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Growth and competitiveness in Central, Eastern and South-Eastern Europe: The role of innovation

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Contents

Abstract

This paper examines the state of innovation in Central, Eastern, and South-Eastern EU countries. Despite increased innovation capacity, the region faces significant challenges threatening its growth and competitiveness, including severe skills shortages, uneven productivity, and barriers to commercialising innovation.

The paper highlights the role of foreign direct investment in driving innovation, noting that firms established through greenfield investments exhibit higher productivity than their domestic counterparts. Contributing to the skills shortage are low public R&D spending, insufficient corporate investment in continuing education, and emigration. Limited collaboration between universities and businesses and a shortage of risk capital are key obstacles to bringing innovative ideas to market.

To address these challenges, the paper recommends various measures to improve the availability of skilled labour, secure risk capital, foster collaboration between academia and industry, and enhance the overall business environment. Dashboards illustrate how innovation capacity and outcomes vary between CESEE countries, combining data from the EIB's Investment Survey with a range of firm-level public and private datasets.

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Keywords

Innovation, competitiveness, EU-CESEE, CESEE, central, eastern and south-eastern Europe, economic growth, EU accession

JEL classification: O11, O52

About this paper

This paper on innovation in Central, Eastern, and South-Eastern EU (CESEE) was developed through a collaboration among the Austrian National Bank (OeNB), the Vienna Institute for Economic Studies (wiiw), and the European Investment Bank (EIB). These institutions partnered on a broader study exploring competitiveness and future drivers of economic growth in CESEE countries that are EU members: Bulgaria, Croatia, Czechia, Estonia, Hungary, Latvia, Lithuania, Poland, Romania, Slovakia, and Slovenia.

As the EU as a whole assesses its economic competitiveness in the global context, CESEE countries also need to evaluate the sustainability of their economic convergence within the EU and the sectors, technologies, and skills that are likely to drive growth. Despite their varied levels of economic development and different economic structures, these countries share a common history of successful economic transition from centrally planned economies. On the whole, their economies have been considerably more dynamic than those in the rest of the EU. They have made notable progress in areas like digitalisation, decarbonisation, and supply chain resilience. However, they need to upgrade their production capabilities and maintain competitiveness as their cost advantages decline to avoid the middle-income trap—where economies struggle to transition to high-income status due to rising costs and declining competitiveness. Accelerating the shift toward an innovation-driven economy is essential for the region.

The analysis is modular and comprises three papers, each focusing on different aspects:

- **Sources of growth and productivity**: this includes an analysis of productivity trends over the past two decades, in “Will the CESEE region stay in the fast lane or (where) does its growth model need polishing?” (Slačík, 2024).
- **Export structure and comparative advantages**: this paper identifies promising sectors through analyses of export evolution, specialization, and growth potentials using a product space approach. It highlights promising products for specialization across CESEE countries, with findings published in the wiiw Forecast Papers (Guadagno, F., D. Hanzl-Weiss, and R. Stehrer, 2024).
- **Innovation**: This is the focus of the current paper

Executive Summary

Central, Eastern, and South-Eastern Europe EU countries (CESEE) have made notable progress in enhancing their innovation capacity over the past decade. Businesses have doubled their R&D personnel and increased investments in intellectual property. However, significant gaps remain that could hinder the region's growth and competitiveness, especially as China, the US, and other parts of the EU have also invested more in innovation. The region faces a severe skills shortage, and while productivity growth has generally outpaced the North and West of the EU, recent trends show signs of deceleration. Strengthening innovation is essential for raising living standards, reducing reliance on industrial goods production, and enhancing competitiveness.

In this paper, we review the state of innovation in the CESEE region of the EU, using its Northern and Western region as a yardstick. We highlight common developments in its first part before turning to country-specific characteristics.

Across the CESEE region, innovation is largely concentrated in manufacturing, ICT, and pharmaceuticals, driven in part by foreign direct investment (Section 1.2). However, innovation activities are unevenly distributed across firms and geographies, with capital cities and regions with strong academic institutions leading the way.

Labour productivity is more dispersed within economic sectors in CESEE than in the North and West of the EU, partly due to the higher proportion of small firms in CESEE economies (Section 1.3). Smaller firms typically face greater challenges in accessing finance for innovation, leading to lower productivity. Lower investments in innovation result in weaker outcomes, with R&D spending in CESEE about half that of the North and West of the EU (Section 1.4). Technology transfers through FDI appear to help mitigate some of these differences.

Addressing the region's innovation challenges requires increasing the availability of skilled labour, securing adequate risk capital, and adopting cutting-edge technologies while improving the business environment. This paper focuses on three specific challenges, where the European Investment Bank's annual corporate investment survey and its activity in the region helps us to provide insights: leveraging foreign direct investment, addressing the skills shortage, and facilitating the transformation of ideas into innovative products through collaboration and risk capital.

Foreign-owned firms tend to be more innovative and productive than domestically owned ones, but much of this advantage appears due to the size, age, and sectoral differences between the two (Section 2.1). Greenfield investments by foreign firms have the most significant productivity advantage, while firms acquired by foreigners were often already more productive, suggesting a "cherry-picking" effect. However, if only due to the large presence of foreign-owned firms, FDI is set to continue to provide a source of finance and innovative technologies to the region.

A shortage of skilled staff is a major obstacle for CESEE companies, driven by low public R&D investment, inadequate lifelong learning opportunities, and emigration (Section 2.2). Spending on R&D in public and higher education is just over half the level of the North and West of the EU, and academic research quality indicators are similarly low. Emigration has slowed labour force growth and is likely to continue, driven by higher salaries, political stability, and differences in mentality, culture, and lifestyle. This suggest that emigration could be lowered through a broad range of policies, including investments in social infrastructure.

The final challenge is the commercialisation of research findings through collaborative research and risk financing (Section 2.3). Universities in the CESEE region cooperate less with businesses than their Western and Northern EU counterparts, partly due to bureaucratic hurdles and funding constraints. The lack of risk finance for commercialising research results is a significant issue, particularly for small companies. Development banks can play a vital role in addressing these challenges by substituting for absent private markets and supporting their development.

In the second part of the paper, we present dashboards that offer an overview of country-specific innovation characteristics. These dashboards include summaries of growth and convergence, showing that research-intensive sectors are among those that contribute significantly to GDP growth in most countries. They also feature indicators on the business and political environment, availability of skills and finance, and innovation outcomes. The dashboards illustrate that countries perform quite differently across different dimensions of innovation, with some exceeding the EU average while others risk falling behind.

Introduction

There is no doubt that the competitiveness of the European Union's economy is under threat, including in its Central, Eastern, and South-Eastern (CESEE) member countries. Economic growth in the EU has consistently lagged behind that of the United States and China. Meanwhile, per capita income in the US is still about one third higher than in the EU, while China's per capita income is rapidly catching up (**Figure 1**, left-hand panel). Lower productivity accounts for most of this gap (Draghi, 2024). Europe's missed IT revolution is likely to be an important factor (Schnabel, 2024).

At first glance, the outlook for the EU's CESEE members (EU-CESEE) is less gloomy. While overall convergence in the EU has stalled, the CESEE region has caught up with its wealthier peers to the North and West of the EU (EU-NW, **Figure 1a**). These countries have modernised their economies and integrated into international supply chains with the help of foreign direct investment (FDI). EU accession in the 2000s provided access to a prosperous export market, further accelerating technology transfer and driving institutional convergence. GDP convergence has been slower than GDP per capita convergence. This is because the population shrank in the CESEE region by around 10% to approximately 100 million in 2023. Meanwhile, the population in the North and West of the EU increased by just over 10%, reaching about 220 million in 2023.

Figure 1a: Economic convergence of the EU (GDP per capita, PPS, % of EU)

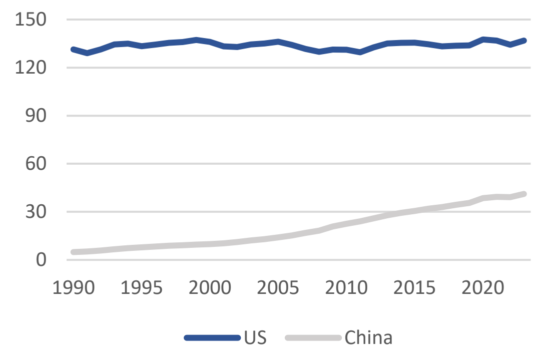
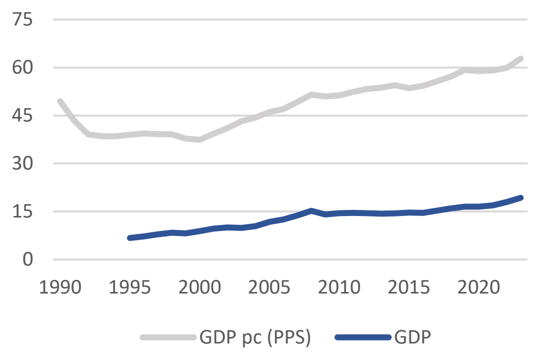


Figure 1b: Economic convergence of EU-CEESE towards the North and West of the EU (% of EU-NW)



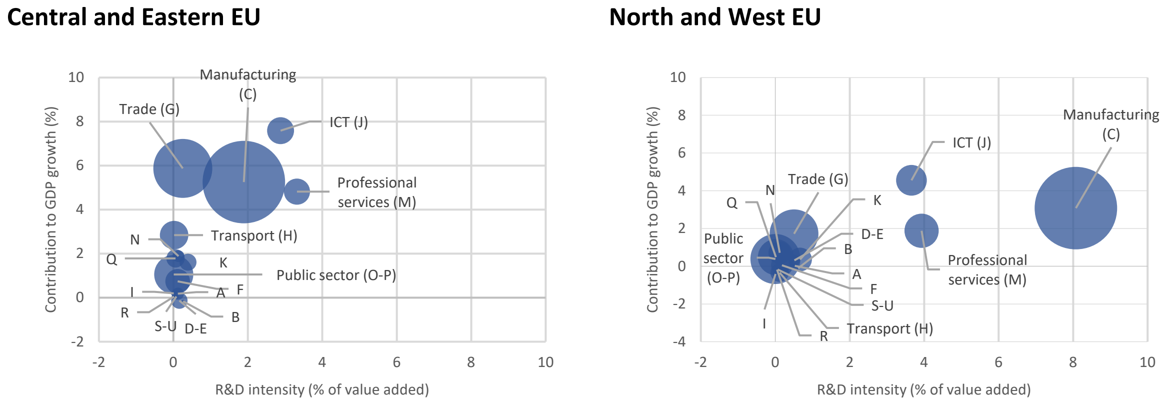
Source: Worldbank and Eurostat, authors' calculations.

Since 2010, however, the convergence of the CESEE region has lost steam (Slačík, 2024). FDI inflows, at 5.2% of GDP in the 2000s, slowed in the decade after the Global Financial Crisis to 2.4% of GDP on average. Energy and especially labour costs have risen. Amid net emigration and population ageing, a shortage of qualified staff has become the most important structural obstacle for corporate investment. CESEE countries appear at risk of falling into the middle-income trap (Zuk, Savelin, 2018; Győrffy, 2022; Stöllinger, 2019; Eichengreen et al. 2013).[1]

In order to stimulate growth and convergence, CESEE countries must invest in knowledge- and technology-intensive production (see, for example, Zavarská et al., 2023, 2024 and Guadagno, 2024). This transformation has started but remains patchy. Over the past decade, some of the largest contributions to GDP growth came from R&D-intensive sectors: Manufacturing, Professional, Scientific, and Technical Services, and ICT, suggesting that the region is well positioned for future growth (**Figure 2, left panel**). However, there are reasons to remain cautious. First, these three sectors are substantially less R&D intensive than in the North and West

[1] The middle income trap is a situation in which the initial advantages of a catching-up economy may disappear once a certain level of development is reached, typically when the labour costs advantages are eroded but the level of technological innovation cannot yet compete with the countries on the technological frontier.

(**Figure 2, right panel**). Moreover, sectors with low R&D intensity also contributed significantly to growth (Transport and Trade), mirroring the region's increased integration in global value chain.



Source: Eurostat, authors' calculations. Note: The width of the bubbles represents their share in value added. R&D intensities are averages over 2013-21 due to limited data availability. The sectors are coded as follows: A=Agriculture, B=Mining, D-E = Infrastructure, F = Construction, I = Accommodation and Food, K = Finance, N = Support services, Q = Health and social work, R = Recreation, S-U other services.

Section I provides an overview of the current state of innovation across the region. Section II presents a set of indicators that assess the progress each individual country has made thus far and highlight remaining gaps.

Section I: Common elements

This section offers a broad overview of business innovation across the EU-CESEE region, albeit with a caveat: it largely glosses over the substantial disparities among its constituent countries. We illustrate these differences in the form of dashboards in Section II. That said, in most of the indicators that we present, the wealthier economies of the region resemble the average economy in the North and West of the EU.

Chapter 1 presents the key indicators we use to assess innovation. We then discuss sectoral and geographical differences in innovation, the wide range of innovation activities across firms, and public support for innovation. In Chapter 2 we pick out three of the challenges that the region faces: i) reaping the benefits of foreign direct investment and foreign ownership; ii) reducing the severe shortage of staff with the right skills; and iii) facilitating the transformation of ideas into innovative products and services. Chapter 3 presents policy recommendations.

1 The state of innovation in the CESEE region

1.1 Overview

The CESEE region has increased its innovative capacity substantially over the past decade. Innovation, defined as the application of new ideas, products, or methods, is inherently challenging to quantify beyond survey-based measures. To provide a more comprehensive picture, we supplement these subjective indicators with "hard" metrics of innovation investment, such as research and development expenditures, and probable innovation outcomes, like productivity enhancements (**Box 1**).

Businesses in CESEE are employing more than twice the number of R&D personnel than a decade earlier.[2] Their share of investments dedicated to intellectual property has seen a gradual uptick, moving from 10% to 12% during the same period.[3] Remarkably, at 2% per annum, labour productivity grew almost three times more than that in the North and West of the EU.[4]

Moreover, businesses are gravitating towards higher value-added segments of production. In the manufacturing sector, numerous foreign companies are relocating product development to the region, capitalizing on the skilled workforce and their relatively lower wages. The region boasts leading players in sectors such as automotive, pharma, biotech, health, and ICT. Tech giants like Google and IBM have also established research centres in the region (**Box 2**).

Box 1: Measuring innovation

We define **Innovation** as the commercial use of new ideas, products or methods where they have not been used before.

Innovation activity is typically gauged through surveys, accounting data such as an increase in intangible assets, or improved productivity. Each of these measures has its own set of advantages and disadvantages. **Surveys** (such as the EIB's Investment Survey or the EU's Community Innovation Survey) can provide a more comprehensive overview of process and product improvements but rely on interviewees' subjective assessments. The accounting values of **intangible assets** include expenditures related to innovation, such as software, databases, and patents, but also items unrelated to innovation, such as goodwill following acquisitions of firms. **Patent applications** are often submitted by teams of researchers working in different locations. Distributing the research activities that led to the patent across countries presents a challenge in particular for the CESEE economies, where an important part of corporate research is done by multinational corporations.

Data on **productivity** is easier to come by but is partly influenced by factors that have nothing to do with innovation (Hall, 2011). For example, higher capacity utilisation in an upswing would typically increase measured productivity even when no innovation has taken place. Productivity is often measured as the quantities of goods or services that were produced per employee (labour productivity). In order to separate the impact of higher capital intensity from that of innovation, labour productivity growth can be decomposed into capital deepening (the increase in capital per employee) and total factor productivity growth (TFP). While TFP growth captures innovation arguably better than labour productivity growth, there are conceptual issues in how to calculate it. We use both measures of labour productivity and TFP in this paper.

Innovation can also be measured by its inputs: most commonly, expenditure on research and development (R&D). The terms "research" and "development" are often used together, especially in the context of corporate innovation, but they refer to distinct phases in the process of creating new products, services, or technologies. **Basic research** aims to increase understanding of fundamental principles while **applied research** attempts to solve specific problems or developing new applications. **Development** aims to use the knowledge gained from research to create practical applications, products, or processes. It focused on designing, testing, and refining new products or services. The distinction is not clear-cut however, in particular between applied research and experimental development. As a result, different statistical sources may report different estimates of R&D activities (OECD, 2015).

[2] Source: Authors' calculations based on Eurostat, comparing researchers and technicians in 2022 with those in 2012.
[3] Source: Authors' calculations based on OECD National Accounts, comparing 2022 with 2012. Due to data limitations, the calculation omits BG, RO, and HR.
[4] Source: Authors' calculations based on OECD Productivity Statistics, comparing GDP per hour worked in 2022 with 2012.

Box 2: Which top R&D spending firms are headquartered in the CESEE region?

Firms in the CESEE region spend about half as much on R&D as a share of their value added than firms in the North and West of the EU. And the region only hosts 8 of the headquarters of the EU's top 1000 R&D spending firms: their activities are largely in pharmaceuticals and ICT, typical for the top R&D spending sectors in the EU. Four are in pharmaceuticals: Gedeon Richter (in Hungary), Krka (Slovenia), Mabion (Poland) and Captor Therapeutics (Poland). Three are in ICT: Asseco (Poland: IT solutions for banking and finance), CD Project (Poland: video games), and Synektik (Poland: IT solutions for the health sector). The last is CEZ, the electricity producer (Czechia). Absent from this list are firms that spend heavily on R&D in CESEE but are foreign-owned (as R&D is registered in the home country). There are no automotive firms among the top R&D spenders headquartered in the region, despite the importance of the automotive sector for the EU's R&D spending. Skoda's 300mn EUR R&D spending in 2022[1] is counted, for example, towards Volkswagen's almost 19bn EUR.

CEZ, Asseco, Gedeon Richter, and Krka are very large companies with turnovers in excess of 1bn EUR in 2023 and over 10,000 employees each, with their incorporation dating back many decades. They have many subsidiaries abroad, including in countries that specialise in R&D activities in their respective businesses: the ICT company Asseco has more than two dozen subsidiaries in the US, while the subsidiaries of CEZ and the pharmaceutical companies Gedeon Richter and Krka lie mainly in the EU and Switzerland.

The other four companies were founded after 2000. Among them, Captor Therapeutics is by far the youngest, having been founded in 2015, and the smallest with a turnover of 4.4mn EUR in 2023. It has a subsidiary in Switzerland. CD Project, considerably larger with a turnover of over 300mn EUR in 2023, has several subsidiaries in Northern America.

