around the CO_2 price or methane tax drives volatility and option value: even if the option is out of the money at the current methane price (i.e. no viable business model and no cash flows at current methane prices), there is option value in the mere possibility that the methane price will be sufficiently high in the future.

19.4.2 Real Put Positions Driven by E and S

Let's now consider a short put option. As mentioned in Sect. 19.3, the Boeing example from Chap. 3 was essentially a written (short) put on safety. By taking shortcuts in safety, every year Boeing earned the put premium in terms of cost savings and higher EPS, until one year a massive bill came in. Let's start the analysis from the short perspective, i.e. Boeing's. The underlying value is the safety level of the aircraft, which is the probability of no accident(s) happening that may result in

Table 19.7 E and S drivers of real put options on F for Boeing example

		Long put	Short put
Underlying value	Safety level as measured by: – Health of passengers – Avoiding multi-billion dollar fines	 – –	 + +
Strike price	Passengers arrive safely due to safety investment	+	–
Volatility	Swings in resulting safety levels	+	–
Time to expiration	Use time of the planes produced	+	–
Risk-free interest rate	PV of the safety investment	–	+

multi-billion dollar fines. Boeing can avoid paying these potential fines by keeping passengers safe and alive via sufficient investment in safety. Safe arrival is the key threshold and hence the strike price (Table 19.7).

Another example of a short put option is BP's Deepwater Horizon oil spill in 2010 (see Box 1.1 in Chap. 1). BP's underinvestment in safety to increase short-term earnings contributed to the massive oil spill, resulting in a multi-billion-dollar settlement for the oil company.

As shown by the Merton model (Merton, 1974), any liability can be seen as a portfolio consisting of (among other positions) a short put. Such liabilities are called contingent liabilities or contingent claims. Contingent liabilities can also arise from the governance dimension (the G dimension from ESG). An example is accounting fraud, which can create large liabilities. The size of the liabilities can sometimes lead to the collapse of the company as discussed in Chaps. 3 and 17.

Comparing Call and Put Examples

There are at least three differences between the put examples and the call examples. First, the put examples are not a transition risk. It is not part of a bigger societal challenge, but purely the result of Boeing's and BP's decision to economise on safety. Second, the short puts are not driven directly by competing products. There is no new technology that can eradicate the negative externality. But there is a competitive element in both puts and calls (see below). Third, there is no clear counterparty that has the exact mirror position. It's not the passengers, who unknowingly risk their lives and who pay a bigger price than Boeing does in the event of disaster. Yes, the recipients of the fines seem to take the mirror position, but in fact the financial compensation only partly compensates for their overall losses.

There are also similarities. Both long calls and short puts have a competitive element: companies that invest in long calls increase their competitive composition by frontloading new technology, while companies that write short puts increase their competitive position by cutting costs. But the outcome is opposite from a societal perspective: whereas long calls lead to a race to the top (accelerating transition), short puts may lead to a race to the bottom (offloading risk to society).

19.5 Integrated Value as a Set of Real Options on F, E and S

The previous section discussed real options on F with E or S as drivers, but some are also real options on E and S themselves, i.e. with the payoffs in terms of E and S, and possibly the underlying values as well. For example, the Boeing safety situation can also be seen as a set of put options on S rather than F. After all, by economising on safety, Boeing not only undermines its own future profitability for short-term profit (this is its own short put position of F). Worse, it also puts the lives of airline passengers at risk. And then it is actually Boeing that is long the put on S, and the passengers and society who are short the put on S.

More generally, companies can create options for specific stakeholders, such as shareholders or employees, at the expense of other stakeholders. It is important to be aware of such situations—'sucker games' as Nassim Taleb (2012) calls them. The integrated value perspective helps to make such situations visible, by explicitly comparing EV, FV, and SV—and we can express them in option values on an integrated balance sheet.

Chapter 15 discussed capital structure and showed an integrated balance sheet in Sect. 15.6—see Table 19.8 below.

We can go a step further and express the market value balance sheet as a combination of risk-free assets and liabilities and (put & call) options on F, S, and E. After all, given put-call parity in Eqs. 19.8–19.12, we can express assets as the sum of equity, which can be seen as a call option C, and corporate debt, which can be seen as riskless debt B minus a put option P:

$$Assets = Risky\ debt + Equity = B + C - P \tag{19.25}$$

We can translate this to integrated assets IV:

$$\begin{aligned} IV = &(E\ bond + E\ call – E\ put) + (F\ bond + F\ call – F\ put) \\ &+ (S\ bond + S\ call – S\ put) \end{aligned} \tag{19.26}$$

So, we get a string of call and put options on F, S, and E. Figure 19.27 visualises these options.

