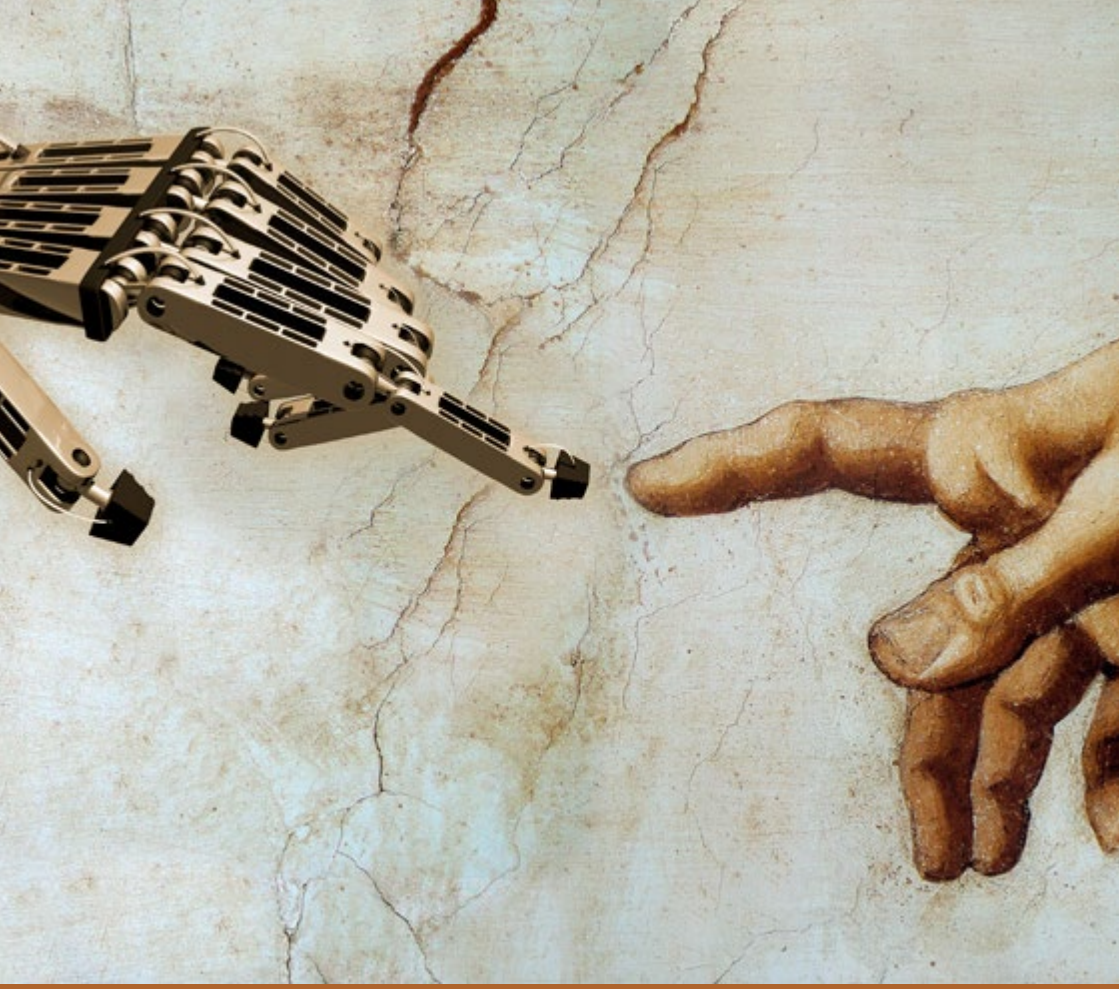

DON'T FEAR AI

Robert Atkinson

BIG IDEAS

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European Investment Bank
The EU bank

Don't fear AI

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BIG IDEAS

Over the last decade, Europe and most advanced economies have experienced a decline in productivity, leading to political unrest and rising uncertainty about the future.

A new production revolution, enabled in part by artificial intelligence (AI), is now emerging, bringing a new wave of technologies, but there are widespread fears that these changes will also bring a big rise in unemployment as machines replace human beings in large numbers.

History tells us that we should not be afraid of industrial change. AI will take over some tasks, but this will not happen all of a sudden and there will be plenty of work left for humans. Restricting or slowing down new technology will not help the world economy. Instead, nations need to help people adjust to more technically advanced jobs, while education should focus more on "21st century skills" such as teamwork and critical thinking. These are our next real challenges.