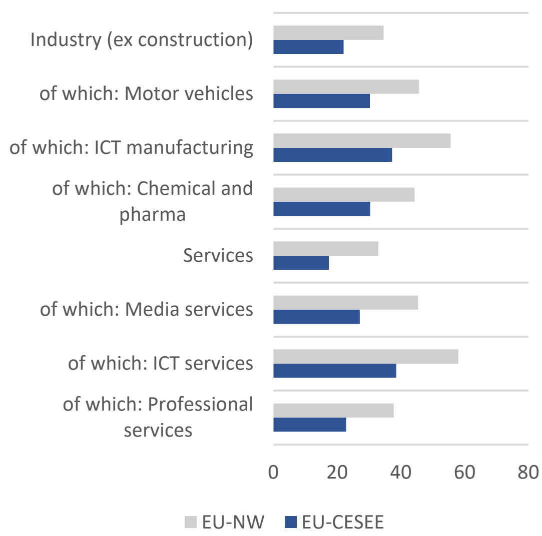
Despite the progress, significant gaps persist that must be addressed to ensure the region's growth and competitiveness. China, the US, and, to a lesser extent, the rest of the EU, have also amplified their innovation investments, raising the bar for the CESEE region. The region is grappling with a severe skills shortage: the number of Science, Technology, Engineering and Mathematics (STEM) graduates in CESEE has plateaued over the past decade, while the overall number of graduates has declined by more than 20%.[5] In 2023, only eight of the world's largest 2500 R&D investors had their headquarters in the CESEE region.[6] The same year, residents in the entire region only filed a mere 1585 patents with the European Patent Office (EPO), in stark contrast to German resident firms, which filed nearly 25,000 patents.[7] While productivity growth in the region has generally outpaced that in the North and West of the EU, it has recently shown signs of deceleration.

[5] Source: Authors' calculation based on Eurostat, comparing 2013/14 with 2020/21.
[6] Source: The 2023 EU Industrial R&D Investment Scoreboard | IRI (europa.eu)
[7] By residence of the first applicant. Source: Authors' calculation based on EPO.

1.2 Sectoral and geographical concentration of innovation

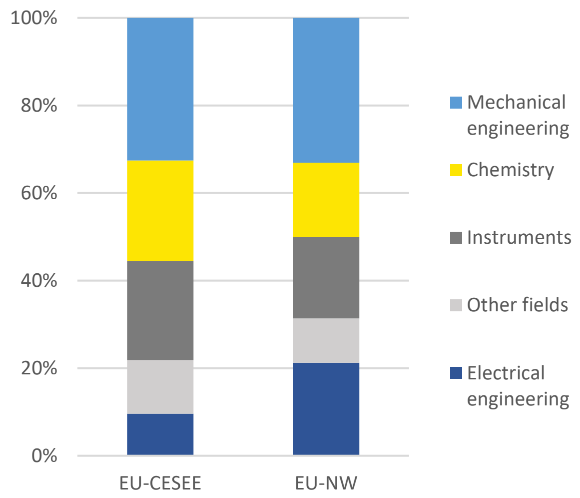
Both surveys (**Figure 3a**) and patents (**Figure 3b**) show that innovation is concentrated in the same sectors in the CESEE region as in North and West of the European Union. The main areas of industrial innovation are vehicles, the chemical and pharmaceutical sectors, information and communication technology (ICT), and intermediary products.

Figure 3a: Product innovations in selected sectors (% of firms)



Source: Eurostat Community Innovation Survey 2020. Note: Industry ex construction: B-E, Motor vehicles: C29-C30, ICT manufacturing: C26-C28, Chemical and pharma: C19-C22, Services: G46-M73_INN, Media services: J58-J60, ICT services: J61-J63, Professional, scientific, and technical services: M71-M73.

Figure 3b: Distribution of patents granted (by area, 2023, % of patents granted)

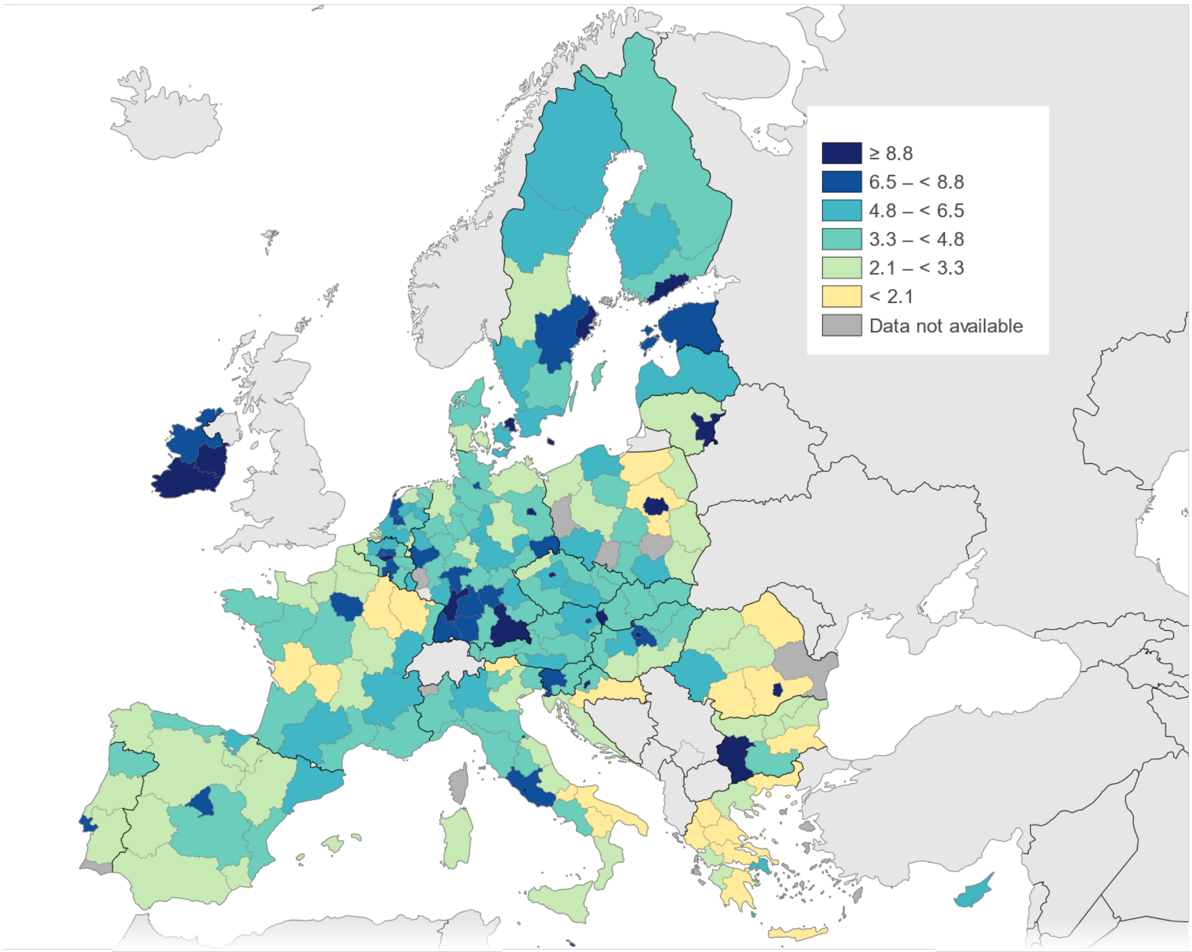


Source: European Patent Office. Note: Regional allocation of patents by residence of first applicant.

In almost all sectors, the share of innovative firms appears to be smaller in the CESEE region than in the North and West of the EU. The share of patents in key technologies (green, digital, and biotech) is about the same in the CESEE region, with a somewhat greater share of biotech (15% vs 10%) and smaller share of green patents (13% vs 10%).[8] In the services sector, ICT and professional services stand out as the most innovative.

[8] Source: EIB staff calculations based on Patent Cooperation Treaty (PCT) patents (PATSTAT) in collaboration with the Research and Development Monitoring Research Centre (ECOOM) at KU Leuven university. Note: Patents in green technologies are measured based on the methodology of Haščič and Migotto (2015), with further adjustments implemented by ECOOM. The patent classification in biotechnology is based on the classification established by KU Leuven. The biotechnology domain is the combination of Fraunhofer technology classes 15 (biotechnology) and 16 (pharmaceuticals). The digital patent classification is based on the European Patent Office (EPO) (2017). Patents may be allocated to multiple categories.

Figure 4: Employment in technology and knowledge-intensive industries (% of total employment)



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Cartography: Eurostat – IMAGE, 10/2024

Source: Eurostat Science and Technology.

Research and development tends to take place in major cities, often centred around excellent universities or research institutions. In the services sector, the region's capital cities are often hubs for R&D activities. In manufacturing, R&D tends to be located together with production outside capital cities. **Figure 4** proxies their location by the regional share of employment in technology and knowledge-intensive industries. (A map drawn for overall, or business, R&D expenditures, would look qualitatively very similar.) For example, Warsaw has a growing reputation in the IT and fintech sectors, driven by a strong academic foundation in computer science and engineering. Prague hosts several innovative companies in IT, AI, and robotics (eg, Avast). The city has a vibrant startup scene with many incubators and accelerators. Brno is home to a thriving innovation ecosystem, particularly in IT, life sciences, and engineering. However, in an international comparison, the region is not a hub for innovation clusters. For example, the World Intellectual Property Organization only ranks a single CESEE cluster, Warsaw, among its top 100 clusters in its 2023 Science and Technology Cluster Ranking. In contrast, 16 clusters in the North and West of Europe are among the top 100.[3]

1.3 Dispersion of innovation activities across firms

On average, firms in in the EU-CESEE region invest less in digitalisation and innovation compared to their counterparts in the North and West of the EU. This disparity is in part due to a higher proportion of firms in the CESEE region that allocate minimal or no investment towards R&D and digitalisation.

Figure 5a: Distribution of investments in R&D across firms (% of total investment expenditures)

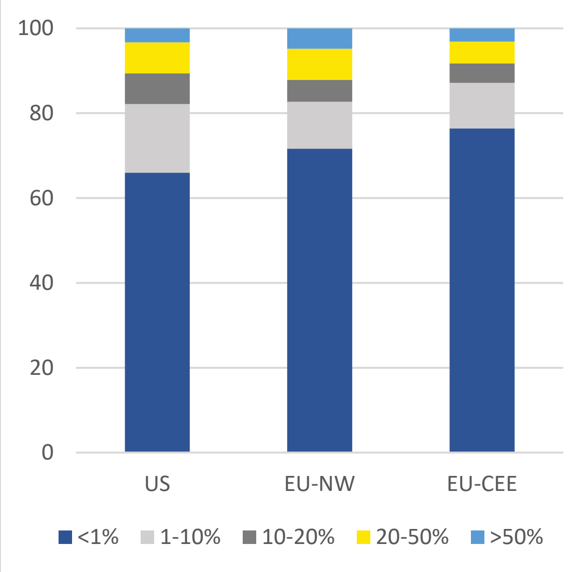
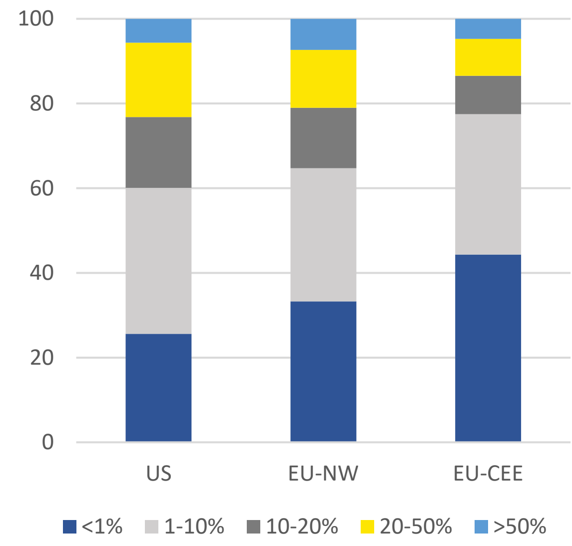


Figure 5b: Distribution of investments in digital technologies across firms (% of total investment expenditures)



Source: EIB Investment Survey, 2016-23. Note: The bars report the investment shares for the financial year preceding the (annual) interviews. Data for the US are for 2018-22.

For instance, during financial years 2015-2022, 76% of firms surveyed in the CESEE region allocated less than 1% of their total investment expenditures towards R&D (**Figure 5a**). Only 72% of firms in the North and West of the EU, and a mere two-thirds of firms in the US, reported similarly negligible R&D investments. The difference is driven mainly by manufacturing, where 65% of CESEE firms but only 54% of firms in the North and West of the EU spend less than 1% of their investment in R&D.

Moreover, firms in the CESEE region that allocate a large portion of their investments to R&D are less common. For example, only 8% of firms in the CESEE region allocated more than 20% of their investment expenditures towards R&D, compared to 12% in the North and West of the EU, and 10% in the US.

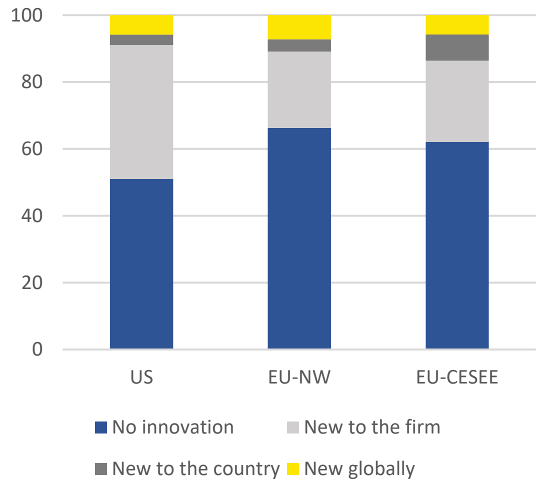
These trends are also evident in investments in digital technologies (**Figure 5b**).

During 2016-2023, 44% of firms surveyed in the CESEE region allocated less than 1% of their investment expenditures towards digitalisation. In contrast, such a low share of investments in digitalisation was observed for only 33% of firms in the North and West of the EU, and 26% of firms in the US.

Relatively low investments in innovation translate into weaker innovation activities. However, while larger shares of firms in the US innovate than in the EU, the differences between firms in the CESEE region and those in the North and West of the EU appear small (**Figure 6**).

One reason may be transfers of technology through FDI, which allows firms in the CESEE region to innovate by adopting technologies that are new to the firm or the country without incurring the corresponding investments in R&D (see Section 2.1).

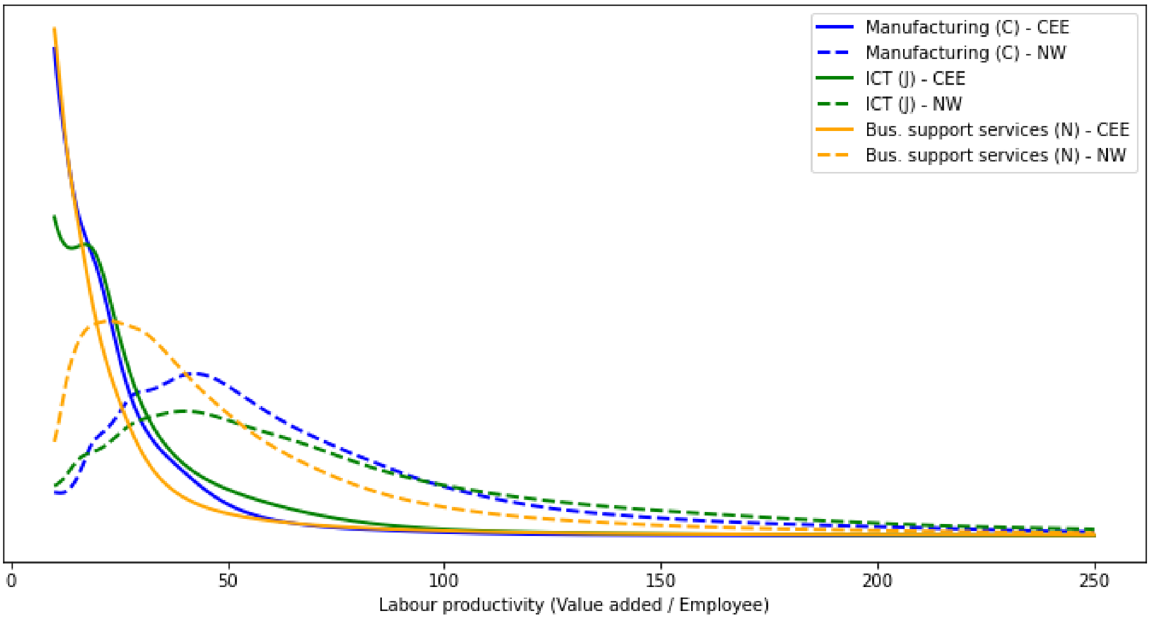
Figure 6: Distribution of innovation across firms (% of all firms)



Source: EIB Investment Survey, 2016-23. Note: The bars report the share of firms that did not innovate and of those that innovated, by type of innovation, during the financial year preceding the (annual) survey. Data for the US are for 2018-22.

New technologies appear to diffuse more slowly to the least productive firms in the CESEE region: within sectors, labour productivity is more dispersed than in the North and West of the EU. This dispersion, measured as the standard deviation relative to the mean, is high because some firms are highly productive, but average productivity remains lower than in the North and West (**Figure 7**). One reason is the higher proportion of small firms in CESEE economies. Smaller firms typically have lower productivity than larger firms, partly because they face greater challenges in accessing finance to fund innovations (see section 2.3). The productivity gap between small firms in the CESEE region and those in the North and West of the EU is particularly large (**Figure 8a**).

Figure 7: Estimated distribution of labour productivity (selected sectors, CESEE and North and West of the EU)



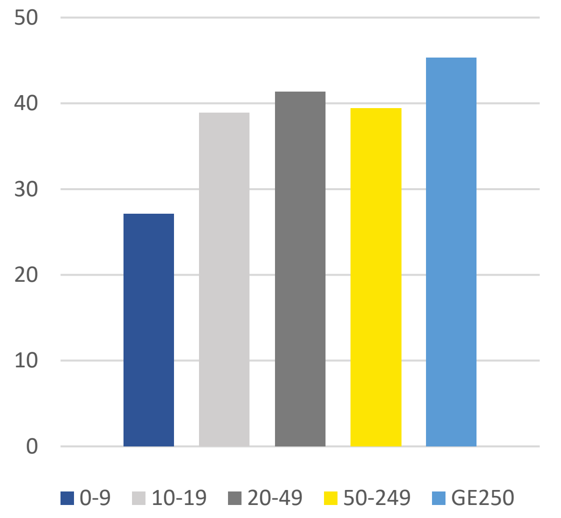
Source: Authors' calculations using Compnet.
Note: Due to data limitations, the density functions are based on CZ, HR, HU, LT, LV, SI for CESEE and on BE, DK, FI, NL, SE for the North and West of the EU, for 2019 using 2010 prices. Procedure: (1) Sampling from the distributions of log of labour productivity, for which Compnet provides percentiles at the (country, sector) level, with the number of draws proportional to employment in the respective country and sector; (2) pooling the samples across countries within each macro region; (3) estimating the distributions of the pooled samples.

