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Toward Innovation-driven Growth:

Innovation Systems and Policies in EU Member States of Central Eastern Europe

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Abstract

This study builds on our previous analyses of a new growth model for the EU member states of Central and Eastern European (CEE), focusing on fostering innovation-driven development. We aim to explain the types of innovation systems and policies that enhance domestic innovation capabilities, drawing on global best practices. A critical evaluation of the current innovation landscape in EU-CEE countries is conducted, particularly in the context of the green and digital transitions. The study assesses the strengths and weaknesses of both national innovation initiatives and opportunities provided by EU industrial and technology policy frameworks. Based on these insights, we offer actionable policy recommendations to promote innovation-driven growth, enhance productivity, and boost economic convergence over the medium term, taking into account the unique political and historical contexts of the EU-CEE countries. Additionally, we prepare country-specific briefing notes tailored to the individual development needs and opportunities of each nation.

Keywords: Innovation policy, technological development, Central Eastern Europe, convergence

JEL classification: O14, O31, O38

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COMPARATIVE REPORT

Executive Summary

The EU member states of Central Eastern Europe (EU-CEE) – Poland, Czechia, Slovakia, Hungary, Slovenia, Croatia, Romania, Bulgaria, Estonia, Lithuania and Latvia – have undergone an impressive economic catch-up process since the early 2000s. However, the previously successful model of adopting labour-intensive production steps as an 'extended workbench' for Western corporations is increasingly reaching its limits, as we demonstrated in a previous study (Grieveson et al., 2021). The fundamental problem is that the key technological competencies and the segments of production with the highest added value are situated in the 'headquarter economies' of Western Europe. In contrast, the EU-CEE countries continue to specialise in labour-intensive production. Coupled with major structural changes such as decarbonisation and digitalisation, this growth model must therefore be replaced by a new one, more strongly driven by innovation. Only then will these countries be able to catch up with Western Europe in terms of productivity and living standards.

In a follow-up study (Zavarská et al., 2023), we investigated how a customised industrial policy could help EU-CEE countries to escape their 'middle-income trap'. The main finding: industrial policy needs to be stepped up in the region, all the more so at a time when countries around the world are rediscovering its significance. In this necessary effort to climb the technological ladder, there is much for EU-CEE to learn from the East Asian tiger states. They share a similar starting-point, namely the dominance of multinational corporations and a highly export-oriented nature, which the East Asian tigers have successfully leveraged to their advantage. With a highly successful industrial policy, these countries have managed to take the technological lead in some areas and create world-class companies, for instance in electronics or semiconductors.

Having established the need for a new growth model and made the case for industrial policy, we turn to innovation, the other ‘missing piece’ that will be required to achieve the next stage of convergence in EU-CEE. We explore how these countries could establish innovation systems at the national level, enabling them to catch up technologically and economically with the front-runners in Western Europe.

In this endeavour, EU-CEE countries face several challenges. For one, they do not spend enough on research and development (R&D), which undermines their innovation activities. R&D expenditure is, however, slowly rising, particularly in Poland, Czechia and Croatia. Nevertheless, all countries in the region fall far short of the official EU target of 3% of GDP for R&D. Only Slovenia and Czechia record R&D expenditure of 2% of GDP, while Slovakia, Bulgaria, Latvia and Romania are below 1%. Although some countries excel in exporting medium and high-tech products, in many cases this is driven by foreign direct investment (FDI) and historical industrial strengths, rather than contemporary domestic innovation. As a result, high-level technological expertise mainly resides within large multinational companies that maintain extensive production sites in these countries, while R&D is carried out primarily in their Western European headquarters. This means that cutting-edge expertise and technology are only available on the ‘islands’ of the production plants of these companies in the EU-CEE countries. Because of this isolated existence, local companies, especially small and medium-sized ones, struggle to benefit from cutting-edge technology. Exports of innovative services are currently very limited.

Although the region has quite a high share of graduates in science, technology, engineering and maths (STEM subjects), the education system struggles to achieve quality and universities are underfunded. The region has a long way to go in green innovation, hampering its competitiveness in this crucial area of the EU's envisaged 'twin' (digital and green) transformation. By contrast, the region appears better positioned for the digital transformation. In particular, there are a number of emerging innovative enterprises in EU-CEE countries in digital technologies. However, many of them lack strong connections to the broader innovation system and tend to operate as isolated success stories.

Reflecting these challenges, the innovation performance of the region is not particularly promising, although there are some positive developments. With the exception of Estonia, all EU member states in Central Eastern Europe are below the EU average and outside the global top 30. However, the innovation performance is generally in line with the economic development of each country, albeit with some exceptions. Estonia clearly outperforms, while Poland, Slovakia and Romania underperform.

From the policy side, despite recent progress, an overarching problem is the lack of co-ordination and financial support for innovation and R&D activities by national governments. The disconnect between FDI policies and innovation policies further complicates the implementation of strategies to enhance industrial innovation and upgrade EU-CEE's position in value chains. Although EU membership provides opportunities for collaboration and learning, the current innovation policy approach of the EU, which is focused more heavily on the needs of advanced countries, hinders active participation by EU-CEE countries. Only a few EU-CEE countries utilise their national policy space to engage more actively in EU initiatives.

IRELAND AND SINGAPORE AS ROLE MODELS

In this context, Ireland and Singapore can serve as an inspiration for EU-CEE, as they each successfully transitioned from an FDI-dominated to a more balanced innovation system, in which domestic firms actively contribute to the generation of innovations. Like the EU-CEE countries, their early economic growth was mainly driven by large multinational enterprises (MNEs) – similar to the 'extended workbench' model in EU-CEE. Later in their development stage, however, Ireland and Singapore changed their growth strategies. One notable element was the focus on a highly selective investment promotion approach (called 'innovation by invitation' in Ireland), which involved specifically attracting investments that corresponded to the country's own industrial strengths and potential. Additionally, a systematic and highly focused approach was taken to connect foreign companies with local firms and suppliers to establish industrial clusters in promising niches. Incentives were also created to encourage foreign companies already operating in the country to carry out more R&D locally, thus bringing in more added value.

A critical factor here was well-trained skilled labour. Both Ireland and Singapore have made great efforts to orient vocational training and, above all, university education in STEM subjects as closely as possible to the needs of their own economies. Other success factors included significant government funding of R&D through grants and tax breaks, the strengthening of scientific research at universities, the creation of government research funding agencies, the networking of university and commercial research, good framework conditions for start-ups, and easier immigration of highly qualified people from abroad.

POLICY RECOMMENDATIONS

Considering the specific innovation landscape of EU-CEE countries and building on the success stories from other parts of the world, this study articulates a series of recommendations aimed at guiding the EU-CEE region's next growth phase, advocating for a transition from imitation to innovation.

1. Facilitate effective co-ordination of the innovation system

› Encourage the establishment of a long-term innovation strategy that provides stability and planning security and is not subject to the electoral cycle. This is linked to the creation of a central innovation agency to co-ordinate the various elements of a coherent innovation policy at the national level.

› Improve the utilisation of EU funds and provide more money at the national level for the promotion of innovation. From a converging country's perspective, the reality that EU-CEE can lean on EU finances is a substantial advantage, which needs to be leveraged more strongly.

› Improve the public administration and its institutions. In addition to expanding the pool of innovation policy experts within the public sector, this includes a shift towards a culture of evidence-based policy making, establishing and strengthening in-house capacities to analyse different policies and their interactions.

2. Enable companies to climb up the technological ladder

› Strengthen the innovative potential of domestic companies, helping them to upgrade and grow. Key strategies in this direction involve fostering local supplier development, offering targeted R&D incentives, as well as promoting clusters. Avoiding an arbitrary over-emphasis on high-tech sectors is also crucial, ensuring that innovation policies are locally relevant for realistic and effective outcomes in the region.

› Select FDI in a targeted way and focus on areas that align with the country's traditional industrial strengths in order to build upon them. Create incentives for foreign MNEs operating in the country to conduct more R&D locally, thereby bringing additional value.

› Connect MNEs operating in the country with local companies so that the latter can benefit from their technological expertise and know-how. Eventually, industrial clusters should emerge that reflect the country's strengths and specialisations.

› Identify and develop promising industrial niches. Facilitate a targeted specialisation of the economy in the most promising areas that offer the greatest comparative advantage. The EU-wide approach, known as 'smart specialisation', can be especially useful, as it seeks to achieve intelligent, inclusive and sustainable growth within the given economic conditions.

› Move away from tax incentives as the main instrument to stimulate R&D spending by companies towards more direct grants, especially in EU-CEE countries with fewer fiscal constraints.

3. Strengthen universities and research institutions

› Increase the exchange and improve networking between science and business. This includes making collaboration between universities and industry a prerequisite for certain types of funding, reviewing the regulatory frameworks governing publicly funded institutions, and establishing and actively using technology transfer offices, as well as participating in EU-wide initiatives that encourage the commercial application of research.

› Promote international partnerships and create opportunities for the cross-border mobility of researchers. There are various means of stimulating such partnerships, such as making research collaboration grants more widely available, negotiating various fellowship programmes (also within the EU-CEE region), and simplifying work permits and visa procedures for international researchers.

› Stimulate internationally outstanding scientific excellence. This should, however, be relevant to the local economy and its industrial base and take their needs into account.

4. Develop human capital

› In order to have enough well-trained specialists available for an innovation-based growth model, vocational training and university education need to be expanded, especially in the STEM subjects of science, technology, engineering and mathematics.

› Talented workers from abroad should be recruited in a targeted manner, and skilled citizens who have emigrated should be enticed with special incentives to return home. It is well known that the EU-CEE countries are grappling with a pronounced ‘brain drain’ and, consequently, a significant shortage of skilled labour. This situation is often linked to challenging living conditions, ranging from expensive housing to a lack of childcare and inadequate healthcare. This also necessitates a new social policy to improve living conditions.

› Vocational training and apprenticeships should be made more attractive so that young, talented people follow these pathways, especially in technical and scientific fields. EU-CEE countries can build on the presence of MNEs to advance apprenticeship and internship programmes, career exploration programmes, and mentorship initiatives to ensure that students get hands-on experience from a relatively early age. The aim is to also ensure a more balanced talent distribution, so that high-achieving students are more drawn to, and can excel in, vocational pathways.

5. Improve access to funding for innovative companies

› In order to offer innovative companies better access to suitable financing from the outset, a legal framework and market conditions that reward innovation and risk-taking need to be cultivated. In particular, simplifying regulations, encouraging new fund creation, and promoting regional funds for smaller markets can be useful. Governments should cautiously explore co-investment mechanisms, avoiding disruption to private funding.

1. Introduction

The EU member states of Central Eastern Europe (EU-CEE) have achieved remarkable socioeconomic development since their EU accession. Leveraging skilled but cost-competitive labour forces, and helped by geographic proximity to established industrial networks, the region was able successfully to link up to global value chains (GVCs) through substantial inward foreign direct investment (FDI). Consequently, all EU-CEE countries are presently classified as high-income countries in a global comparison, despite some having been in the lower middle-income group less than 20 years ago. Moreover, the industrial sectors in which EU-CEE countries concentrate the majority of their economic activity are characterised by relatively high technological sophistication, most notably automotive and electronics manufacturing. The Harvard Growth Lab's Economic Complexity Index ranks Czechia sixth in the world, with Slovenia ninth, Hungary 11th and Slovakia 12th (all rank higher than the US or France).

However, a previous study by Friedrich-Ebert-Stiftung and the Vienna Institute for International Economic Studies (Grieveson et al., 2021) established that this growth model was reaching its limits and needed to be adapted to ensure continued improvement in living standards in the region. The pursuit of a subsidiary-driven economic model has resulted in the positioning of EU-CEE countries as 'factory' economies within international production networks, carrying out predominantly low value-added production activities. We established that there is not enough thought and certainly not enough action in the region about how to adapt it to achieve the next stage of convergence, and concluded that the region must move away from a largely passive approach to FDI attraction to a more active policy, and push much more strongly for a transition from imitation to innovation (Grieveson et al., 2021).

In a follow-up study (Zavarská et al., 2023), we established that industrial policy must form a central part of the next stage of the region's convergence. No country has ever truly become wealthy without industrial policy, but the specific EU-CEE context requires solutions that are specific to the region. Although the FDI approach should not be abandoned entirely, we proposed that the region should be much more discerning about its FDI attraction policies, and think of them – as was previously the case in East Asia – as a component of industrial policy, with a long-term strategy targeting particular sectors and FDI attraction policies working in tandem with that. We also stressed the importance of better aligning industrial policy making with a national innovation system, and establishing an entrepreneurial network of actors (including government, the private sector, academia and business agencies) to enhance the competitiveness and innovativeness of EU-CEE industries.

Having established the need for a new growth model and made the case for industrial policy, we turn in this paper to innovation, the other 'missing piece' that will be required to achieve the next stage of convergence in EU-CEE. Innovation-driven growth represents the key to closing the remaining gaps with the most advanced countries of the EU. This requires EU-CEE countries to build up their own technological capabilities and competitive domestic firms, which cannot take place without a well-functioning national innovation system supported by a sound set of policies. There are three main reasons why a radical upgrading of innovation policy in the region is necessary.

First, it is well established that innovation is necessary to achieve sustained economic growth: **75 years of economic literature and at least one Nobel Prize have contributed to proving this point.**[1] All industrial revolutions brought new technologies and opportunities for old and new innovators to climb the technological ladder by adopting and innovating upon those technologies.[2] Today, the 'twin' (green and digital) transition, together with the rise of new technological fields, offers challenges and opportunities to emerging economies that seek to join the club of the most innovative world economies. For EU-CEE, the necessity of more domestic innovation-led growth is especially clear, given that the region's predominant economic model of the last 30 years relied on an extremely high level of economic openness, something that is now threatened by increased geopolitical tensions and signs of geo-economic bloc building.[3] Although EU-CEE could benefit from 'nearshoring' or 'friendshoring' in this environment, this is far from assured, and if global trade grows less quickly than in the past, domestic sources of growth, including innovation, will have to pick up the slack.

To become innovation leaders, economies go through several steps, and in many ways EU-CEE is still close to the beginning of this process. The first step is spurring productivity growth, which is the most primitive sign of an innovative economy. One of the key forms of spurring productivity is by investing in state-of-the-art capital goods (machinery) – which today include robots and other machines that allow for the automation of production. With their FDI-driven industrialisation process, EU-CEE countries have completed this first step rather successfully. Yet in turn, the adoption of new technologies brings far more benefits than boosting productivity: it allows firms to reverse engineer the technologies produced elsewhere, adapt them, and introduce small improvements to them. The more a country invests in R&D, the more these small innovations become the starting-point of larger innovation efforts. But ultimately, an innovative economy needs to do more than increase its productivity and adopt new technologies. The ability to introduce new innovations that can be commercialised at home and abroad is what truly makes the difference.

This brings us to the second stage: the EU-CEE region faces the specific challenge of the concentration of technological know-how in multinational corporations and the low technological maturity of domestic companies. As we outlined in Grieveson et al. (2021), even the multinationals tend to carry out only a very limited amount of their R&D in EU-CEE, instead still preferring mostly to outsource lower-value production and keep the innovation work at home. This creates a very particular challenge for EU-CEE in terms of the transition to a more innovative growth model, although one where the examples of East Asia and Ireland (which used to be in a similar position) can provide some guidance, as we will show. The EU-CEE region has a generally weak level of research and development (R&D) spending, but even within that context the business sector tends to be a particular problem. More domestic business R&D spending will be a central component of a successful transition to a new growth model in the region.

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1 For a review of this literature, see Easterly and Levine (2001); Verspagen (2004).

2 See, for example, Perez (2002); Fagerberg and Verspagen (2021).

3 Aiyar et al. (2023).

Third, a full understanding of the central importance of the government in driving innovation is often lacking in the region, and this must change. Although at the academic level, the importance of the government in the innovation system is well established (we outline this in Chapter 2), this understanding is not always visible in the policy world, including in EU-CEE. In all highly innovative economies, even the US, the government plays an important role in driving technological progress and innovation.[4] EU-CEE needs a better appreciation of this fact among policy makers (something that this paper hopes to contribute towards) and also a specific application of a national innovation system that takes into account the institutional weaknesses and gaps that exist in much of EU-CEE. Identifying this EU-CEE specific application of the government's role in innovation is a central goal of this paper.

Therefore, while much can be learned and applied from rich countries, previous success stories in East Asia and Ireland, and the academic literature, clearly much of our work will need to identify solutions that fit the specific needs of EU-CEE. As we go through this paper, we will in particular pay attention to three facets of the EU-CEE case that must be taken into account when formulating recommendations on innovation policy for this region.

First, the region has institutional gaps and shortcomings that will make all of this harder. An effective innovation system rests on numerous pillars, including human capital development, basic and applied research activities, commercialisation of knowledge, and innovation financing. A multitude of actors need to actively collaborate to build up these pillars. Such synergetic innovation systems have yet to be formed in EU-CEE countries (although major differences exist within the region, and some countries do already show signs of the formation of such synergies). Domestic firms generally lack the capabilities for producing new technologies and, most importantly, to transform these innovations into commercial products and services.[5] The scarcity of financing for start-ups, particularly in the early stages of the life cycle, further constrains the entrepreneurial environment and leads to the relocation of competitive firms abroad. There are also challenges related to higher education institutions and human capital development, hindering the generation and market application of world-class research.

Second, innovation policy has been largely absent in the region for 30 years, and therefore much must effectively be built from scratch. During the socialist period, the EU-CEE countries operated under a Soviet-style R&D system characterised by low levels of in-house research activities of firms and high centralisation, with innovation and production compartmentalised and isolated from each other.[6] In the transition period that followed, EU-CEE saw a decline of traditional state-owned industries and a reduction of R&D-related tasks that used to take place within these structures. Moreover, Washington Consensus reforms gave priority to market liberalisation, privatisation and deregulation, with explicit innovation policies not figuring in the policy discourse. The EU accession process was the first time that the issue of innovation policy was brought to the table for most of these countries. As these innovation policies emerged as a consequence of EU prescription rather than from an endogenous policy impetus, effective translation of EU priorities into the domestic context remained limited. Because these economies can be considered relatively new to the realm of innovation policy making, they are still learning how to effectively design and implement such policies.

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4 Mazzucato (2013).

5 See, for example, Stojčić et al. (2020); OECD (2021); Szczygielski (2019).

6 Suurna and Kattel (2010); Radosevic (1998); Loewen and Schulz (2019).

Third, just as is the case for industrial policy, EU-CEE must operate within the framework of EU membership, which imposes some constraints but also offers significant support and opportunities. The EU's ambition to strengthen innovation continues to be a driving force of innovation policy initiatives in EU-CEE. The wide adoption of smart specialisation strategies and the introduction of EU-wide innovation promotion initiatives play a significant role in shaping innovation policy making in the region. At the same time, the policy direction of EU-CEE reflects growing awareness of the importance of innovation in driving economic progress. This is particularly pressing, given that many older EU member states are also increasing their industrial and innovation policy efforts with support to domestic firms (helped by the European Commission's relaxation of state aid rules in response to the Russian invasion of Ukraine and the US Inflation Reduction Act), which could further widen the gap between EU-CEE and the wealthiest parts of the EU.[7] Although most EU-CEE countries' capacities in designing and implementing innovation policies are still in nascent stages, there is growing recognition that an improved innovation policy set-up is vital. This momentum can be used to advance innovation-based growth in the region, in a way that makes the most of the strongly embedded presence of EU-CEE in global production networks via foreign enterprises, as well as creating, diffusing and marketing domestic knowledge.

The rest of this study is organised in the following way. Section 2 introduces basic concepts related to national innovation systems, highlighting the unique role played by each innovation system actor. It also looks at successful innovators from different parts of the world, and considers policy lessons that EU-CEE countries can derive from their experience. Section 3 critically assesses the current innovation climate of EU-CEE countries, reviewing the performance of the innovation system. Section 4 examines the current policy set-up in the region, looking at various national as well as EU-wide initiatives. In Section 5, we consolidate the findings of the previous sections into actionable policy recommendations. Our aim is to propose a set of medium-term priorities that would promote innovation-driven growth in EU-CEE countries, taking into account the benefits for wider society.

Our analysis is underpinned by the notion that innovation is not a one-size-fits-all concept. Although there are common principles and best practices, each EU-CEE country has its own set of strengths and weaknesses. Hence, we also include country-specific briefing notes for each of the 11 EU-CEE economies at the end of the report, providing an overview of the situation in each country, as well as country-specific policy insights.

[7] Of the approved programmes in 2022 to use state aid to support firms suffering from the fallout of the Russian invasion of Ukraine, 77% were accounted for by just two countries, France and Germany, with 53% accounted for by Germany alone. See https://www.euronews.com/business/2023/01/17/germany-france-account-for-most-eu-state-aid-heres-why-its-a-concern

2. Innovation systems and innovation policies: basic concepts and best practices for EU-CEE to follow

Key messages

› Innovation is not produced by firms alone. In creating new knowledge and innovations, firms interact and co-operate with a great variety of actors. This web of actors, with their links and interactions, constitutes the innovation system.

› Within the innovation systems, some linkages are particularly important. These include the interactions between: i) small and large firms; ii) national and foreign companies; iii) firms and universities (and other research organisations); iv) firms and the financial sector; and v) firms and the state (with all its layers of government – national and subnational – as well as all its agencies and organs).

› The experiences of Ireland and Singapore provide relevant examples for EU-CEE on how innovation policies can spur the transition from an FDI-dominated to a more balanced innovation system, in which domestic firms actively contribute to the generation of new innovations.

› In Ireland, a selective policy of FDI attraction ('innovation by invitation') has prioritised investments in strategic industries and R&D-intensive activities. This approach was coupled with a strong policy aimed at creating innovative clusters, where multinational enterprises (MNEs) could collaborate with domestic firms.

› In Singapore, close collaborations and interactions with multinational firms enabled improvements to the productivity and reliability of local small and medium-sized enterprises (SMEs), and fostered innovation by them. Owing to the active involvement of foreign firms, the education system could provide students with industry-relevant skills.

2.1. UNDERSTANDING INNOVATION FROM A SYSTEMS PERSPECTIVE

Firms almost never innovate in isolation: they rely on a system comprised of higher education providers, research centres, government bodies and the financial sector. It is through effective collaborations among these actors that new innovations take shape. Policies play a fundamental role in shaping innovation systems, supporting individual actors within the system, as well as the linkages among them. To foster successful innovation policies, it is crucial to understand the unique contributions of the various actors of an innovation system, and the dynamics of their interactions.