This is the second essay in the *Big Ideas* series created by the European Investment Bank.

The EIB has invited international thought leaders to write about the most important issues of the day. These essays are a reminder that we need new thinking to protect the environment, promote equality and improve people's lives around the globe.


DON'T FEAR AI

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Over the last decade productivity has declined in most advanced economies and Europe's performance has been especially disappointing: since the last financial crisis labour productivity in the 28 EU Member States grew just 0.7 annually. At this rate, it will take a century for Europe's per-capita incomes to double. No wonder there is political unrest across the continent.

Thankfully, a "next production revolution," enabled in part by artificial intelligence (AI), is emerging. This could boost growth in Europe's productivity, wages and gross domestic product (GDP) perhaps as soon as five to ten years from now, but fully capturing the benefits of this new production revolution will require European policymakers and the European public to embrace rather than resist its rapid emergence and the transformation of most industries in the continent.

A major barrier to a whole-hearted embrace of the next production revolution comes from the growing narrative from a set of vocal techno-Jeremiahs that this technology-driven productivity acceleration is something to be feared and slowed, as it will eliminate massive numbers of jobs, leading to mass dislocation and even a jobless future. Nothing could be more wrong, for the simple reason that technology spurs productivity, which in turn spurs more spending, creating other jobs. Periods of higher productivity in the US economy have been correlated with lower unemployment rates.

Faux "solutions" such as universal basic income, a tax on "robots," or regulations that shackle innovation, are not only unnecessary, but would also be harmful, slowing income growth and keeping workers out of the labour market. There will be plenty of jobs, but Europe needs better policies and programmes to help workers make successful adjustments to face the next production revolution.

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CREATIVE DESTRUCTION COMES IN WAVES

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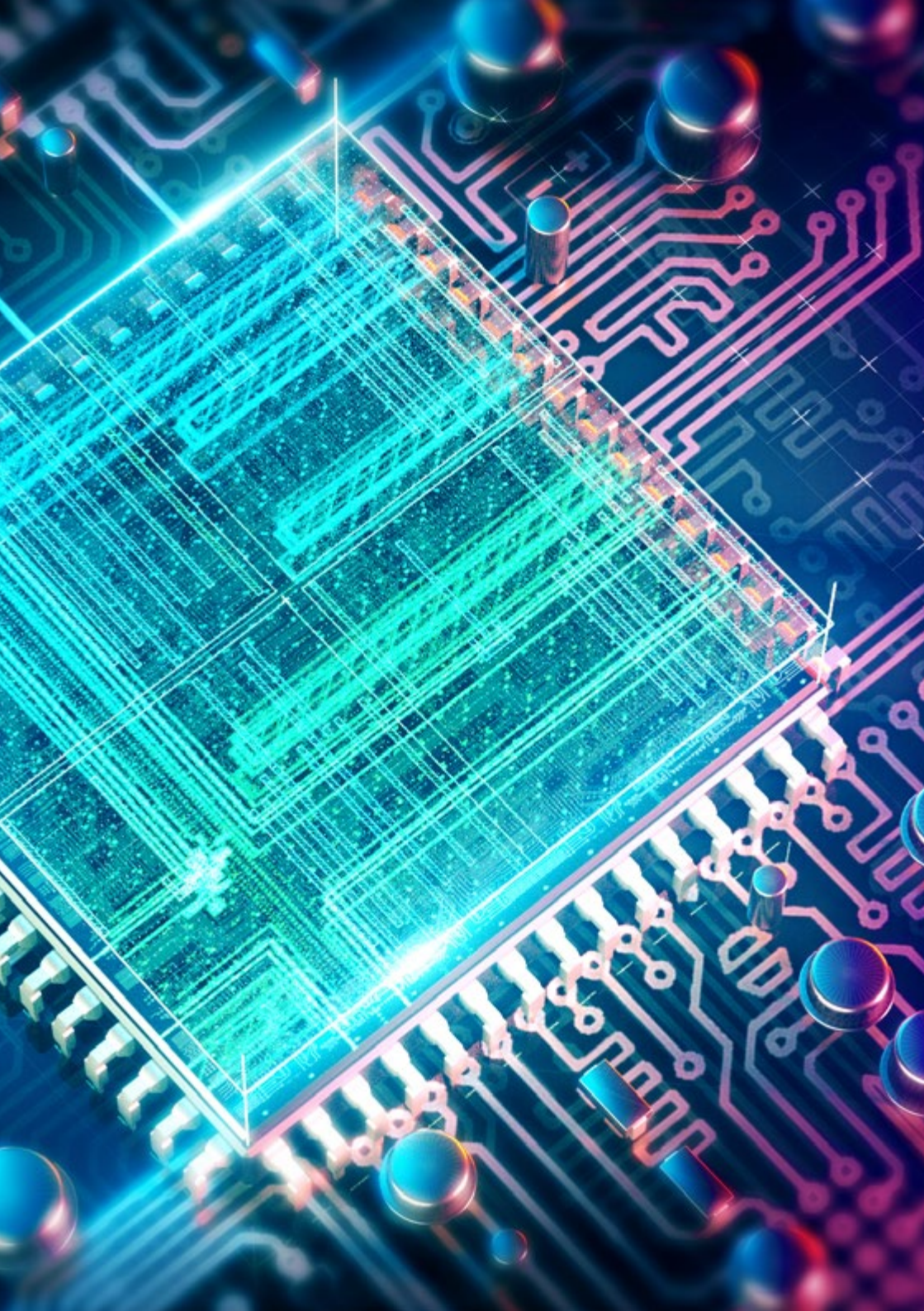
Those who follow in the tradition of economist Joseph Schumpeter – who coined the term "creative destruction" – argue that economic change is driven by the emergence of "general purpose technologies" that transform a wide range of industries and production systems.