1.4 Public support for research, development, and innovation

Spending on R&D in the CESEE region is about half of that in the North and West of the EU. The gap is particularly pronounced in business R&D, with businesses in CESEE spending only 0.8% of GDP on R&D compared to 1.8% in the North and West (**Figure 8b**).

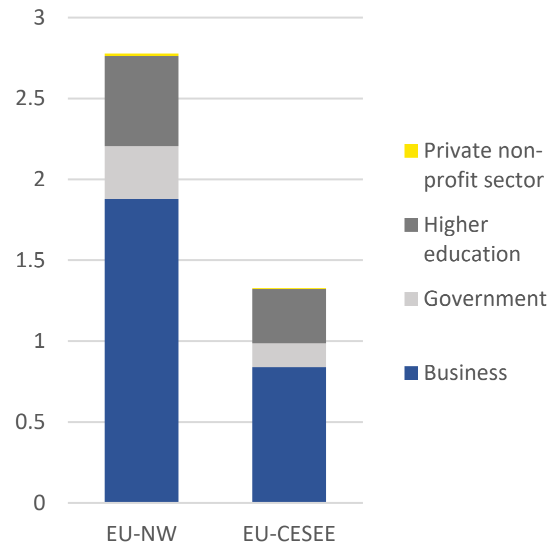
Even though CESEE governments spend less overall on R&D, they support a larger share of business R&D (**Figure 9a**). In 2021, government funding accounted for 10% of business R&D in the CESEE region, compared to only 4.5% in the North and West. Additionally, transfers from other sources, such as EU funds (including Horizon and structural funds) and contributions from multinational companies, provide significant funding for domestic R&D activities (**Figure 9b**).

Figure 8a: Labour productivity of firms in CESEE (% of productivity of firms in the North and West of the EU, 2021)



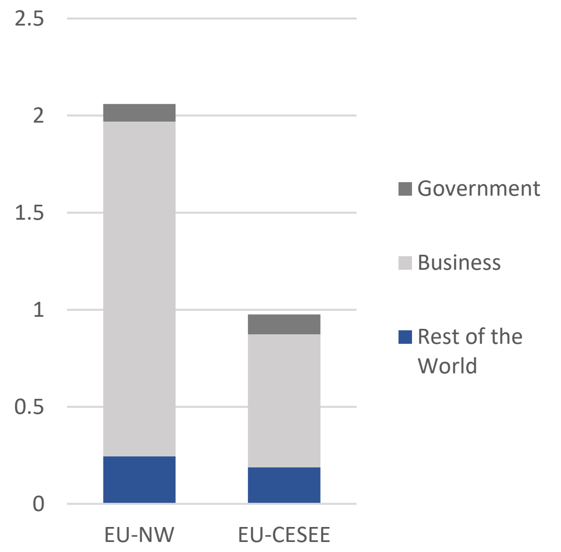
Source: Eurostat Structural Business Statistics.

Figure 8b: Spending on R&D by sector of performance (2021, % of GDP)



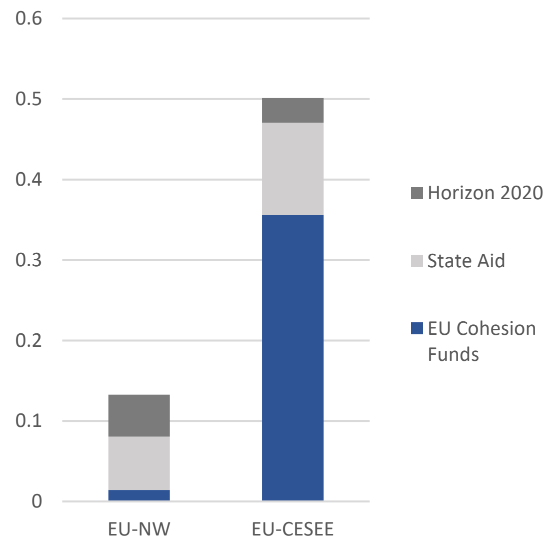
Source: OECD MSTI.

Figure 9a: Financing sources of business sector R&D (2021, % of GDP)



Source: OECD MSTI. Note: Total financing does not equal total spending in Figure 8b due to differences in the data sources, see OECD (2015), section 12.6. "NW" omits DK, "CESEE" omits BG, RO, HR. Rest of the World (eg, EU structural funds, financing by foreign parent companies of R&D in their domestic subsidiaries) is the average contribution of financing from abroad across countries in each region.

Figure 9b: Key public financing sources for projects related to R&D and innovation
(2014-20, % of GDP)



Source: Authors' calculations using project-level information on EU structural funds provided in Kohesio and in Horizon 2020. Note: "EU Cohesion Funds" shows the value of funding whose objective includes "Research and Innovation" or "ICT". "State Aid" includes funding whose objective is "Research, development and innovation".

2 Challenges and opportunities

Stimulating innovation across the CESEE region presents numerous challenges, many of which are not unique to this area. These challenges include increasing the availability of the skills necessary for innovation, securing adequate risk capital, adopting cutting-edge technologies, all while improving the overall business environment.[9] Labour shortages are already prompting some firms to shift their innovation activities from the North and West of the EU to the CESEE region, and within the CESEE region to its less developed areas. However, expanding these innovation activities into larger innovation hubs is a complex task. It requires the concurrent presence of skilled talent, access to finance, and firms engaged in research and development. Each of these elements is more easily attracted to locations where the others are already well-established. Consequently, creating new innovation hubs involves overcoming the interdependencies and inertia that favour the established centres of innovation in the North and West of the EU.[10]

In this section, we concentrate on three specific challenges, where we can contribute expertise gained through our annual large-scale corporate investment survey and through our lending activity in the region: capitalising on foreign direct investment and foreign ownership; addressing the acute shortage of appropriately skilled staff; and enabling the transformation of ideas into innovative products and services through cooperation between universities and business and the provision of risk capital.

2.1 Augmenting the role of foreign-owned firms in innovation

When the CESEE region moved to market-based economies in the 1990s, governments viewed FDIs as a key channel for the adoption of technology, the build-up of an export base, and the economic convergence of the CESEE region to the rest of the EU. Attracted by the proximity to key export markets, generous government incentives, and an ample availability of cheaper skilled labour, FDI flowed mainly from countries in Western and Northern Europe (**Figure 10a**). From 1993 to 2020, foreign investment in the CESEE region averaged 4.4% of CESEE GDP, outpacing the global average of FDI inflows, which stood at 2.5% of global GDP (Jovanović and Hanzl-Weiss, 2022).

Today, foreign firms hold a central position in the CESEE economies. They contribute 40% to the region's value added and account for just over 25% of employment, both figures being double their counterparts in the rest of the EU.[11] Foreign ownership shares are notably high in manufacturing, finance, and ICT (Figure 10b). In the automotive sector, foreign-owned firms generate nearly 90% of the region's value added and employ just over 80% of the sector's workforce.

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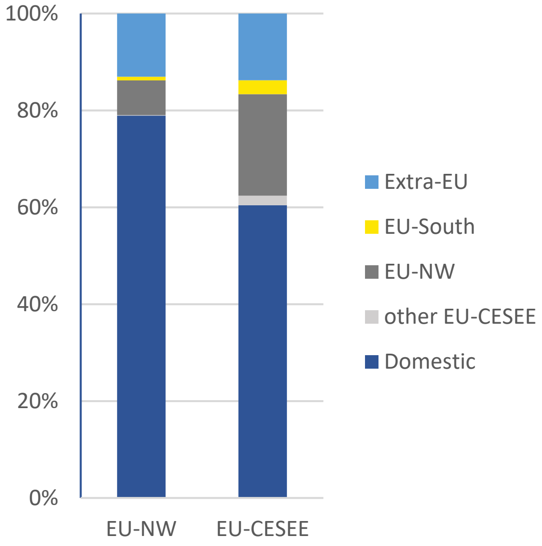
9 See Zavarská et al (2023) for a recent discussion of some of these challenges.

10 On the importance of path dependency for innovation see, for example, the stickiness of knowledge at the spatial as well as organizational level (von Hippel 1994; Li and Hsieh 2007), and the fact that knowledge flows and spillovers are localized (Jaffe, Trajtenberg, and Henderson 1993; Feldman and Kogler 2010).

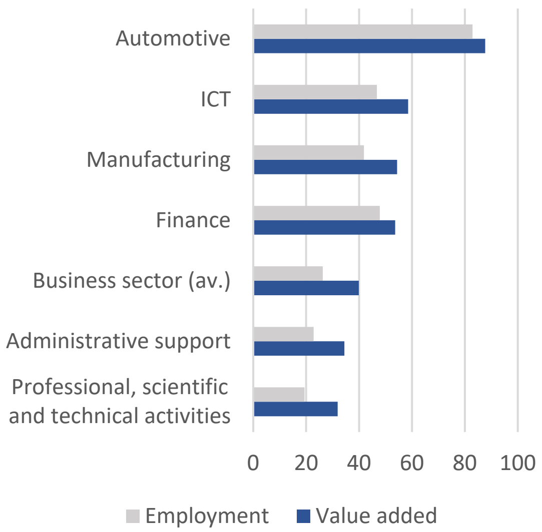
11 Source: Eurostat (Globalisation in Business Statistics). Data are from 2021.

Figure 10a: Headquarter locations (% of value added)



Source: Eurostat Globalisation and Business Statistics, 2021

Figure 10b: Value added and employment of foreign-owned firms in CESEE in selected sectors (% of total value added and employment)



Source: Eurostat Globalisation and Business Statistics, 2021

Foreign direct investment can be an important driver of innovation, directly and indirectly. Foreign-owned firms can stimulate innovation directly by providing finance, transferring technology, managerial and organisational know-how, contact to foreign markets, and via their own local R&D activities. Indirectly, these firms can stimulate innovation within their supply chain by demanding enhanced quality of goods supplied. They can also set benchmarks for after-sales service for their customers and prompt competitors to innovate to sustain their market presence. Thus, FDI can be a potent driver of innovation including domestic firms.[12]

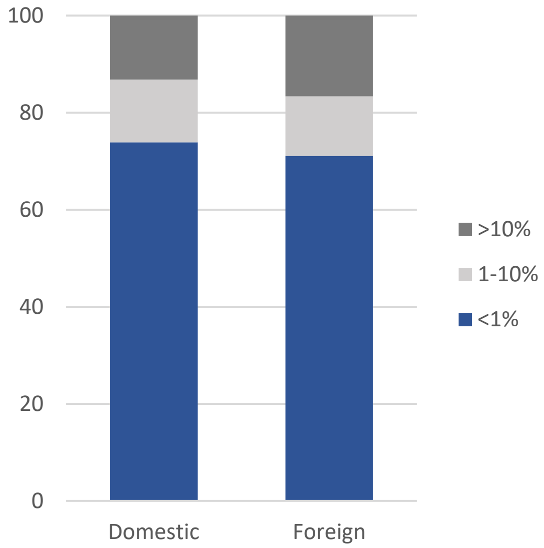
Evidence for the direct role foreign-owned firms play in stimulating innovation is stronger than for their indirect role.[13] We focus here on this direct effect. The EIB's Investment Survey provides some evidence that innovation by foreign companies was somewhat more tilted towards the development of new technologies, whereas that of domestically owned companies was more tilted towards adaptation of technologies.[14]

[12] The role of FDI in driving innovation is discussed in the economic geography literature part of the discussion of the literature that stresses the role played by interregional interactions such as trade or firm investments (Boschma and Iammarino 2009; Neffke et al. 2018; Elekes, Boschma, and Lengyel 2019). Another part of the literature emphasises the importance of the relatedness of industries and technologies (Boschma 2017; Whittle and Kogler 2020), as exemplified in the product space (Hidalgo et al. 2007, and the second paper of this Series, Guadagno et al. 2024), industry space (Neffke, Henning, and Boschma 2011) and knowledge spaces (Kogler, Rigby, and Tucker 2013; Kogler, Essletzbichler, and Rigby 2017). See, eg, Crescenzi et al (2022) for a recent contribution and the references contained therein.

[13] See Smelc (2023) for a recent literature overview.

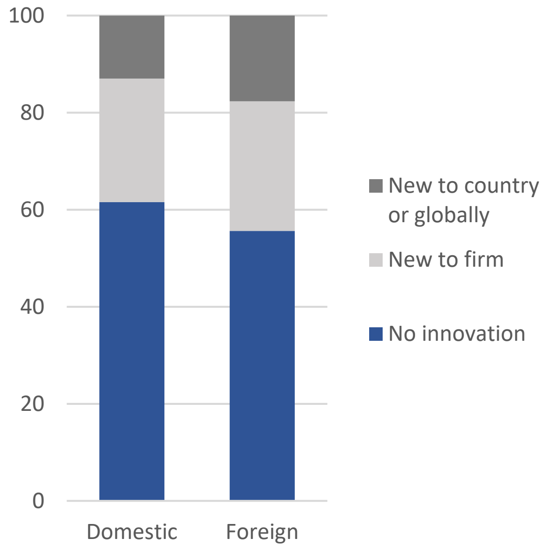
[14] Ultimate ownership information was obtained from ORBIS for almost 16,000 firms, corresponding to two thirds of firms interviewed in EIBIS during 2015-19 and 2022. Unmatched firms' innovation resembled those of domestically owned firms. Results are weighted to match the overall distribution of firms (domestic and foreign owned) to the distribution of value added of firms independently of their ownership, rather than separately for each group of ownership. Imperfect matching and the weighting procedure may introduce biases in the reported results.

Figure 11a: R&D investments in EU-CESEE by location of ultimate owner
(% of total investment expenditures, 2015-22)



Source: EIB Investment Survey. Note: The bars report the share of EU-CESEE firms that spend less than 1% of their investment on R&D (blue bar), between 1-10% (light grey bar), and more than 10% (dark grey) on average during 2015-19 and 2022.

Figure 10b: Novelty of innovations in EU-CESEE by location of ownership (% of firms, 2015-22)



Source: EIB Investment Survey. Note: The bars report the share of EU-CESEE firms that did not innovate (blue bars), introduced products, services, or processes new to the firm (light grey bars), and products, services, or processes new to the country or the world (dark grey) in the financial year preceding the interview on average during 2015-19 and 2022.

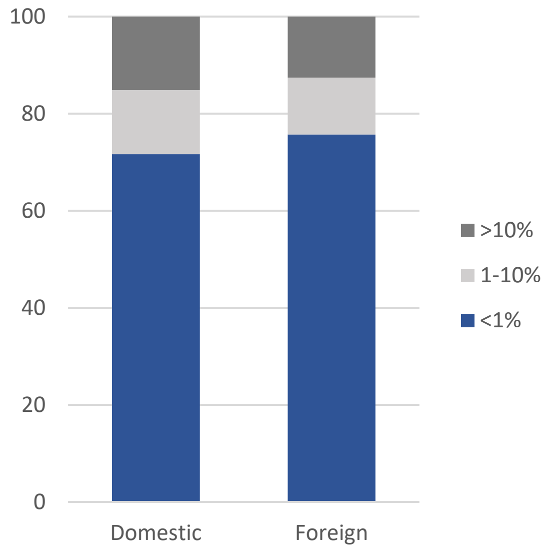
During 2015-22, foreign-owned firms directed a greater share of their investment towards R&D (**Figure 11a**). A greater share of foreign companies reported innovations that were new to the country or the world, whereas a greater share of domestically owned companies reported innovations that were (only) new to the company (**Figure 11b**). [15]

However, foreign-owned companies are also larger, younger, and more concentrated in manufacturing relative to domestic firms. Larger firms and those in manufacturing tend to invest more in R&D independently of the location of their owner. Foreign ownership plays less of a role. When comparing like-for-like by controlling for size, age, location, and sectoral activities, foreign ownership is associated with lower investment in R&D (**Figure 12a**), and no differences in innovation (**Figure 12b**).[16]

[15] Greater R&D intensity of foreign-owned firms is also reflected in employment. In manufacturing, 1.7% of CESEE employees work in R&D in firms with owners from the North and West of the EU, vs. 1.3% in domestically owned firms. Source: Eurostat Globalisation in business statistics.

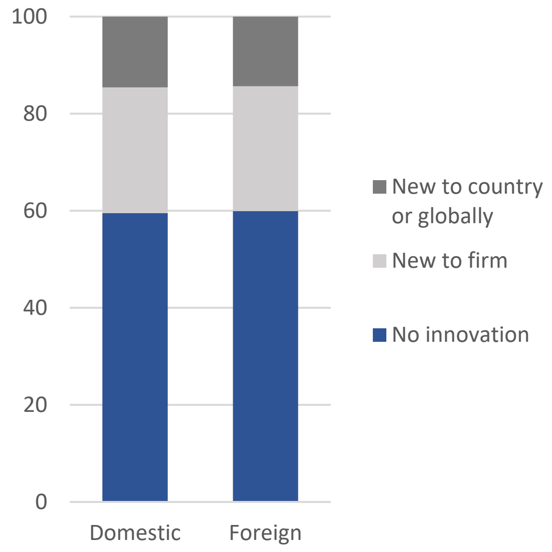
[16] "Like-for-like" comparisons show predictive margins of the location of ownership in an ordered logit regression that controls for firm characteristics.

Figure 12a: R&D investments in EU-CESEE by location of ultimate owner, holding constant other firm attributes (% of total investment expenditures, 2015-22)



Source: EIB Investment Survey. Note: The bars report the share of EU-CESEE firms that spend less than 1% of their investment on R&D (blue bar), between 1-10% (light grey bar), and more than 10% (dark grey) on average during 2015-19 and 2022, controlling for their age, year, sector, location, and size.