The innovation system – key points

1. Firms cannot produce all innovations on their own.
2. They need a system around them – the 'innovation system'.
3. The innovation system is generally made up of education providers, universities and research centres, the financial sector, and the government.
4. Policies can help the innovation system work better and produce more innovations.

2.1.1. Firms

Firms are central actors of the innovation system – after all, it is through firms that economies bring innovative products and services to the market. A variety of firms exists: large and established firms, together with new young enterprises, start-ups and spin-offs; domestic and international firms; suppliers, customers and competitors. Ideally, all of these companies co-exist in an innovation system, because each of them can contribute differently to the innovation landscape of an economy.

Large established firms are the largest R&D spenders in any economy, including in EU-CEE – although their R&D expenditures are much lower than those of large firms in Western Europe (see Section 3)**.** Whether we think of computers, pharmaceuticals or chemical industries, the role of large firms cannot be overemphasised. However, once firms grow and become market leaders, they tend to become less prone to introducing new breakthrough technologies. Instead, they begin to focus on marginal innovations, with a view to improving the products and services they already offer. This is because large established enterprises not only have lower incentives to introduce disruptive innovations that can jeopardise existing markets, but also are inherently less suited to come up with radical innovations. Hence, although their contribution to an economy's R&D activity is substantial, an innovation system cannot rest on large firms alone.

Owing to their small size, flexible organisational culture and arrangements, start-ups are more capable of disrupting established markets and creating new ones. This can be seen for instance in the Baltic countries, where start-ups are shaping entirely new industries, including in digital services and high-tech science-based industries (see Section 3). Because of these complementarities, large companies seek alliances with small firms, or spin off parts of their companies, with a view of preserving their creativity and innovation potential. Innovation systems also benefit from the presence of small enterprises, which work as specialised suppliers for larger firms. The development of specialised suppliers, often domestic SMEs, is of particular importance for the innovation systems of EU-CEE, as it is through these companies that linkages with multinational enterprises can be maximised, with potential impacts on technological upgrading.

Considering the innovation systems of many EU-CEE economies, foreign firms (often MNEs), are of high relevance, as they allow these economies to maintain their presence in higher-tech industries. These firms also tend to bring new technologies, managerial practices and quality standards into the host economy. Under these circumstances, a certain degree of knowledge flows and technology transfers inevitably occurs. Indeed, the convergence path of EU-CEE has been a clear illustration of this

reality. Although these knowledge flows can be very important to the local economy, extending beyond these should be a priority of the innovation policies of any FDI-dependent economy (Section 2.2 delves deeper into the policies required to achieve this).

2.1.2. Universities and research organisations

The role of present-day universities extends beyond higher education provision and basic/scientific research, increasingly encompassing applied research with commercialisation potential. As it became apparent that universities and research institutes are valuable partners in innovation projects, they were mandated to move away from their ivory towers and become increasingly entrepreneurial (a process that has worked particularly well in the US and some parts of Europe). As a consequence, successful collaborations between industry and academia evolved from fairly simple, one-shot relations such as training, consultancies and contract research, to complex collaborative projects and hybrid structures such as universities' spin-offs. In an innovation system where these interactions work effectively, firms benefit, as they gain access to scientific knowledge and state-of-the-art research, empowering them to produce more radical innovations with higher economic value.

BOX 1 / THE COMMERCIALISATION EFFORTS OF KU LEUVEN

In Europe, the Belgian university KU Leuven is a pioneer and a success story of commercialisation of academic research. Over the past five decades, the university has spun off 151 new companies in high-tech fields such as 3D printing, artificial intelligence, vaccines and chip inspection. With a technology transfer office active since 1972 and boasting 130 employees with a diverse technical background covering collaborative agreements, business development, funding, intellectual property and spin-offs, KU Leuven helps academics to bring new innovations to the commercialisation phases. Indeed, the office has the technical competencies to gauge if a certain innovation is worthy of patent protection and if it has the potential to become a commercial product. Finding sources of finance (through a vast network of investors and entrepreneurs), incubation and then incorporation are all activities that the multidisciplinary set of employees of the technology transfer office can take on. Key factors behind the success of the technology office have been the set-up of a fund to provide seed capital to the spin-off companies, a large enough team to be able to act as a one-stop shop, and autonomy in decision making. So far, nothing comparable has been established in EU-CEE.

The greater integration of universities and research institutions into the innovation system also benefits academia, as it incentivises academics to file for patents and start their own businesses. Entrepreneurial activity allows universities to access new sources of funding from external investors or technology licences. These funds can eventually be reinvested in education and research, thereby allowing universities to grow and improve. So far, however, this is more an aspiration than a reality for the EU: at present, only a few universities in Europe truly engage in close partnerships with firms and conduct market-oriented research, establishing technology transfer offices to co-ordinate and promote commercialisation. This has motivated the European Commission to promote policies that would allow greater involvement of universities in innovation policy making, for instance in the design of smart specialisation strategies. Examples of highly entrepreneurial universities are rare, and are concentrated in the UK, with a few also in Belgium (see Box 1), the Netherlands, Switzerland, Austria, Germany and

Sweden. As we discuss in Section 4, some EU-CEE economies are also making efforts to increase the commercial value of their research systems, although the region still has a long way to go in this respect.

2.1.3. The financial sector

Within the financial system, venture capitalists are considered to be the closest to innovative firms. Venture capital was created to finance early-stage high-tech start-ups that inevitably struggled to find finance from traditional providers of capital. Indeed, start-ups in the most innovative industries are the riskiest firms to finance: the type of innovations that they pursue are generally radical, often requiring large capital investments and entailing a high-risk profile. These firms are young, small, and have no financial history or collateral – all elements that increase their risk profile.

The venture capital market found much more fertile ground in the US than in Europe (with the exception of the UK), where the start-up ecosystem is much less dynamic. However, in Western Europe, the consequent lack of dynamism is counterbalanced by the presence of large R&D spenders, whereas the majority of the EU-CEE economies cannot count on similarly large companies. Therefore, financial constraints to innovation need to be carefully examined. To create new innovative industries and firms, these economies might find it attractive to promote venture capital investors that can support local start-ups. In several cases, as discussed in Section 4, this entails the establishment of public venture capital funds.

Although it has become increasingly common to use public funding to stimulate the dynamism of venture capital markets, there is, at best, only partial evidence that this really works. Therefore, EU-CEE countries should heed the mistakes of more developed countries before following their lead. In their earliest days, some venture capital investors had an instrumental role in the growth and success of start-ups in science-based and R&D-intensive industries, for example in biotech. However, since the 2010s, venture capitalists have changed their investment strategy, spreading their funds over many companies, in the hope that some of them will eventually become the next 'unicorn' (a privately held company worth over USD 1bn). Their investments also became more focused on software and digital services, in which, as a result of digitalisation, starting new businesses and introducing new innovations has become easier. This intense focus by investors on 'unicorns' and digital services has resulted in the neglect of other sectors where innovations are more difficult to develop, but equally or even more necessary.[8] Hence, if not properly channelled towards strategic industries and/or societal challenges, state intervention in support of venture capital financing alone is hardly justifiable. Amid this scenario, a whole set of innovative companies that are largely overlooked by venture capitalists are still hoping to improve their access to finance, whether through other actors in the financial sector or via the state. In this regard, the state can play an important role in providing or channelling financing towards the more credit-constrained innovative firms. The European Commission, for example, already promotes a variety of schemes and programmes in this area, which open up opportunities for EU-CEE countries.[9]

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8 Engel et al. (2016); Ewens et al. (2018); Lerner and Nanda (2020).

9 For instance, InvestEU is just one of the vehicles of such financial instruments.

2.2. INNOVATION POLICIES TO PROMOTE TECHNOLOGICAL UPGRADING: TAKING INSPIRATION FROM IRELAND AND SINGAPORE

Several countries with similar starting-points to EU-CEE, in terms of economic development level or the strong role of foreign firms in the economy, have successfully strengthened their innovation systems and climbed up the technological ladder. These countries relied on a carefully calibrated mix of policies, all geared towards the central objective of increasing the domestic economy's innovation capacity. In this section, we examine the experiences of two such countries: Ireland and Singapore.

Although there are notable differences with EU-CEE countries, Ireland and Singapore share important characteristics with them: they are both relatively small by world standards and highly export-oriented, and both benefit from a favourable geographic position close to important hubs in global value chains. As in the EU-CEE region, Ireland and Singapore initially attracted significant FDI because of a low-cost but qualified labour force, as well as generous investment promotion activities. In their subsequent development paths, however, Singapore and Ireland successfully leveraged their position in global value chains to transition to innovation-driven growth, attracting R&D-intensive FDI and cultivating domestic innovative firms. Drawing on their experience, three essential pillars of innovation policy, crucial for contemporary EU-CEE, are identified and reviewed in turn.

2.2.1. Attracting higher-quality FDI and strengthening linkages with domestic suppliers

For EU-CEE countries looking to attract higher-quality FDI, the 'innovation by invitation' approach adopted by Ireland is of high relevance. Although EU accession allowed EU-CEE economies to link up to more innovative economies via global production networks, so far EU-CEE have benefited from these linkages only to a certain degree. The activities performed by foreign firms in these countries continue to be heavily skewed towards production and assembly (a point we emphasised in Grieveson et al., 2021; Zavarská et al., 2023). This was also the case in the early stages of industrialisation in Ireland. Ireland's inflows of FDI until the 1980s were mostly in labour-intensive industries, taking on the role of assemblers in global GVCs. value chains.

Over time, the Irish government managed to attract higher-quality FDI by becoming more selective in its investment promotion activities. It prioritised FDI into technologically advanced industries (such as electronics, machinery, pharmaceuticals and medical instruments and equipment) and R&D-intensive activities, prioritising firms interested in conducting R&D in the country and collaborating with domestic firms. This targeted promotion of FDI in Ireland is sometimes referred to as 'innovation by invitation', and entailed, for example, offering higher rates of financial support to multinational enterprises in well-defined priority areas and market niches (see Box 2 for details of how this policy was implemented).[10] This approach is very different from the one currently in place in most EU-CEE countries, where FDI promotion policies mention very broadly defined sectors, or offer indiscriminate blanket support, as we discussed in Zavarská et al. (2023).

[10] Bradley (2006); Buckley and Ruane (2006).

Furthermore, Ireland took a project-based approach to FDI incentives, to maximise the benefits arising from FDI. In this way, the policy intervention took into account not only the specific sectors, but also the different potentials brought by different foreign firms and their individual investment projects. On the one hand, following a selective project-based approach is not easy as it requires strong state capacity (to avoid conflicts of interests and other unwanted behaviours). On the other, finding market niches and defining clear-cut policy priorities are essential elements of policy making. Indeed, this niche-finding exercise is at the core of modern-day innovation and industrial policy making, and is not limited to the EU's smart specialisation strategy.

BOX 2 / THE FOUR STEPS OF THE IRISH 'INNOVATION BY INVITATION' APPROACH

The Irish Industrial Development Agency adopted a sophisticated system to apply its 'innovation by invitation' approach. Its four steps can be summarised as follows:

(i). find niche markets with high value/volume potential in Europe;

(ii). identify firms active in these markets, which already export large volumes into Europe or could be interested in setting up a production unit in Europe;

(iii). persuade these enterprises to invest in Ireland; and

(iv). agree on the incentive package that would secure the investment and simultaneously maximise the benefits for Ireland as the host economy.

Once the desired FDI projects came in, Ireland dedicated further efforts to strengthen linkages between foreign enterprises and domestic suppliers. Admittedly, this is a major challenge for EU-CEE countries, which suffer from a 'dual-track' structure of the economy, with highly productive multinational firms on the one hand, and less productive domestic firms on the other (see Zavarská et al., 2023). To bring these two groups closer together, Ireland introduced the National Linkage Programme, intended to spur the accumulation of capabilities of local suppliers in order for them to be able to co-operate with the multinational enterprises in the country. Specifically, as part of the National Linkage Programme, the Irish Industrial Development Agency worked with 250 multinational enterprises to identify high-potential local suppliers. Once selected, these suppliers were monitored for technology improvements, quality, cost and service requirements. Meanwhile, the programme provided grants to foreign investor firms to encourage them to link with local suppliers. To ensure efficiency, the grants were conditional on employment and local-content creation. The results of this programme were so startling that the Irish experience is often considered a best practice example. Indeed, the Irish National Linkage Programme incorporates all the essential elements of a policy of this sort: an active role for the government, a critical mass of customers and potential suppliers, effective use of technical audits, funding to improve business practices, and a full 'buy-in' by the private sector. Its success is illustrated by the large number of Irish SMEs that became suppliers to international market leaders (such as IBM, Apple and Dell). Over time, these SMEs also expanded internationally.[11]

[11] O'Malley et al. (2008); Sabha et al. (2020).

Similarly, Singapore implemented a highly successful policy mix to upgrade its position in global value chains, primarily through its Local Industry Upgrading Programme. As the name suggests, the programme upgraded, strengthened and expanded the pool of local suppliers to foreign enterprises operating in Singapore. As part of the incentive package provided via this programme, multinational firms were encouraged to transfer knowledge to local suppliers, with the aim of achieving technological upgrading of domestic entities. The incentives allowed Singaporean SMEs to enter into close collaborations with foreign investors, and benefit from trainings and transfer of new competencies. Some SMEs became successful in developing new innovations and engaged in joint R&D projects with their multinational firm-mentors.

Beyond the transfer of technologies, the Programme incentivised transfers of marketing and business process knowledge, as this would help local firms to enhance their efficiency and reliability. These interventions allowed domestic SMEs to improve their productivity and value added.[12] A parallel objective of the Programme was to create an industry of local suppliers capable of being not only innovative enough to supply Singaporean-based multinational enterprises, but also to expand internationally. Because of the programme, some local suppliers were encouraged to follow their customers to other locations in Southeast Asia.

The Programme was initially tailored to the electronics industry and managed to develop a local industry in precision engineering and components assembly. Building on several success stories within this industry, the Singaporean government scaled up the programme to include other sectors, such as aerospace and information technology.[13] In parallel, an increasing number of employees and engineers from foreign firms operating in Singapore left their companies to set up their own manufacturing SMEs, and started working as suppliers of their former employers. In this way, interactions between foreign and domestic firms (and also between small and large firms) were strengthened, supporting the formation of a successful innovation system.

2.2.2. Making domestic firms more innovative

The ultimate objective of innovation policy is to make firms operating in the country more innovative. Yet, in a context such as the EU-CEE one, knowledge spill-overs from foreign firms can be maximised only when domestic firms possess sufficient 'absorptive capacity' (i.e. when domestic firms are competent enough to understand and learn from the knowledge passed on by the multinationals). Indeed, to effectively learn, absorb and adapt the knowledge transferred by a foreign firm, it is crucial that local suppliers engage in R&D in-house. The knowledge and competencies that they acquire while conducting their own R&D is essential to grasp the technicalities involved in the knowledge transfer.

Fiscal and financial incentives to promote R&D are the most standard policy tools in this regard: among these, grants might be particularly relevant for EU-CEE economies that lack a domestic productive sector capable of its own innovation and R&D (see Box 3). Moreover, as other EU countries, including France and Germany, increasingly turn to subsidies to stimulate innovation, it is vital for EU-CEE countries, to the extent that is possible, to consider the adoption of assertive support strategies to avoid a further widening of the technological gap. Acknowledging that EU-CEE countries

[12] Sabha et al. (2020).

[13] UNCTAD (2011).

are unlikely to be able to match the financial resources and 'spending effectiveness' of the more advanced EU countries, a more strategic use of grants is still important, especially as more EU initiatives and financing become available for these purposes.

BOX 3 / CHOOSING THE RIGHT R&D INCENTIVES

Fiscal incentives

Although widely used, these instruments are mainly effective in supporting the final phases of an innovation project, when the last experimentations are needed to fine-tune the innovation.[14] However, when firms are not used to undertaking R&D, or do not have the financial resources to kick-start innovation projects (as is the case in many EU-CEE economies), tax incentives alone are not sufficient to induce them to invest in R&D. The necessary changes in business practices and business culture, and also the type of activities that firms undertake and the sectors they operate in, cannot be changed by a tax rebate. This is partly the reason why some (more audacious and more fiscally unconstrained) governments offer R&D subsidies and grants.

Grants/subsidies

Particularly when subsidies provide longer-term funding, recipients are better positioned to engage in (longer-term) research and innovation projects, needed to generate the next breakthrough technology. Moreover, these policy tools can incentivise more scientific/explorative basic research, because the recipient is given the funds when the project starts, and is not asked to return them – so it is not necessary to reach commercialisation and profitability. Therefore, firms prefer non-repayable grants and subsidies to loans when engaging in particularly risky and uncertain projects, as they would have to repay their loans even if the projects fail. Meanwhile, the risks of the success of these projects are almost entirely borne by the state, which could potentially lower the incentives of the firm to exert the maximum efforts in the execution of the project. For this reason, performance-based subsidies are increasingly used.

Loans and other financial instruments

Loans and other financial instruments are more cost-effective for the state and entail a 'fairer' distribution of risks between the investor and investee. Such instruments could potentially attract higher-quality projects, also as a consequence of the repayment obligation. When loans are paid back, funds return to the state, generating 'reflows' that can be reinvested. Even so, because profitability needs to be taken into account when considering a loan, these instruments are better suited to finance projects that are already close to commercialisation.[15]

In addition, as the Irish and Singaporean experiences illustrate, a wide range of tailored policy instruments – beyond R&D incentives – can and should be implemented to promote the innovativeness of domestic firms. Returning to the case of Ireland, the linkages between research and industry were reinforced via the creation of subsidised centres to apply new technologies in niche areas of relevance to industry and competence centres where researchers undertook market-oriented

[14] Appelt et al. (2020); OECD (2023a).

[15] Grimsby (2018); Wishlade et al. (2017).

R&D projects. Innovation vouchers – small lines of credit given to businesses (especially SMEs) by governments, which allow them to obtain tailored scientific outputs and expertise from public research institutions – offered SMEs additional opportunities to collaborate with universities. The growth of domestic innovative firms was further promoted by entrepreneurship policies: each university was incentivised to set up its own incubator, also via grants, and funds were available for start-ups (for example through the Growth Fund).[16]

Of key importance – particularly for the development of the Irish software industry – were initiatives to help firms upgrade their business processes and design new business strategies. For example, the Centre for Software Engineering was set up to provide assistance in quality control and ways to improve productivity. In parallel, other government initiatives focused on finding a new niche position for Ireland. This focus on quality, plus a conscious effort to identify a profitable niche which would avoid competition with other global players, made Irish companies highly successful in the international arena, and is an important message for EU-CEE policy makers.[17]

In Singapore, the development of local start-ups was favoured by a wide-range of policy instruments, allowing local high-tech start-ups, especially in life sciences, to benefit from a fertile innovation system.[18] The policy mix covered the areas of education and skill formation, the attraction of foreign talent, regulations to remove obstacles to technological entrepreneurship, infrastructure (e.g. from more traditional types, such as ports, to more innovative facilities such as incubators and science parks), and innovation financing. These policies were complemented by a series of investment incentives in the forms of selective tax reductions and investment credits.

2.2.3. Supporting the development of human capital

Human capital, which encompasses the knowledge and skills of a country's population, is the foundation of any innovation-driven economy. Singapore has had notable success in implementing policies in the area of human capital development. Importantly, these policies dynamically evolved over time, reflecting the specific stages of development of the country. This is a crucial lesson for EU-CEE, to periodically assess the types of job profiles their industries need, and adapt their education policies accordingly. In the case of Singapore, policies first expanded and improved vocational education training through a plethora of reforms to increase the quantity and quality of vocational education providers. To make vocational training more attractive to students, the institutes featured high-tech facilities and amenities comparable to those of modern universities overseas.

When Singaporean firms became productive enough to be ready to introduce their own innovations, engineers and technicians became even more necessary. Increasing the number of graduates from technological universities was deemed important for the growth of high-tech industries, particularly microelectronics, computers, telecommunications, material science, robotics and biotechnology.[19] On the one hand, the higher enrolment rates were the population's response to the government's message that science and technical education offered a promising career and highly

[16] Lin et al. (2010).

[17] Heavin et al. (2003).

[18] Yeo (2016); Wong and Singh (2008); Wong (2003).

[19] Wong and Singh (2008).

competitive salaries. Today, the same message is reiterated, for example, by targeted efforts to promote career fairs to raise students' awareness of job opportunities in STEM-related (science, technology, engineering and maths) fields. On the other hand, the government implemented several measures to boost the number of graduates from technological universities, such as increasing their capacities to increase their student intake.

The attractiveness of these studies was further promoted via an emphasis on the internationalisation of Singaporean universities. Singaporean students could benefit from the teaching of star academics, actively recruited by the government and helped by a liberal immigration policy. They could also spend time at top universities overseas, because of the partnerships signed by the government, and could benefit from exchanges with foreign students visiting Singaporean universities. International students at Singaporean universities also benefited from subsidised fees in some selected scientific fields. In these cases, subsidies were conditional on a service obligation to work in Singapore for a minimum of three years after graduation. This ensured that the country could continue to benefit from the presence of this foreign talent. Finally, multinational enterprises were also encouraged to send Singaporean engineers to the headquarters to acquire new knowledge and skills. In view of the possibilities offered by the European Commission's programmes for students and staff mobility, the EU-CEE could leverage this aspect in their innovation systems.

The Singaporean experience also teaches EU-CEE that it is crucial for education providers to prioritise industry-relevant competencies. In Singapore, polytechnical education and specialised technical training programmes were devised involving multinational enterprises and foreign industrial training institutes. To further ensure that the skills prioritised by the education system were consistent with the expectations of the industry, the entire education sector was co-ordinated by the education ministry as well as the Economic Development Board. These institutions tracked trends in labour demand, and involved multinational enterprises and other firms in order to better understand their needs and to train technicians for their factories. In return, the foreign firms could choose their employees from among the pool of graduates. The education ministry also set up the Curriculum Development Institute of Singapore to ensure consistency with the long-term industrial ambitions of the economy. Singapore also emphasised on-the-job training. For example, students from Singapore Polytechnic University were required to complete a year-long internship. The extended duration of this allowed them both to learn more and to establish a closer relationship with the company.