General purpose technologies share several characteristics, including rapid declines in price and improvements in functionality; widespread use across different industries and production functions; and a significant, measurable impact on the macroeconomy. These technologies appear to come in waves, with periods of emergence and adoption characterised by rapid growth and periods of exhaustion and slow growth.

> **"Advanced economies have experienced so far five technology-powered waves: the steam engine; iron; steel and electricity; electromechanical and chemical technologies; and information technology and communications technology.**

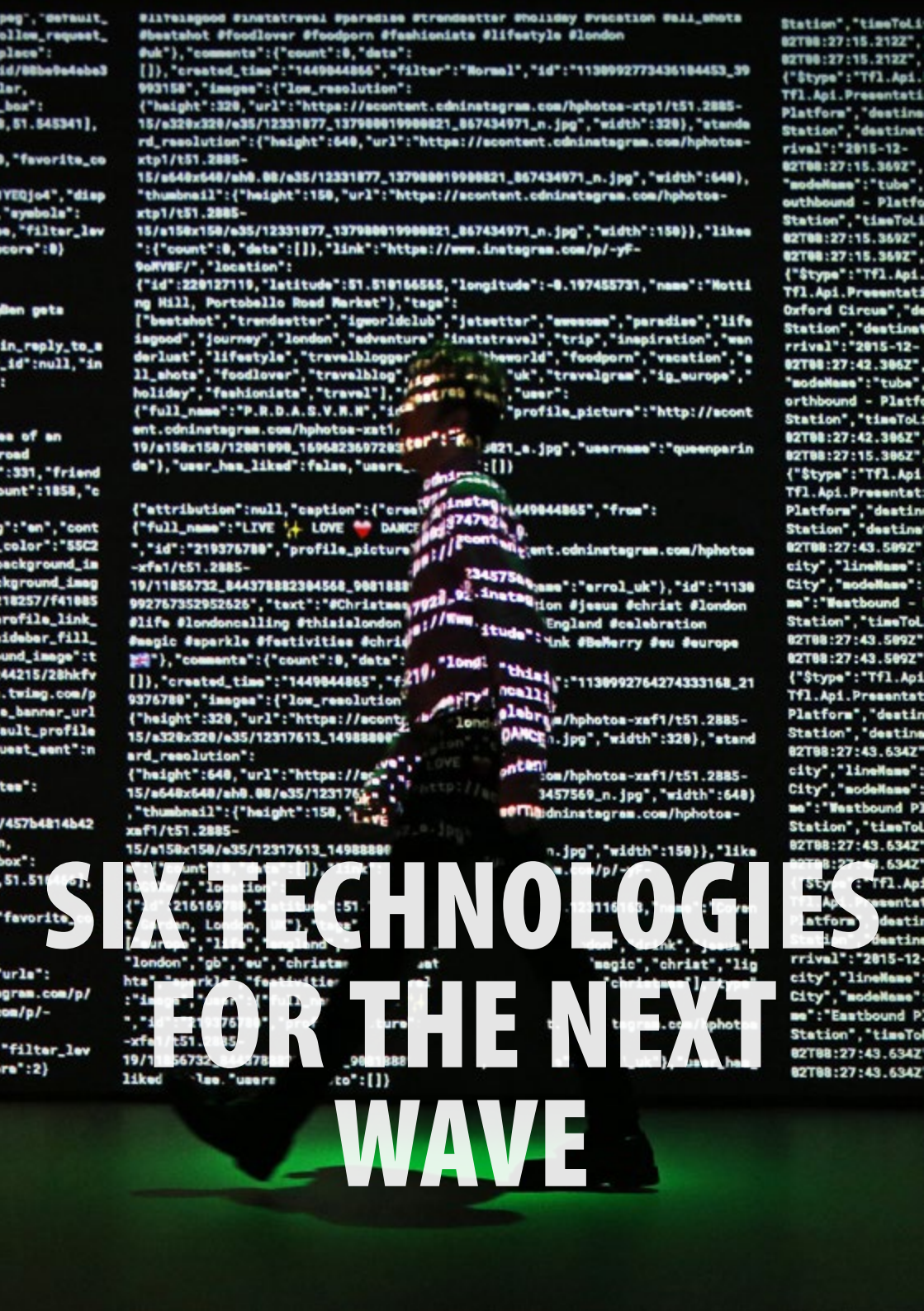
Advanced economies have experienced so far five technology-powered waves: 1. the steam engine starting in the 1780s and 1790s; 2. iron in the 1840s and 1850s; 3. steel and electricity in the 1890s and 1900s; 4. electromechanical and chemical technologies in the 1950s and 1960s; and 5. information technology and communications technology of the 1990s and 2000s. [1]