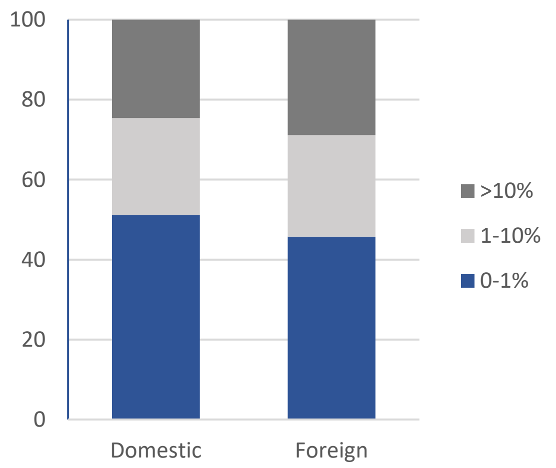
Figure 12b: Novelty of innovations in EU-CESEE by location of ownership, holding constant other firm attributes (% of firms, 2015-22)



Source: EIB Investment Survey. Note: The bars report the predicted share of EU-CESEE firms that did not innovate (blue bars), introduced products, services, or processes new to the firm (light grey bars) and new to the country or world (dark grey) in the financial year preceding the interview, averaged over 2015-19 and 2022, controlling for their age, year, sector, location, and size.

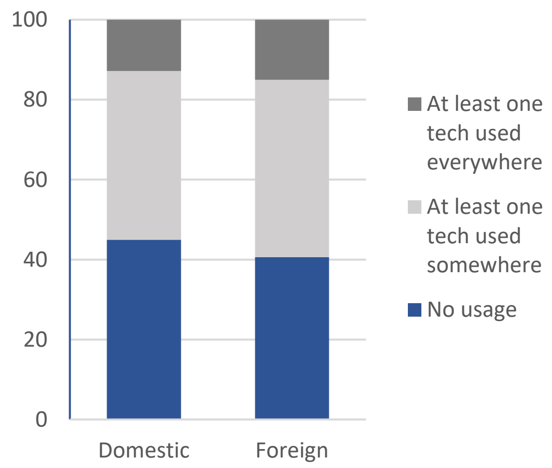
Relative to similar domestic firms, foreign firms spend more of their investments on digitalisation than on R&D (**Figure 13a**). Perhaps as a result, they also make greater use of advanced technologies, than domestic firms, even when comparing firms that have similar characteristics (**Figure 13b**).[17]

Figure 13a: Investments in digitalisation by location of ultimate owner, holding constant other firm attributes (% of total investments)



Source: EIB Investment Survey. Note: The bars report the share of EU-CESEE firms that spend less than 1% of their investment on R&D (blue bar), between 1-10% (light grey bar), and more than 10% (dark grey) on average during 2015-19 and 2022, controlling for their age, year, sector, location, and size.

Figure 13b: Use of advanced technologies by location of ultimate owner, holding constant other firm attributes (% of firms)



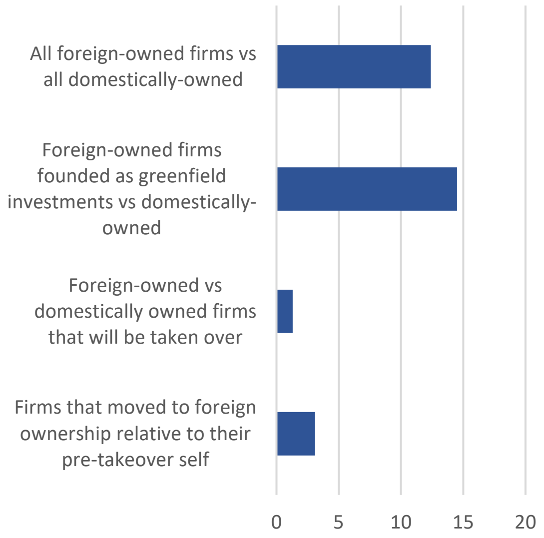
Source: EIB Investment Survey, 2023. Note: The bars report the share of EU-CESEE firms that used none of the advanced technologies asked about (blue bar), at least one such technology somewhere in their business (light grey bar), and at least one such technology everywhere in their business (dark grey bar) during FY2022, controlling for their age, sector, location, and size.

Greater investments in digitalisation and in advanced technologies are likely to be one of the reasons for which foreign firms appear to be more productive than their domestic peers.[18] Indeed, on average firms with a foreign owner appear to have 12% higher total factor productivity (**Figure 14**).

17 The list of technologies about whose usage firms were interviewed differed depending on the sector in which the firm is active: construction (C), infrastructure (I), manufacturing (M), and services (S). These technologies are: 3D printing (C, I, M), Augmented/virtual reality (C, S), Automation via advanced robotics (M), Big Data analytics and artificial intelligence (I, M, S), Drones (C), Digital platform technologies (I, S), and The internet of things (all).

18 Several studies have investigated the impacts of FDI on productivity. Damijan et al. (2003), Javorcik (2004) and Lipsey (2006) have found that FDI has produced positive technological spillovers and has had positive effects on productivity, while Bijsterbosch and Kolasa (2010) and Damijan et al. (2013) have argued that the productivity effects are heterogenous and depend on where the FDI flows go, with industries of higher technology intensity experiencing greater productivity benefits.

Figure 14: Apparent productivity gain through foreign ownership (EU-CESEE firms, % increase in total factor productivity relative to control group)



Source: Authors' calculations based on ORBIS. The results are derived from a firm-level panel regression of TFP (obtained as an OLS residual of a regression of real value added on the number of employees and the value of the firm's capital stock) onto lagged values of TFP, leverage, cash ratio, sales ratio, and total assets, a foreign ownership dummy, and country-sector-year fixed effects. The sample combines all firms across the CESEE region for which data is available in ORBIS during 2008-2020. Error bars are derived from standard errors clustered at the firm level. Details are available from the authors.

The difference between the productivity of foreign and domestically owned firms is particularly large for greenfield investment: controlling for firm-specific factors, the TFP of those firms in the CESEE region that were founded by foreign companies is almost 15% larger than that of its domestically owned peers (Figure 14, second bar from the top). In contrast, the productivity of firms acquired by foreign investors in M&A transactions increases only marginally after relative to before the takeover (by about 1.3%).[19] The primary reason for the higher productivity of foreign-owned firms is that foreign investors tend to acquire companies that were already more productive than their domestically owned peers before the acquisition. In fact, domestically owned firms that are later acquired are only 3% less productive than foreign-owned firms (Figure 14, second bar from the bottom).

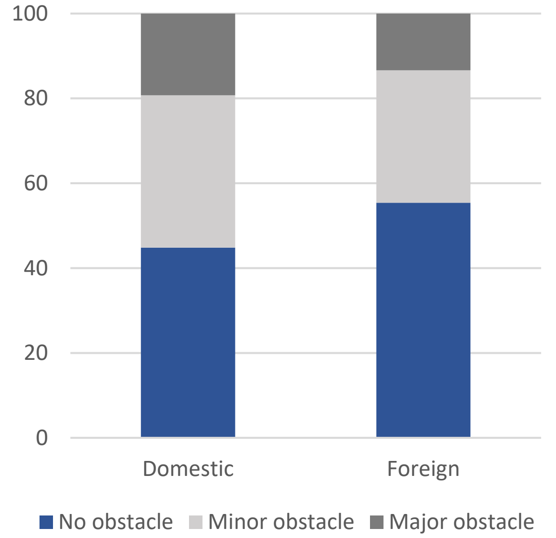
This pattern of foreign firms investing more in digitalisation and advanced technologies but less in R&D arguably reflects the region's ongoing role in global value chains: a focus on the production of goods and the provision of services, rather than their development or post-production sales (Stöllinger, 2019, 2021, Stöllinger and Zavarská, 2023, Guadagno et al, 2023). Research and experimental development activities are often conducted close to companies' headquarters due to the challenges in monitoring them. The quality and timeliness of the delivery of intermediate goods, such as a car's rubber mat, can be relatively easily specified in contracts. However, the cost, duration, and outputs of research and experimental development activities are more elusive. This necessitates a degree of trust in the workforce's skills and motivation from management, who in turn need to monitor progress frequently to ensure that projects remain on track. The transfer of expatriate management to ensure monitoring of research and experimental development is expensive and might only be justified in large, strategic export markets with large pools of skilled staff, such as India, China, and the US.

[19] Ownership change between 2008 and 2020. Further productivity gains may arise after our sample ends. However, Gregori at al. (2024) argues that cross-border take-over may even result in negative productivity trend after the treatment, on the larger sample of EU countries.

That said, there are reasons to believe that foreign firms will become more innovative in the region. Foreign companies are increasingly transferring product testing and development into the region. This shift is encouraged by lower wage costs and government subsidies aimed at attracting foreign investments into higher-value-added tasks. It has been made possible by the trust that foreign owners have developed in the capabilities of the local workforce over their decades-long presence in the region. In 2021, the number of employees in R&D in foreign firms was 2.5 times higher than a decade earlier. Foreign-owned companies are also significantly less likely to report that financial constraints, which can constrain R&D activities, are a barrier to their investments (**Figure 15**).

How much this presence can be expanded further depends crucially on the availability of staff. In Slovakia, for example, the government's Innovation Office estimates that staff is so scarce that any new R&D centre would have to attract staff from existing centres (**Box 3**). Additional openings of R&D facilities would then not raise the share of higher-value added activities in the economy overall. In Romania, qualified staff is still easier to find, and has, for example, contributed to the rapid growth of the business services sector (**Box 4**).

Figure 15: Importance of financial constraints by location of ultimate owner, holding constant other firm attributes (% of firms)



Source: EIB Investment Survey. Note: Predictive margins for ownership location from an ordered logit controlling for firm age, year, sector, location, and size, 2015-19 and 2022.

Box 3: The role of foreign-owned industrial R&D centres in the Slovak Republic.[20] Most industrial R&D centres in the Slovak Republic are foreign-owned and started to emerge 10-15 years ago. They were attracted by the supply of skilled staff, low wages, and increasing trust in the ability of the local teams to conduct tasks that go beyond production. Over time, these centres took on more complex projects. One example is Continental Tires' Technology Center in Puchov, where it had been producing tires since 1950. Puchov lies in Northern Slovakia close to the border to Czechia and today houses the largest plant for the production of truck and bus tires in Europe.[21] Another example is Takaneda, a Japanese pharmaceutical company, establishing its "Innovation Capability Center" in Bratislava.

Foreign-owned industrial R&D centres typically include 50-500 employees and are situated at sites where the foreign firm also produces, largely because of their focus on product testing and development. As a result, they are located around cities outside the capital. The proximity of a good technical university is also important because it enables firms to attract graduates. With Slovakia's specialisation in automotive, skills in mechatronics and programming (such as to virtually simulate wear and tear) are in great demand. Concerns about losing qualified staff discourages the establishment of centres in which competing firms conduct their R&D activities close to each other. Silicon-valley-type centres therefore appear some way off.

Industrial R&D centres are typically not well connected with the local economy. Local R&D serve as service providers to foreign headquarters and can be unaware of domestically owned firms with similar interests. With a focus on product testing and development, gains from cooperation with local firms that serve as suppliers may not be large. Instead, cooperation with universities, which in any case may offer greater benefits for research and experimental development, is typically limited to lectures and internships. Finally, internal approval processes for novel types of cooperations that require the approval of company headquarters can be slow.

[20] This box is based on discussions with the Research & Innovation Policies Unit of the Government Office of the Slovak Republic.
[21] Source: Production plant Púchov (continental-tires.com)

Meanwhile, domestically owned firms are expanding their R&D activities as well. Just as foreign-owned firms, they have increased their R&D staff by a factor of about 2.5 between 2011 and 2021.[22] By 2021, domestic firms employed just above half of all R&D employees in businesses. The productivity of these investments appears to be about the same as for foreign-owned firms. According to our estimates, domestically-owned R&D investments are followed by innovations with about the same likelihood as in foreign firms. The likelihood that innovations are raising their profitability is somewhat lower than for foreign firms; however, the differences appear to be small.[23]

Box 4: Innovation in business services in Romania

Over the past years, Romania's business services sector has experienced robust growth, becoming an important contributor to the country's economic development. This box is based on a 2023 survey by the Association of Business Service Leaders in Romania among 77 firms in the sector (ABSL, 2023).

The industry is predominantly international, with 75% of surveyed companies being foreign-owned. Of these, 30% are headquartered in the Americas and 43% in Europe. Firms most frequently offer IT services, finance and accounting, and procurement and supply chain management, most commonly in English, German, Romanian, French, and Italian. Two-thirds work exclusively for their parent organizations, the remainder offer their services more widely.

Innovation has been crucial to the sector's growth, particularly through expanding the scope and complexity of services. A key driver of this innovation is the adoption of increasingly sophisticated automation solutions. Over half of the surveyed companies use robotic process automation (RPA) to automate tasks such as data entry, invoicing, and report generation. The use of more advanced technologies, such as autonomic process automation and cognitive automation, has also grown. These technologies enhance RPA by incorporating autonomous decision-making and artificial intelligence (AI) for more complex tasks like natural language processing and decision support.

Compared to other CESEE countries, Romania has relatively manageable skills shortages. However, competition for skills is intensifying, particularly for those that the industry is looking for: digital and automation skills and foreign language proficiency. The availability of skills constrains firms' ability to move to regions with lower wage levels. More than two thirds of employees work in Bucharest, a relatively high-wage region.

2.2 Overcoming the shortage of skills

Lack of skilled staff is among the major obstacles to investment for CESEE companies. When asked about their major obstacles to investment, innovative firms most frequently quoted a lack of staff with the right skills in almost all CESEE countries ahead of the pandemic and the energy price shocks in 2020 and 2021.[24] While high uncertainty and high energy costs have temporarily taken the top position, highly educated staff is an increasingly scarce resource. The average unemployment rate of 25–64-year-olds with tertiary education in CESEE has declined on average from 4.9% in 2013 to 1.6% in 2023.[25]

Low investments in R&D in the public and higher education sectors, an apparent neglect of life-long learning, and emigration are key reasons for the shortages of skills. We discuss them below. Population ageing will aggravate the problem: relative to 2023, the number of people aged 25-64 is forecast to decline in the CESEE region by 5.5% by 2030 and by 20% by 2050. In contrast, the number of people in same age group is expected to remain broadly constant in the North and West of the EU, pushed up by immigration.[26]

[22] Source: Eurostat (Globalisation in business statistics). Business sector, based on BG, CZ, HU, PL, and SK due to data limitations.

[23] Results are based on (1) a logit regression of a binary variable describing whether a firm innovated, depending on whether it invested in R&D in the preceding year, interacted with an ownership dummy; and (2) a panel ordered logit regression of a firm's profitability on the type of innovation it made in the preceding year. Regressions include firm controls and year fixed effects and use data from EIBIS and ORBIS.

[24] Source: EIBIS, 2016-23.

[25] Source: Eurostat (LFS). A more direct measure of shortages might be vacancy rates of professionals and skilled technicians / service sector employees. However, other than for Hungary, this data is largely missing.

[26] Source: Eurostat EUROPOP2023 (base line forecast).

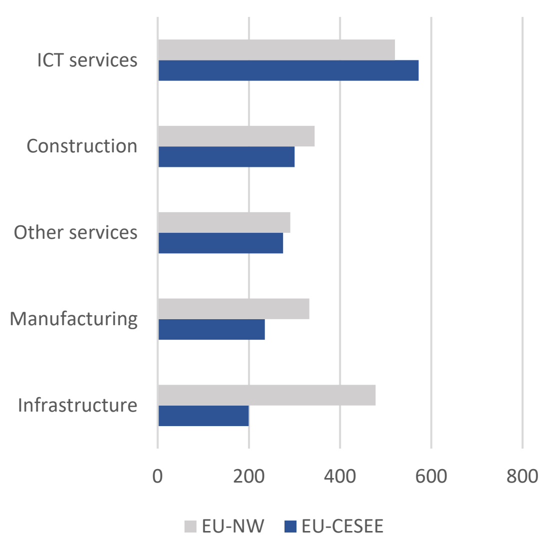
2.2.1 Low public investments in R&D

Spending on R&D conducted in the public and higher education sectors is – at 0.5% of GDP in 2021 – just over half of the average in the North and West, without much change over the past two decades. By now, measures of output of R&D suggest that this spending is about as productive as that in the North and West. But it took time for these investments to pay off. The share of international co-publications and the share of publications among the 10% most cited publications are both just under half of their values in the North and West, up a third from a decade earlier.[27] Greater research output is also reflected in the increased the attractiveness of universities among foreign doctoral students: foreigners now comprise about 15% of all doctoral students in the region, up from 5% a decade ago – but still only half the share of foreign doctoral students in the North and West of Europe.[28]

2.2.2 Low corporate investment in continuous education

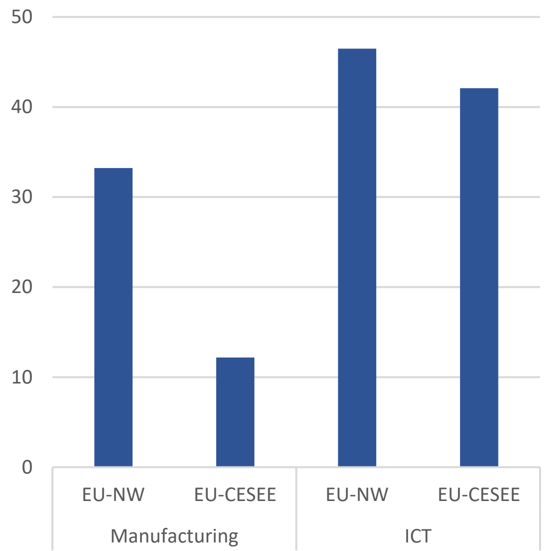
Companies not only spend less on research and development than their peers in the North and West of the EU but also appear to offer their staff fewer opportunities for learning and development. According to EIBIS, firms in the CESEE region spend about a third less on training in real terms (**Figure 16a**). This difference is more pronounced in infrastructure and manufacturing and noticeably absent in ICT.[29]

Figure 16a: Corporate investment in training (EUR per employee per year, PPP adjusted)



Source: EIB Investment Survey, 2016-23.

Figure 16b: Employees spending all or most of their working time using cognitive skills
(% of employees)



Source: Eurostat LFS, 2022.

Consistent with the lower spending of companies in learning and development is the smaller proportion of employees that spend much time on cognitive tasks in manufacturing (Figure 16b).[30] The difference is largest for employees with at most secondary education and disappears for those with tertiary education. It likely reflects the role that CESEE firms still play in global value chains: a greater focus on production, and less value added in development and post-production services (see above). Relative to the North and West, skilled industrial / service employees make up a much larger share of employment in manufacturing at the expense of

[27] Source: European Commission (2024), European Innovation Scoreboard. GDP-weighted averages of country scores.
[28] Source: Eurostat.
[29] Source: EIBIS, based on 19,721 responses in CESEE and 21,293 in the North and West of the EU. Responses were truncated at the 1 and 99 percentile, deflated using the national price indices for education, and adjusted for different costs of training across countries using service sector PPPs.
[30] Source: Eurostat Labour Force Survey, Ad-hoc module, 2022.

professionals.[31] This has not changed over the past decade. In contrast, the share of professionals has increased substantially in ICT, from 49% to 62%, leaving no differences in the composition of the workforces across regions. In ICT, cognitive tasks are equally common in the CESEE Region and the North and West of the EU.