Singaporean education policies placed great emphasis on the quality of the education system, an aspect of significant relevance for EU-CEE. A set of reforms raised the quality of the education system, by improving English skills, oversight of the curriculum, schools' management, pedagogical practices, teacher recruitment and training, and performance assessment practices. An information-gathering mechanism helped school administrators to assess the strengths and weaknesses of their schools and track student performance. In addition, teachers' salaries were equalised with those of engineers and lawyers. A certification programme for teachers and continuous training also helped improving teaching quality.

Although the Irish and Singaporean cases are often referred to as best practices, in trying to replicate these programmes, EU-CEE should be mindful of a few critical elements. First, these programmes are expensive, requiring sound fiscal capacities to carry out such initiatives. Significant financial resources are needed to maintain the initiatives for as long as they are needed, and it takes

time until returns from these investments can be reaped. Second, they require strong state capacities to shape and implement the policy. Indeed, the experience of these two countries also emphasises the need for a diverse and intricate set of policy measures to be implemented in order to establish a growth model centred around innovation. Such a policy mix calls for a highly competent government agency, for example to effectively identify market niches and co-ordinate various programmes. Third, the success of the policy crucially depends on the quantity of existing suppliers and the active co-operation of multinational enterprises, which can only be partly induced by the fiscal and financial incentives. At present, these elements – state capacities and financial resources earmarked for innovation – are still lacking in some EU-CEE economies, as discussed in the following sections.

3. Innovation performance of EU-CEE economies

Key messages

› With the exception of Estonia, all EU-CEE countries are below the EU average and outside the global top 30 for innovation performance. The level of innovation performance of EU-CEE countries is mostly in line with their level of economic development, although Estonia outperforms, and Poland, Slovakia and Romania underperform on this basis.

› EU-CEE countries do not spend enough on R&D and have insufficient industry-academia collaboration. Only a handful of EU-CEE firms make substantial R&D investments by EU and global comparison.

› Several EU-CEE countries are strong in terms of innovative exports of medium and high-tech products. This, however, reflects FDI-driven manufacturing specialisms based on innovation imported from abroad, as well as the region's industrial heritage, rather than contemporary domestic innovation.

› Exports of innovative services, by contrast, are currently limited, although there are promising signs that this could improve in EU-CEE in the future.

› Many EU-CEE countries are above the EU average in terms of human capital development, but the underfinancing of tertiary STEM education will jeopardise this if not addressed.

› Innovative enterprises are starting to emerge, particularly in digital technologies and linked sectors. However, product innovations by EU-CEE SMEs mostly lag the EU average. Similarly, in terms of innovation financing and business investment, EU-CEE lags behind EU average levels.

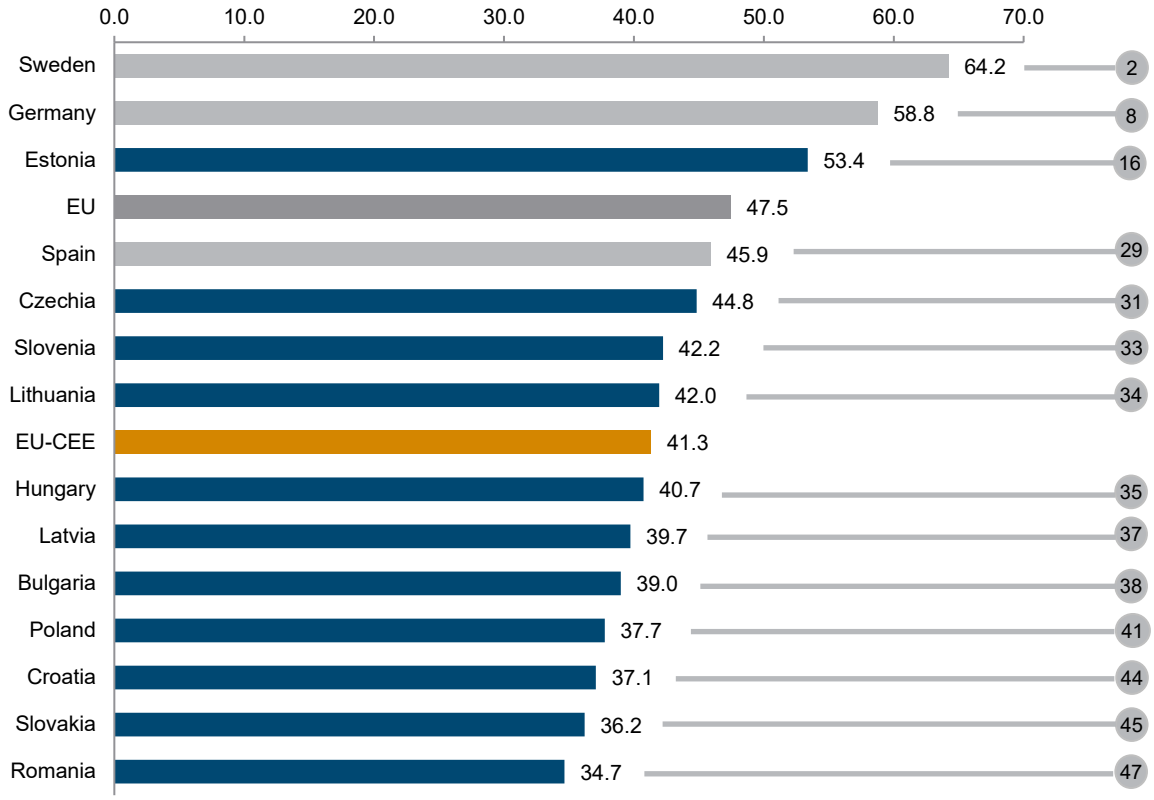
› EU-CEE has a long way to go in green innovation, but appears better equipped for the digital transition from an innovation perspective.

3.1. INNOVATION PERFORMANCE OVERVIEW

EU-CEE overall has a level of innovation that roughly corresponds to its level of economic development, placing it mostly 'average' or 'below average' on innovation indices that include developed countries. In the Global Innovation Index (GII)[20] ranking of 134 countries, all EU-CEE countries except Estonia are all ranked outside the top 30. Estonia, ranked 16th, is the only country in EU-CEE with an above EU-average score (Figure 1). The overall standing of EU-CEE countries underscores the still limited capacity of innovation systems to act as drivers of economic growth in the region. At the same time, the alignment of innovation rankings with development levels of countries underscores the interconnectedness between developmental stages and innovation capacity, highlighting the pivotal role of innovation in fostering growth.

[20] The GII allows for global comparisons, relying on 80 indicators to measure the performance of the entire ecosystem (WIPO, 2023). The GII combines indicators related to innovation inputs (which include aspects such as institutions, human capital and research, infrastructure, and market and business sophistication) as well as innovation outputs (knowledge and technology, and also creative outputs).

Figure 1 / GII ranking of EU-CEE countries and EU comparator countries, 2023



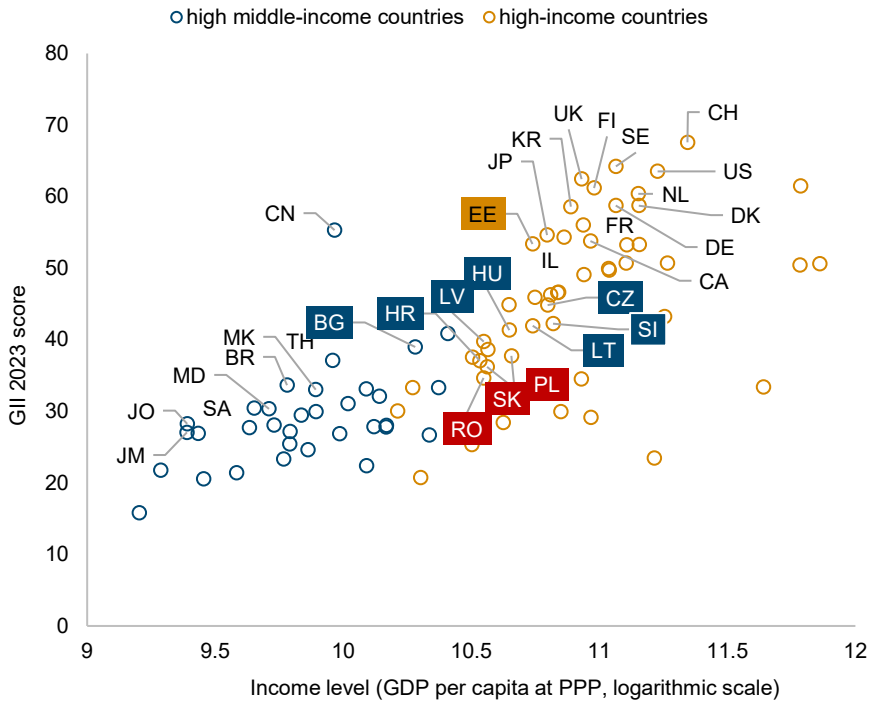
Source: GII, 2023.

Estonia is the only country in EU-CEE which is performing above expectation on innovation relative to its level of economic development. Bulgaria, the only upper middle-income country, matches expectations for its economic development level, despite being ranked third in its income group. Poland, Slovakia and Romania underperform even relative to their level of development, according to the 2023 Global Innovation Index (Figure 2).

The European Innovation Scoreboard 2023 (EIS)[21] classifies all EU-CEE countries as either moderate or emerging innovators. All countries score below the EU average, and notably below the level of Germany and Sweden, which may be regarded as innovation leaders in the Western European context. Except for Estonia, Slovenia and Czechia, none of the countries outperforms Spain, which is selected as an example of a weaker performer among the 'old' EU member states (Figure 3).

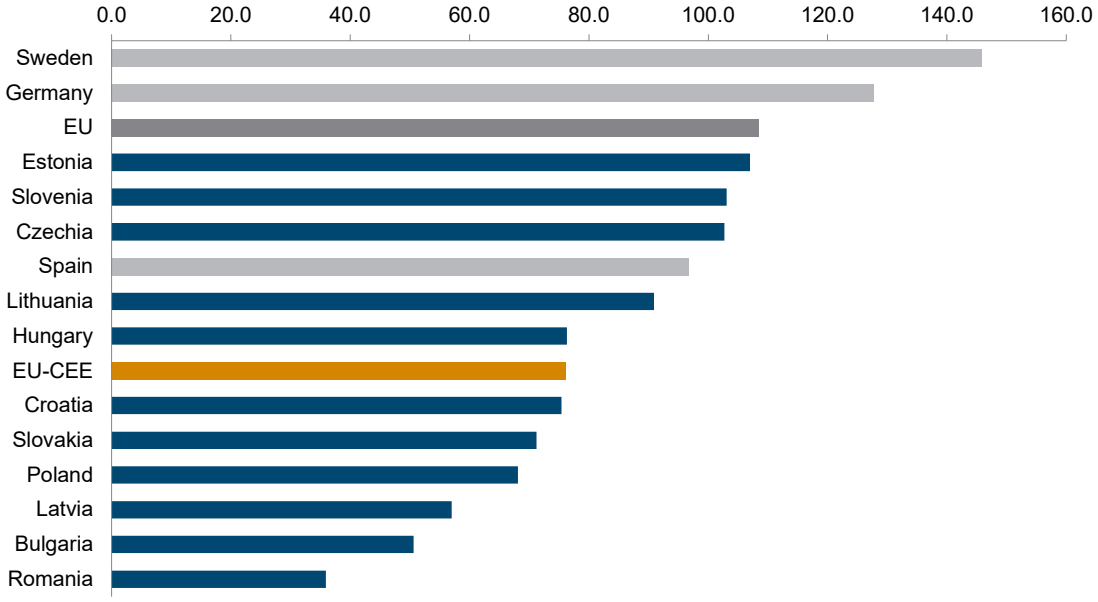
[21] The EIS is another commonly used composite indicator for innovation efforts and outcomes. It assesses innovation performance in the EU context. It identifies strengths and weaknesses of countries relative to the targets of innovation goals and policies of the EU, and classifies all EU countries into four performance groups: innovation leaders, strong innovators, moderate innovators and emerging innovators (European Commission, 2023b).

Figure 2 / Innovation performance relative to income level



Note: only high middle-income countries and high-income countries depicted; outperforming innovators in their respective income groups and EU-CEE countries are labelled. Estonia is labelled orange as an outperformer; Poland, Romania and Slovakia are labelled red as underperformers; other EU-CEE countries are labelled blue as matching the expectations for their income groups.
Source: GII, 2023.

Figure 3 / Relative positions of EU-CEE and comparator countries in EIS, Summary Innovation Index scores, 2023



Source: EIS, 2023.

In some sub-components of the scoreboard, EU-CEE displays better performance, and there are other areas in which the region is showing signs of improvement. EU-CEE scores relatively well in the sub-components of *linkages,*[22] (where the smallest gap to the EU average is observed), *innovators*[23] and *digitalisation* (Table 1). Since 2016, large improvements are also evident in the following sub-dimensions: *innovators*, *linkages* and *attractive research systems*. By contrast, major weaknesses are visible for *human resources* (with a deterioration since 2016), *firm investments, intellectual assets,* and *finance and support* (Table 1).

Table 1 / Relative positions of EU-CEE in sub-dimensions of EIS, 2016 and 2023

	EU	EU-CEE			
	2023	2016	2023	Change	Gap to EU
0 Summary Innovation Index	108	65	76	11	-32
3.1 Innovators	140	50	105	55	-35
3.2 Linkages	133	76	119	44	-14
1.2 Attractive research systems	109	41	72	31	-37
4.1 Employment impacts	108	59	80	21	-28
1.3 Digitalisation	117	77	90	13	-27
2.3 Use of information technologies	107	76	87	11	-21
4.3 Environmental sustainability	103	73	64	10	-39
4.2 Sales impacts	99	64	73	8	-27
2.1 Finance and support	122	67	74	6	-48
3.3 Intellectual assets	92	58	63	4	-29
2.2 Firm investments	109	63	64	2	-44
1.1 Human resources	94	76	71	-5	-23

Note: sub-dimensions of EIS sorted in descending order according to the change in average EU-CEE scores between 2016 and 2023.
Source: EIS, 2023.

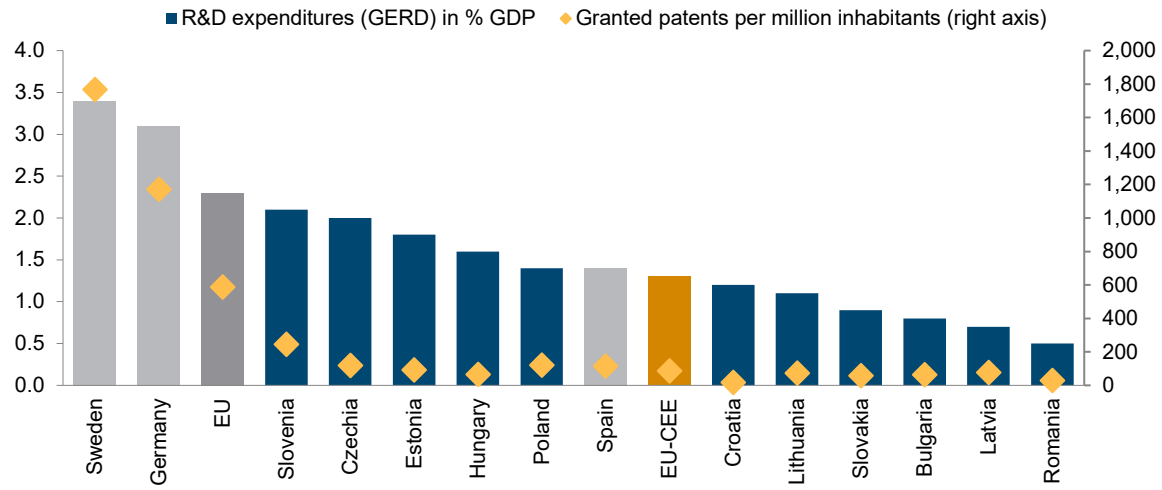
3.2. R&D SPENDING AND PATENTS

EU-CEE countries do not spend enough on R&D, but there are signs of improvement. Low expenditures on R&D and low patent activity are serious impediments to the development of innovations, limiting innovation system development based on domestic scientific achievements. EU-CEE countries have recorded underfinancing of R&D activities over a long period, and all countries lie far from the 3% of GDP target set by the Lisbon Strategy, and even below the EU average of 2.3% (Figure 4). Only Slovenia and Czechia met the 2% threshold. Furthermore, only five countries post values above Spain's modest level of 1.4%. Romania, Latvia, Bulgaria and Slovakia show the largest weaknesses, with R&D funding below 1% of GDP. On a more positive note, the chronic weakness of EU-CEE research systems, and the consequent lack of innovation capacity, appears to be improving. All EU-CEE countries posted an increase in the R&D expenditure share in GDP over the last ten years, with the largest rises in Czechia and Poland, each of 0.7 percentage points (pp), and Croatia (0.5 pp).

[22] The *linkages* sub-dimension is captured by three indicators: collaboration of innovative SMEs, public-private co-publications, and job-to-job mobility of human resources in science and technology.

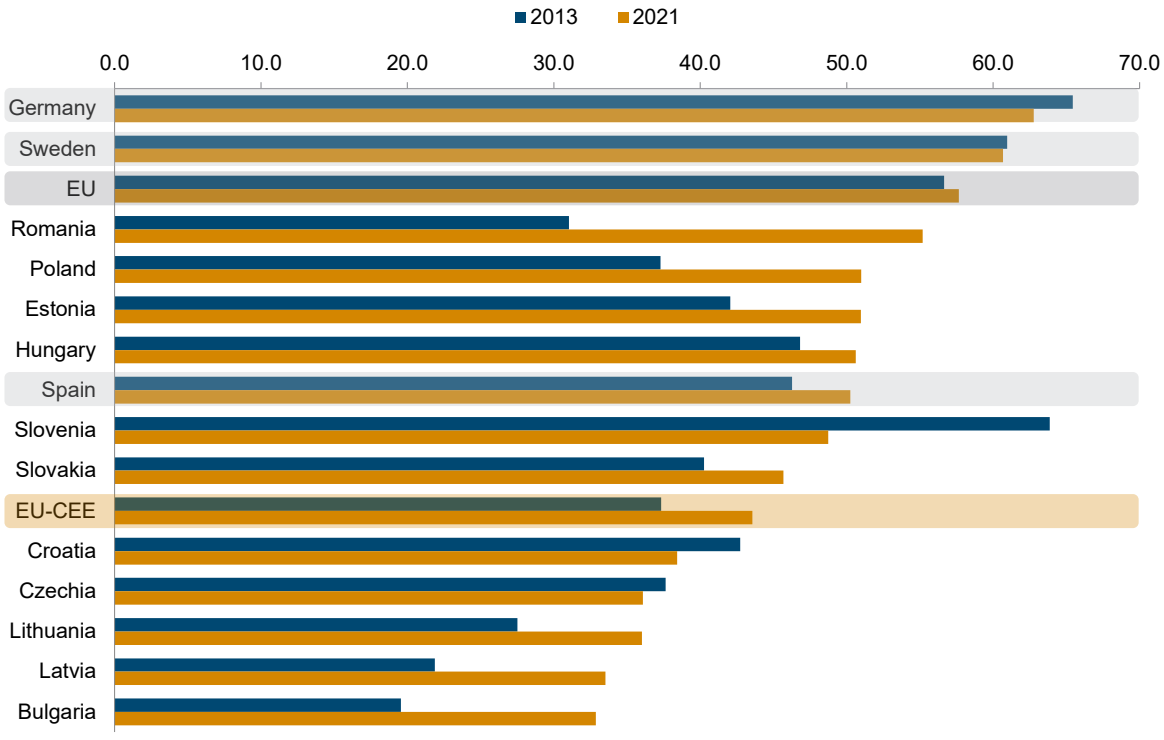
[23] The *innovators* sub-dimension captures business and process innovations by SMEs.

Figure 4 / R&D expenditure and granted patents in EU-CEE



Sources: Eurostat; WIPO; WDI; own calculations.

Figure 5 / Share of R&D funded by business, %



Note: arranged in descending order, 2021.
Sources: EIS; Eurostat; own calculations

The region's limited investment in R&D partly reflects the weakness of domestic firms in driving innovation system development. The share of R&D funded by business, which indicates how innovative firms are, is below the EU average in all EU-CEE countries. A slight increase – larger than for the EU on average – is evident for the region overall in 2013-2021. Most of the economies showed improvement, apart from Slovenia, Croatia and Czechia (Figure 5). Only six companies originating from EU-CEE appear in the list of the top 1,000 R&D spenders in the EU, and only two in the top 2,500 worldwide, as revealed by the 2022 EU Industrial R&D Investment Scoreboard (Table 2).

Table 2 / EU-CEE companies in the top 1,000 EU ranking of firms with largest R&D investments

EU rank	Company	Country	Industry	R&D in 2021; EUR m
171	Gedeon Richter	Hungary	Pharmaceuticals & biotechnology	165.4
179	Krka	Slovenia	Pharmaceuticals & biotechnology	154.6
363	CD Projekt	Poland	Leisure goods	48.3
476	Asseco Poland	Poland	Software & computer services	26.6
543	ČEZ	Czechia	Electricity	21.8
948	Captor Therapeutics	Poland	General retail	3.8

Source: EU Industrial R&D Investment Scoreboard, 2022.

Linked to R&D, patent activity is another area of relative weakness for EU-CEE's innovation landscape at present. Here, the gap with leading EU economies and the EU average is even larger than observed in R&D spending.[24] Slovenia (245 granted patents per million inhabitants) clearly outperforms all other EU-CEE countries, with only Poland (120) and Czechia (119) posting larger values than Spain (Figure 4). Contrary to R&D expenditures, not all countries showed improvement over the last ten years for granted patents: declines were observed in Slovenia and Latvia (from initially relatively high levels), as well as in Croatia and Hungary. Relative to the EU average, Poland and Czechia, as well as Bulgaria, Slovakia and Lithuania (with initially rather low levels of patent activity), posted the largest improvements over the last decade.[25]

3.3. HIGH-TECH EXPORTS OF GOODS AND SERVICES

For most EU-CEE economies, the main strength of their innovation performance is export-oriented rather than domestically directed. It is largely based on the transfer of technology via FDI, traditional specialisations in manufacturing, and respective industrial and technological capacities built up over time. Largely because of their high level of integration into GVCs, four EU-CEE economies – Slovakia, Czechia, Hungary and Slovenia – post larger shares of medium and high-tech products in total product exports than the EU average. Slovakia and Czechia exceed even Germany, while Romania lies above Sweden. On the other hand, the Baltic countries, Bulgaria and Croatia, with weaker manufacturing capabilities, are the weakest performers, behind Spain (Figure 6, Panel a).