At present developed countries appear to be in the midst of a period of relative stagnation: the existing information and communications technology system has reached to the top of the "S curve" (the S curve describes the shape of the technology lifecycle: at the bottom of the curve progress is slow, as the curve steepens progress speeds considerably, until reaching the top of the curve, when it slows again).

A decade or two ago, rapid improvements in operating systems, computer chips, broadband speeds, and smartphones mattered a lot. People and companies rushed to buy new computers when the latest Intel processor and Microsoft operating system came out, in the process scrapping perfectly good computers. But today, these and related technologies are not only improving more slowly (Moore's law, the prediction that computing power would double every 18 to 24 months, has slowed), but are already so good that scrapping existing equipment in favour of new ones is a less compelling proposition: computers, smartphones and broadband speeds are "good enough" for the majority of tasks.

This maturity, more than any other factor, likely explains the slowdown over the last decade in both capital investment and productivity in European economies. [2]


SIX TECHNOLOGIES
FOR THE NEXT
WAVE

SIX TECHNOLOGIES FOR THE NEXT WAVE

The current period of stagnation will eventually be replaced by a new, sixth wave, grounded in new technologies so powerful that organisations and people will be compelled to buy them en masse?

Six technologies look like candidates for the next innovation wave: the Internet of things, advanced robotics, block chain, new materials, autonomous devices, and artificial intelligence. Perhaps artificial intelligence is the most important one.

“ Six technologies look like candidates for the next innovation wave: the Internet of things, advanced robotics, block chain, new materials, autonomous devices, and artificial intelligence. Perhaps artificial intelligence is the most important one.

Artificial intelligence has many functions, including but not limited to learning, understanding, reasoning, and interaction. [3] There are two very distinct types of artificial intelligence: narrow and strong. The first one describes computer systems adept at performing specific tasks, such as Apple’s Siri virtual assistant that interprets voice commands. [4] The second one, also referred to as artificial general intelligence, is a hypothetical type of artificial intelligence that can meet or exceed human-level intelligence and apply this problem-solving ability to any type of problem. [5] Many of the fears, such as the elimination of jobs, stem from the notion that strong artificial intelligence is feasible and imminent. [6] However, at least for the near future, computer systems that can fully mimic the human brain are only going to be found in scripts in Hollywood, and not labs in Silicon Valley.

As for the six technologies that are already in the marketplace, they are generally still too expensive and not powerful enough to drive economy-wide productivity. For this reason, despite the excitement over "Industry 4.0" technologies, they do not appear to have been adopted on a large scale, as evidenced in part by the fact that most manufacturers appear to be in the very early adoption stages. Likewise, there is considerable excitement about machine learning software systems, but their current capabilities remain relatively limited, notwithstanding some promising early applications.