2.2.3 Brain drain

Emigration has slowed labour force growth in the region since the 1990s. The region's labour force (aged 25-64) grew only 4% between 2000 and 2020 (North and West: +12%).[32] The mirror image is the quadrupling of the stock of CESEE migrants in the North and West of the EU, from 1.7mn to 6.5mn in 2020.[33]

Surveys suggest that emigration, whether temporary or permanent, will continue to depress the labour force in the region. Younger and more educated individuals appear more willing to migrate (Barišić et al, 2024). In a recent EU-wide survey, 11% of interviewees in the CESEE region with post-secondary education intend to work abroad for at least two years.[34] Their preferred destinations are in the North and West of the EU: Germany (25%), Austria (14%), and the Netherlands (10%), followed by Italy (9%) and Spain (7%).[35] Corresponding inflows into the region from the rest of the EU appear unlikely: destinations other than the above mentioned ones were preferred by only 9% of individuals region with post- secondary education in the North and West, and 4% in the South. Instead, inflows from extra-EU countries appear more likely, whose labour market integration may be more challenging (Tverdostup, 2024).

Data on time spent abroad during a degree point into the same direction. Spending time abroad during a degree increases the likelihood of working subsequently in the host country (Parey and Waldinger, 2011). CESEE students are more likely to spend time abroad in the North and West of the EU (1.2% of students) than in other CESEE countries (1%). There is no sign of a corresponding inflow to the region: only 0.2% of students from the North and West are studying in CESEE, while 1.3% study abroad in their home region.[36]

The factors that make emigration attractive tend to change only slowly. Average nominal earnings are twice higher in the North and West of the EU relative to Slovenia and almost six times higher relative to Bulgaria, and convergence has been slowing. 40% of interviewees with secondary or tertiary education most frequently pointed to higher earnings as their reason for intending to move abroad (Eurobarometer, 2022). A fifth of respondents also pointed to the political stability, mentality, culture, and lifestyle of their preferred host countries (**Figure 17a**).[37]

[31] 60% of manufacturing employees in the CESEE region are classified as skilled industrial workers, vs 40% in the North and West of the EU. Only 8.8% are classified as professionals, vs 17% in the North and West of the EU. Source: Eurostat Labour Force Survey.

[32] Source: Eurostat.

[33] The stock of inward migrants only about doubled over the same period, to 0.7mn. Source: UN DESA.

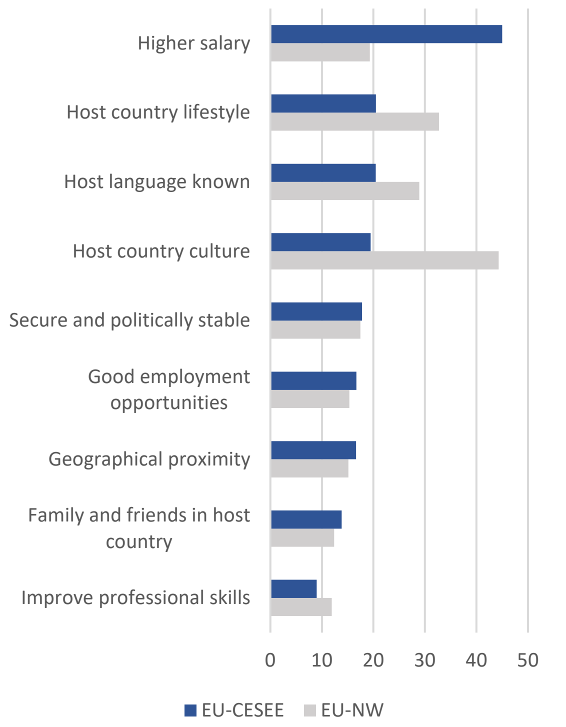
[34] Source: Eurobarometer (2022). Country-level shares were aggregated using the size of the labour force aged 25-64 with tertiary education.

[35] Source: Eurobarometer (2022). Respondents were able to indicate multiple destinations. Country-level shares were aggregated using the size of the labour force aged 25-64 with tertiary education. There is no breakdown available for preferred destination countries other than those mentioned.

[36] Source: Eurostat (Degree mobile graduates).

[37] In addition, Bygnes and Flipo (2017) found that political dissatisfaction encourages emigration.

Figure 17a: Main reasons for choosing host country for working abroad (% of interviewees with at least post-secondary qualifications)



Source: Eurobarometer 528: Intra-EU labour mobility after the pandemic, 2022. Question: "Why would you prefer to work in this country or these countries? (MAX. 3 ANSWERS)" Omits answers that were given less frequently.

Figure 17b: Impact of having lived abroad (% of returnees with at least post-secondary qualifications)

Source: Eurobarometer 528: Intra-EU labour mobility after the pandemic, 2022. Question: "What was the impact of the experience of living or working in another country on your life?" Omits answers that were given less frequently.

In principle, emigration can benefit the region when returning emigrants bring back skills and networks that they can apply domestically. In the CESEE region, 10% of those with at least post-secondary qualifications have lived and worked abroad, and many report that they returned with improved skills. For example, 20% indicated that their experience abroad qualified them for their current role (**Figure 17b**).[38] However, returnees in the CESEE region appear to make less use of their abilities compared to their peers returning to the North and West of the EU. This may be because they worked in positions below their qualifications and did not acquire new skills, or they may be less able to apply their new abilities in the CESEE region.

2.3 Transforming innovative ideas into marketable products and services

In this section, we concentrate on two important aspects related to the commercialisation of research: collaborative research between businesses and higher education institutions, and the funding for businesses' R&D endeavours and their commercialisation via venture capital and debt financing.

2.3.1 Joint research between businesses and higher education institutions

Not all firms possess the necessary competencies and capabilities to create and commercialize innovations on their own. For those that do not, a viable strategy is to share or acquire relevant resources through collaboration—whether within a corporate group, or with suppliers, customers, universities, and research

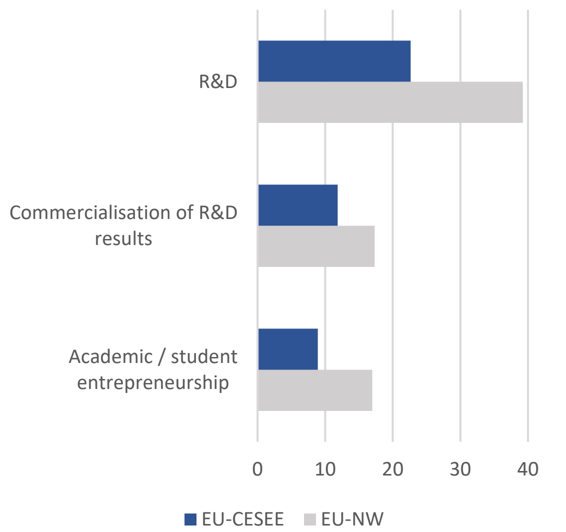
[38] Source: Eurobarometer (2022). Country-level shares were aggregated using the size of the labour force aged 25-64 with tertiary education.

institutes. Such collaboration can reduce the cost of innovation, although companies still need to invest in R&D and develop the skills required to guide these partnerships and fully leverage the knowledge gained. In this brief section we focus on the collaboration between firms and universities.[39] Strengthening this form of cooperation features in many countries' innovation plans.[40]

Universities excel at fundamental research and pioneering technologies while businesses excel at adapting new ideas to market needs. Combining the two strengths to guide research agendas and processes has long been recognised as a key driver of innovation.[41]

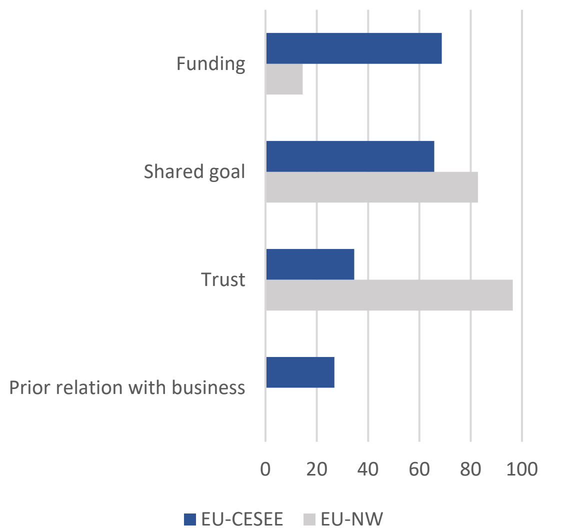
Surveys suggest that universities in the CESEE region tend to cooperate less with businesses than their peers in the North and West of the EU (**Figure 18a**).[42] Differences are particularly large in manufacturing (15% of firms in the North and West, vs 9% in the CESEE region).[43] The key success factors are sufficient funding and shared goals (**Figure 18b**).

Figure 18a: Extent of collaboration between business and universities (% of academics that cooperated to a medium or high extent)



Source: University-business cooperation in Europe, 2017. Note: The bars show the share of academics that cooperated with businesses to a medium or high extent in the stated activity.

Figure 18b: Academics' most frequently quoted factors that make collaboration successful according to academics that cooperate with businesses



Source: University-business cooperation in Europe, 2017. Note: The bars show the frequency with which these factors appear among countries' most often quoted success factors.

The factors holding back collaboration are cumbersome bureaucratic processes and a lack of funding from universities, businesses and government. Academics in the North and West agree on the bureaucratic processes but, instead of funding, are more concerned about the different motivations of businesses and academics and their different time horizons.

Despite these obstacles, academics that are engaged in cooperation overwhelmingly intend to extent their cooperation, by a margin of over 70% (North and West: 46%). Key success factors, academics from both regions agree, are trust and shared objectives. In addition, academics in the CESEE region point to sufficient funding. Prior relationships with business partners also facilitate cooperation for CESEE academics, perhaps suggesting that there is potential for creating networks or organising events to facilitate relationship building (Galan-Muros and Davey, 2019). Businesses' assessments of the relative importance of these factors are very similar, with

39 See Stojčić (2020) for a broader evaluation of different cooperation types, also based the Community Innovation Survey.

40 Eg, Republic of Estonia (2022), Ministry of Industry and Trade of the Czech Republic (2023), South-East Regional Development Agency (for Romania).

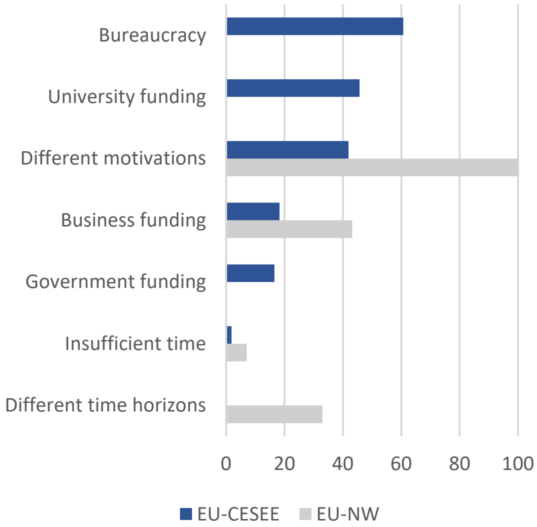
41 See the literature review of Galán-Muros and Plewa (2016).

42 Source: University-business cooperation in Europe: University Perspective. Country studies, available at University-Business Cooperation in Europe (ub-cooperation.eu). Data are from 2017 and aggregated using GDP weights.

43 Source: Eurostat Community Innovation Survey, 2020. Country-level results are aggregated using the number of firms in each country as weights.

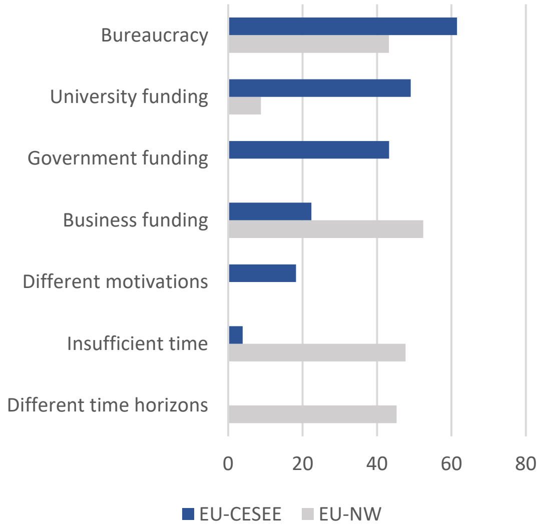
those in the CESEE region emphasising a shortage of funding, and those in the North and West differences in motivation and time horizon. Businesses in both regions agree that trust and shared objectives are the key success factors.

Figure 19a: Most frequently quoted factors that make collaboration unsuccessful according to academics that do not cooperate with businesses



Source: University-business cooperation in Europe, 2017. Note: Bars show the frequency with which these factors appear among countries' most often quoted factors.

Figure 19b: Most frequently quoted factors that make collaboration unsuccessful, by academics that cooperate with businesses



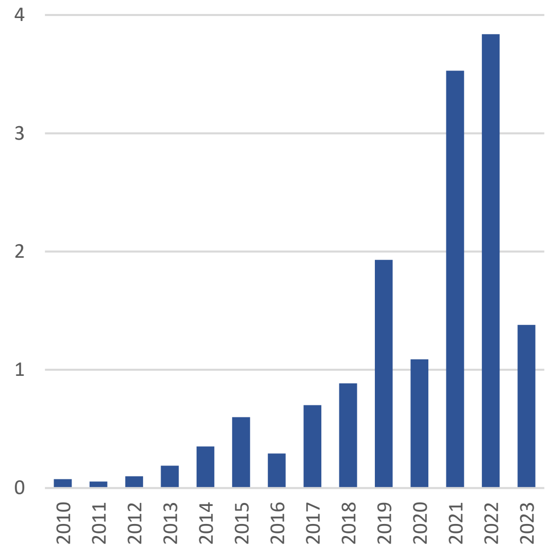
Source: University-business cooperation in Europe, 2017. Note: Bars show the frequency with which these factors appear among countries' most often quoted factors.

2.3.2 The availability of risk financing in private markets

Expanding the availability of risk capital is crucial for fostering innovation, especially among young firms. Payoffs from research and development tend to take time to materialise, if they materialise at all. This type of activity is therefore frequently financed out of internal resources. Firms that tap external finance to fund research and development are typically large (with a portfolio of products at different stages in their lifecycle) or have physical assets in place that can be used as collateral. Young and small innovative firms need to rely on patient, risk-friendly investors that provide, for example, venture capital or venture debt.

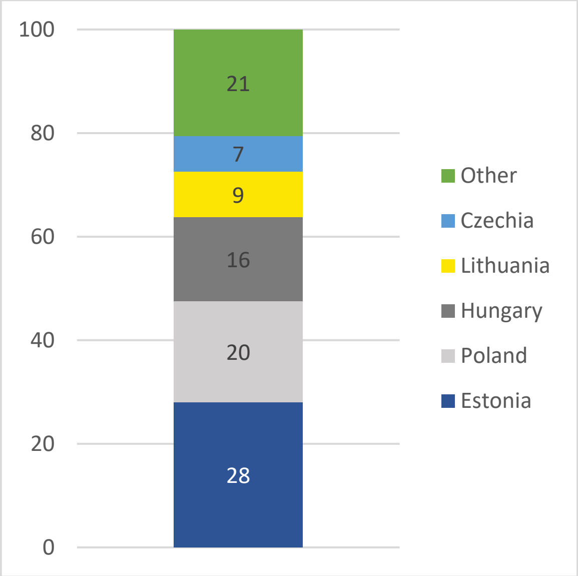
Venture capitalists (VC) provide funding to startups that have the potential for rapid growth but may not yet be profitable. These companies are typically perceived as too risky for banks. They often operate in industries like technology, biotechnology, and other sectors in which successful commercialisation of innovation requires disruptive investments and scale. The activity of venture capitalists serves as an indicator of the vitality of the startup environment. Despite slowdowns in 2016, 2020, and 2023, VC investments have grown significantly in CESEE countries over the past decade. They averaged nearly USD 3 billion annually in the last three years, compared to less than USD 1 billion per year in the previous decade (**Figure 20a**). The average size of VC deals in CESEE has also steadily increased, reaching around USD 2.3 million in the last three years, up from below USD 1 million on average during 2011-2020. However, the average size of VC deals in CESEE remains smaller than in North-West Europe and Southern Europe, where deal sizes averaged close to USD 6.5 million and USD 4 million, respectively, during 2021-2023.

Figure 20a: Venture capital investments in CESEE (USD bn)



Source: Authors' calculations based on Pitchbook data. Note: The data have not been reviewed by PitchBook analysts.

Figure 20b: Share of venture capital investment by country (% of CESEE total)



Source: Authors' calculations based on Pitchbook data. Note: Based on the total volumes between 2013-2023. Other countries include Croatia (6%), Bulgaria (4%), Romania, Slovakia and Latvia (3% each) and Slovenia (2%). The data have not been reviewed by PitchBook analysts.

The share of VC investments in CESEE countries as a share of EU doubled in recent years. However, relative to the rest of the EU, the region remains relatively marginal as a destination for venture capital: from 3% in 2013, CESEE VC investments reached only 5% of the EU total in 2022 and 2023. The region's share in the number of deals rose from 6.5% to 11% in 2023.

Only Poland and Estonia rank among the top ten promising European countries for VC investments in the latest European Investment Fund (EIF, 2023) survey. Estonia dominates CESEE VC investments, accounting for 28% of the region's total between 2013 and 2023, followed by Poland (20%) and Hungary (16%), see **Figure 20b**. Estonia also leads in VC investments per capita, ranking among the top EU countries, largely due to later-stage rounds for Bolt[44], which made up 45% of Estonia's total VC inflows in 2021 and 2022.

Several barriers hinder the growth of the VC market in the CESEE region, many of which are difficult to address through policy. One challenge is the chicken-and-egg problem that affects innovation ecosystems, favouring established VC markets. As a result, many innovators relocate to places like San Francisco, London, or other EU countries to secure funding. The VC industry in the CESEE region is relatively young, with a shorter history of successful exits compared to more mature markets like the UK and the US. Additionally, the small size of individual CESEE economies limits the growth potential of firms and the average investment size of VC funds and makes it more difficult for funds to diversify their investments within a single country. Investing in multiple countries within the region adds to a fund's legal and due diligence costs. Furthermore, venture capital funds in the CESEE region struggle to attract qualified staff (EIF, 2023), just as firms in the region more broadly.