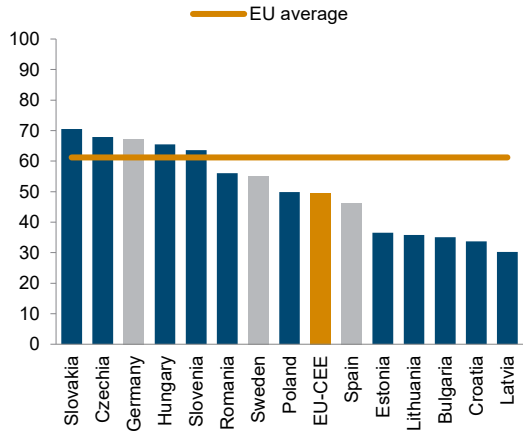
[24] Measured as granted patents per million inhabitants.

[25] By 7, 3, 6, 5 and 4 percentage points, respectively.

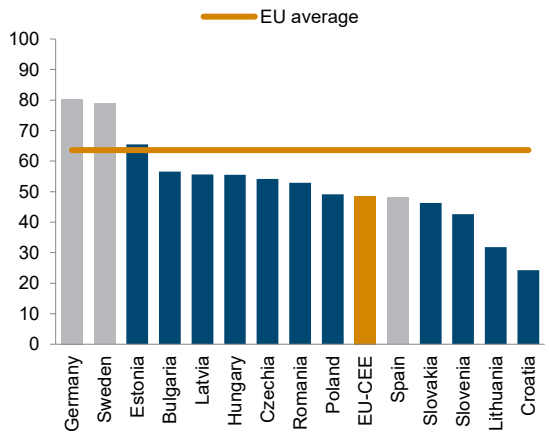
Conversely, for knowledge-intensive services exports, only Estonia outperforms the EU average (and only marginally). All countries lag far behind Germany and Sweden (Figure 6, Panel b). For economies largely relying on tourism (such as Croatia and Slovenia), knowledge-intensive services feature less prominently in their exports. However, knowledge-intensive services may offer opportunities for EU-CEE countries lacking a strong manufacturing base, as they require less capital investment and can be built up primarily on human capital. We observe some gradual shifts in this direction in the less industrialised countries of the region, such as the Baltic states, where the development of the IT sector has been progressing relatively favourably (see Zavarská et al., 2023).

Figure 6 / High-tech exports of goods and services in EU-CEE and selected EU countries

a) Exports of medium and high-technology products, % of total product exports



b) Knowledge-intensive services exports, % of total services exports



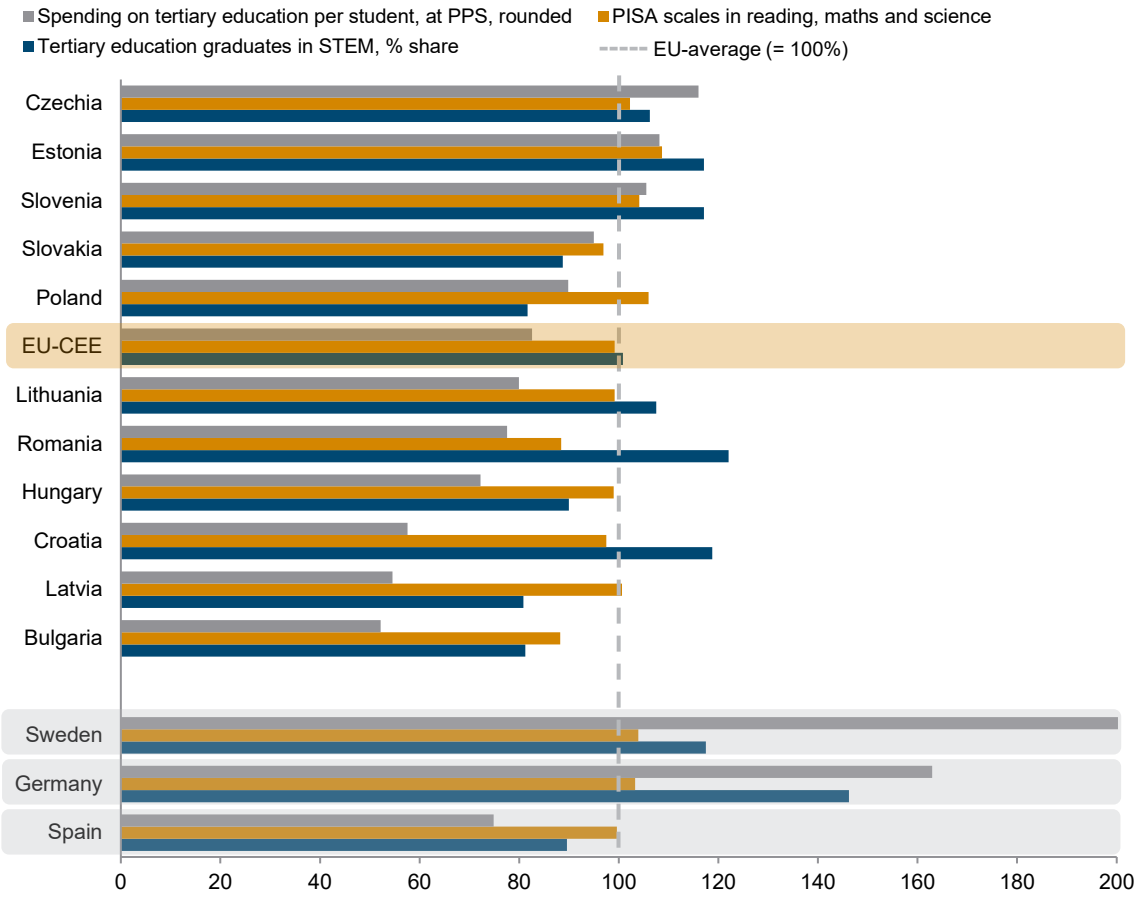
Source: Eurostat.

3.4. HUMAN CAPITAL

EU-CEE has a relatively high share of science, technology, engineering and maths (STEM) graduates, but education systems in general are of a lower quality than in Western Europe, which is a major risk factor for future innovation performance. On the one hand, the higher than EU average share of STEM graduates in the majority of EU-CEE countries is a very promising factor. On the other hand, rather weak PISA scales relative to the EU average, coupled with the serious underfinancing of the education system – shown, for example, by annual expenditures per student in tertiary education (Figure 7) – reveal the need for more policy measures aimed at the strengthening of human capital and national higher education systems. In view of labour shortages and unfavourable demographic developments observed in European countries,[26] human capital quality is becoming a critical factor for innovation capacity development in the region. In Section 3.1, we also pointed to the overall risk for the region stemming from the deterioration of this sub-dimension.

[26] Astrov et al. (2021).

Figure 7 / Main indicators of the educational system in EU-CEE and comparator countries, relative to EU average, %



Note: arranged in descending order separately in EU-CEE and peer countries groups by spending per student.
Sources: EIS; Eurostat.

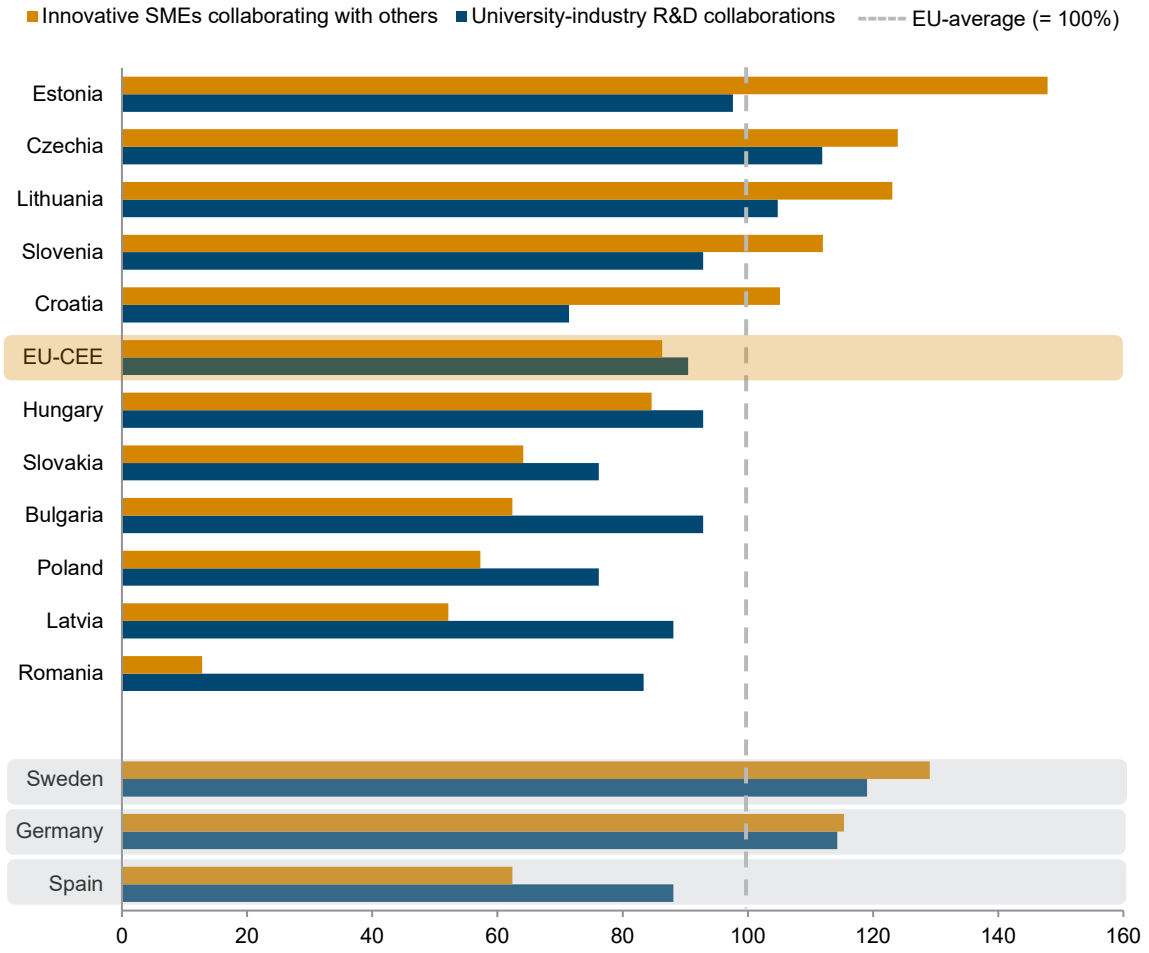
3.5. COLLABORATIONS

Academia-industry research collaboration is a uniformly weak element across the whole of the EU-CEE region, and is assessed by survey results as weaker than EU average in all countries except Czechia and Lithuania (Figure 8)**.** This is an issue from an innovation perspective because a well-functioning collaboration network and linkages between various actors – such as universities, scientific institutes, large firms, subsidiaries of multinational enterprises, start-ups and innovative SMEs – is an important feature of a successful innovation system, as pointed out in Section 2.

By contrast, some potential is emerging through the relatively good results in collaborations of innovative SMEs, particularly in some countries. This development partly reflects government efforts to develop a start-up-friendly ecosystem (see Section 4). However, the speed of development and the level of collaboration between innovative SMEs vary significantly between countries. The share of innovative SMEs collaborating with other actors is larger than the EU average in five out of 11 countries. Survey results indicate that Estonia even outperforms Germany and Sweden, and Czechia and Lithuania lie above Germany. Slovenia and Croatia also fare better than the EU on average. On the

other hand, a huge gap is apparent for Romania, which reaches only 12.6% of the EU average. Latvia, Poland and Bulgaria also underperform in this indicator.

Figure 8 / Collaboration in EU-CEE and comparator countries, relative to EU average, %



Note: arranged in descending order, separately in EU-CEE and peer countries groups by share of R&D funded by business.
Sources: EIS; Eurostat; own calculations

3.6. FUNDING

Despite rapid growth, innovation funding is still relatively underdeveloped, generally constrained by low supply of capital market instruments as well as weak demand from retail investors.[27] Nevertheless, a positive trend is confirmed by the survey-based indicator of finance for start-ups and scale-ups, for which all countries, except for Romania, are above the EU average, with Estonia and Latvia outperforming both Sweden and Germany[28] (Figure 9). Other studies[29] show that when it comes

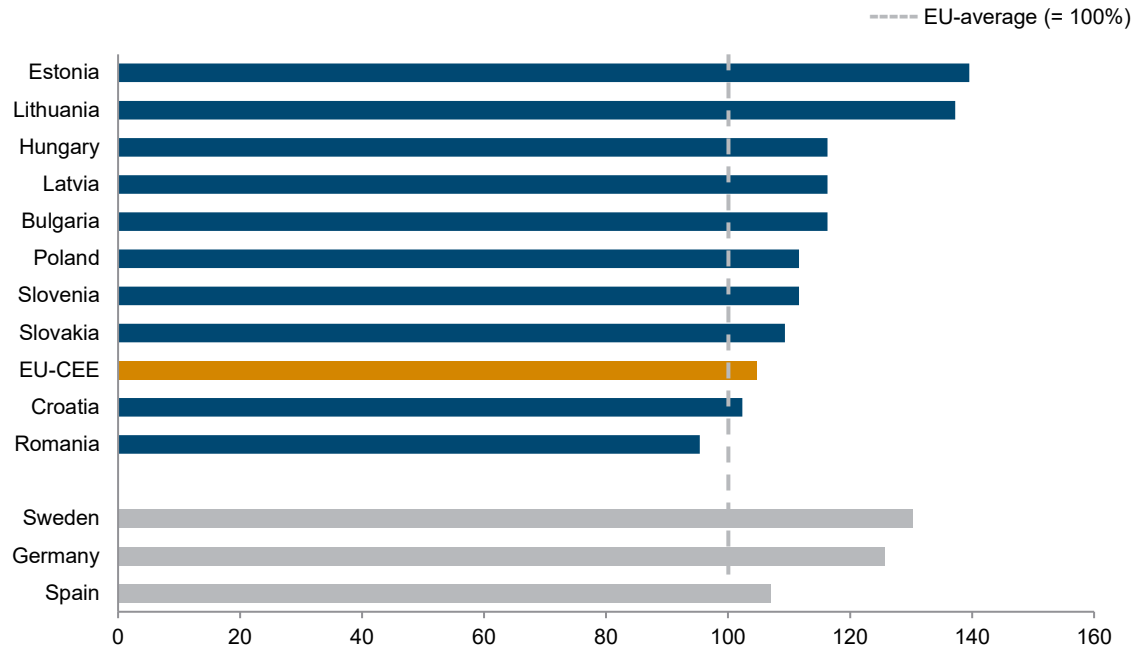
[27] Silvestri (2019).

[28] However, one should consider a limitation of this indicator as based on survey results. It shows an average perception score (five-year average of 2015-2022) of experts on finance for starting and growing firms in the National Expert Survey (NES) carried out by Global Entrepreneurship Monitor (GEM).

[29] Correia et al. (2018).

to venture capital activity, the ICT sector accounts for the bulk of the transaction volume in the region. However, EU-CEE companies report struggles in obtaining the necessary financing for their businesses, with the share of firms facing difficulties in obtaining external financing higher in EU-CEE than in the EU overall. More worryingly, firms classified as 'leading innovators' face more significant financial constraints than less innovative firms. This observation partly reveals the constraints associated with the role of venture capital in propelling innovation-driven development, as discussed in Section 2.

Figure 9 / Finance for start-ups and scale-ups in EU-CEE and comparator countries relative to EU average, %



Note: arranged in descending order, separately in EU-CEE and peer countries groups.
Sources: GII, 2023; own calculations.

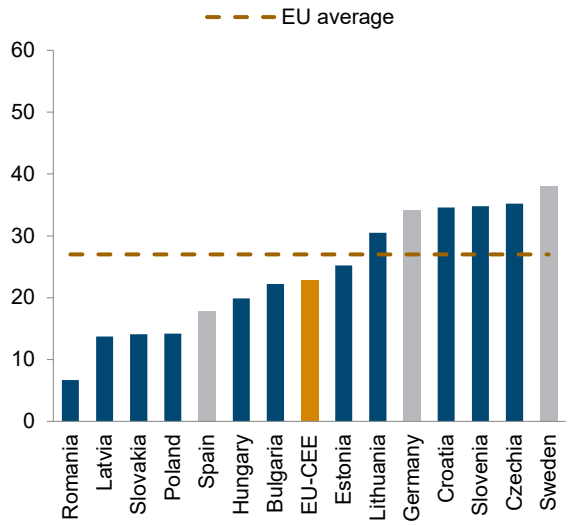
3.7. SMES AND START-UPS

The role of innovative SMEs as diffusers of knowledge and drivers of innovation still needs to be strengthened in EU-CEE. A combination of product and process innovations (the former, for example, in bringing a new or significantly improved product to the market, and the latter in coming up with new or significantly improved ways of processing, marketing or organising production) is essential for achieving sustained economic development. In EU-CEE, the implementation of business process innovations is at present more widespread among SMEs than product innovations. Nevertheless, the gap relative to the EU average persists in both cases, and is larger for business process innovations. Czechia, Slovenia, Croatia and Lithuania outperform EU averages, with all except Lithuania also ahead of Germany for the share of SMEs implementing product innovations. The same countries (but in a slightly different order) are also at or above the EU average level when it comes to process innovations. Czechia even outperforms Sweden in this respect. A significant effort is required by Romania to improve its position; it scores less than 10% in the relevant indicators (Figure 10).

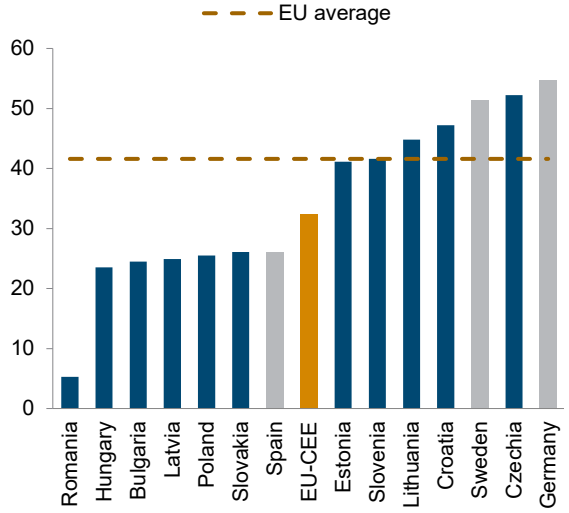
Highly innovative SMEs and start-ups tend to be concentrated in digital technologies and related sectors at present. Particular EU-CEE strengths include software and e-commerce in Czechia (with 'unicorn' firms such as Rohlik.cz or Productboard); ICT and car manufacturing in Croatia, with numerous rapidly growing companies and the 'unicorn' firm Rimac; business software and HR, fintech, cybertech, healthtech, advanced manufacturing and industry in Lithuania; and satellite technology, artificial intelligence, plastics and automotive engineering in Slovenia.[30] However, the macroeconomic impact of these firms remains limited and they tend to operate largely as isolated success stories.

Figure 10 / Innovative SMEs in EU-CEE

a) SMEs with product innovations, % share



b) SMEs with business process innovations, % share



Source: Eurostat.

3.8. INNOVATION IN THE CONTEXT OF THE 'TWIN' GREEN AND DIGITAL TRANSITIONS

The 'twin' green and digital transitions in the EU will have a major economic and social impact on EU-CEE. If the region does not upgrade its innovative capacities in both these areas, it risks being left behind by the next phase of economic development. The COVID-19 pandemic created a lasting shift towards remote work and a more digital economy, while emerging AI is threatening to disrupt many traditional industries in a major way. Meanwhile, the green transition has a particular resonance in EU-CEE, where the carbon intensity of production tends to be much higher, and so the changes required of industry will be particularly large. All of this will place great demands on EU-CEE's innovation capabilities.

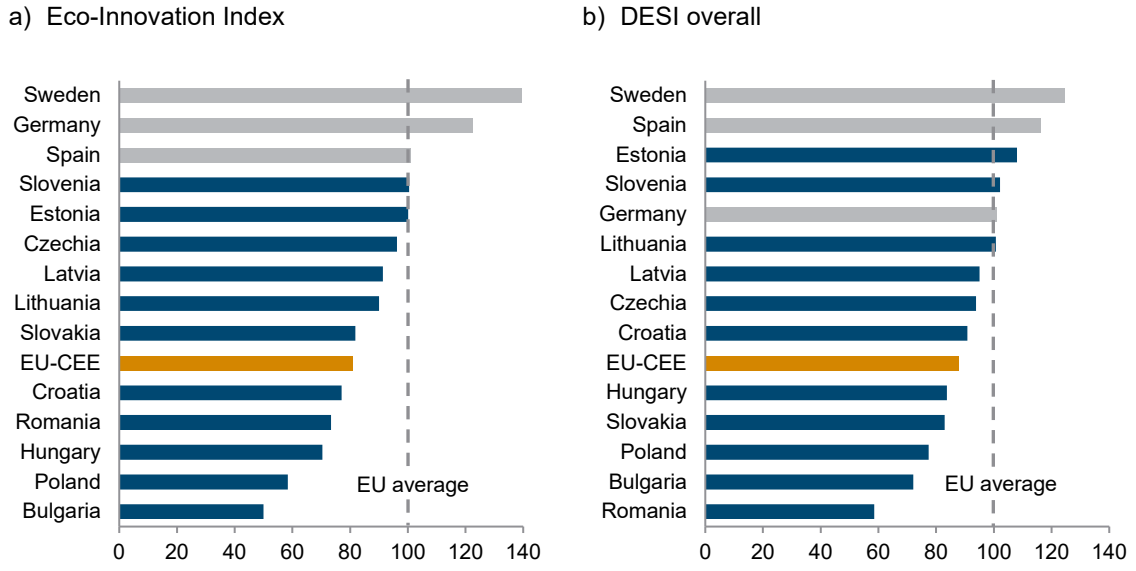
From an innovation perspective, EU-CEE has a long way to go in tackling the green transition. To capture the innovation system performance from an environmental perspective, we compare countries according to a composite indicator, namely the Eco-Innovation Index (Eco-II) of the Eco-Innovation

[30] See the country briefings at the end of the report; see also McKinsey (2020).