Think of autonomous vehicles: fully autonomous cars that are safe and affordable for most consumers are at least 15 years away. [7] And fully dexterous robotic hands are not likely to be in the market before 2030 or even 2040. [8] As robotics expert and entrepreneur Rodney Brooks writes, "having ideas is easy. Turning them into reality is hard. Turning them into being deployed at scale is even harder." [9]

However, if this next wave of innovation follows prior technological trajectories, the technologies will likely experience rapid price declines and significant performance improvements over the next decade. As this occurs, widespread installation will start, according to the innovation scholar Carlota Perez, allowing many organisations to replace existing technologies with more productive systems. [10]


046
mph
52
AI
Autonomous
Driving

THE NEXT PRODUCTION REVOLUTION

What is the growth impact of the next production revolution? This is perhaps the single most important economic question for Europe. It is striking that economists looking at the same set of facts can have such divergent views, with techno-pessimists seeing stagnation and techno-utopians seeing an unprecedented flourishing.

> **“Some technologies will substitute for workers; others will complement workers.**

Economist Robert Gordon, perhaps the most widely cited pessimist, argues that advanced economies have picked virtually all the “low-hanging fruit” and future growth will stagnate. But Gordon and other pessimists do not fully appreciate the potential of the new technologies to improve in price and quality and therefore transform industries. [11] As one example, Gordon dismissed the productivity potential of autonomous cars, failing to understand that the reduction in accidents and the decrease in traffic jams would generate an estimated $1 trillion in annual savings to the US economy. [12]

Conversely, the techno-utopians, such as World Economic Forum leader Klaus Schwab, see the next production revolution as qualitatively different as past transformations and believe that the technology is advancing at an exponential rate. He writes: “We stand on the brink of a technological revolution that will fundamentally alter the way we live, work, and relate to one another. In its scale, scope, and complexity, the transformation will be unlike anything humankind has experienced before.” [13] Schwab and other pundits tell us that powered by artificial intelligence, fully autonomous vehicles, humanoid robots and other breakthroughs, change will come at rates that will make the Industrial Revolution look like a period of stability.

But such utopians base their predictions on over-optimistic assumptions. One is that computing power will advance at past rates. But, as mentioned, Moore's law has already slowed and it is doubtful it will continue ad infinitum. [14] As Sanjay Banerjee, Director of the Microelectronics Research Center at University of Texas in Austin puts it, "no exponential is forever." [15]

Second, there is simply no reason to believe that this coming technology wave will be any different in pace and magnitude than past waves. Each past wave led to improved technology in a few key areas (e.g., steam engines, railroads, steel, electricity, chemical processing, information technology, etc.) and these were subsequently used in other sectors. But none completely transformed all industries or processes.

The sixth wave will no doubt affect many industries, processes, and occupations, but many will remain largely untouched, at least in terms of automation: education, healthcare, sports and law-making for example. Artificial intelligence won't replace doctors in the near future, but it will help them make better diagnoses and treatment decisions.

Some technologies will substitute for workers; others will complement workers.

A SLOW PACE OF CHANGE?

A SLOW PACE OF CHANGE?

The pace of change of these transformations is always slower than many believe. Past technology transformations have taken at least thirty years to work their way from initial introduction to close to full "installation."

There are three reasons for this relatively measured pace. First, new technology systems don't emerge fully formed. Early versions are less advanced than later ones. We saw this with the electric motor introduced in the early 1910s: it took decades for improvements in power, price, and quality to enable electric motors to be transformative. Going forward we will likely see this pattern in many technologies, such as autonomous vehicles. The best (and quite expensive) current autonomy technology still requires drivers for many functions. Affordable cars, where humans can go on a long, complicated trip asleep in the backseat, are decades away.

> **"Annual European labour productivity growth rates could increase to perhaps 3%. If Europe can achieve these growth rates, it will mean significantly faster income growth (a doubling of per-capita incomes in 27 years, rather than 100).**

Second, even though new technologies are often better than old ones, old technologies are usually not completely scrapped, at least until their value depreciates significantly. This means a much slower process of change than many techno-futurists postulate. For example, while the push-button elevator was invented in 1923, it was not until 1990 that most elevator operator jobs in the United States had been eliminated. [16] Today, it will likely be no different, particularly with industries that must scrap expensive capital goods. Trucking companies will not suddenly toss all their expensive articulated lorries in the junk yard even if affordable self-driving trucks emerge. Finally, not all organisations are first adopters. As the literature on diffusion of innovation clearly shows, some adopt early, most adopt in a middle stage after the technology is de-risked, and some late. [17]