[44] Bolt is a mobility company, offering ride-hailing but also food delivery, micro mobility (scooters, bikes) and carsharing services, which was founded in 2013 in Estonia. Bolt is currently having 150 million customers across countries. In recent years, the company received later stage VC rounds of EUR 120m in 2020, EUR 600m in 2021 and 628m in 2022.

3 Policy implications

Innovation benefits from many of the broad policies that support competitiveness, economic growth, and wellbeing. Improving the business environment to reduce regulatory and political uncertainty, strengthening economic and social infrastructure to attract people and firms, and raising the availability of finance through better integration of EU capital markets are policies that would very likely stimulate not only allocative efficiency but also innovation.

That said, there is also a case for policies specifically targeting innovation. Where production has focused on low-value-added activities, as in some sectors and regions in CESEE, innovation is hampered by its path dependency. Skills, finance and risk capital, and the presence of firms with similar specialisations are almost complementary ingredients to innovation. Their complementarity implies that innovation tends to happen where it has taken place in the past. Bringing innovation to a new region requires simultaneous investments in all areas. This is difficult and argues for innovation policies that support each one of these factors while it is falling behind the others. The following paragraphs mention a few of these policies, taking up the discussion on challenges in the preceding section.[45]

Foreign ownership: Foreign-owned firms appear more productive and innovative but this can largely be explained by their size and sector of activity. It is not necessarily a direct effect of foreign ownership. Only greenfield investments appear to have a clear productivity advantage over domestic firms. Firms that have undergone foreign takeovers seem more productive than their domestically owned peers, but in part because they were already more productive before the ownership change. In addition, the academic consensus is that spillovers from foreign to domestic firms appear quite small, and can be even negative (Gregori et al, 2024). Overall, therefore, our analysis provides support for encouraging greenfield investment but not for privileging foreign to domestic ownership more generally. However, if only due to the large presence of foreign owned firms, FDI is set to continue to provide a source of finance and innovative technologies to the region. Most CESEE countries put FDI on the same footing as the domestic industry in their industrial policies (eg, BG, EE, SI).[46] In addition, some CESEE countries provide incentives for domestically or foreign-owned firms that are targeted towards activities that would help functional diversification (eg, CZ, PL, RO, SK).

Skills: Improving skills for innovation, is, just as for skills more generally, a long-term endeavour. Policy can encourage the take-up of STEM subjects, in particular among women (eg, OECD, 2011, 2012, 2023), strengthen research outputs through systematic, independent evaluations (eg, OECD, 2010), and invest in professional development of academic staff to improve the quality of university education. The difficulty lies in setting the right incentives. For example, including publication counts into performance-based contracts can provide incentives to publish more but of lower quality.

Innovation thrives in a diverse and inclusive environment. Therefore, maintaining an open stance towards qualified immigration is essential. The recent immigration in the CESEE region from Ukraine presents a unique opportunity to bolster the talent pool (eg, Strzelecki et al., 2022, for Poland). Governments can make it easier for immigrants to put their skills to use through local language education, by providing support services to help families settle into the community, by increasing the number of foreign-language schools for expats, and by offering foreign-language programmes at universities (eg, Research and Innovation Authority of the Slovak Government Office, 2023).

Finally, enhancing cultural, health, and transport infrastructure can make the region more attractive to both returnees and potential new residents. These investments not only help in retaining talent but also in attracting new, skilled individuals who are crucial for fostering innovation.

Facilitating the transformation of ideas to products. We focused on two aspects: cooperation between universities and businesses, and the availability of risk finance. Regarding the former, survey results are quite clear: bureaucratic procedures are to be slimmed down, and more funding needs to be provided, to make these cooperations more successful in the East of the EU. The success factors are also interesting in this respect: aside from funding, the most important are prior relationships, shared goals, and trust. Prior relationships and trust

[45] See, for example, Zavarska et al (2024) for policy recommendations at the country level.

[46] Hungary sticks out in that it promotes domestic ownership in all but the manufacturing sector. See Zavarska et al (2023), p. 101.

might be fostered through networking events. Shared goals might require rewarding research cooperation more on the side of universities – that is, on ensuring that evaluation and professional success of academics not only depends on publications.

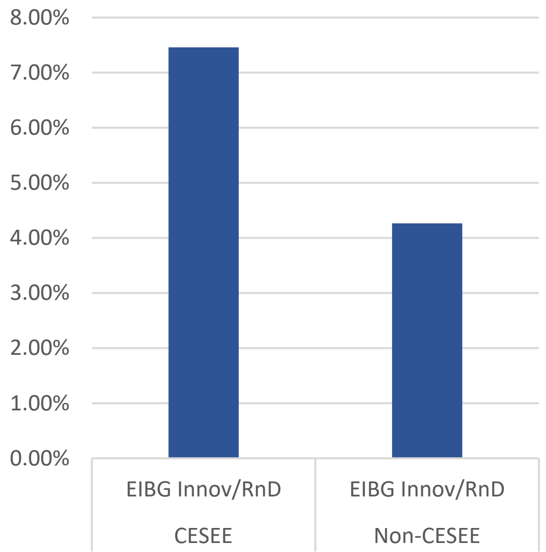
The lack of risk finance is an issue throughout the EU, but it is an even greater obstacle to investment for small companies in its Eastern countries. The key issues are small scale, poor liquidity, and few diversification opportunities. These problems are typical for small jurisdictions such as those in the CESEE region. Unfortunately, they are also complementary, such that they need to be tackled together. For example, liquid equity markets attract early-stage investors because they provide an opportunity to exit. When the market is small, fixed investment costs – such as those needed to understand the regulatory framework – can deter investors and prevent its growth. Development banks can play an important role in substituting for absent private markets and in supporting their development (see **Box 5** on the European Investment Bank's funding of innovation). In the medium term, a further integration of EU capital markets and predictable, transparent, and growth-friendly economic policies appear to be necessary.

Box 5: Financing Innovation in CESEE: the role of the European Investment Bank

Innovation is crucial for Europe's green and digital transitions, as well as for reducing dependence on strategic imports and technologies. It is also essential for preserving Europe's competitiveness and ensuring that jobs and wealth are created domestically. In this context, the European Investment Bank Group stands as one of the largest public supporters of innovation within the European Union, providing both long-term capital and advisory support.

Since 2000, the European Investment Bank Group – comprised of the European Investment Bank and the European Investment Fund - is one of the largest public supporters of innovation in the European Union: it has invested over EUR 270 billion in innovation and skills. In 2023 alone, the Group provided, in terms of signatures, overall EUR 19.7 billion to support innovation, digitalization, and human capital, out of a total of EUR 87.9 billion in new financing. This investment has led to tangible outcomes, such as 11.6 million new 5G service subscribers, improved healthcare for 130.6 million people, and financing for education facilities benefiting 1.2 million students. Through the European Investment Fund (EIF), the EIB Group is also the largest provider of venture capital in the European Union. The EIF has supported nearly half of the European unicorns—young companies valued at over USD 1 billion—that have emerged in the past 15 years.

Figure 21: EIB Group support for innovation (% of R&D expenditures 2022)



Source: Authors' calculations based on EIB Group. Note: Numbers are based on the overall projects' contribution to the Innovation, Digitalization and Human Capital (IDHC) policy area of the EIB Group, assessed based on eligibility criteria of at the project's appraisal. EU-wide projects are excluded from the calculations. The most recent R&D data from Eurostat is available for 2022. Source: authors' calculations based on EIB disbursement data and Eurostat.

The EIB Group's support for innovation manifests in several ways: development and commercialization of new products, processes, and business models; promotion of investment in R&D, education, upskilling, and training; and improving connectivity and access through broadband and mobile networks. It also fosters the adoption and diffusion of digital and other emerging technologies across various sectors, including climate change mitigation, digitalisation, and the space industry.

The innovation support in the CESEE countries appears to be more relevant, if compared to R&D expenditures, than in other regions across the EU. The share of EIB Group signatures to innovative projects represented around 7.5% of the region's total R&D expenditures in 2022. This proportion is substantially larger than the share of innovation signatures among other EU27 countries (Figure 21).

By co-financing innovative projects, the EIB encourages the participation of other investors from the private and public sector and stimulates the development of markets for risk capital. For example, Czechia and the European Investment Fund (EIF) in 2023 launched a EUR 55 million fund of funds, backed by the Recovery and Resilience Facility, to support investments in early-stage venture capital funds focused on strategic digital technologies.

The RRF Czech Fund of Funds, managed by the EIF, will invest in three venture capital funds: a pre-seed co-investment fund, a fintech fund focused on applications of distributed ledger technologies, and a technology transfer fund commercialising research from leading Czech universities in the field of artificial intelligence.[1] These funds aim is to attract funding from private investors by providing an initial amount of capital and by offering management and investment expertise. In its 2024 National Reform Programme, the Czech Republic announced its intention to create additional funds of funds with the EIB specifically for seed and pre-seed investments into spin-off companies of research organizations.[1]

Section II: Country Dashboards

This section presents dashboards for each EU-CESEE country, highlighting their unique innovation and growth performance. The goal is to show how these countries differ, following the earlier section that discussed their common features. Unlike the European Commission's EU Innovation Scoreboard or the detailed briefings by Zavarská et al. (2024), our dashboards include information on economic convergence, fastest-growing sectors, and indicators based on the EIB's Investment Survey. Unlike Zavarská et al. (2024), we do not propose country-specific economic policies.

The following paragraphs explain the indicators, their relevance, and provide examples from the CESEE countries.[47]

The top part of each dashboard offers background information on the country's growth performance. The first indicator is GDP per person in 2023, adjusted for purchasing power. Higher **GDP per person** is linked to higher wages, which affect FDI and influence migration. It also determines the availability of government resources for policies, including innovation support, and serves as a proxy for wealth, influencing investors' risk aversion and their willingness to fund early-stage companies. In 2023, GDP per person ranged from 24,155 euros in Bulgaria to 34,383 euros in Slovenia, with Slovenia and the Czech Republic nearing the EU average of 37,780 euros.

The second indicator, average annual **growth relative to the EU average** during 2015-23, shows the country's progress toward economic convergence. This period was chosen to include relevant trends while accounting for the pandemic and the Ukraine-war-induced energy shock. All CESEE countries outpaced the EU average during this time, with growth ranging from +0.3 percentage points per year in Romania and Latvia to +1.5 percentage points in Slovenia.

The third indicator measures the **share of foreign-owned firms in GDP** within the business economy in 2021, reflecting the importance of foreign investment. This share varies from 27% in Slovenia to 49% in Slovakia.

The three indicators on the right highlight the most research-intensive sectors, contrasting them with the fastest-growing sectors and those contributing the most to GDP growth. **R&D intensity** is calculated by comparing firms' R&D expenditure to their sector's value added. We aimed for a detailed economic overview using a consistent sector classification, balancing granularity with data availability. Consequently, we used 2-digit NACE codes for most manufacturing and tech-intensive services, while larger aggregates were applied to other sectors (see annex for details). Since some sectors are much larger than others, we complemented the fastest-growing sectors with those making the largest contributions to GDP growth.

ICT services stand out for their high research intensity and rapid growth from 2017 to 2021. Despite contributing only 2-3% of value added in many countries, they were among the sectors with the largest contribution to GDP growth in Bulgaria, Croatia, the Czech Republic, Hungary, Latvia, Poland, and Romania. In contrast, less research-intensive sectors like trade and construction drove growth in other countries.

The lower section of each dashboard highlights three key areas directly related to innovation: the institutional and policy environment, the availability of skills and knowledge, and innovation outcomes. Each indicator shows the country's score, the range of outcomes in the CESEE region (noted by > and <), and the EU average, represented by a blue dot.

The institutional and funding environment is assessed through the business environment, government spending on education, the share of business R&D funded by the government, and the size of venture capital markets. The **business environment** indicator is an average of 24 metrics related to political effectiveness, private enterprise policies, and competition and tax regimes, compiled by the Economist Intelligence Unit. Despite only reporting their average, we retain over 90% of the variation within the CESEE region because the components are highly correlated across countries. A higher score indicates a better business environment, with Croatia scoring the lowest among CEE countries and Estonia performing above the EU average.

In addition to this broad measure, we include two indicators specifically related to innovation: **education spending**, which underpins long-term innovation, and the **share of business R&D funded by the government**. Estonia leads in education spending, while Hungary tops in government-funded business R&D. The outcomes

[47] Due to limited data availability, the indicators do not all refer to the same years.

are reflected in **PISA scores for mathematics and science**, and in business sector R&D expenditures. PISA scores correlate strongly with education spending, with a correlation exceeding 90%. **Business R&D spending** also correlates with government funding, albeit at a lower 50%, suggesting that business R&D is given more support where so far it has been low, or possible inefficiencies in support allocation or design. Slovenia's business sector spends the most on R&D relative to GDP, while Romania and Latvia spend the least.

Risk capital availability, represented by total **venture capital investments** from 2013 to 2023, is also included in this section. Instead of using USD per capita, we show levels to highlight market size. As expected, venture capital markets are larger in wealthier countries, with Estonia outpacing Slovenia by nearly thirty times during this period.

The middle section focuses on the availability of skills and knowledge for innovation. Beyond PISA scores and business R&D expenditures, we present the **share of STEM graduates** in 2021 – the share of those with university-level science, technical, engineering, or maths qualifications – and **firms cooperating with universities**, from 2020. Countries with higher university cooperation also tend to have strong collaborations with research institutions, with an 85% correlation. Slovenia and Estonia score highest in this area, while Bulgaria ranks lowest in cooperation, PISA scores, and STEM graduates (only ahead of Hungary).

The right section displays indicators of innovation output, based on the EIB's Investment Survey. The first indicator measures the **average number of advanced technologies** that firms use. This is based on interviews conducted in 2022 and 2023 in which firms indicated whether they use specific technologies in their operations or base their business on them. [48] The second indicator, the **share of firms introducing new products or services** to the country or the world during the preceding financial year, averages responses from 2015 to 2022. The final indicator assesses the impact of innovation on economic growth and welfare, measured by **GDP growth due to increased total factor productivity**, which reflects growth not attributable to employment or capital stock increases.

[48] The list of technologies about whose usage firms were interviewed differed depending on the sector in which the firm is active: construction (C), infrastructure (I), manufacturing (M), and services (S). These technologies are: 3D printing (C, I, M), Augmented/virtual reality (C, S), Automation via advanced robotics (M), Big Data analytics and artificial intelligence (I, M, S), Drones (C), Digital platform technologies (I, S), and The internet of things (all).

Bulgaria

GDP (EUR p.P., 2023)	24,155	**Highest R&D intensity**	Pharmaceutics (C21); ICT manufacturing (C26); ICT services (J62-J63)
Growth vs EU av. (pp p.a., 2015-23)	0.5	**Fastest growing**	ICT services (J62-J63); Finance (K); ICT manufacturing (C26)
GDP contr. by foreign firms (%, 2021)	29	**Largest growth contribution**	Trade (G); Finance (K); ICT services (J62-J63)

Institutions and funding

Business environment (index)

3.1

Spending on education (% of GDP)

3.9

Share of bus. R&D financed by the government (%)

(no data)

Venture capital (2013-23, USD mn)

606.8

Skills and knowledge

Skills: PISA score, maths & science (EU=100)

40

Skills: STEM graduates (% of pop)

3.2

University-business collaboration (% of firms)

4

R&D expenditures of the business sector (% of GDP)

0.5

Innovation outcomes

Number of advanced technologies in use

1.0

Firms with innovations new to the country/world (% of firms, annually)

7

GDP growth due to higher productivity, 2010-19 (% p.a.)

4.3

▶ ◀ Range CEE countries ● EU average See Annex for legend.

Croatia

GDP (EUR p.P., 2023)	25,965	**Highest R&D intensity**	Vehicles (C29); ICT services (J62-J63); Other transport equipment (C30)
Growth vs EU av. (pp p.a., 2015-23)	0.8	**Fastest growing**	Vehicles (C29); Non-metallic minerals (C23); ICT services (J62-J63)
GDP contr. by foreign firms (%, 2021)	32	**Largest growth contribution**	Trade (G); Construction (F); ICT services (J62-J63)

Institutions and funding

Business environment (index)

3.0

Spending on education (% of GDP)

4.8

Share of bus. R&D financed by the government (%)

(no data)

Venture capital (2013-23, USD mn)

1226.7

Skills and knowledge

Skills: PISA score, maths & science (EU=100)

94

Skills: STEM graduates (% of pop)

5.2

University-business collaboration (% of firms)

8

R&D expenditures of the business sector (% of GDP)

0.8

Innovation outcomes

Number of advanced technologies in use

1.2

Firms with innovations new to the country/world (% of firms, annually)

9

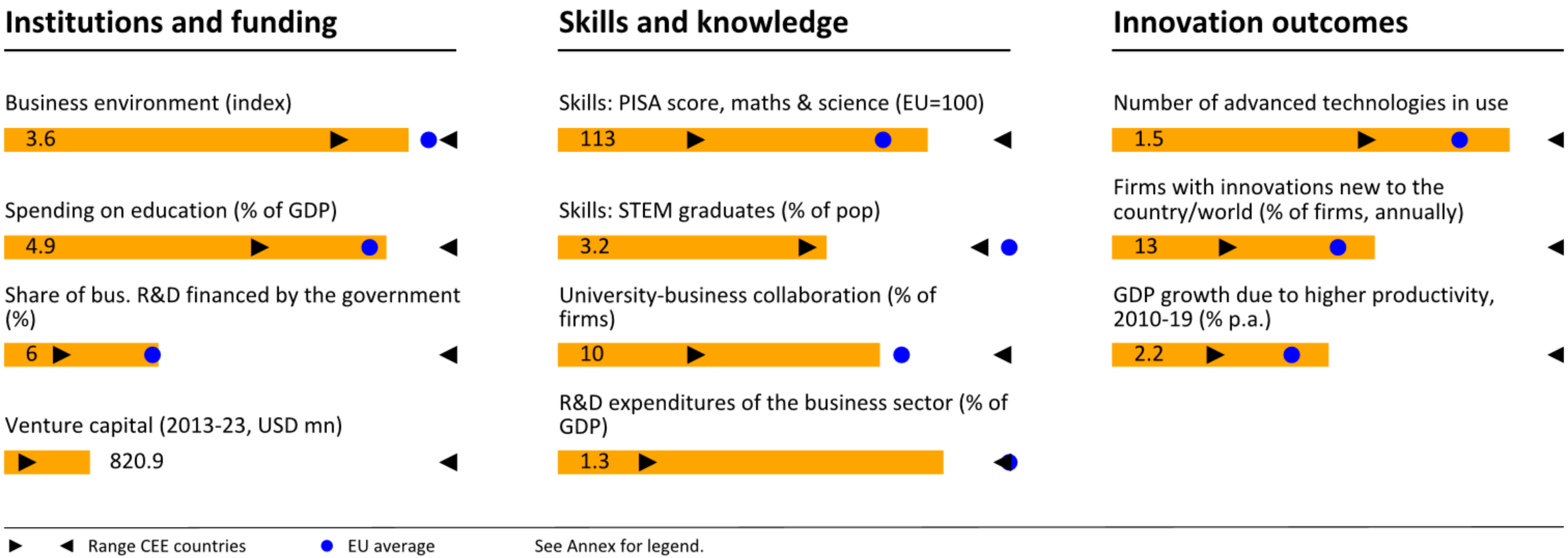
GDP growth due to higher productivity, 2010-19 (% p.a.)