Scoreboard (Eco-IS) 2022.[31] Based on their eco-innovation performance, EU countries are classified into three groups: leaders, average performers and the catching-up group. Five countries of the EU-CEE region are placed in the average eco-innovation performers group, while all remaining EU-CEE economies are placed in the catching-up group. Slovenia (100.5%) and Estonia (100.2%) are the only two countries slightly above the EU average for eco-innovation overall performance, but even these are still below the level of Spain (Figure 11).

By contrast, EU-CEE seems better placed for the digital part of the twin transition. The Digital Economy and Society Index (DESI) provides an overall assessment of the performance of EU countries in relation to the digital transition. It is a composite indicator encompassing five dimensions of digitalisation: connectivity, human capital, use of internet services, integration of digital technology and digital public services. DESI points to narrower gaps in the development of the digital economy between most of the EU-CEE countries and the EU average. Three countries already outperform the EU average: Lithuania (100.8%), Slovenia (102.1%) and Estonia (108%), with the latter two of these also ahead of Germany. These conclusions are in line with the relatively favourable performance of EU-CEE in the 'digitalisation' dimension of the European Innovation Scoreboard (presented earlier, in Table 1), as well as the findings of our previous study (Zavarská et al., 2023), which highlighted important prerequisites to boost economic growth through the digital channel, as well as industry 4.0 trends in multiple EU-CEE countries.

Figure 11 / EU-CEE and comparator countries' Eco-II and DESI scores, 2022



Sources: DESI, 2022; EII, 2022.

[31] The index combines performance in five dimensions: eco-innovation inputs, eco-innovation activities, eco-innovation outputs, resource efficiency and socioeconomic outcomes, measured by 12 individual indicators.

4. The innovation policy landscape of EU-CEE countries

Key messages

- The effectiveness of designing and implementing innovation policies varies across the region, which is reflected in the divergent outcomes in innovation performance.
- Despite recent progress, such as the establishment of innovation agencies, a general challenge is that the innovation policy landscape of EU-CEE countries remains fragmented. FDI policies also tend to operate in isolation from innovation policies, making it difficult to implement industrial innovation strategies to upgrade EU-CEE's position in value chains.
- Innovation policies directed at firms tend to be skewed towards R&D-based, disruptive innovations, with start-up programmes and R&D tax incentives featuring frequently.
- Policies to promote more basic forms of innovation, such as improving or modifying existing products or processes, do not receive sufficient emphasis.
- Universities are not adequately incentivised to foster industry collaborations and commercialise their knowledge. However, some progress can be seen in parts of the region, including the establishment of technology transfer offices at universities and the growing usage of innovation vouchers.
- There is progress to be made in policies supporting human capital development, particularly in promoting vocational education and training, as well as brain drain mitigation and reversal.
- There are notable differences when it comes to the set-up and implementation of smart specialisation strategies. In some parts of the Visegrád and Baltic countries, smart specialisation appears to operate relatively successfully. These regions demonstrate effective stakeholder engagement, and make smart specialisation a core framework in their innovation policy making.
- EU membership offers promising possibilities for cross-country collaborations and learning, but the the current innovation policy approach of the EU- focused more heavily on the needs of advanced countries- hinders active participation of EU-CEE countries. Only a few EU-CEE countries utilise their national policy space to engage more actively in EU initiatives.

In this section, we review the innovation policy landscape of EU-CEE countries. Our aim is not to provide an exhaustive analysis of all relevant policies. Rather, by considering the main policy instruments used in the region, we intend to highlight some of the key challenges associated with the current situation. The next section (Section 5) sets out recommendations that follow from this assessment, providing a blueprint for addressing the identified areas of concern. For a detailed overview of the policy landscape in each EU-CEE country, see also the country chapters at the end of the report.

4.1. NATIONAL INNOVATION POLICIES IN EU-CEE

4.1.1. Innovation agencies and innovation policy governance

Enhancing innovation performance features frequently in strategic documents of EU-CEE countries, as lagging innovative capacity and the need for a new growth model are relatively widely acknowledged. However, in the current set-up, innovation policies remain highly fragmented. Policies intended to support different actors of the national innovation system are administered by a range of different government units, agencies and intermediary bodies, which seldom come together to co-ordinate their objectives.[32] One consequence of such a fragmented policy landscape is duplication in innovation policy efforts, as different actors inadvertently target similar objectives. Importantly for EU-CEE, FDI policies also tend to operate in isolation from innovation policies, making it difficult to implement industrial innovation strategies that would upgrade the countries' position in value chains and nurture local suppliers to multinational firms, as well as attracting higher-quality FDI.

EU-CEE countries have recently made progress by establishing national innovation agencies responsible for overseeing innovation initiatives. Most EU-CEE countries have an innovation agency in place in one form or another. These agencies are intended to serve as central hubs for policy co-ordination, offering 'one-stop shops' for innovation policy, representing good practice for improved policy governance. As noted in Section 2, strong governing institutions played an important role in Ireland and Singapore. Although in most EU-CEE countries, these agencies are not yet established in a way that their full potential can be met, they imply an encouraging move in the right direction. However, duplication remains an issue, with multiple innovation agencies/co-ordinating institutions present in a number of EU-CEE countries, including Hungary, Croatia, Poland and Slovakia (see the country chapters for details).

Another challenge when it comes to the co-ordination and oversight of innovation policy is the sparse evaluation of the policy mix. Evidence-based approaches to innovation policy making are still rather rare in the region, which can be partly attributed to limited capacities for data collection and analysis within the public sector. Consequently, the evaluation of innovation policies, particularly when considering the innovation system as a whole and the cumulative effects of the policy mix, is infrequent at best. This includes internal assessments, as well as policy reviews in partnership with international organisations. Academic studies[33] flag Romania, Croatia, Bulgaria and Slovakia as in particular need of improvement in this aspect.

4.1.2. Policies supporting firms

A variety of initiatives to promote innovation activities of firms exist across EU-CEE, with R&D tax incentives and support for start-ups in high-technology domains featuring particularly heavily. Eight out of 11 EU-CEE countries offer tax breaks to domestic and foreign firms for conducting R&D activities in their countries. Estonia, the strongest innovator in EU-CEE, does not offer fiscal incentives, and Latvia has recently abolished its R&D tax breaks. As tax-based support is not necessarily a conducive tool for spurring innovation in places where local businesses are not used to

[32] See, for example: World Bank (2019); European Commission (2019; 2022); OECD (2016).

[33] Borrás and Laatsit, (2019)

undertaking R&D (see Section 2), it is not entirely surprising to find reports of low uptake of the available tax breaks, particularly among local small and medium enterprises[34]

In relation to start-up promotion, the overarching challenge lies in transforming singular successes into thriving ecosystems. The fact that a number of EU-CEE countries are striving to create entrepreneurial environments through various start-up programmes is encouraging. In addition to financial support, initiatives include simplified administrative processes, mentorship and collaboration platforms, as well as streamlined visa procedures for entrepreneurs. Reflecting these efforts, countries such as Estonia, Czechia, Slovenia and Lithuania host a rather thriving start-up scene. However, in many cases, competitive domestic firms or even 'unicorns' remain isolated pockets in the economy (see Section 3). This points to the underdevelopment of effective cluster initiatives. Even in the well-known case of the Estonian ICT cluster, the sector remains only a fraction of the national economy, with exports still skewed towards more traditional domains such as forestry and oil shale.

To create demand for local innovative firms, EU-CEE governments are increasingly also utilising public procurement. This is especially the case among the most economically advanced countries of EU-CEE, and is in line with the global trend of increased use of demand-based innovation policy instruments. Although the legal environment governing innovation procurement remains cumbersome in large parts of the region, and institutional fragmentation and corruption often hinders successful implementation,[35] there are growing efforts to leverage the role of public tenders to spur innovation. For instance, by modernising the public infrastructure and adopting new technologies within the government, Estonia not only modernised its public services but also provided a crucial market for local IT companies.[36] Following in these footsteps, Czechia and Poland have also recently put in place relatively ambitious programmes to procure innovation for the needs of the state administration. Such strategies can offer inspiration for other countries in the region, although they need to be coupled with solid governance mechanisms.

One major gap in EU-CEE innovation policies is that they tend to overlook the role of more basic forms of innovation by firms, such as improving or adapting existing products and processes.[37] In the current set-up, innovation is mostly seen as analogous to invention, prioritising support for firms that have the potential to come up with technological breakthroughs. Yet, in order to move up the technological ladder, less advanced countries also need to learn how to imitate effectively, and use this knowledge as a springboard for their own inventions. Given the strong presence of multinational enterprises in these countries, this importantly includes policies for stimulating spill-overs and linkages between domestic and foreign firms (see Section 2). Such policies currently do not feature as integral components of EU-CEE countries' innovation strategies, which is partly a side-effect of the weak co-ordination between FDI strategies and innovation strategies.

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34 See, for example, OECD (2021); Vejvodová, (2022).

35 OECD (2017).

36 Lember et al. (2013); OECD (2017); European Commission (2019).

37 Radosevic (2017a).

4.1.3. Policies supporting universities and research institutions

Underdeveloped industry-university linkages pose a major obstacle to the proper functioning of the innovation system in EU-CEE, with incentives for improved collaboration emerging slowly. The commercial exploitation of research outcomes does not generally receive sufficient emphasis within university priorities. This can be partly attributed to the incentive structure of universities, which often receive funding based on metrics such as the number of enrolled students and the quantity of publications, rather than the quality of research outputs. As a consequence, policies relating to technology transfer, intellectual property exploitation and the valorisation of research results are not frequently integrated into university management strategies.

However, efforts to promote collaborations are increasing, notably through the adoption of innovation vouchers. These are small lines of credit given by governments to businesses (especially SMEs), which allow them to obtain tailored scientific outputs and expertise from public research institutions. By subsidising the costs associated with R&D projects, innovation vouchers encourage businesses to seek expertise from universities, driving collaborative initiatives. The majority of EU-CEE countries have voucher programmes in place, which represents an encouraging trend. In some countries, including Latvia and Romania, the programmes are designed in a way that seeks to emphasise alignment with smart specialisation strategies, indicating efforts to make individual policy instruments more coherent with an overall innovation strategy.[38]

Some countries are also establishing technology transfer offices within universities, to manage their intellectual property and promote the commercial application of research. This good practice is most obviously progressing in Czechia, where all major public universities have put in place technology transfer offices, which encourage spin-off companies and dissemination of knowledge to other actors in the innovation system. Furthermore, these technology transfer offices collaborate with institutions such as CzechInvest (the national investment promotion agency) or local innovation centres. Similarly, in Hungary, the Hungarian Cooperative Doctoral Programme introduced in 2020 encourages PhD students to conduct their research in collaboration with the business sector.

EU-CEE countries have made further efforts to upgrade their scientific research infrastructure, as outdated facilities had hindered local research capacities. Numerous university research centres have been established across EU-CEE, housing advanced equipment for conducting state-of-the-art research. However, a notable issue is that university research centres, along with the advanced equipment they house, are often dependent on various grants (mostly from EU funds), and sometimes become underused once external funding runs out.[39] Moreover, it is a documented issue that tangible investments tend to predominate over intangibles in EU-CEE.[40] As such, infrastructure building is only partly effective, as without complementary investment in skill building, effective utilisation remains limited. Romania has been exploring sustainable maintenance models and regulatory frameworks that encourage the commercial use of its scientific parks (see Box 4).

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38 Business.gov.lv (2023); European Commission (2022).

39 See, for example, Cedzová et al. (2021); Rusu (2022).

40 Astrov et al. (2022); Correia et al. (2018).

BOX 4 / PROMOTING THE COMMERCIAL USAGE OF PUBLICLY FUNDED RESEARCH INFRASTRUCTURE IN ROMANIA

EU finances have provided an impetus for increased spending on research infrastructure upgrading in Romania in recent years, and the country has established a number of technologically sophisticated scientific parks and research centres. However, the maintenance and utilisation of these centres soon came to represent a significant challenge. In recent times, the country has made progress in improving the effective use of its research infrastructure. This is exemplified by the experience of the Iuliu Haţieganu University of Medicine and Pharmacy (UMF Cluj) and its MedFUTURE Research Centre for Advanced Medicine.[41]

UMF Cluj established MedFUTURE in 2015, with the intention of setting up a 'high-performance research centre in the field of translational medicine'. Through the Sectoral Operational Programme for Economic Competitiveness (POSCCE), MedFUTURE received substantial grants – totalling over EUR 10m – to acquire advanced research equipment. Because of the cutting-edge facilities acquired through grant financing, the centre was able to conduct research activities in fields of advanced medicine, such as molecular and functional imaging and a variety of 'omics' technologies. However, after the initial project concluded and grants were exhausted, the specialised equipment became underutilised, running at just 20% of its full capacity by 2021.

Realising the unsustainability of such a set-up, MedFUTURE sought to improve the usage of its facilities to offset the substantial operational costs it faced to maintain the advanced equipment. One way to ensure the centre's future was to offer services to the private sector. However, this required the university to navigate the complex regulations governing the use of publicly funded infrastructure for commercial purposes. To this end, MedFUTURE received technical assistance from the World Bank, under the programme 'Supporting Innovation in Romania's Recovering Regions'. This entailed advisory work on EU state aid rules, as well as coaching activities. It shed light on the nature and extent of commercial activities that are permitted within the regulatory framework, and assisted in-house experts in developing skills to market their services effectively.

MedFUTURE's subsequent commercial endeavours received a highly positive response, resulting in nearly 70 active projects using the centre's infrastructure just one year after its launch. As documented by the World Bank, this represented a remarkable 300% annual growth in usage. Following its strategic reorientation, MedFUTURE signed contractual agreements with a number of private-sector firms. These included a pharmaceutical company's Romanian subsidiary, with the agreement contributing to the development of novel compounds. MedFUTURE also recently established a hemostasis laboratory, expanding its offering and strengthening haemophilia care in the region.

The experience of MedFUTURE showcases the importance of providing a conducive regulatory framework to support innovation originating from research institutions. Unlocking the commercial potential of publicly funded research infrastructure represents one of the ways in which the research system can increase its financial sustainability, augment its social relevance and strengthen linkages within innovation systems.

[41] Based on information from Rusu (2022); Lucut (2022).

4.1.4. Policies supporting human capital development

A challenge shared by most EU-CEE countries is that the education system is not well-aligned to the needs of the labour market. It has been shown that increased emphasis on vocational education and training can counteract this problem, equipping individuals with the expertise needed for successful entry into specific industries. Indeed, the heavy emphasis on a high-quality education system was a critical success factor in Singapore's transformation to an innovative economy (see Section 2.2). In EU-CEE countries, some steps have been taken in recent years, including curriculum reforms, adoption of a dual education system and promotion of lifelong learning, although progress in this dimension represents a formidable task for the region.

Heavy 'brain drain' further diminishes the capacities to carry out innovation-oriented activities in EU-CEE countries, yet the policy response has been limited. Talented individuals, including academics and researchers, often seek opportunities abroad because of the potential for higher income, better research facilities and improved career prospects in other countries in the EU and beyond. To address this issue, some mitigation and 'brain gain' policies have been implemented. These most often encompass initiatives such as scholarships with employment guarantees, fellowships, and grants aimed at retaining and attracting skilled professionals, with such measures found in Bulgaria, Estonia, Lithuania, Slovakia, Poland and Romania. Initiatives that encourage collaborations with foreign universities and attract foreign researchers are also emerging. However, these programmes are often quite small in scale and ambition, supporting only a handful of individuals at a time, and are entirely absent in some countries.

4.1.5. Policies supporting the financial sector

Almost all EU-CEE countries have introduced specific programmes for venture capital development, with mixed success. Czechia and Bulgaria are the only exceptions in this regard, having no stand-alone venture capital policy initiatives. Within specific policies, funds to support start-ups are gaining particular momentum across the region. These innovation funding programmes often involve government-backed funds that co-invest with private investors to support start-ups and innovative businesses, as well as various 'funds of funds' that invest in venture capital. The Baltic states have been particularly active users of such policies, and have been rather successful in promoting the diffusion of innovation funding mechanisms (see also Section 3). As the Baltic experience shows, public-backed funds can be effective when coupled with the creation of a favourable regulatory environment for venture capital, including low registration fees and digitalised public services, as well as low administrative barriers.

In some cases, however, institutional challenges constrain the effectiveness of policies targeting innovation financing. There have been reports of inefficiency, corruption and misuse of public venture capital funds, particularly in those EU-CEE countries characterised by low levels of institutional quality. Active interventions, therefore, do not always translate into tangible outcomes, as they require good governance and sound institutions. Furthermore, governments need to exercise caution in endorsing venture capital, recognising the evolving nature of these markets, as they may not consistently prioritise firms with genuine development potential (see Section 2).

4.2. EU-WIDE INITIATIVES

4.2.1. Smart specialisation

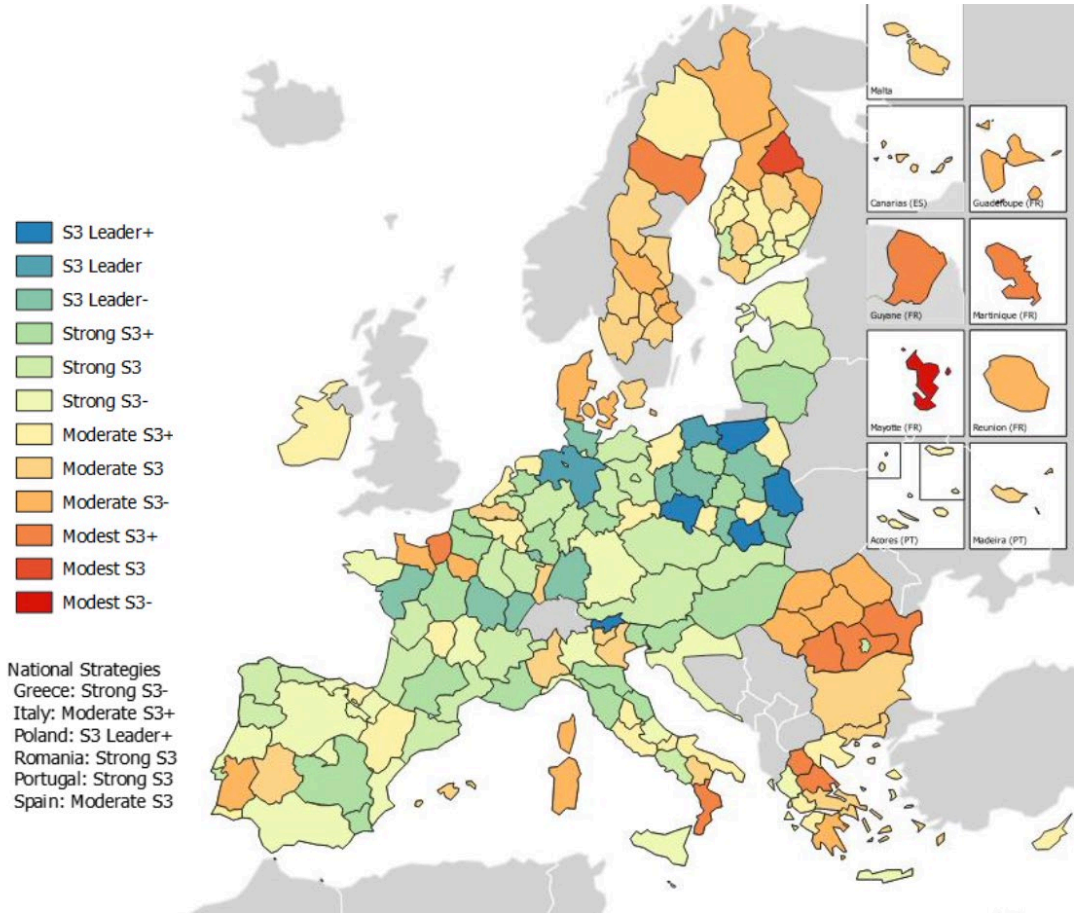
In theory, smart specialisation strategies represent a useful way of creating a balanced and appropriate set of industrial innovation policies across the EU. The idea behind smart specialisation is that economies leverage their distinct strengths by pinpointing particular areas of specialisation and invest in these niches to create a unique knowledge base conducive to innovation. The identification of specialisation areas should take place in a collaborative way, engaging all actors of the innovation system.

In reality, there are notable differences across EU (and EU-CEE) countries in their ability to successfully set up smart specialisation strategies. In particular, the less-developed parts of EU-CEE appear to be struggling to implement well-functioning smart specialisations. As Figure 12 shows, regions in Romania and Bulgaria especially lag on this front. One contributing factor to the observed divergence is the difference in how effectively the specialisation domains are defined. Best practices show that a good smart specialisation strategy specifies well-identified (narrowly defined) priorities. In parts of the EU-CEE, however, one instead finds broad and vague definitions of specialisations, such as in 'innovative technologies', 'cutting-edge technologies', or 'services'. Given that the adoption of a smart specialisation strategy was a condition to securing certain types of EU financing, some regions resulted to pro forma definitions of strategies, arbitrarily selecting sectors, often mirroring what their neighbours were doing. In such cases, the identified smart specialisation priorities do not interact with a country's core innovation strategy.[42] Multiple EU-CEE countries and regions are also facing delays with updating their smart specialisation strategies for the 2021-2027 cycle. All these aspects point to institutional shortcomings in administrating the strategies.

However, there are also areas in EU-CEE where smart specialisation operates relatively successfully, particularly in parts of the Visegrád and Baltic regions (Figure 12). For example, the South Moravian region of Czechia has built a rather strong regional innovation system with this approach. Founded as a joint initiative of the regional and municipal authorities, as well as four reputable universities of the region, the South Moravian Innovation Centre (JIC) is responsible for co-ordinating the regional smart specialisation agenda. The JIC also provides a platform for different innovation system actors to come together and collaborate, allowing for sound stakeholder engagement in the entrepreneurial discovery process. The region's most recent smart specialisation strategy (2021-2027) sets the upgrading of activities of multinational enterprises in the region as one of its core targets, collaborating with the regional office of the national investment promotion agency, CzechInvest, to meet specifically defined targets and objectives.

[42] See, for example, Karo et al. (2017); Di Cataldo et al. (2022); Prognos and CSIL (2021); Blažek (2016); Radosevic, (2017b); Radosevic and Ciampi Stancova (2015; 2018).