So, the reality is that the most likely future technology trajectory appears to be one that will wend its way between the lowlands of techno-stagnation and the highlands of techno-exponentialism. In other words, the future is likely to follow past technology waves, with a new wave of innovation emerging and powering modest growth that will hopefully kick in by the mid-part of the next decade. As such, it is not unreasonable to expect that annual European labour productivity growth rates could increase to perhaps 3%. If Europe can achieve these growth rates, it will mean significantly faster income growth (a doubling of per-capita incomes in 27 years, rather than 100). [18]

LABOUR MARKET TURBULENCE

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The emergence of the next production revolution will not only increase productivity, but also labour market turbulence. More workers are likely to lose their jobs to technological displacement. [19] This is not just about the iconic example of the truck driver being replaced by the self-driving truck, but a host of occupations where technology can boost productivity and require fewer workers.

> **"One reason why actual job loss numbers are not likely to reach the higher end estimates of near or above 50% is that for many occupations, automation doesn't affect the entire job so much as it affects some tasks.**

An increasing number of pundits have raised the alarm, warning that technology is coming for our jobs. Martin Ford, author of *The Rise of the Robots*, speaks for many when he predicts "75% unemployment by 2100." Columnist Kevin Drum, writing in *Mother Jones*, a progressive American magazine, goes even further, predicting that all jobs will be gone in 40 years.

But these claims can safely be dismissed out of hand. Companies invest in process innovation, meaning innovations that boost productivity, to cut costs. But if all or most companies in a market use technologies to cut costs, competition forces them to lower prices, so raising more purchasing power. This added purchasing power is not buried; it is spent, and that spending demand creates new jobs. This dynamic is the same if productivity grows at 1% a year or 10%. This is why the OECD (Organisation for Economic Co-operation and Development) finds that: "Historically, the income-generating effects of new technologies have proved more powerful than the labour-displacing effects: technological progress has been accompanied not only by higher output and productivity, but also by higher overall employment." [20] There is simply no reason to believe that this process will not be true going forward.

MANY OCCUPATIONS HAVE LITTLE CHANCE OF AUTOMATION, SUCH AS FASHION MODELS, SCHOOL BUS DRIVERS, AND BARBERS

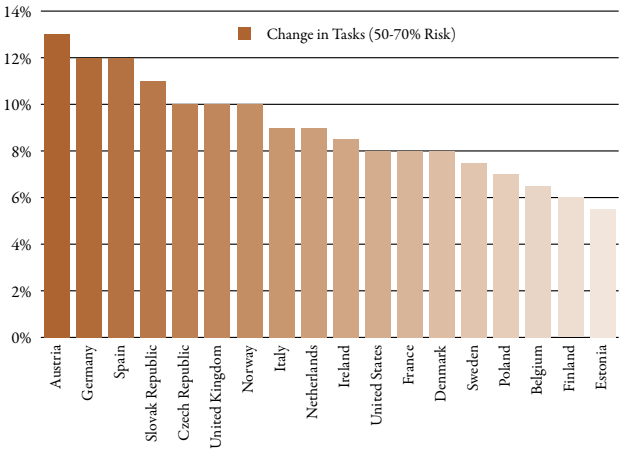
What is likely to be different going forward – at least different from the past two decades or so – is the pace of labour market displacement from the introduction of technology. A number of studies have tried to measure this pace. Perhaps the most widely cited, from Oxford's Osborne and Frey, estimated that 47% of US jobs could be eliminated by technology over the next 20 years. [21] Yet, it is almost impossible to read an article on technology and job loss without seeing their study quoted as the gospel.

Their study appears to significantly overstate the share of jobs at risk by including many occupations that have little chance of automation, such as fashion models, school bus drivers, and barbers.

The actual numbers are likely to be much less. In the United States the Information Technology and Innovation Foundation (ITIF), a think tank, estimated that at most 20% of US jobs are likely to be automated over the next 15 years. [22] These US-based estimates are likely to be quite similar for European economies. For example, according to the OECD, the share of jobs at high risk from automation in the short run is only slightly higher in ten European nations than in the United States and lower in seven (see Figure 1). [23] The McKinsey Global Institute estimated that in select EU economies around 20% of jobs (in the UK) to 24% (in Germany, Italy and Switzerland) were at risk from technology (US estimates were similar). [24]

One reason why actual job loss numbers are not likely to reach the higher end estimates of near or above 50% is that for many occupations, automation doesn't affect the entire job so much as it affects some tasks. As McKinsey concludes: "Very few occupations will be automated in their entirety in the near or medium term. Rather, certain activities are more likely to be automated, requiring entire business processes to be transformed, and jobs performed by people to be redefined." [25] In other words, technology will lead more to job redefinitions and opportunities to add more value than to outright job destruction.