Table 19.8 Integrated balance sheet (based on market value)

S assets	20	S debt	5
		S equity	15
E assets	15	E debt	25
		E equity	-10
F assets	25	F debt	5
		F equity	20
Total integrated assets	**60**	**Total integrated liabilities**	**60**

EV =	E bond	+ call on E	- put on E
example:	+: natural capital improvements realised -: natural capital destruction caused	still to be realised emission savings	biodiversity damage resulting from activities
+			
FV =	**F bond**	**+ call on F**	**- put on F**
example:	CF from business as usual	potential additional CF from current / new projects / products	potential reductions in CF from current / new projects / products
+			
SV =	**S bond**	**+ call on S**	**- put on S**
example:	+: health improvements realised -: health reductions caused	still to be realised health improvements	still to be experienced health reductions from, for example, savings on safety
=			
IV =	**I bond**	**+ call on I**	**- put on I**

Fig. 19.27 A conceptual IV balance sheet as a combination of options

The appealing aspect of the options perspective is that it is more dynamic than the ordinary balance sheet perspective. It emphasises the need to always ask the question: what are the implicit options that the company has written on behalf of society? These implicit options are both positive (the company's opportunities to improve E and S) and negative (the company's ability to offload E and S risks).

Expressing E and S in options helps people to see nonfinancial benefits and costs more clearly. Unfortunately, the data are often lacking to properly value those options, but you can fill it out intuitively. And ideally, you carefully consider the relations between those options.

19.6 Conclusions

Financial options are contracts that give the owner the right to buy (in the case of a call option) or sell (in the case of a put option) a security at a pre-specified price (the exercise price). The seller or writer, who is short the option, has the opposite position of the buyer, and has to exercise the contract if the buyer wants to do so. The flexibility is on the side of the buyer, but the seller is compensated with a premium paid by the buyer.

Options are interesting since they offer alternative ways of looking at situations, including outside of contractual settings. In that case, they are called real options. A real option is the opportunity to make a particular business decision, exemplifying the value of flexibility. Real options come in various types, such as the option to delay and the option to expand. They can be applied in valuation and in investment decisions, including M&A.

One can analyse many situations as combinations of options, using concepts such as put-call parity, which also allows for the interpretation of capital structure in terms of options. Moreover, one can visualise both financial options and real options with decision trees and payoff graphs for better intuitive grasp of situations.

Real options on F can have E or S drivers: payoff in terms of F, but with E or S as the underlying values. For example, a CO_2 price or a methane tax could bring a real option in-the-money by increasing its PV of cash flows.

But there are also real options on E and S themselves, i.e. with the payoffs in terms of E and S, and possibly the underlying values as well. For example, a company's activities might engender the option to improve or worsen biodiversity. And often, there is interaction between F options and S or E options, which can come at each other's expense. In fact, companies have a lot of put options against society, but awareness of it is low. This calls for an integrated view on options or integrated value expressed in real options, which makes these options and their trade-offs more explicit.

Key Concepts Used in this Chapter

Abandonment option is the option to stop an operation, for example to shut down a plant at a cost (the exercise price) to avoid much higher on-going costs (negative exposure to the underlying value).

American option can be exercised at any time, up and until expiration date.

Ask price is the price at which market makers are willing to sell the option.

Bid price is the price at which market makers are willing to buy the option.

Binomial tree is a timeline with two branches per date that show alternative possible events.

Call option gives the owner the right to buy a security at the strike or exercise price; the underlying security can be anything, such as a company's stock, an exchange rate, or a commodity.

Decision tree shows two or more possible values for an asset, such as a stock, in the next period.

European option can only be exercised at the expiration date.

Exercise price (or strike price) of an option is a fixed price at which the owner of the option can buy (in the case of a call) or sell (in the case of a put) the underlying security or commodity.

Financial option is a contract where one of the parties has the right, but not the obligation, to buy (call option) or sell (put option) an asset at a strike price at a certain period of the time to the other party.

Implied volatility is the volatility of the option's underlying value (here the stock price), as implied by the price of the option in an option pricing model.

In-the-money means that the price of the underlying value is above (below) the strike price in the case of a call (put) option; the option will be exercised.

Intrinsic value is the value that a given option would have if it were exercised today; the intrinsic value is the amount by which the strike price of an option is profitable or in-the-money as compared to the stock's price in the market.

Long position refers to stocks or options that have been bought and are owned (see also short position).

Open interest refers to the number of options or future contracts that are held by traders and investors in active positions. These positions have been opened, but have not been closed out, expired, or exercised.

Option premium is the price for the option paid by the owner (holder) to the seller (writer).

Out-of-the-money means that the price of the underlying value is below (above) the strike price in the case of a call (put) option; the option will not be exercised.

Payoff structure shows the payoff on an option in relation to the underlying value, without premium.

Profit diagram shows the profit on an option in relation to the underlying value; the profit diagram includes the payoff and the premium.

Put-call parity shows that assets (S) and a put on assets (P) is equal to riskless debt (B) and a call on assets (C).

Put option gives the owner the right to sell a security; the underlying security can be anything, such as a company's stock, an exchange rate, or a commodity.

Real option is the opportunity to make a particular business decision, exemplifying the value of flexibility; real options come in various types, such as the option to delay and the option to expand; they can be applied in valuation and in investment decisions, including M&A.

Short position refers to stocks or options that are owed, but not owned (see also long position).

Strike price (or exercise price) of an option is a fixed price at which the owner of the option can buy (in the case of a call) or sell (in the case of a put) the underlying security or commodity.

Time value of an option is the premium an investor would pay over its current intrinsic value, based on the probability it will increase in value before expiry (i.e. the volatility).

Writing an option refers to selling an options contract in which a fee, or premium, is collected by the writer in exchange for the right for the holder of the option to buy or sell shares at a future price and date.

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