Figure 12 / Smart specialisation scoreboard, 2014-2020



Note: the scoreboard is a comparative assessment of all 185 smart specialisation strategies in EU member states and regions. For details, see Prognos and CSIL (2021; 2022).
Source: Prognos and CSIL (2022).

4.2.2. Framework EU initiatives

EU membership provides opportunities for collaboration and learning, but the current innovation policy approach of the EU- focused more heavily on the needs of advanced countries- makes it challenging for EU-CEE countries to participate. This is a point we also emphasised in the context of industrial policy (see Zavarská et al., 2023). Cross-border initiatives of the EU represent useful mechanisms for less advanced countries in their innovation-capacity building – framework EU programmes such as Horizon Europe do not only financially support innovative researchers in EU-CEE countries, but also help these nations tap into the expertise and resources of more advanced countries, fostering knowledge exchange and technological advancement. However, ensuring the effective participation of EU-CEE countries in the European Research Area and EU's joint policy initiatives represents a formidable challenge. This is because the focal point of the EU's industrial innovation policies tends to be on the technological frontier, which does not necessarily align with the development stages and capabilities of EU-CEE nations.[43] As a result, the ability to participate greatly depends on the economic strength of the member state.

[43] Landesmann and Stöllinger (2019); Zavarská et al. (2023).

To tackle this challenge, a few EU-CEE countries recently began using their national policy space to spur more active participation in EU initiatives. There is growing recognition that it is not only necessary to adapt EU initiatives in a way that would be more suitable for EU-CEE's development levels, but also for EU-CEE countries to devote more efforts into securing increased representation in cross-border collaborations. Consequently, some EU-CEE countries, particularly in the Visegrád region, have implemented policies to enhance their participation in EU-wide innovation programmes. These initiatives include aspects such as simplified access to information on various project calls, financial and technical assistance in the project acquisition process, and matching grants for successful applicants, in order to ensure continuity of research after the EU programme and encourage commercialisation of research.

Some integration of local firms into international and EU collaboration networks is emerging in the region. For instance, Important Projects of Common European Interest (IPCEI) [44] represent one of the relevant EU policy initiatives interlinking innovative EU firms, which can help EU-CEE countries to augment their technological capacities through cross-EU knowledge exchange. Although no EU-CEE countries participated in the first IPCEI in the field of microelectronics, the second programme, approved in June 2023, includes Czechia, Poland, Romania and Slovakia. Poland had already participated in the first IPCEI for batteries, which started in 2019 and aims at innovations across the whole batteries value chain. In the second batteries programme, approved in 2021, two more EU-CEE countries – Croatia and Slovakia –joined. In hydrogen, Czechia, Estonia, Poland and Slovakia participated in the first IPCEI (hydrogen technology), and Poland and Slovakia in the second (hydrogen industry), aimed at the reduction of the natural gas dependency in Europe via innovations in the hydrogen value chain. Although EU-CEE partners seem to be more involved in IPCEI in the most recent programmes, the number of participating firms is still low, and is less than from Western Europe.

[44] https://competition-policy.ec.europa.eu/state-aid/legislation/modernisation/ipcei/approved-ipceis_en

5. Policy recommendations

EU-CEE needs a new, innovation-driven growth model. As the most innovative and advanced economies show, government policy is central to innovation-driven growth in terms of funding and creating networks between all relevant parts of the innovation process. The experience of countries such as Ireland or Singapore, both of which successfully made the transition from a reliance on foreign enterprises to become global innovation leaders, indicates that EU-CEE countries are also capable of making this transition if the right sets of policies are put in place.

At present, however, there are notable differences in innovation performance across the region. As we show in this study, low levels of business R&D spending and weak collaboration among innovation actors stand out as crucial factors impeding the performance of EU-CEE innovation systems. A major challenge lies in the low level of innovativeness of domestic companies, coupled with the concentration of technological know-how within foreign enterprises, which are currently isolated from the rest of the economy. The policy landscape is a mixed picture, with some EU-CEE countries making progress in fostering innovation through proactive initiatives supporting firms, researchers and the financial sector, while others face challenges in creating a conducive environment, hindered by weak policy co-ordination, institutional shortcomings and inadequate incentive structures. Despite these differences, all EU-CEE countries are in the relatively early stages of their innovation system development.

In this final section, we consolidate these insights to propose solutions available to EU-CEE policy makers. We break down our recommendations into five pillars.

5.1. STRENGTHENING THE GOVERNANCE OF THE INNOVATION SYSTEM

5.1.1 Implement a long-term strategy that is not subject to radical change or abandonment based on the electoral cycle, empowering a single innovation agency to co-ordinate the innovation policy mix. The current policy landscape of the region reveals a lack of clearly defined roles among innovation policy actors and inadequate collaboration, hindering the synergy between individual policies. Some countries are already making progress in this direction by establishing new co-ordinating mechanisms and institutions, merging agencies with related agendas and more clearly defining responsibilities.

For instance, recent developments in Estonia can offer inspiration. Following long-standing challenges with fragmentation, the governance of innovation policies was consolidated in 2022 through the establishment of the Estonian Business and Innovation Agency. This was done by merging KredEx and Enterprise Estonia, both of which were previously independently active in supporting innovation, attracting FDI, recruiting talent from abroad and promoting start-ups. This represents a first step in Estonia's efforts to bring together innovation policies with other related areas and establish a clear division of roles among the actors involved in innovation policy making.

Ideally, EU-CEE countries would organise a national summit on innovation as a first step, with all relevant actors from politics and science involved in identifying the country's comparative advantages and formulating a consensus-based long-term innovation strategy based on this. Given the uneven environment in terms of institutional quality and political stability in EU-CEE, this is naturally more feasible in some countries than others, but should be the eventual aim of the whole region. After that, innovation agencies should be strengthened and streamlined, and tasked with implementing and, where necessary, updating the strategy, free from political micro-management.

Additionally, a more critical focus on implementation is necessary within these structures, transforming policies from paper to reality. The innovation agencies should take a central role in overseeing this process and creating platforms for the actors of the innovation system to come together and collaborate.

To ensure a sustained commitment to innovation policy, these agencies need to become robust governance mechanisms that have at least some level of insulation from political fluctuations. This may involve insulating key decision-making bodies from political appointments and ensuring that leadership positions within innovation agencies are based on technical expertise. Despite various geo-economic differences, the experience of East Asia provides a useful guide to such a pragmatic approach.[45] At the core of its policy making was a long-term strategy with the buy-in of all key actors, so that policies could be implemented over much longer periods than a single election cycle.

5.1.2 Make better use of EU funds and back them with stronger national innovation efforts. From a converging country's perspective, the reality that EU-CEE can lean on EU finances is a substantial advantage. Nevertheless, the low absorption rates in specific countries and the frequent inefficiency in utilising EU funds represent a missed opportunity. Moreover, these countries traditionally dedicate a disproportionate share of their funds (also EU funds) to tangible investments, underemphasising the role of intangibles such as R&D. This calls for a re-evaluation of how available funds are being spent.

Furthermore, a better continuity of available support measures needs to be ensured, to avoid situations such as the underutilisation of research infrastructures, or the premature abolition (as a result of the conclusion of specific EU funding) of incentives that were working effectively. This can be made possible by the better governance of innovation policies and a more consistent evaluation of EU calls at the national level. In addition, tools such as matching grants can be used to complement EU funding with national efforts, therefore ensuring a full national buy-in of innovation policies.

5.1.3 Improve the quality of public administration. To enhance the effectiveness of innovation policies, prioritising improvements within the public administration is crucial. In addition to expanding the pool of innovation policy experts, this includes a shift towards a culture of evidence-based policy making, by establishing and strengthening in-house capacities to analyse different policies and their interactions. This transformation ultimately relies on the quality of public servants. As the private sector often tends to offer more attractive career opportunities in the EU-CEE region, the issue of 'brain drain' also relates to the flow of labour from public to private sector. Hence, enhancing the attractiveness of public-sector employment to compete with opportunities in other areas of the labour market is crucial. This includes

[45] See Zavarská et al. (2023) for lessons learned from the East Asian experience from the EU-CEE perspective.

offering competitive compensation and benefits, creating a dynamic organisational culture, and providing attractive career progression opportunities.

Here, the progress made in Slovakia is worth mentioning. Most Slovak ministries have set up analytical units composed of subject-matter experts, responsible for evidence-based policy evaluations.[46] Their aim is to guide reforms and achieve policy change in line with international best practice. Throughout the process, they are committed to more efficient use of public resources, underpinned by the principle of value for money. By providing scholarships to students at foreign universities and linking them to employment within these analytical units, the recruitment of skilled experts is further facilitated.

At the same time, recognising institutional capacity as a critical bottleneck, it is crucial to advance institutional quality and engage a spectrum of stakeholders beyond the state, such as industry associations or chambers of commerce. Empowering these entities to self-organise and align with supportive policies is vital for translating policy objectives into reality.

5.2. HELPING FIRMS TO CLIMB UP THE TECHNOLOGICAL LADDER

5.2.1 Boost the innovativeness of domestic firms to help them upgrade and grow. An important objective of future innovation policies in EU-CEE is to strengthen the innovation profile of existing enterprises. As the backbone of these economies is composed essentially of three types of firms – foreign firms, second-tier specialised suppliers and other domestic firms – it is a priority that all of these are given a chance to upgrade. In this regard, nurturing local supplier development, incentivising secondary, downstream innovations, and enhancing organisational and management capabilities are all important objectives of the new innovation policy toolkit of the region. To achieve this goal, an appropriate policy mix has to be designed. This includes R&D incentives – fiscal, and especially, financial incentives (as discussed under Point 2.6 below); policies in support of clusters, to promote learning across firms; and policies to maximise learning opportunities from FDI (see Point 2.2); and policies to help firms to upgrade their business strategies by identifying promising market niches (see Point 2.4), but also to improve the quality (for example, via a higher uptake of international quality certifications) and sustainability of local production. Meanwhile, the initiatives and incentives for digitalisation – which is already a quite active area of policy making in the region and a relative area of strength – should be maintained and, where necessary, made more effective.

It is also important to recognise that for EU-CEE countries, the move from imitation to innovation involves not only promoting cutting-edge innovation, but also getting the initial stage of imitation right. Productivity gaps between EU-CEE and the world's most advanced economies are still generally huge, indicating major catch-up potential via the further absorption of existing innovation. Hence, while embracing the digital and green transition and making the most of megatrends, it is important to avoid an over-emphasis on science-based or R&D-intensive sectors and be mindful of the innovation potential of more traditional, lower-tech industries. This is consistent with the idea that, beyond scientific excellence, innovation policies should also strive for local relevance. This is crucial not just to set realistic goals for the region, but also to allow these new companies to become fully embedded in the innovation system.

[46] See https://www.mfsr.sk/sk/financie/hodnota-za-peniaze/analyticke-jednotky/

5.2.2 Be more selective in FDI promotion, and incentivise existing multinational enterprises to take on more knowledge-intensive activities. EU-CEE countries need to embrace a more strategic approach in their FDI promotion policies to encourage upward movement in the value chain (as we emphasised in Zavarská et al., 2023). In this regard, successful innovators such as Singapore and Ireland, characterised by their openness to FDI and collaborative partnerships between foreign and domestic firms, can serve as compelling examples for EU-CEE countries. These economies were also able to redirect the focus of multinational firms already present in the country from production and assembly to research, design and development activities. This requires moving away from giving out financial incentives to incoming investors in an untargeted way, and implementing FDI promotion policies that prioritise sectors aligned with a country's innovation goals (such as priority areas identified in smart specialisation strategies). The 'innovation by invitation' approach taken by Ireland, whereby the incoming investments were scrutinised and promoted on the basis of their innovation potential, is a particularly useful way to look at FDI promotion policies going forward.

Ultimately, whether FDI can be redirected towards more technology-intensive activities such as R&D will also depend on whether these countries will be able to strengthen their innovation system, for example by upgrading existing industries, creating innovative ancillary industries and (good-quality) second-tier suppliers, and by offering multinational firms highly qualified STEM graduates, with competencies in line with the needs of industry (see Points 3 and 4).

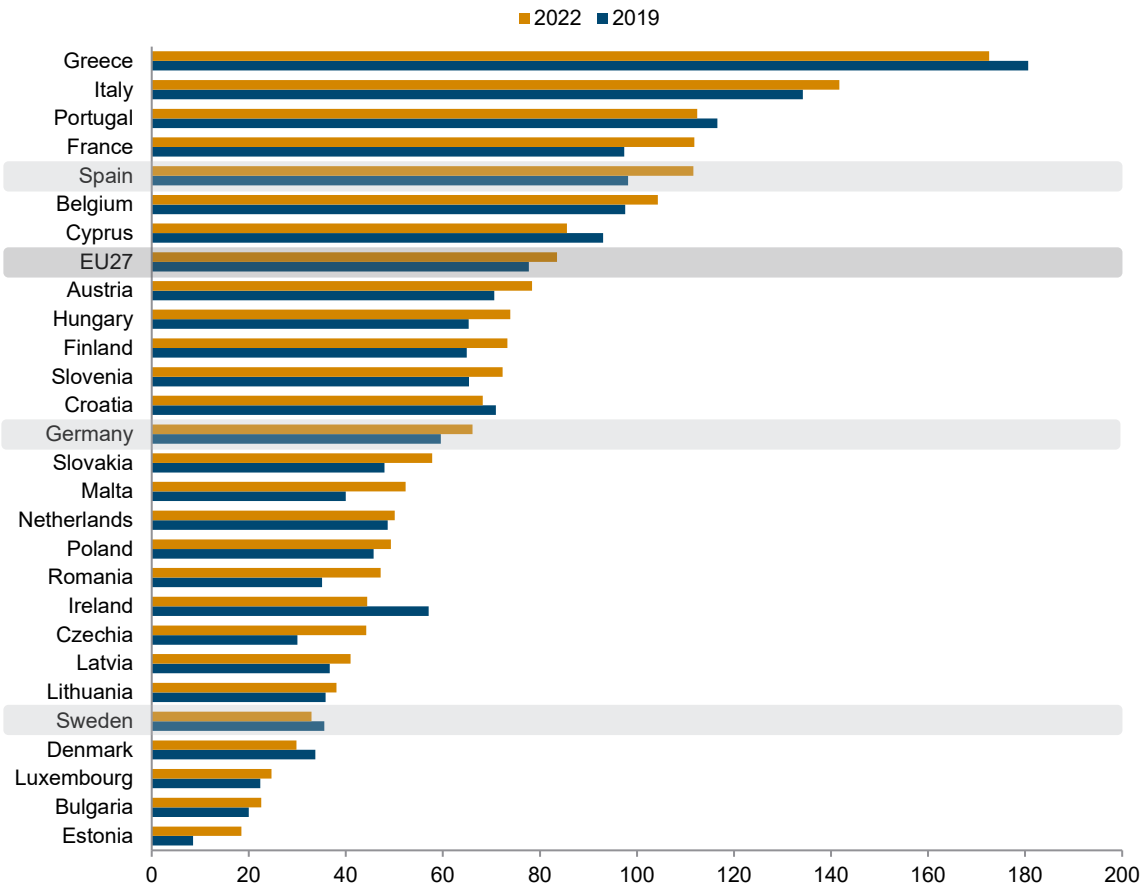
5.2.3 Put more emphasis on policies stimulating linkages between multinational enterprises and local firms. Given the dual-track economic structures of EU-CEE, where highly productive foreign enterprises continue to operate in relative isolation from domestic firms, the countries of the region need to become more successful importers and users of foreign knowledge. First, this requires augmenting the capabilities of domestic firms (as outlined in Point 2.1). Once domestic firms reach a sufficiently high level of quality that they supply foreign firms in the country, the ensuing technological transfers and knowledge spillovers that originate from these collaborations will further accelerate the upgrading of the domestic firms. Therefore, in addition to the FDI promotion strategies we suggest in Point 2.2, policies should focus on steering foreign investments into existing clusters or innovation hubs to induce collaboration between local and domestic firms, establishing networking platforms between local specialised suppliers and the multinational enterprise, or negotiating greater training and collaboration with local education institutions. These facets remain largely absent from the core of present-day innovation policy efforts, and FDI policies are isolated from industrial and innovation strategies.

5.2.4 Identify promising niches and build them up, relying on the smart specialisation framework. As we highlighted in this study (and also in the previous study, see Zavarská et al., 2023), a number of internationally competitive firms have emerged from EU-CEE in recent years. So far, these remain isolated success stories with limited economic relevance. But, if supported with the right set of policies, their presence can forge pathways into new and successful niches. This requires long-term strategic thinking on the side of governments (see also Point 1.1), as the private sector cannot be expected to succeed on its own. Hence, it is necessary to step up efforts in cluster building and export promotion, as well as in expanded collaboration platforms such as innovation hubs. As shown in the case of Ireland, government initiatives can help local smaller firms to find these market opportunities and exploit them by helping them in the formulation of business and internationalisation strategies.

The smart specialisation framework can be particularly useful for identifying promising niches, bridging the domains of industrial and innovation policy making. These strategies have to be produced by EU member states, with certain EU funds channelled to the priorities identified in the smart specialisation documents. As such, the priorities identified within the framework can contribute to more targeted innovation policy initiatives. Moreover, the smart specialisation offers specific tools and guidelines to policy makers, and the implementation of the strategy has led to some institutional learning in the sphere of innovation policy making. In addition, if implemented well, the strategy effectively combines ambition (with the strategy having a forward-looking element) and realism (as it concentrates on present specialisations and endogenous capacities). Both of these elements are particularly important in least advanced countries and regions, which need a structural change process that is truly transformative, yet feasible.

5.2.5 Move away from fiscal incentives as the core instrument to spur business R&D spending. As this study has shown, EU-CEE countries skew towards fiscal R&D incentives, with a limited presence of other financial instruments. This is in contrast with some very recent trends in more advanced EU member states, especially Germany, where a return of state aid in support of industries is evident. For a deeper structural transformation processes to take place, the region should not shy away from using other instruments, such as subsidies and even grants, to create new innovative industries and cultivate successful domestic firms.

Figure 13 / General government debt, % of GDP



Source: Eurostat.

This holds particular relevance for certain countries of the EU-CEE region, which are characterised by solid fiscal space and relatively sound institutional quality. Although the pandemic caused a significant increase in government debt-to-GDP ratios in much of the region, and indeed the whole EU (Figure 13), and was followed by a sharp rise in interest rates that makes servicing this debt more expensive, the situation is far from equal across the region. Some countries are constrained in their fiscal policy options and by their institutional quality, whereas others, such as Czechia and the Baltic states, have some room for manoeuvre.

Given the EU membership of the countries under consideration, it is necessary take into account the specific regulations and restrictions imposed by the EU in relation to state aid schemes.[47] It is important to note that state aid in support of R&D and innovation is deemed compatible with EU rules. Especially following changes to the recent amendments to regulations on state aid,[48] direct financial support is being increasingly utilised by various EU member states. Given that these exceptions relate in particular to the twin transition, if well-designed and targeted, they can be a useful tool to advance R&D activities related to green and digital technologies.

Where possible, countries can also consider more strategically leveraging public procurement as a means of supporting innovation activities of firms. By incorporating innovation criteria into procurement processes (as is increasingly done by certain EU-CEE countries), governments can incentivise companies to develop and deliver cutting-edge solutions.

5.3. STRENGTHENING THE ROLE OF UNIVERSITIES AND RESEARCH INSTITUTIONS

5.3.1 Strengthen the links between academia and business. Given the low competitiveness of EU-CEE research systems, particularly when it comes to marketability of the generated knowledge, universities play a limited role within EU-CEE's innovation systems. In part, this relates to the financing structure of universities, as their funding is only loosely tied to their research outputs. By making collaboration between universities and industry a prerequisite for certain types of funding, governments could achieve a variety of important objectives, such as encouraging knowledge flows between academia and industry, supporting the growth of science-based industries, and bringing university curricula closer to industry needs. To ensure greater marketability of knowledge, it is also essential to review the regulatory frameworks governing publicly funded institutions, to ensure that these do not impede the ability to create spin-offs, or to capitalise on intellectual property, or to utilise idle research equipment for commercial purposes. The establishment and active use of technology transfer offices, which is increasingly becoming the norm in Czech universities (see Section 4), represents good practice that should be replicated more widely in the EU-CEE region overall. In addition, a wider application of tools such as innovation vouchers would stimulate stronger university-industry linkages, inducing business demand for research produced by local universities. Also in this field, the region can leverage EU funds and initiatives. For example, Horizon Europe encourages the commercial application of research outputs.

[47] In particular, the General Block Exemption Regulation (GBER) and the de minimis Regulation.

[48] Commission Regulation (EU) 2023/1315 of 23 June 2023.

5.3.2 Encourage international partnerships and provide opportunities for cross-border mobility of researchers. Promoting active participation in cross-border research networks provides scope for greater learning, improving the quality of research institutions. This is a major advantage that EU-CEE countries have over other regions looking to boost their innovative capacities, as their membership of the EU gives their researchers relatively unimpeded access to collaboration with some of the most advanced research institutions in the world. There are various means of stimulating such partnerships, such as making research collaboration grants more widely available, negotiating various fellowship programmes (also within the EU-CEE region), and simplifying work permits and visa procedures for international researchers. The design of these EU-wide initiatives can also act as an inspiration for creating EU-CEE-specific cross-border research programmes.

5.3.3 Promote international excellence without neglecting local relevance. Although it is crucial to promote the international competitiveness of EU-CEE research institutions, a focus on excellence can result in a situation where the knowledge produced does not reflect the economic conditions and industrial needs of EU-CEE countries. In this sense, it is important to simultaneously motivate more locally embedded research, matching and dynamically reviewing education policies with evolving stages of economic development (as done successfully in Singapore; see Section 2). This builds on the point concerning the importance of secondary innovation in the EU-CEE context (Point 2.1). Hence, inducing downstream collaboration of universities, closer to the stages of commercialisation, should not be neglected.