Figure 1: Percentage of Workers in Jobs at High and Medium Risk of Automation [26]



Even if the share of jobs impacted by technological change is likely to be modest, the impact on individual workers can be challenging. While the past wave of automation had larger impacts on middle-wage jobs, both in services and manufacturing, it looks likely that the next wave will have significantly larger impacts on lower-wage and lower-skill occupations. Indeed, the correlation between average wage of an occupation and risk of automation in the United States is negative and quite large (-0.59 for the Oxford University estimates and -0.52 for the ITIF estimates). The correlation with average years of schooling for each occupation and risk of automation is also negative and large (-0.64 for Oxford, -0.51 for ITIF). And when using ITIF data, the occupations that have the highest risk of being automated have the lowest median wage ($32,380), the occupations with the next highest risk have the second lowest median wage ($34,990), and so on. The White House Council of Economic Advisors also used the Oxford data and found that 83% of jobs making less than $20 per hour would come under pressure from automation, as compared to 31% of jobs making between $20 and $40 per hour and just 4% of jobs making above $40 per hour. [27]


BAKED
GRANOLA

The OECD also estimated that 44% of American workers with less than a high school degree hold jobs made up of highly automatable tasks while 1% of people with a bachelor's degree or higher hold such jobs. [28] There is no reason to expect different effects in Europe, given the similarities of the economies and technologies to be used.

While this occupational differential will have some negative impacts, overall it is likely to be extremely positive. If low skill jobs are more likely to be automated it will mean that individuals with lower incomes are more at risk of displacement. And given their more limited resources (finances, social networks, and skills), making successful transitions to new employment can be more difficult.

At the same time, however, automating more lower-wage jobs will mean fewer of these jobs. Because the firms employing lower-wage workers in these increasingly automated occupations will be able to lower the prices of their goods or services, consumers will have more purchasing power. That spending will create jobs at all wage levels. The net result will be an occupational shift to middle- and higher-wage jobs. This will be an unalloyed plus for many workers now stuck in low-wage occupations where it is difficult for employers to raise wages because of low productivity levels. But it is incumbent upon policymakers to enact policies and programmes to more effectively help these workers successfully make employment transitions.

In addition, many workers in low-wage jobs have more skills than they need for their current job (the college grad waiting tables). This suggests that some workers in low-wage jobs have enough skills to move into higher paid, moderately skilled jobs. [29] In fact, a European Commission study estimated that 40% of EU workers are overqualified for the jobs they hold. [30] Some are in these occupations due to choice; but in other cases it is because there are not enough jobs in Europe that require a college education. These workers should have an easier time transitioning to newly created middle-wage jobs.

THE BIG CHALLENGE

THE BIG CHALLENGE

If Europe is to avoid an even greater populist, neo-Luddite backlash against the next production revolution, policymakers will need to take greater and more effective steps to help regions and individuals at risk from technology disruption.

One place to start is with better help for lagging regions. Some workers who lose their jobs due to new technologies can and will move to regions where employment growth is stronger, but not all workers are willing or able to do so. As such, smart policies and programmes to spur growth in lagging regions can help minimise social disruption from the next production revolution.

But the biggest challenge will be to help individual workers make successful transitions. European policymakers should embrace the concept of "flexicurity," as Scandinavian nations have, which commits not to ensure that workers will never get laid off, but to minimise the number of workers at risk; and then, for those who are laid off, provide support so they can make successful and expeditious transitions. Policies limiting lay-offs will only postpone the inevitable. Likewise, providing laid-off workers with very generous and long-term benefits will not only help ensure higher unemployment rates, but also lead to more workers being out of the labour market for long periods of time, hurting the very workers the benefits are intended to help. For the longer a worker is out of the labour force, the harder it is for him or her to re-enter. Rather the goal should be finding a balance between being overprotecting and too severe.