1.0

▶ ◀ Range CEE countries ● EU average See Annex for legend.

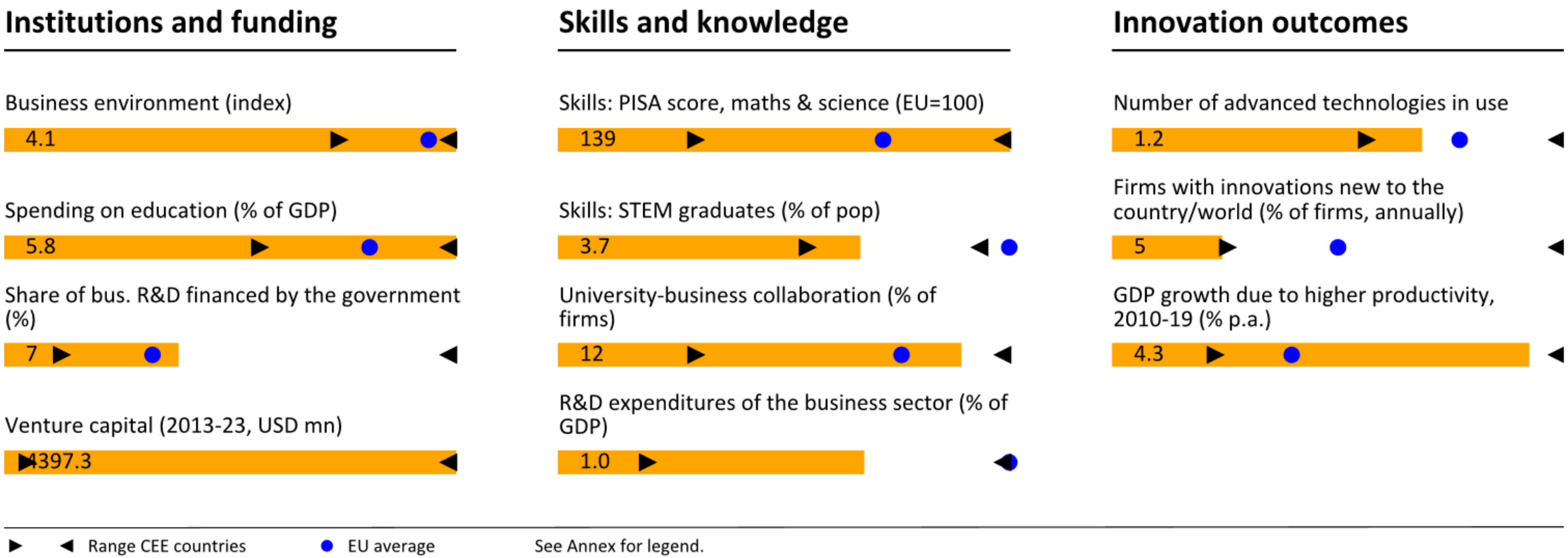
Czechia

GDP (EUR p.P., 2023)	34,910	**Highest R&D intensity**	Other transport equipment (C30); ICT services (J62-J63); Pharmaceutics (C21)
Growth vs EU av. (pp p.a., 2015-23)	1.3	**Fastest growing**	ICT services (J62-J63); Telecom services (J61); Finance (K)
GDP contr. by foreign firms (%, 2021)	44	**Largest growth contribution**	ICT services (J62-J63); Trade (G); Finance (K)



Estonia

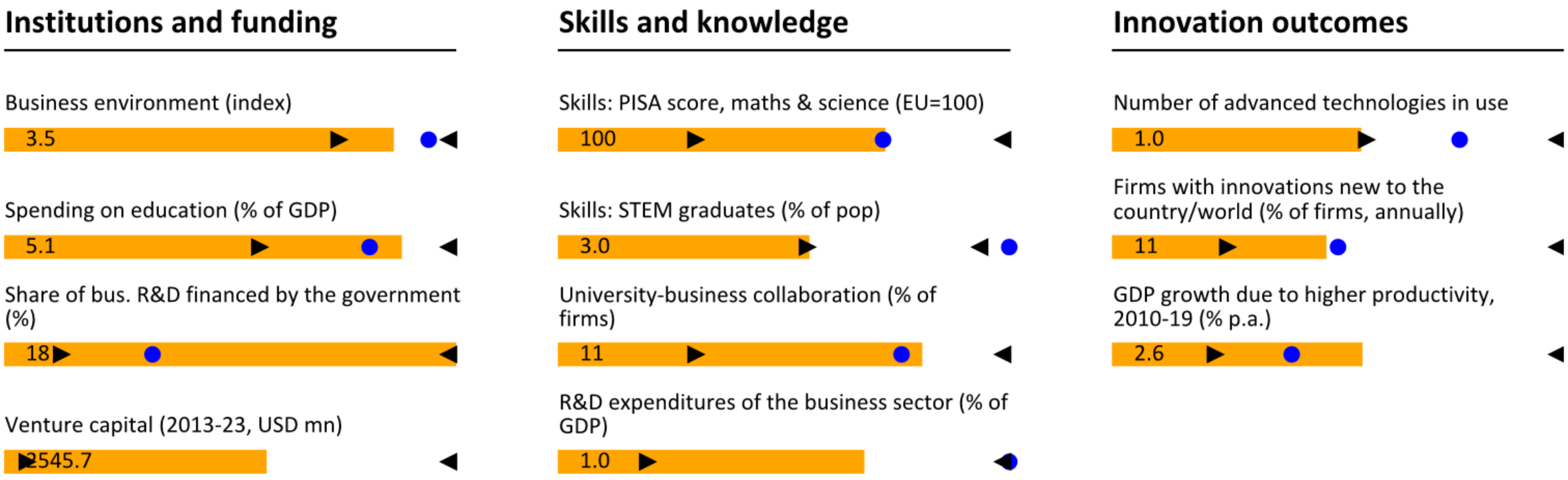
GDP (EUR p.P., 2023)	30,656	**Highest R&D intensity**	Chemicals (C20); ICT manufacturing (C26); Pharmaceutics (C21)
Growth vs EU av. (pp p.a., 2015-23)	1.0	**Fastest growing**	Telecom services (J61); Chemicals (C20); Basic metals (C24)
GDP contr. by foreign firms (%, 2021)	38	**Largest growth contribution**	Construction (F); Transportation (H); ICT services (J62-J63)



See Annex for legend.

Hungary

GDP (EUR p.P., 2023)	28,740	**Highest R&D intensity**	Pharmaceutics (C21); Vehicles (C29); Other transport equipment (C30)
Growth vs EU av. (pp p.a., 2015-23)	1.0	**Fastest growing**	Mining & quarrying (B); Electrical equipment (C27); ICT services (J62-J63)
GDP contr. by foreign firms (%, 2021)	42	**Largest growth contribution**	Trade (G); ICT services (J62-J63); Construction (F)



▶ ◀ Range CEE countries ● EU average See Annex for legend.

Latvia

GDP (EUR p.P., 2023)	26,591	**Highest R&D intensity**	Telecom services (J61); Electrical equipment (C27); Pharmaceutics (C21)
Growth vs EU av. (pp p.a., 2015-23)	0.3	**Fastest growing**	Basic metals (C24); Chemicals (C20); Electrical equipment (C27)
GDP contr. by foreign firms (%, 2021)	35	**Largest growth contribution**	Trade (G); ICT services (J62-J63); Agriculture (A)

Institutions and funding

Business environment (index)

3.7

Spending on education (% of GDP)

5.3

Share of bus. R&D financed by the government (%)

2

Venture capital (2013-23, USD mn)

352.2

Skills and knowledge

Skills: PISA score, maths & science (EU=100)

110

Skills: STEM graduates (% of pop)

3.0

University-business collaboration (% of firms)

9

R&D expenditures of the business sector (% of GDP)

0.3

Innovation outcomes

Number of advanced technologies in use

1.1

Firms with innovations new to the country/world (% of firms, annually)

22

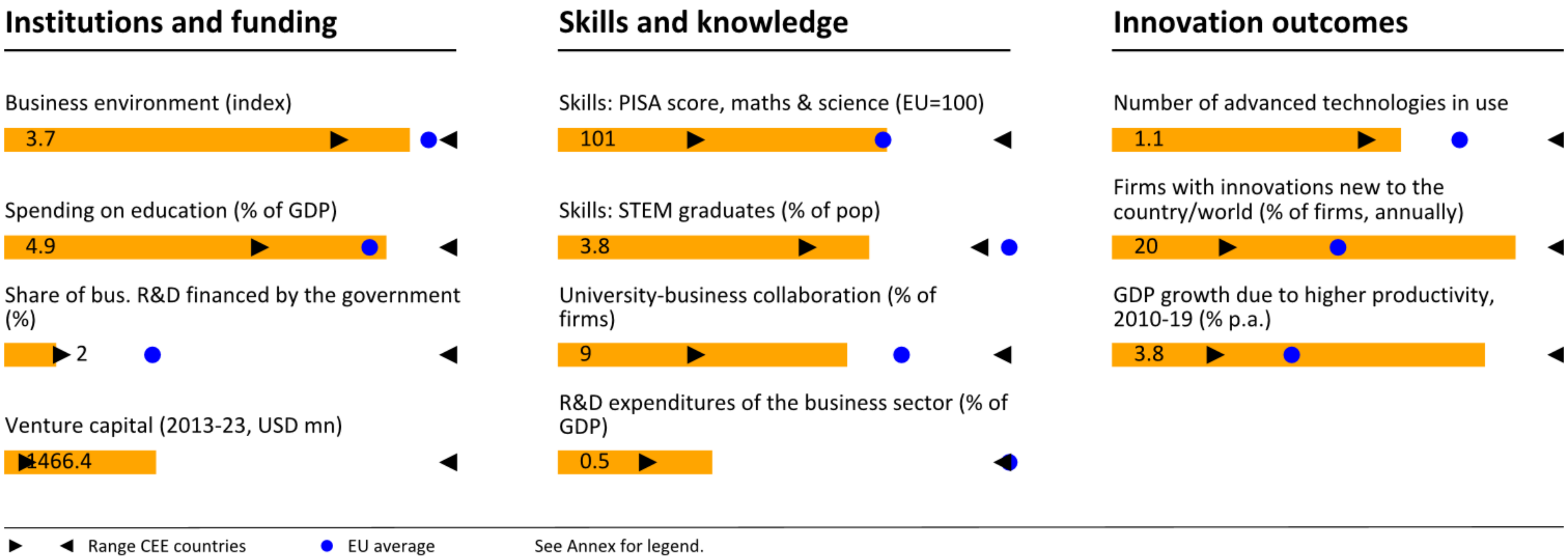
GDP growth due to higher productivity, 2010-19 (% p.a.)

4.7

▶ ◀ Range CEE countries ● EU average See Annex for legend.

Lithuania

GDP (EUR p.P., 2023)	32,454	**Highest R&D intensity**	ICT manufacturing (C26); Electrical equipment (C27); ICT services (J62-J63)
Growth vs EU av. (pp p.a., 2015-23)	0.5	**Fastest growing**	Other transport equipment (C30); Chemicals (C20); ICT manufacturing (C26)
GDP contr. by foreign firms (%, 2021)	30	**Largest growth contribution**	Trade (G); Transportation (H); Construction (F)



See Annex for legend.

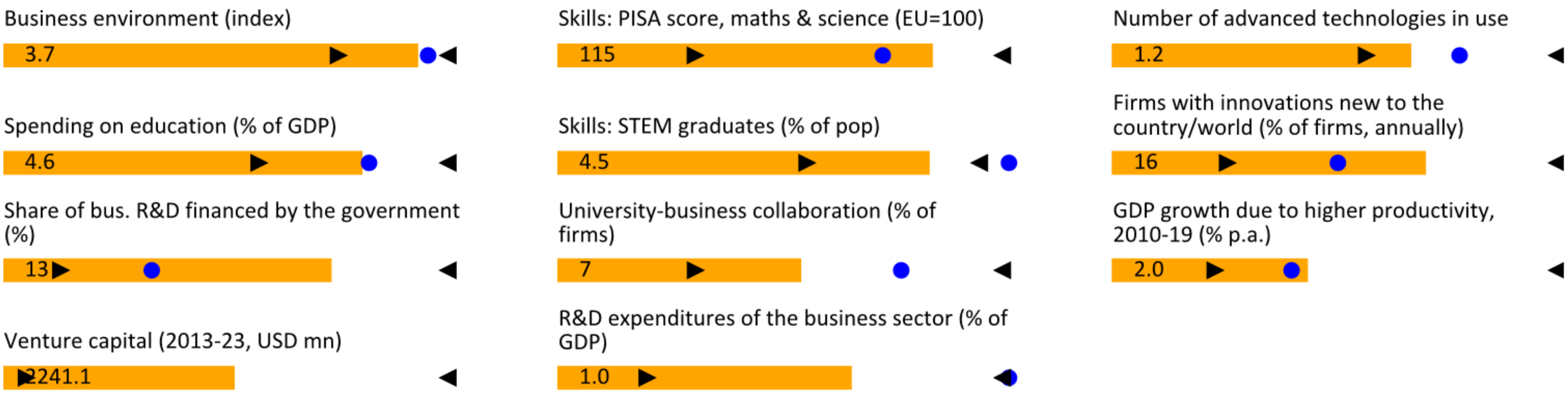
Poland

GDP (EUR p.P., 2023)	30,114	**Highest R&D intensity**	ICT manufacturing (C26); ICT services (J62-J63); Pharmaceutics (C21)
Growth vs EU av. (pp p.a., 2015-23)	1.0	**Fastest growing**	ICT services (J62-J63); Electrical equipment (C27); Health & social work (Q)
GDP contr. by foreign firms (%, 2021)	40	**Largest growth contribution**	Trade (G); ICT services (J62-J63); Health & social work (Q)

Institutions and funding

Skills and knowledge

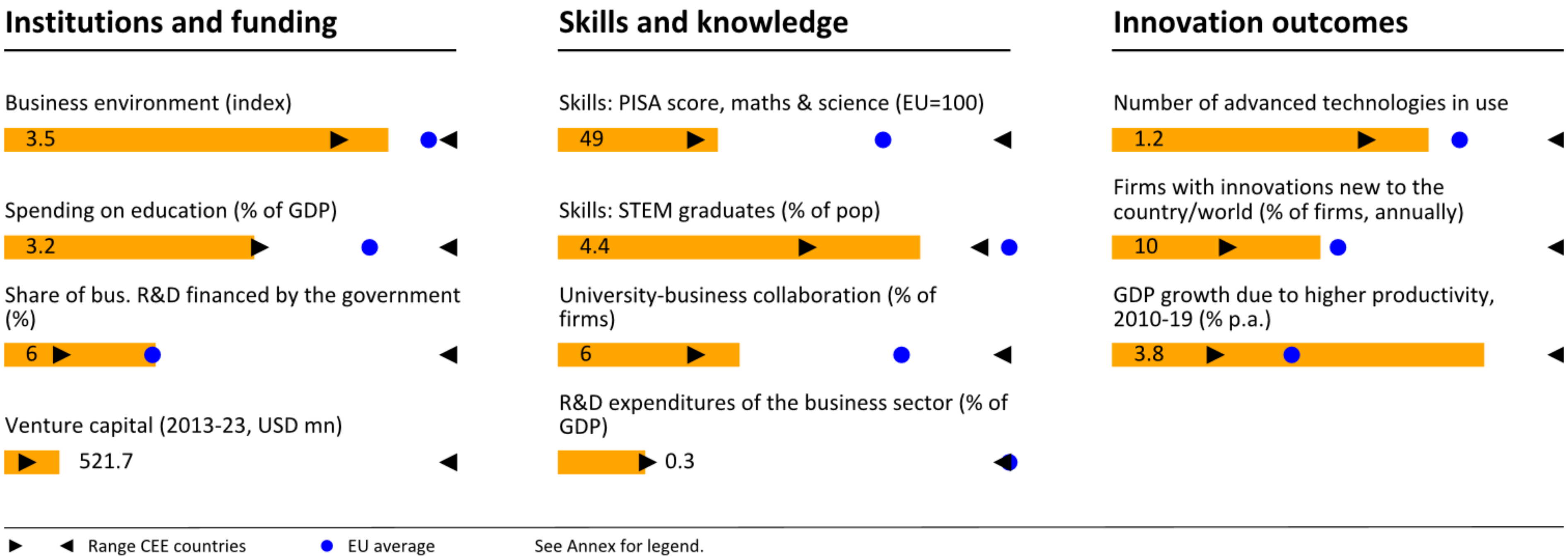
Innovation outcomes



▶ ◀ Range CEE countries ● EU average See Annex for legend.