5.4. DEVELOPING HUMAN CAPITAL FOR INNOVATION

5.4.1 Expand STEM education. As Section 3.4 showed, despite the high number of STEM graduates in several EU-CEE economies, a gap still exists with more advanced EU economies, most notably Germany. Moreover, the quantity of STEM graduates needs to be accompanied by the provision of high quality STEM education at all levels. As illustrated for example in the relatively low – and in many cases, deteriorating – PISA scores of EU-CEE pupils, particularly in science and mathematics (see the country chapters), there is a need to emphasise these fields more strongly in the education system. These skills are a fundamental prerequisite for innovation activities, not limited to technologically advanced, science- and engineering-intensive industries. In order to expand the availability of STEM graduates and professionals, the region should provide higher incentives to students to undertake STEM programmes, for example via scholarships for local as well as foreign students, grants to establish and expand STEM activities and pathways in universities that are state-of-the-art (covering topics such as artificial intelligence, data science, robotics, etc.), as well as knowledge building through cross-border exchange (Point 3.2) to improve the quality of the programmes. Moreover, primary and secondary education curricula should put greater emphasis on science and mathematics, as well as technical and IT skills such as programming. Where this is not already the case, EU-CEE countries can consider making school leaving examinations in these subjects compulsory.

5.4.2 Develop more assertive policies aimed at retaining, attracting and getting back talent from abroad. Brain drain is a serious impediment to the innovation-driven growth of the region, with high-performing students and skilled workers often choosing to move abroad in search of a better life. Policy instruments to offset the ‘pull’ factors from outside remain underdeveloped in the region, with some EU-CEE countries having no explicit initiatives in this direction. These incentives can take various forms,

including scholarships with employment guarantees, grants, fellowships, streamlined visa and work permit procedures. Through these initiatives, the objective is to provide more exciting opportunities to skilled professionals for working and living in EU-CEE countries.

Furthermore, in order to retain young people and encourage the return of emigrants, the role of social policies cannot be underestimated (a point we also emphasised in Grieveson et al., 2021). This involves aspects such as tackling the availability of housing in these countries, especially for young families, as well as improving 'liveability' through the quality of public services such as healthcare, childcare and public transport.

5.4.3 Dedicate greater efforts to making vocational education and training (VET) more attractive to students. In order to build an education system equipped to efficiently absorb, adapt and ultimately, produce knowledge, it is not only necessary to bring universities closer to industry needs, but also to consider the role of secondary education. Opportunities to learn outside the classroom need to be encouraged, expanding work-based learning within EU-CEE VET curricula. EU-CEE countries can build on the presence of multinational firms to advance apprenticeship and internship programmes, career exploration programmes and mentorship initiatives, to ensure that students get hands-on experiences from a relatively early age. Incorporating industry representatives into the dialogue on the development of curriculum frameworks can further align labour market needs with the skills being taught at schools.

An additional challenge lies in best-performing students often tending to opt for general education pathways, sidelining VET in the region. Hence, there is a need to come up with strategies to make VET more appealing to students. Policy makers can explore various merit-based scholarships, or recognition programmes specifically for those excelling in vocational pathways. The aim here is also to ensure a more balanced talent distribution, so that high-achieving students are more drawn to, and can excel in, vocational learning.

5.5. EXTENDING THE ROLE OF THE FINANCIAL SECTOR

5.5.1 Ensure innovative ventures have access to the right type of finance. Creating a conducive legal and investment climate is crucial for expanding the availability of investors in risky, innovative enterprises. The progress in creating markets for private and public financing mechanisms varies significantly across EU-CEE countries. Drawing inspiration from the successful innovation financing strategies of the Baltic states can be especially useful. This entails reviewing the regulatory environment and lowering the administrative barriers to setting up funds, as well as actively incentivising the emergence of new funds. The promotion of regional funds can also be useful in pooling smaller markets. Furthermore, governments can explore the viability of co-investment mechanisms or government-run funds, although they need to be careful not to crowd out and displace private funding. It is also important to keep in mind that different stages of innovation require different forms of finance, and hence governments need to review whether certain stages or certain firms are not particularly financially constrained.

PART B

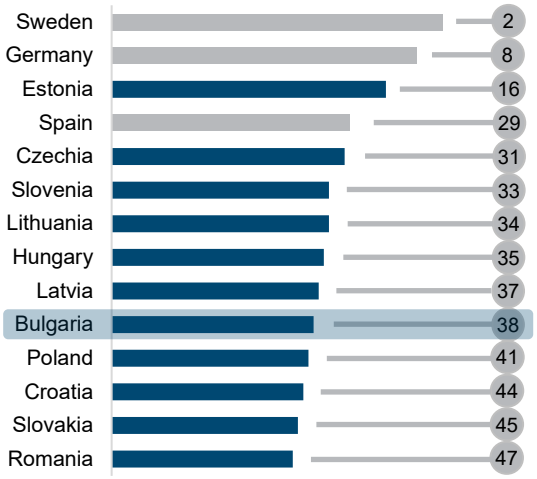
COUNTRY BRIEFINGS

Bulgaria

INNOVATION LANDSCAPE

Bulgaria's innovation performance is average by EU-CEE standards, according to the Global Innovation Index. This outcome is actually rather positive, given that it is the poorest EU member state. Furthermore, Bulgaria outperforms all its neighbouring countries and those in the Western Balkans. However, it is still among the worst-performing EU countries, and has seen its ranking decline since 2021.

Figure 14 / Global Innovation Index – Bulgaria - Rank 38 out of 132 countries



Source: GII 2023.

The country scores particularly strongly in ICT access and ICT services exports. The ICT sector has a long tradition in Bulgaria, dating back to the communist era, and the software industry stands out as its best-performing sector. According to the Bulgarian Association of Software Companies, the share of the software sector in GDP has increased nearly threefold during the last 10 years. Another key strength is intellectual assets, and especially design and trademark applications, in which Bulgaria performs better than the EU average. However, severe deficiencies in institutions, market sophistication, and human capital and research hinder innovation progress. Prolonged bureaucratic procedures and regulatory challenges, such as frequent legislative changes and a weak rule of law, create difficulties and unpredictability in doing business in Bulgaria. Correspondingly, the investment climate in the country is weak. After Hungary, Bulgaria is the most corrupt EU country, according to the Corruption Perceptions Index 2023. The ageing population and 'brain drain' remain major challenges to the country's innovation capabilities.

Although Bulgaria's ICT sector demonstrates strong performance, it mostly digitalises foreign economies, with over 85% of software industry revenue stemming from exports. 2022 saw the birth of the first ever Bulgarian 'unicorn', Payhawk, an internationally active fintech start-up valued at over USD 1bn. However, most Bulgarian companies face challenges in adopting ICT solutions, partly because of the dominance of small and medium-sized enterprises (SMEs) in the domestic economy. Local SMEs exhibit a markedly low level of innovation, hindered by constraints in human and financial resources. They contribute nearly half of Bulgaria's turnover, above the EU average of 34.1%. The role of industrial clusters is insignificant; entrepreneurs misunderstand their basic characteristics and purpose as innovative organisational networks, and there are gaps in the legislative framework and insufficient monitoring mechanisms.

Bulgaria has a notably low innovation capacity concerning megatrends. The country is ranked second to last in the European Commission's Digital Economy and Society Index 2022. More than 70% of enterprises in the country have made only small or no investments in digital technologies. Less than 30% of SMEs have reached at least a basic level of digital intensity. Furthermore, Bulgaria has the lowest score in the EU's Eco-Innovation Index, at 48% of the EU average. Bulgaria reaches only 35% of the EU level on eco-innovation outputs, and just 17.3% of the EU average for resource efficiency outcomes. In the circular economy component of the Eco-Innovation Index, Bulgaria ranks particularly weakly for business operations, at 36% of the EU average.

Table 3 / Bulgaria - National Innovation System Indicators

Priority areas	Indicator	Bulgaria	EU	EU-CEE
Education system	Tertiary education graduates in STEM, share in % (UNESCO)	**19.5**	24	24.2
	Spending on tertiary education per student, in EUR at PPP (Eurostat)	**4,170**	7,990	6,600
	PISA scales in reading, maths and science (GII)	**427**	484	480
Technological capacities of enterprises	R&D (GERD) financed by business, share in % (Eurostat)	**32.9**	57.7	43.5
	R&D expenditures (GERD) in % of GDP (Eurostat)	**0.8**	2.3	1.3
	SMEs with product innovations, share in % (EIS)	**22.2**	27.0	22.8
	SMEs with business process innovations, share in % (EIS)	**24.5**	41.6	32.4
	Finance for start-ups and scale-ups, average perception scores from 0 to 10 (GII)	**5.0**	4.3	4.5
Collaborations and linkages	Innovative SMEs collaborating with others, share in % (EIS)	**7.3**	11.7	10.1
	University-industry R&D collaborations, average perception scores from 0 to 7 (GII)	**3.9**	4.2	3.8
Innovation outcomes	Granted patents per million inhabitants (WIPO)	**63**	586	86
	Exports of medium and high-technology products, in % of total product exports (EIS)	**35.1**	61.2	49.5
	Knowledge-intensive services exports, in % of total services exports (EIS)	**56.6**	63.6	48.6

Note: Data for EU and EU-CEE are simple averages, except for EIS and Eurostat, with original data for EU.
Data for 2021 or the most recent available year; more details on the methodology and data availability to be found in the Annex.
Sources: EIS 2023; Eurostat; GII 2023; UNESCO; WIPO; World Bank, WDI.

Table 4 / Bulgaria - Mapping innovation policy initiatives

	Yes/No	Name of the initiative/programme	Comments
Innovation agency	Yes	Ministry of Innovation and Growth	Former Agency for Science and Innovation closed (replaced by Ministry of Innovation and Growth).
Programmes for human capital development	Yes	Human Resources Development Programme 2021-2027	Co-financed by the European Social Fund and the national budget.
Programmes for human capital attraction and retention (e.g. reverse brain drain)	Yes	National programme 'Stefan Stambolov Fund'	State funding for master's degree up to BGN 200,000 per year to study in the most elite universities in the world if, after graduation, students return to work in Bulgaria for at least three years.
Start-up programmes (incubators, dedicated financing, etc.)	Yes	Operational programmes 'Innovation and competitiveness', 'Human resource development', 'Initiative for SMEs'	Over 95 incubators; funding applications difficult and time-consuming.
Venture capital programmes	No		
Cluster programmes	Yes	EU operational programme 'Innovation and competitiveness' (OPIC)	Completed.
Technology-specific policies	Yes	Innovation Strategy for Intelligent Specialization 2021-2027	Transforms Bulgaria into an innovative, smart, green, digital and connected country.
Tax incentive schemes	No		Low corporate tax rate for all (10%).
Others	Yes	Institute for Computer Science, Artificial Intelligence and Technology (INSAIT) Innovation vouchers to support academia-industry collaboration	First in SEE, co-financed by Bulgarian government, Bulgarian business, Amazon, Google, DeepMind, SiteGround. As a part of operational programme 'Research, innovation and digitalisation for intelligent transformation', until the end of 2023.

COUNTRY-SPECIFIC POLICY PRIORITIES AND RECOMMENDATIONS

› **Improve the innovation potential of the domestic research system, encouraging university-industry collaborations.** The collaboration between universities and businesses is marked by only sporadic knowledge and technology transfer. The weak regulatory environment and the lack of incentives impede collaboration between industry, universities and other public research organisations. To enhance co-operation, a new, well-defined legal framework is essential. This framework should regulate the fundamental principles, rules and scope of intellectual property management policies within scientific organisations and facilitate the transfer of knowledge to the industry. Additionally, the creation of tax incentives for enterprises, alongside other financial tools, is necessary to support collaborative efforts.

› **Develop more assertive policies aimed at retaining, attracting and getting back talent from abroad.** Bulgaria's population is shrinking at one of the fastest rates in the world, resulting in a significant loss of demographic and intellectual capital. Retaining, attracting and getting back talent from abroad are recognised as priorities at the political level. However, the current policies are lacking in substance. The policy measures are limited mostly to information provision through campaigns, portals and consultation services to attract and get back high-skilled individuals. What is absent are proactive steps to establish incentives, facilitate the return process and provide support for effective integration. This could be achieved through competitive salaries, bonuses, housing provisions, fringe benefits, student credits that need not be repaid if the students choose to remain in Bulgaria, language courses, anti-discrimination policies, and improving the quality of public services such as healthcare, childcare and public transport. A good example is the national programme 'Stefan Stambolov Fund', which allows Bulgarian students to receive state funding for studying at prestigious international universities if they commit to returning to work in Bulgaria for a minimum of three years afterwards.

› **Increase expenditures dedicated to investments in R&D, with EU funds complementing stronger national innovation efforts.** In 2022, research and development (R&D) expenditures in Bulgaria amounted to only 0.75% of GDP, well below the EU average of 2.2%. Some 40% of the funding came from foreign sources, followed by domestic enterprises at 34.7%, and the state budget at 24.6%. Furthermore, public funds are allocated on an annual basis, hindering the implementation of sustainable long-term strategic programmes and making funding for scientific research inadequate and unpredictable. To address this, increasing public spending on R&D, providing fiscal incentives for enterprises investing in R&D, and implementing a new comprehensive policy for the advancement of scientific research, innovation and technology would be beneficial.

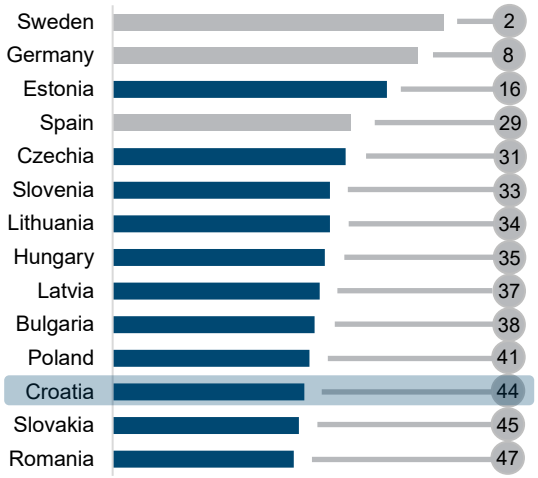
› **Empower a single innovation agency with implementing a long-term strategy, and as free as possible from political interference.** The former Agency for Science and Innovation has been closed and replaced by the Ministry of Innovation and Growth. Although the establishment of such a ministry underscores the country's commitment to innovation, it also exposes the innovation strategy to significant political fluctuations, particularly given Bulgaria's record of changing governments four times in two years. Establishing a single innovation agency, insulated from political influences, would provide the required stability and sovereignty for the effective implementation of a long-term strategy. A diminished connection to politics could also reduce the likelihood of corruption within the agency.

Croatia

INNOVATION LANDSCAPE

With a performance well below the EU average, Croatia is still classified as an emerging innovator in the European Innovation Scoreboard. It is ranked 44th in the world in the Global Innovation Index, the third-lowest ranking among EU-CEE countries, which testifies to major room for improvement in the innovation system. Nevertheless, Croatia's innovation performance is in line with the country's development level and recent efforts are bringing the country closer to the EU core. Croatia is confronted with the challenge of transforming its tourism-reliant economy into an innovative, knowledge-based one. This challenge is compounded by an underdeveloped institutional environment, shortages of ICT specialists and weak linkages between academia and industry, as well as low and decreasing research and development (R&D) expenditures and government support for business R&D. Owing to these limited efforts, the country is not producing enough exports of medium and high-tech manufactures and knowledge-intensive services. Patents are also insufficient; the number of patents per inhabitant is the lowest in the EU-CEE region.

Figure 15 / Global Innovation Index – Croatia - Rank 44 out of 132 countries



Source: GII 2023.

Despite these challenges, there are some signs of progress. Croatia has a strong share of tertiary educated graduates in STEM subjects, and universities produce good-quality scientific publications. The country can count on a robust share of innovative small and medium-sized enterprises (SMEs), especially in the ICT sector. Croatia's accession to the EU in 2013 provided a boost to local IT companies and the ICT sector. Government modernisation efforts and enterprise investments have seen the ICT sector expand at a steady pace since 2017. Venture capital expenditures have been on the rise for several years, and Croatia is home to two 'unicorns': the communications platform Infobip, and the highly innovative car manufacturer Rimac Automobili, which is also participating in the second IPCEI (Important Projects of Common European Interest – an EU initiative) for batteries: European Battery Innovation (EuBatIn). Although Croatia's performance on patent applications is unsatisfactory, the country has improved its applications of other intellectual properties, in particular trademarks – a sign that less R&D-intensive innovations might be more relevant in the Croatian context.

On the 'megatrends' of the twin transition, Croatia's performance is mixed, with a relative strength in the digital sphere offset by challenges in relation to the green transition, mirroring much of the rest of EU-CEE. With respect to the green transition, Croatia ranks in the 'catching-up group' on the European

Commission's 2022 Eco-Innovation Scoreboard, with a fairly average performance by EU-CEE standards. Like other countries of the region, the scoreboard ranks Croatia strongly for innovation activities, but much less so for outputs, suggesting that significant efforts in this area are not yet sufficiently translating into specific outcomes. The lack of relevant green skills particularly hinders innovation activities in the country's transition to a net-zero economy. To tackle those deficiencies, Croatia earmarked the bulk share of 2021-2027 cohesion policy funds, some EUR 4.5bn, for green transition measures.

Table 5 / Croatia - National Innovation System Indicators

Priority areas	Indicator	Croatia	EU	EU-CEE
Education system	Tertiary education graduates in STEM, share in % (UNESCO)	28.5	24	24.2
	Spending on tertiary education per student, in EUR at PPP (Eurostat)	4,600	7,990	6,600
	PISA scales in reading, maths and science (GII)	472	484	480
Technological capacities of enterprises	R&D (GERD) financed by business, share in % (Eurostat)	38.4	57.7	43.5
	R&D expenditures (GERD) in % of GDP (Eurostat)	1.2	2.3	1.3
	SMEs with product innovations, share in % (EIS)	34.6	27.0	22.8
	SMEs with business process innovations, share in % (EIS)	47.2	41.6	32.4
	Finance for start-ups and scale-ups, average perception scores from 0 to 10 (GII)	4.4	4.3	4.5
Collaborations and linkages	Innovative SMEs collaborating with others, share in % (EIS)	12.3	11.7	10.1
	University-industry R&D collaborations, average perception scores from 0 to 7 (GII)	3.0	4.2	3.8
Innovation outcomes	Granted patents per million inhabitants (WIPO)	17	586	86
	Exports of medium and high-technology products, in % of total product exports (EIS)	33.7	61.2	49.5
	Knowledge-intensive services exports, in % of total services exports (EIS)	24.3	63.6	48.6

Note: data for EU and EU-CEE are simple averages, except for EIS and Eurostat, with original data for EU.
Data for 2021 or the most recent available year; more details on the methodology and data availability to be found in the Annex.
Sources: EIS 2023; Eurostat; GII 2023; UNESCO; WIPO; World Bank, WDI.

Table 6 / Croatia - Mapping innovation policy initiatives

	Yes/No	Name of the initiative/programme	Comments
Innovation agency	Yes	The Business Innovation Centre of Croatia – BICRO National Innovation Council	BICRO was created in 1998 and is tasked with allocating state funds for R&D projects. The National Innovation Council was created in 2018 and focuses on the absorption of EU funds for innovation.
Programmes for human capital development	Yes	National Efficient Human Resources Programme	The programme is financed by the European Social Fund (ESF+) scheme and is aimed at upskilling the Croatian workforce in 2021-2027. It also provides scholarships for STEM studies. Croatia ran a similar programme in 2014-2020.
Programmes for human capital attraction and retention (e.g. reverse brain drain)	Yes	'I Choose Croatia' programme	Active employment scheme to attract human capital from abroad, focusing on underdeveloped areas and depopulated rural areas, including Slavonia, Dalmatinska Zagora, Banovina, Kordun, Lika and Gorski Kotar.

Contd.

Table 6 / Continued

	Yes/No	Name of the initiative/programme	Comments
Start-up programmes (incubators, dedicated financing, etc.)	Yes	Start-up support scheme	The Croatian Bank for Reconstruction and Development (HBOR) provides loans (from EUR 50,000 to EUR 300,000) with a repayment period of up to 14 years for young entrepreneurs and start-ups.
Venture capital programmes	Yes	Croatian Venture Capital Initiative 2 (CVCi 2)	EUR 80m programme, jointly financed by the European Investment Fund and the Croatian Regional Development Ministry to support early-stage Croatian companies with high growth potential.
Cluster programmes	Yes	CEDRA programme (cluster for 'Eco-Social Innovation and Development' in Split-Dalmatia County) Association of Croatian ICT Clusters Croatian national cluster for the ICT industry Croatian Competitiveness Clusters (CCC) programme	CEDRA is an association founded in 2013, aimed at promoting social entrepreneurship, sustainable development and social innovations. The association prepares and implements projects financed from national, EU and other sources in co-operation with the public, private and civil sectors. It participates in local, regional, national and international projects and programmes. The association of Croatian ICT Clusters was founded in 2007 to connect and increase the collaboration within ICT clusters, located in Rijeka, Varaždin, Dalmatia, Istria, Slavonia and Međimurje. The Croatian national cluster for the ICT industry was founded in 2013 to provide a cooperation platform for local ICT companies. A 'Croatian Competitiveness Clusters' (CCC) programme was also launched for 48 months, from 2016 to 2020, as a tool to implement the Croatian Smart Specialisation Strategy.
Technology-specific policies	Yes	Digital Dalmatia; Southern European Entrepreneurship Engine (S3E) programme	Project launched by the Split-Dalmatia County, with the intention of encouraging and developing the ICT sector and to support start-ups in the county. The S3E Programme was founded in 2022 as part of Horizon Europe. It aims to support research teams to explore the commercial viability of deep tech start-ups and support them in their growing phase.
Tax incentive schemes	Yes	Tax incentives for technology investment (under the Investment Promotion Act)	Income tax reduction by 50% of the statutory rate for five years from the initial investment for 'micro enterprises', provided that a minimum of three new jobs had been created. For larger investments of up to EUR 1m, reduction of the income tax rate by 50% of the statutory rate for 10 years from the start of the investment, provided that the enterprise created a minimum of five new jobs.
Others		Eurostars 3 voucher programme - European Partnership on Innovative SMEs/Eurostars	Collaborative projects in the Eurostars 3 programme, co-funded by the EU's Horizon Europe scheme. The programme aims to promote co-operation between innovative Croatian SMEs and other partners (including large companies, universities, and research organisations) by funding international collaborative R&D and innovation projects.
Sector-specific initiatives		IPCEI 'European Battery Innovation' (EuBatIn) programme	Rimac Automobili is the Croatian partner in this IPCEI, tasked with performing three R&D battery systems projects and with setting up a R&D lab, a battery testing facility and a pilot production plant for the realisation and industrialisation of battery project results. Owing to the EuBatIn programme, Rimac Automobili is expected to emerge as a leading company in the European battery-system technology high-performance segment.