To do that, policymakers should adopt the operational models of some of the world's best-in-class programmes, such as Singapore's SkillsFuture programme. The lessons from Singapore are fourfold. First, government policy needs to make a major commitment to skill development and workforce transition. Second, such efforts need to be closely linked to employers and markets, including through training vouchers and credits. Germany has done an excellent job in this regard with its longstanding and widespread employer-supported apprenticeship system. Third, such efforts need to be much more flexible and take full advantage of advanced information technology tools. Finally, incremental changes in existing institutional arrangements will not be enough. If policymakers are to respond effectively to the challenges of a more turbulent labour market, they will need to drive significant institutional reform, particularly in the high school and higher education sectors; provide more support for institutions focused on technical training; and provide skills valued by employers.

European nations may want to focus on several areas. The first is to enable more workers to obtain "better" skills and other competencies so that if they are dislocated by technology they will be better positioned to make a successful transition. One key is to shift the education system, particularly at the high school and post-secondary levels, towards an increased focus on teaching both "21st century skills" such as teamwork, analytical skills, critical thinking and more technical skills.

NEW SKILLS REQUIRED

NEW SKILLS REQUIRED

As Manuel Trajtenberg writes in a study that addresses the next production revolution, the skills employers desire are seldom taught in school. Employers want workers with strong analytical, creative, and adaptive capabilities, but few secondary or collegiate schools impart these competencies. [31] Moreover, schools appear to be teaching technical subjects such as computer science and statistics poorly when compared to the needs of the next economy. [32] Thus, reforms such as high school career academies; [33] project-based learning; reducing the rigidity of state high school graduation course distribution and graduation requirements; and a focus on increased adoption of workforce-focused classes, including business, statistics, and engineering, would all help future workers have a stronger base of skills with which to cope with a more turbulent labour market. In addition, more should be done to encourage and support corporate partnerships with new kinds of high schools. For example, IBM has worked to develop P-TECH (Pathways in Technology, Early College High School) in New York City, which runs from grade 9 to grade 14, and works to give students marketable skills in information technology.

At the same time, nations can do more to encourage employers to expand workforce training efforts. This can include wider use of portable skills credentialing; supporting sector-wide training and development plans, as Singapore has done; establishing an "Investors in People" programme modelled on the UK's effort to offer annual awards to employers who do the best job of investing in their workforce; supporting industry-led skills alliances; promoting greater use of apprenticeship programmes, as Germany has done; and increasing use of portable training accounts, such as those established in France. [34]

European nations could also productively cooperate on how to better use technology to facilitate online skill assessment, career navigation, training and workforce placement. Many government-run websites are now limited in their offer. Governments should consider partnering with the private sector to improve their digital offer. For instance, in the United States the Markle Foundation's Skillful Initiative, funded in part through Microsoft Philanthropies, has partnered with LinkedIn to help Colorado workers identify training for in-demand occupations. [35]

FLEXICURITY, A GUIDING PRINCIPLE?

FLEXICURITY, A GUIDING PRINCIPLE?

Finally, the concept of flexicurity needs to be more than a commitment; it should evolve into active labour market policy. It needs to be a guiding principle by which European nations orient themselves toward technological change. Increasingly, many in Europe appear to view technologically-driven employment loss as so disruptive to the individuals affected that society should attempt to slow the pace of change to a more "human" pace, or at minimum, not do anything to accelerate it. Bill Gates speaks for many in Europe (and the United States) when he says, "At a time when people are saying that the arrival of that robot is a net loss because of displacement, you ought to be willing to raise the tax level and even slow down the speed of that adoption somewhat to figure out, 'OK, what about the communities where this has a particularly big impact? Which transition programs have worked and what type of funding do those require?'" [36]

Embracing flexicurity as an overarching guiding principle means rejecting these notions and acknowledging that technology-based productivity growth, some of which may lead to job displacement, is fundamentally a progressive force, without which wages and living standards will grow more slowly. To be more open to technological innovation, we must not apply the "precautionary principle", but rather accept the hypothetical risk posed by technology. Imposing restrictive regulations on technologies based on speculative fears would only slow their development and limit their benefits. Countries should instead embrace the innovation principle, which says that policymakers should address risks as they arise, or allow market forces to address them, and not hold back progress because of hypothetical concerns. [37]

If European nations work together in a spirit of embracing the new production revolution, and ensure that the benefits are widely shared, they can look forward to a more prosperous economic future.

Notes

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[11] For example, Gordon dismisses the economic impact of autonomous vehicles, claiming that the only benefit is that people can read their emails while driving. This ignores the considerable evidence that autonomous vehicles will dramatically reduce accidents and improve traffic flow, leading in the United States to an estimated $1 trillion annual economic savings.

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[18] Three percent growth per year leads to a doubling in 27 years.

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