Romania

GDP (EUR p.P., 2023)	29,970	**Highest R&D intensity**	Vehicles (C29); Pharmaceutics (C21); Media (J58-J60)
Growth vs EU av. (pp p.a., 2015-23)	0.3	**Fastest growing**	ICT services (J62-J63); Machinery & equipment (C28); Electrical equipment (C27)
GDP contr. by foreign firms (%, 2021)	42	**Largest growth contribution**	Trade (G); ICT services (J62-J63); Health & social work (Q)



Slovakia

GDP (EUR p.P., 2023)	27,413	**Highest R&D intensity**	ICT services (J62-J63); Other transport equipment (C30); Pharmaceutics (C21)
Growth vs EU av. (pp p.a., 2015-23)	0.6	**Fastest growing**	Pharmaceutics (C21); Food & beverages (C10-C12); Machinery & equipment (C28)
GDP contr. by foreign firms (%, 2021)	49	**Largest growth contribution**	Public admin, defense & education (O-P); Health & social work (Q); ICT services (J62-J63)

Institutions and funding

Business environment (index)

3.6

Spending on education (% of GDP)

4.5

Share of bus. R&D financed by the government (%)

5

Venture capital (2013-23, USD mn)

449.0

Skills and knowledge

Skills: PISA score, maths & science (EU=100)

84

Skills: STEM graduates (% of pop)

3.0

University-business collaboration (% of firms)

7

R&D expenditures of the business sector (% of GDP)

0.6

Innovation outcomes

Number of advanced technologies in use

1.3

Firms with innovations new to the country/world (% of firms, annually)

11

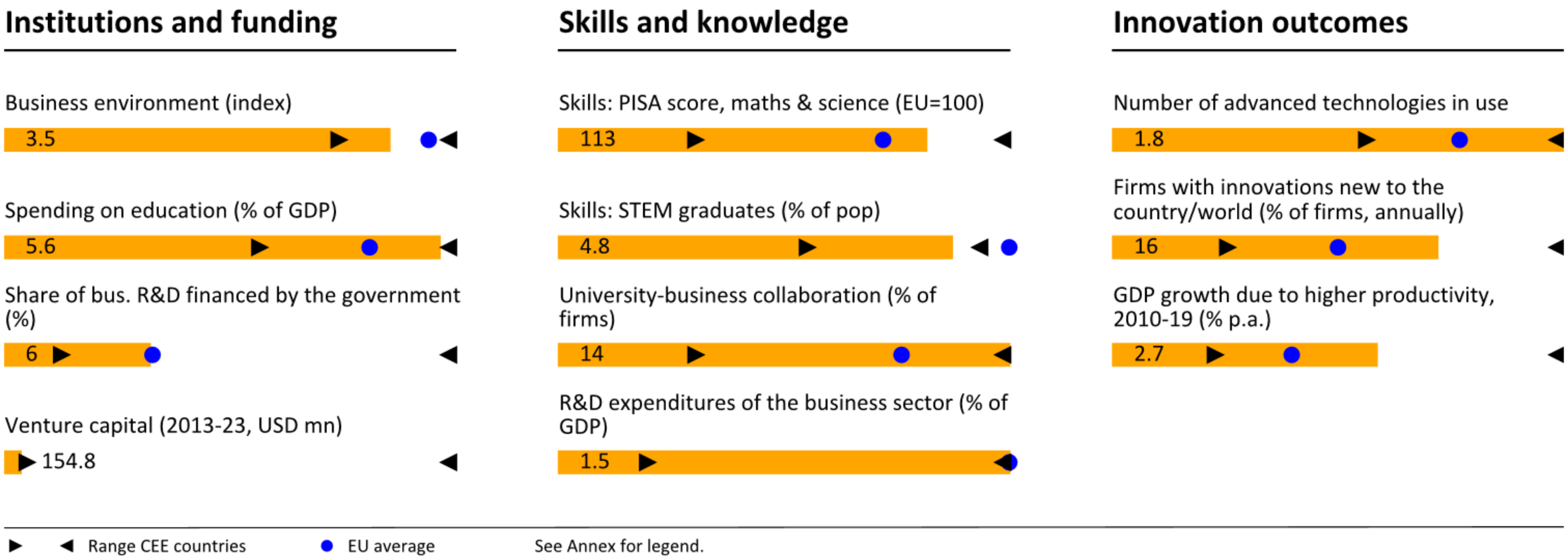
GDP growth due to higher productivity, 2010-19 (% p.a.)

2.1

▶ ◀ Range CEE countries ● EU average See Annex for legend.

Slovenia

GDP (EUR p.P., 2023)	34,383	**Highest R&D intensity**	Pharmaceutics (C21); ICT manufacturing (C26); Other transport equipment (C30)
Growth vs EU av. (pp p.a., 2015-23)	1.5	**Fastest growing**	ICT services (J62-J63); ICT manufacturing (C26); Other transport equipment (C30)
GDP contr. by foreign firms (%, 2021)	27	**Largest growth contribution**	Construction (F); Trade (G); Finance (K)



Annex: Construction of the dashboard indicators

GDP per capita

Source: Eurostat, Statistics | Eurostat (europa.eu), 2023.

Unit: EUR PPP

Value added of foreign-owned firms

Source: Eurostat, Statistics | Eurostat (europa.eu), 2021

Unit: % of total value added

Computations: computed the ratio between non-domestic firms' value added and total value added, for NACE aggregate "B-S_X_O_S94".

Sectors with highest R&D spending relative to value added

Source: Eurostat, Statistics | Eurostat (europa.eu), 2021

Unit: % of value added

Computations: computed the share of each 2-digit sector's R&D spending (in million Euro) relative to its value added.

Sectors considered:

NACE	Name
A	Agriculture, forestry and fishing
B	Mining and quarrying
C10-C12	Manufacture of food products; beverages and tobacco products
C13-C15	Manufacture of textiles, wearing apparel, leather and related products
C16-C18	Manufacture of wood, paper, printing and reproduction
C20	Manufacture of chemicals and chemical products
C21	Manufacture of basic pharmaceutical products and pharmaceutical preparations
C22	Manufacture of rubber and plastic products
C23	Manufacture of other non-metallic mineral products
C24	Manufacture of basic metals
C25	Manufacture of fabricated metal products, except machinery and equipment
C26	Manufacture of computer, electronic and optical products
C27	Manufacture of electrical equipment
C28	Manufacture of machinery and equipment n.e.c.
C29	Manufacture of motor vehicles, trailers and semi-trailers
C30	Manufacture of other transport equipment
C31-C32	Manufacture of furniture; other manufacturing
C33	Repair and installation of machinery and equipment
D-E	Electricity, gas, steam and air conditioning supply; water supply; sewerage, waste management and remediation activities
F	Construction
G	Wholesale and retail trade; repair of motor vehicles and motorcycles
H	Transportation and storage
I	Accommodation and food service activities

J58-J60	Publishing, motion picture, video, television programme production; sound recording, programming and broadcasting activities
J61	Telecommunications
J62-J63	Computer programming, consultancy, and information service activities
K	Financial and insurance activities
N	Administrative and support service activities
O-P	Public administration and defence; compulsory social security and education
Q	Human health and social work activities
R	Arts, entertainment and recreation
S-U	Other service activities; activities of households as employers and extraterritorial organisations and bodies

Missing observations:

NACE	**Countries**
B	LV, SK
C21	LT
C24	EE, LV
C30	LV
C31-C32	LV
D-E	SK
I	SI
J61	PL
Q	SI
R	BG, PL, SI
S-U	BG, EE, HR, HU, LT, LV

Fastest growing sectors

Source: Eurostat, Statistics | Eurostat (europa.eu), 2017-2021.

Unit: % growth

Computations: computed value added growth using Chain linked volumes, index 2015=100.

Missing observations:

NACE	Countries
C21	LT
S-U	All countries

Sectors with largest contribution to growth

Source: Eurostat, Statistics | Eurostat (europa.eu), 2017-2021.

Unit: % contribution to growth

Computations: using Chain linked volumes, index 2015=100, computed each sector's growth in value added, divided it by total economy's growth, and weighted the result by each sector's share of GDP, based on sectoral composition of GDP in 2017.

Missing observations:

NACE	Countries
C21	LT
S-U	All countries

Business environment

Source: Economist Intelligence Unit (2023).

Computation: Simple average of the following subindicators, each of whom is scored on a scale of 1-5 (Political effectiveness: 1-10): Bureaucracy, Consistency and fairness of the tax system, Corporate tax burden, Corruption, Crime, Degree of private property rights protection, Degree to which fiscal regime encourages new investment, Distortions arising from lobbying by special interest groups, Efficiency of legal system, Employers' social security contributions, Freedom of existing businesses to compete, Government regulation, Institutional effectiveness, Policy orientation, Political effectiveness, Price controls, Promotion of competition and curbing of unfair business practices, Protection of intellectual property, Protection of minority shareholders, State control/ownership, Tax complexity, Top marginal personal income tax rate, Transparency and fairness of the political system, Value-added tax.

Spending on education

Source: Eurostat, Statistics | Eurostat (europa.eu), 2022.

Unit : % of GDP.

Government support for business R&D

Source: Eurostat, Statistics | Eurostat (europa.eu), 2021.

Unit: % of all funds for R&D.

Computations: computed the share of government funds for business R&D over the total of business R&D funds.

PISA scores, mathematics and science

Source: OECD, PISA - Select Criteria (oecd.org), 2023 and Eurostat.

Computation: Simple average of mean scores for mathematics and sciences, aggregated using the country-level population of 15-year old pupils (Eurostat).

Share of university graduates in STEM subjects

Source: Eurostat, Statistics | Eurostat (europa.eu), 2022.

Unit: % of labour force aged 15-64.

Firms cooperating with universities

Source: Eurostat, Link: Statistics | Eurostat (europa.eu), 2020.

Unit: % of all firms

R&D expenditure in the business sector

Source: Eurostat, Statistics | Eurostat (europa.eu), 2022

Unit: % of GDP

References

Association of Business Service Leaders in Romania (ABSL) (2023), *Business services sector in Romania*.

Barišić, A., M. Ghodsi, A. Sabouniha, and R. Stehrer (2024), *The Factors Driving Migration Intentions and Destination Preferences in Central, East and Southeast European Countries*, wiiw Working Paper No. 247, May.

Bijsterbosch, M. and M. Kolasa (2010), *FDI and productivity convergence in Central and Eastern Europe: An industry-level investigation*, Review of World Economics, 145, 689-712.

Boschma, R. (2017), *Relatedness as driver of regional diversification: A research agenda*, Regional Studies, 51(3), 351-364.

Boschma, R. and Iammarino, S. (2009), *Related variety, trade linkages, and regional growth in Italy*, Economic Geography, 85(3), 289-311.

Bygnes, S. and A. Flipo (2017), *Political motivations for intra-European migration*, Acta Sociologica, 60(3), 199-212.

Crescenzi, R. and R. Ganau (2024), *Inward FDI and regional performance in Europe after the Great Recession*, Cambridge Journal of Regions, Economy and Society.

Crescenzi, R., A. Dyèvre, and F. Neffke (2022), *Innovation Catalysts: How Multinationals Reshape the Global Geography of Innovation*, Economic Geography, 98(3), 199-227.

Damijan, J. P., M. Rojec, B. Majcen, and M. Knell (2013), *Impact of firm heterogeneity on direct and spillover effects of FDI: Micro-evidence from ten transition countries*, Journal of Comparative Economics, 41(3), 895-922.

Damijan, J. P., M. S. Knell, B. Majcen, and M. Rojec (2003), *Technology transfer through FDI in top-10 transition countries: How important are direct effects, horizontal and vertical spillovers?*, Horizontal and Vertical Spillovers.

Draghi, M. (2024), *An Industrial Strategy for Europe*, Acceptance Speech at the Monastery of San Jeronimo de Yuste, June 14.

Economist Intelligence Unit (EUI), *Business environment ranking methodology*, Available at link.

Eichengreen, B., D. Park, and K. Shin (2013), *Growth Slowdowns Redux: New Evidence on the Middle-Income Trap*, NBER Working Paper No. 18673.

EIF (2023), *VC Survey 2023: Market sentiment, scale-up financing and human capital*, Available at link.

Elekes, Z., R. Boschma, and B. Lengyel (2019), *Foreign-owned firms as agents of structural change in regions*, Regional Studies.

European Patent Office (EPO) (2017), *Patents and the Fourth Industrial Revolution: The inventions behind digital transformation*, Munich, European Patent Office.

Feldman, M. P. and D. F. Kogler (2010), *Stylized facts in the geography of innovation*, In *Handbook of the Economics of Innovation*, 1, 381-410.

Galán-Muros, V. and C. Plewa (2016), *What drives and inhibits university-business cooperation in Europe? A comprehensive assessment*, R&D Management, 46(2), 369-382.

Galan-Muros, V. and T. Davey (2019), *The UBC ecosystem: Putting together a comprehensive framework for university-business cooperation*, Journal of Technology Transfer, 44, 1311-1346.

Gregori, W. D., M. Martinez-Cillero, and M. Nardo (2024), *The effects of cross-border acquisitions on firms' productivity in the EU*, The World Economy, 47, 9-36.

Guadagno, F., D. Hanzl-Weiss, and R. Stehrer (2024), *Where are the Growth Potentials in CESEE? An Illustration of Sectors and Products Using the Product Space*, wiiw Forecast Report No. 47, July.

Győrffy, D. (2022), *The middle-income trap in Central and Eastern Europe in the 2010s: Institutions and divergent growth models*, Comparative European Politics, 20(1), 90-113.

Hall, B. H. (2011), *Using productivity growth as an innovation indicator*, University of Maastricht and UC Berkeley Report for the High Level Panel on Measuring Innovation, DG Research, European Commission, October.

Haščič, I. and M. Migotto (2015), *Measuring environmental innovation using patent data*, OECD Environment Working Papers No. 89.

Hidalgo, C. A., B. Klinger, A. L. Barabási, and R. Hausmann (2007), *The product space conditions the development of nations*, Science, 317(5837), 482-487.

Jaffe, A. B., M. Trajtenberg, and R. Henderson (1993), *Geographic localization of knowledge spillovers as evidenced by patent citations*, Quarterly Journal of Economics, 108(3), 577-598.

Javorcik, B. S. (2004), *Does foreign direct investment increase the productivity of domestic firms? In search of spillovers through backward linkages*, American Economic Review, 94(3), 605-627.

Jovanovic, B. and D. Hanzl-Weiss (2022), *Economic and Social Impacts of FDI in Central, East, and Southeast Europe*, wiiw Research Report No. 464.

Kogler, D. F., D. L. Rigby, and I. Tucker (2015), *Mapping knowledge space and technological relatedness in US cities*, In *Global and Regional Dynamics in Knowledge Flows and Innovation*, Routledge, pp. 58-75.

Kogler, D. F., J. Essletzbichler, and D. L. Rigby (2017), *The evolution of specialization in the EU15 knowledge space*, Journal of Economic Geography, 17(2), 345-373.

Li, C. Y. and C. T. Hsieh (2009), *The impact of knowledge stickiness on knowledge transfer implementation, internalization, and satisfaction for multinational corporations*, International Journal of Information Management, 29(6), 425-435.

Lipsey, E. R. (2006), *Measuring the impacts of FDI in Central and Eastern Europe*, In *Foreign Direct Investment in Europe*, pp. 37.

Ministry of Industry and Trade of the Czech Republic (2023), *National Research and Innovation Strategy for Smart Specialisation of the Czech Republic 2021–2027*.

Neffke, F., M. Hartog, R. Boschma, and M. Henning (2018), *Agents of structural change: The role of firms and entrepreneurs in regional diversification*, Economic Geography, 94(1), 23-48.

Neffke, F., M. Henning, and R. Boschma (2011), *How do regions diversify over time? Industry relatedness and the development of new growth paths in regions*, Economic Geography, 87(3), 237-265.

OECD (2010), *Performance-based Funding for Public Research in Tertiary Education Institutions: Workshop Proceedings*, Paris.

OECD (2011), *Skills for Innovation and Research*, Paris.

OECD (2012), *Encouraging student interest in Science and Technology Studies*, Paris.

OECD (2015), *Frascati Manual 2015*, Paris.

OECD (2023), *Gender, Education and Skills*, Paris.

Parey, M. and F. Waldinger (2011), *Studying abroad and the effect on international labour market mobility: Evidence from the introduction of ERASMUS*, Economic Journal, 121(551), 194-222.

Republic of Estonia (2022), *Estonian Research and Development, Innovation and Entrepreneurship Strategy 2021–2035*.

Research and Innovation Authority at the Slovak Government Office (VAIA) (2023), *Magnet for Talent*. Available at link.

Schnabel, I. (2024), *From Laggards to Leader? Closing the Euro Area's Technological Gap*, Inaugural lecture of the Wicksell Prize, Florence, June 6.

Slačík, T. (2024), *Will the CESEE region stay in the fast lane or (where) does its growth model need polishing?*, wiiw Forecast Report No. 475, September.

Šmelc, P. (2023), *Spillover effects from multinational enterprises: A literature review*, World Economy and Policy (WEP), Prague University of Economics and Business, Faculty of International Relations, Center for European Studies, 2(2), 1-12.

South-East Regional Development Agency, *The Regional Smart Specialization Strategy (RIS3) for the South-East Region 2021-2027*, Romania.

Stojčić, N. (2021), *Collaborative innovation in emerging innovation systems: Evidence from Central and Eastern Europe*, The Journal of Technology Transfer, 46(2), 531-562.

Stöllinger, R. (2019), *Functional specialisation in global value chains and the middle-income trap*, wiiw Research Report No. 441, October.

Stöllinger, R. (2021), *Testing the smile curve: Functional specialisation in GVCs and value creation*, Structural Change and Economic Dynamics, 56, 93-116.

Stöllinger, R. and Z. Zavarská (2023), *No Sign of Functional Upgrading in EU-CESEE Countries So Far*, Monthly Report 11/2022 - FDI in Central, East and Southeast Europe (wiiw.ac.at), 17-22.

Strzelecki, P., J. Growiec, and R. Wyszynski (2022), *The contribution of immigration from Ukraine to economic growth in Poland*, Review of World Economics, 158, 365-399.

Tverdostup, M. (2024), *Shifting patterns of migration in Europe: New source countries, old challenges*, wiiw Policy Notes and Reports No. 78, June.

Von Hippel, E. (1994), *"Sticky information" and the locus of problem solving: Implications for innovation*, Management Science, 40(4), 429-439.

Whittle, A. and D. F. Kogler (2020), *Related to what? Reviewing the literature on technological relatedness: Where we are now and where can we go?*, Papers in Regional Science, 99(1), 97-114.

Zavarská, Z., A. Bykova, R. Grieveson, D. Hanzl-Weiss, and O. Sankot (2023), *Industrial Policy for a New Growth Model: A Toolbox for EU-CESEE Countries*, wiiw Research Report No. 469, July.

Zavarská, Z., A. Bykova, R. Grieveson, and F. Guadagno (2024), *Toward innovation-driven growth: Innovation systems and policies in EU member states of Central Eastern Europe*, wiiw Research Report No. 476.

Żuk, P. and L. Savelin (2018), *Real convergence in Central, Eastern, and South-Eastern Europe*, European Central Bank, July.

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