COUNTRY-SPECIFIC POLICY PRIORITIES AND RECOMMENDATIONS

› **Improve administrative capacity to strengthen innovation policy making and improve absorption of EU funds.** Croatia's innovation landscape faces challenges in the investment climate, owing to administrative barriers and inefficient bureaucracy. Improving the capacity of public administration and cultivating innovation expertise within these structures is necessary to strengthen the innovation system. A streamlined and more capable public administration would support the country's innovation landscape, for example, by facilitating a faster tendering process and by accelerating the absorption of EU funds. The proper absorption of EU funds should be prioritised to facilitate additional investments, given that EU funds act as one of the main drivers of Croatia's economic growth. Nevertheless, it is also paramount that the country increases national funding to innovation, to match EU funds and ensure continuity and buy-in of innovation policy initiatives.

› **Dedicate more funding to human capital development**. Given the challenges Croatia faces in diversifying away from tourism, human capital capable of contributing to the emergence and growth of more knowledge-intensive industries is essential. For this reason, programmes for human capital development should be developed, especially to promote STEM education, particularly in relation to ICT. Indeed, the current low number of ICT specialists is considered a serious bottleneck for the development of the ICT sector and other industries related to the digital transition. Older workers – whether unemployed or in need of upskilling and reskilling – should also be targeted by these initiatives. In terms of upskilling and reskilling programmes, a valuable addition to Croatia's current skill set would be investment in green skills; digital skills seem relatively advanced across the population.

› **Expand government support to business R&D and non-R&D expenditures.** Government support to business R&D expenditures is currently too low by EU standards (and in some cases even by EU-CEE standards). Therefore, allocating more resources to R&D incentives is a key policy priority for Croatia. Although evaluation and reform of the tax incentives might help improve their uptake, expanding the offer of financial instruments and grants could also have an impact on the willingness of Croatian firms to engage in R&D. As for financial instruments, loans and venture capital are available, but the offer could be expanded to firms of all sizes and to other types of instruments, depending on an assessment of the real needs of the business sector. As for grants, the offer could be expanded to include grants for appropriate non-R&D expenditures, which could be also conditional on the achievement of certain milestones (i.e. the successful application for a trademark).

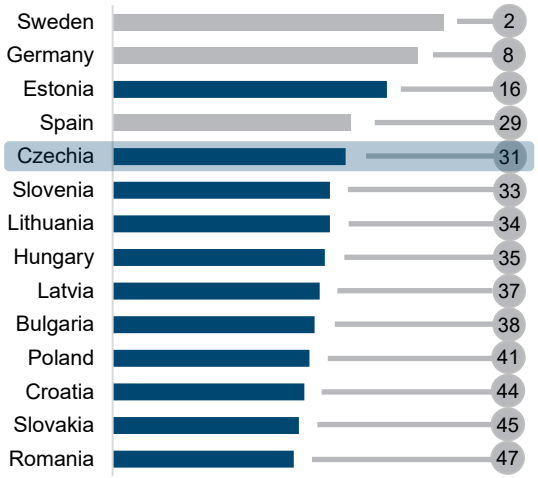
› **Identify promising niches and build them up**. Diversifying the Croatian economy is another imperative that requires innovation and industrial policies. Although this is a huge challenge, the country has already created a few pockets of excellence outside its core areas of specialisation. Building on the isolated successes such as Rimac Automobili, innovation policies could try to promote clusters and industries related to these successful domestic firms (such as specialised suppliers, service providers, providers of inputs and components). This exercise could also be undertaken in the process of designing the next smart specialisation strategy for the Programming Period 2021-2027. Indeed, by engaging in a more rigorous prioritisation exercise, Croatia could move away from broadly defined priorities (as specified in the 2014-2020 strategy) and make the S3 document its real blueprint to channel resources towards most promising niches for its future competitiveness.

Czechia

INNOVATION LANDSCAPE

Czechia is one of the strongest countries in the EU-CEE region for innovation performance, and is positioned as a moderate innovator among EU member states. In global comparisons, the country ranks 31st, which is generally in line with its level of development.[49] Given Czechia's high level of industrialisation, fuelled by foreign investment, particularly in sophisticated manufacturing sectors, innovation outputs in the form of high-tech exports are the country's core strength. However, foreign value added is the dominant contributor behind this outcome, especially in advanced sectors such as ICT, electronics and automotive.[50]

Figure 16 / Global Innovation Index – Czechia – Rank 31 out of 132 countries



Source: GII 2023.

The robust education system and skilled workforce are Czechia's main assets in innovation performance, as shown by the high share of graduates in STEM subjects, the good quality of learning outcomes in secondary education and relatively high education spending – all of which exceed the EU average, as seen in the data below. There are growing efforts to foster linkages between academia and industry, with leading universities such as Charles University, Czech Technical University and Masaryk University establishing technology transfer offices and focusing more on applied research. The collaboration of universities and other innovation actors at the local level is contributing to dynamic regional innovation systems in some parts of the country, notably around the capital, Prague, and in the region of South Moravia, home to Czechia's second-largest city, Brno. These regions also boast rather well-functioning smart specialisation strategies and regional policy instruments that contribute to the creation of start-ups, particularly in the ICT sector.

However, Czechia consistently struggles to boost the innovation spending of businesses, which remains a major weak point. Only the country's large energy conglomerate (ČEZ Group) reaches internationally competitive levels of research and development (R&D) investment.[51] As a result, little patenting activity takes place, reflecting the country's weak ability to produce and market its own technologies. Policy has

[49] According to GII's expected vs. observed innovation performance.

[50] Refer to the OECD TiVA database for details.

[51] Based on the EU R&D Scoreboard 2022.

contributed to the emergence of a number of clusters, especially in the digital sphere, some of which partake in various EU collaboration platforms.[52]

Considering the 'megatrends' of the twin transition, Czechia's performance is mixed. With respect to the green transition, it fares rather well in innovation activities, but weakly in innovation outputs, suggesting that the efforts made do not translate into effective outcomes.[53] The digital transition offers more promise, with a few highly successful domestic firms emerging in the ICT sector. Two Czech firms (Mycroft Mind and Codasip) participate in Important Projects of Common European Interest (IPCEI) on microelectronics and communication technologies. Nevertheless, broader digitalisation of the economy and society remains a challenge. Investments planned under the Recovery and Resilience Facility are a step in the right direction.

Table 7 / Czechia - National Innovation System Indicators

Priority areas	Indicator	Czechia	EU	EU-CEE
Education system	Tertiary education graduates in STEM, share in % (UNESCO)	25.5	24	24.2
	Spending on tertiary education per student, in EUR at PPP (Eurostat)	9,270	7,990	6,600
	PISA scales in reading, maths and science (GII)	495	484	480
Technological capacities of enterprises	R&D (GERD) financed by business, share in % (Eurostat)	36.1	57.7	43.5
	R&D expenditures (GERD) in % of GDP (Eurostat)	2.0	2.3	1.3
	SMEs with product innovations, share in % (EIS)	35.2	27.0	22.8
	SMEs with business process innovations, share in % (EIS)	52.2	41.6	32.4
	Finance for start-ups and scale-ups, average perception scores from 0 to 10 (GII)	n/a	4.3	4.5
Collaborations and linkages	Innovative SMEs collaborating with others, share in % (EIS)	14.5	11.7	10.1
	University-industry R&D collaborations, average perception scores from 0 to 7 (GII)	4.7	4.2	3.8
Innovation outcomes	Granted patents per million inhabitants (WIPO)	92	586	86
	Exports of medium and high-technology products, in % of total product exports (EIS)	67.9	61.2	49.5
	Knowledge-intensive services exports, in % of total services exports (EIS)	54.2	63.6	48.6

Note: data for EU and EU-CEE are simple averages, except for EIS and Eurostat, with original data for EU.
Data for 2021 or the most recent available year; more details on the methodology and data availability to be found in the Annex.
Sources: EIS 2023; Eurostat; GII 2023; UNESCO; WIPO; World Bank, WDI.

[52] See the Czech National Cluster Association: https://nca.cz/mapa-klastru-v-cr/

[53] See the Eco-Innovation Scoreboard.

Table 8 / Czechia - Mapping innovation policy initiatives

	Yes/No	Name of the initiative/programme	Comments
Innovation agency	Yes	Technology Agency of the Czech Republic (TACR); Research, Development and Innovation Council (RVVI)	TACR acts as an innovation agency in the country, preparing and realising relevant policy programmes. RVVI is an advisory body of the government and oversees the national innovation policy agenda and also nominates board members of TACR.
Programmes for human capital development	Yes	Reforms proposed under the second pillar of the Innovation Strategy of the Czech Republic 2019-2030: 'Polytechnical education'	Progress on the implementation of proposed instruments not clear.
Programmes for human capital attraction and retention (e.g. reverse brain drain)	Yes	Promotion of foreign students through programme 'Support for foreign scholarship holders studying at public universities'	Initiatives to attract foreign students into universities dominate; programmes for reversing brain drain generally absent.
Start-up programmes (incubators, dedicated financing, etc.)	Yes	Various support measures from CzechStartups.org by the investment promotion agency CzechInvest; Start-up internationalisation support by the export promotion agency CzechTrade; Further initiatives envisaged under the third pillar of the Innovation Strategy of the Czech Republic 2019-2030: 'National start-up and spin-off environment'	A variety of programmes to support start-ups exist in the country, facilitated mostly by CzechInvest.
Venture capital programmes	No		No specific programmes in this area.
Cluster programmes	Yes	Promotion of innovative clusters through the operational programme TAK ("Spolupráce-Klastry")	Calls aimed at SMEs and research organisations.
Technology-specific policies	Yes	THETA2 administered by TACR (Modernisation of the energy sector); The Czech Hydrogen Strategy of the Ministry of Industry and Trade	Initiatives related to the technological development in the area of clean energy tend to dominate.
Tax incentive schemes	Yes	Application of deductions for R&D costs from the tax base (latest revision in 2019)	There are indications that fiscal incentives are not frequently picked up by SMEs.
Others		Other initiatives include: 'Innovation vouchers – call II' as part of the operational programme 'Technology and Applications for Competitiveness 2021-2027' Various programmes of TACR to support cross-border research collaborations (e.g. KAPPA, DELTA2)	

COUNTRY-SPECIFIC POLICY PRIORITIES AND RECOMMENDATIONS

› **Integrate FDI policy more closely with the national innovation and industrial strategies, with the intention of upgrading the position of Czechia in global value chains.** Although Czechia's FDI incentive scheme sets out strategic areas that are of particular interest for the country, the available support still remains broad. The issue of upgrading in value chains is partly identified in the Innovation Strategy of the Czech Republic 2019-2030, but the defined goals and tools remain very vague. More emphasis needs to be placed on local supplier development and on incentives for the creation of spill-overs, such as steering foreign investments into existing clusters or innovation hubs to induce collaboration between local and domestic firms, establishing networking platforms between local suppliers and multinational enterprises (MNEs), or negotiating greater training and collaboration with local education institutions. The experiences of Ireland and Singapore can offer particularly useful insights for Czechia on how to effectively leverage an MNE-driven economic structure to build up domestic innovative capacities (see recommendations in Section 5.2 of the main report). Moreover, investment promotion activities and innovation initiatives can be co-ordinated more effectively if they fall within the competence of one overseeing authority. Although CzechInvest has been moving in this direction by establishing the 'Czech Startups' programme, going beyond the focus on start-ups to encompass a wider firm population would be called for. Recent developments in Estonia, which has been consolidating its innovation and investment promotion activities under the Enterprise Estonia umbrella, might offer some inspiration[54].

› **Motivate higher R&D investments by firms, placing more emphasis on non-fiscal R&D incentives, such as direct grants.** As mentioned above, low R&D spending by businesses is a major weakness of Czechia, which has not significantly improved over time. The small uptake of R&D-related tax breaks compounds the issue. This reality is acknowledged by the Innovation Strategy of the Czech Republic 2019-2030, which sets out the goal of increasing the actual use of the available tax deductions. However, in order to boost R&D spending by firms, the discussion needs to extend beyond tax-based tools. This is because, as we emphasised in our study, non-fiscal financial incentives (both repayable and non-repayable) are a more effective means of boosting R&D investments in the region (see Recommendation 2.5 in the main report). Given Czechia's relatively well-developed institutions and sound fiscal space, there is room for administering more grant-type instruments to support innovation activities in the country.

› **Leverage the well-developed human capital present in the country by fostering tighter linkages between the education system and industry.** Czechia has made notable progress in recent times in establishing departments within its major universities to support the commercial application of academic research. Innovation vouchers[55] are also available to stimulate collaboration of universities with firms. However, there are indications that the industry-academia linkages remain ad hoc and case-based rather than systematic, even in parts of the country that have high-quality universities and a relatively well-established regional innovation system.[56] Hence, stronger incentives relating to universities and their financing structures (such as making collaboration between universities and

[54] See the Estonian country chapter for more details.

[55] Innovation vouchers are small lines of credit given to businesses (especially SMEs) by governments, which allow them to obtain tailored scientific outputs and expertise from public research institutions.

[56] See, for example, the SWOT analysis presented in the Regional Innovation Strategy 2021-2027 for the South Moravian Region.

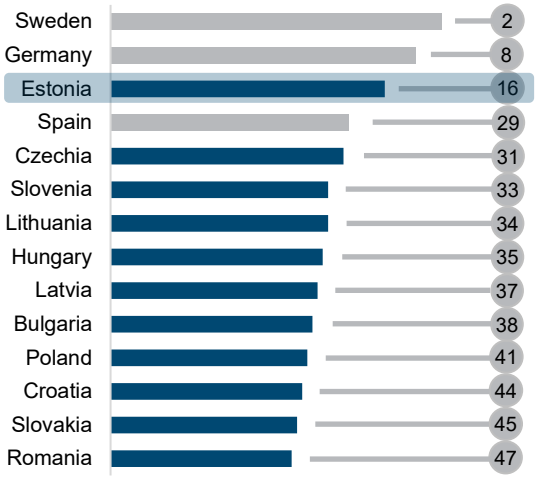
industry a prerequisite for certain types of funding) are needed. Likewise, platforms that would encourage more frequent interactions between actors to build trust and stimulate closer collaborations are also required. These require policies such as the establishment of innovation hubs, joint appointment programmes and networking platforms, through which trust can be built (see also Recommendation 2.3 in the main report). Furthermore, given the persistent skill shortages in Czechia, there is a need to align educational programmes with the evolving needs of the labour market. A particular focus should be placed on the development and expansion of vocational training and polytechnic education initiatives, ensuring that students acquire practical skills and knowledge that directly translate into the workforce. The smart specialisation strategy can offer further insights regarding the specific areas that could be prioritised.

Estonia

INNOVATION LANDSCAPE

Estonia is a small economy with remarkably high innovation capacity – it ranks 16th in the Global Innovation Index and is among the innovation leaders in the European Innovation Scoreboard. Europe's leader in start-ups and unicorns per capita, Estonia's innovation potential is based on its STEM-oriented and highly competitive education system, its transparent and well-operating institutions and efficient infrastructure, a high degree of digitisation in the government and the economy, a favourable investment and tax environment, and sound use of venture capital, as well as proactive policies to support start-ups and innovation within firms.

Figure 17 / Global Innovation Index – Estonia - Rank 16 out of 132 countries



Source: GII 2023.

With 10 unicorns founded in Estonia (including Skype, Bolt and Wise) and 1,444 start-ups currently in operation (mainly in the sectors of business software and HR, fintech, and consumer products and services), the country has a high degree of innovation creation and adoption. Beyond start-ups, innovation adoption in established firms has also accelerated over the last decade, with AI adoption doubling over the last two years.

Estonia's share of knowledge-intensive services' exports is far above the EU-CEE level, and surpasses the EU average. Yet, despite high-quality innovation inputs, exports of medium and high-tech manufacturing products are lagging far behind exports of knowledge-intensive services, marking one of the innovation weaknesses of Estonia. The economy's persistently high energy dependency, relatively underdeveloped innovation clusters, low expenditures on research and development (R&D), and low number of patents per capita are among other areas where the Estonian innovation system could improve. Furthermore, Estonia ranks above the EU-CEE level in product and business processes innovations in SMEs, yet below the EU average.

Whereas Estonia pioneered digital innovation, both in state services and business operations, green innovation started to catch up relatively recently and now forms the core of innovation strategies. Three Estonian high-tech companies (Skeleton Technologies, Elcogen and Stargate Hydrogen Solutions) are participating in the Important Projects of Common European Interest (IPCEI) EU policy initiative 'H2 technology' in the frontier research on the hydrogen value chain. Further integration of research and technologies (DeepTech) and development of clusters bringing together high-tech services and manufacturing with state-of-the-art research is another objective set for the next decade.

Table 9 / Estonia - National Innovation System Indicators

Priority areas	Indicator	Estonia	EU	EU-CEE
Education system	Tertiary education graduates in STEM, share in % (UNESCO)	28.1	24	24.2
	Spending on tertiary education per student, in EUR at PPP (Eurostat)	8,640	7,990	6,600
	PISA scales in reading, maths and science (GII)	526	484	480
Technological capacities of enterprises	R&D (GERD) financed by business, share in % (Eurostat)	50.9	57.7	43.5
	R&D expenditures (GERD) in % of GDP (Eurostat)	1.8	2.3	1.3
	SMEs with product innovations, share in % (EIS)	25.2	27.0	22.8
	SMEs with business process innovations, share in % (EIS)	41.1	41.6	32.4
	Finance for start-ups and scale-ups, average perception scores from 0 to 10 (GII)	6.0	4.3	4.5
Collaborations and linkages	Innovative SMEs collaborating with others, share in % (EIS)	17.3	11.7	10.1
	University-industry R&D collaborations, average perception scores from 0 to 7 (GII)	4.1	4.2	3.8
Innovation outcomes	Granted patents per million inhabitants (WIPO)	92	586	86
	Exports of medium and high-technology products, in % of total product exports (EIS)	36.5	61.2	49.5
	Knowledge-intensive services exports, in % of total services exports (EIS)	65.5	63.6	48.6

Note: data for EU and EU-CEE are simple averages, except for EIS and Eurostat, with original data for EU.
Data for 2021 or the most recent available year; more details on the methodology and data availability to be found in the Annex.
Sources: EIS 2023; Eurostat; GII 2023; UNESCO; WIPO; World Bank, WDI.

Table 10 / Estonia - Mapping innovation policy initiatives

	Yes/No	Name of the initiative/programme	Comments
Innovation agency	Yes	Enterprise Estonia (EAS) + KredEx	The merging of KredEx and Enterprise Estonia (EAS) in 2022 was the first step towards the creation of a single Estonian Business and Innovation Agency. KredEx and Enterprise Estonia have been active in all areas – promoting innovation, supporting the development of sustainable business models and research-intensive solutions, attracting FDI with high added value, aiding in recruitment of top-level international workers, advising businesses on potential trade partners and expansion into foreign markets, helping to develop the start-up ecosystem. KredEx and Enterprise Estonia offer grants, loans, venture capital, credit insurance and guarantees to promote innovation activities within firms.
Programmes for human capital development	Yes	Under the Estonian Education Strategy 2021-2035 and the Estonian Lifelong Learning Strategy 2020	Both strategies envisage specific actions for the development of skills and knowledge that are in line with labour market needs, prioritising the provision of work-based learning to boost productivity.
Programmes for human capital attraction and retention (e.g. reverse brain drain)	Yes	Startup Visa programme e-Residency programme Returning researcher grant	The well-established Startup Visa programme allows non-EU founders to set up their start-up in Estonia, as well as easing the process for Estonian start-ups to hire non-EU talent. The e-Residency programme was launched in 2014 to allow entrepreneurs worldwide to establish, run and grow their companies online, using Estonian digital business services (currently there are around 100,000 e-residents). The returning researcher grant is administered by the Estonian Research Council and aims to support the return to Estonia of researchers – Estonian citizens or current/former Estonian residents – who have been working outside Estonia.
Start-up programmes (incubators, dedicated financing, etc.)	Yes	Startup Estonia	A well-established organisation, which implements several initiatives to develop the knowledge and skills of start-up founders, improve the access to finance for start-ups and address regulatory bottlenecks.
Venture capital programmes	Yes	SmartCap	Well-established programme established in 2011, which aims to create a vital venture capital market and enable innovative Estonian companies to emerge and grow globally.
Cluster programmes	No		
Technology-specific policies	No		
Tax incentive schemes	No		Although there is no specific tax programme to boost innovations, 0% tax on retained and reinvested profits and a flat 20% income tax for distributed profits (it will increase to 22% in 2024) are deemed to have a positive effect on firms' innovation activities.
Innovation collaboration platform	Yes	Accelerate Estonia Estonian ICT Cluster	Launched in 2019, Accelerate Estonia is Estonia's governmental innovation lab, operating as a platform for all Estonian ministries, the public and private sectors, experts and entrepreneurs to join forces in identifying, developing and implementing innovations. The platform aims to remove regulatory barriers and expand market possibilities to boost innovative entrepreneurship. The Estonian ICT Cluster initiative was recently established as a collaboration platform for ICT companies, aiming to boost the development of new ICT products and solutions, promote the exchange of knowledge and experience, and foster their export to the international market.

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COUNTRY-SPECIFIC POLICY PRIORITIES AND RECOMMENDATIONS

› **Increase expenditures dedicated to R&D, with EU funds complementing stronger national innovation efforts**. Whereas research and innovation promotion are well-established government priorities, actual gross spending on R&D falls below the EU27 average and amounts to less than 2% of GDP. The recently established Accelerate Estonia platform, which promotes close collaboration between public authorities and entrepreneurs, is an important milestone as it reinforces the government's role in identifying and implementing innovations. However, the public investment in R&D and innovation needs to be more stable, predictable, and transparent, with funding mechanisms aligned with the strategic priorities identified in the smart specialisation strategies.

› **Better identify the responsibilities, tasks and role of the newly created single investment agency.** At present, the Estonian innovation system suffers from fragmentation, overlapping responsibilities, and lack of strategic vision and leadership. The lack of co-ordination and communication between the key agencies responsible for identifying, supporting and implementing innovations results in duplication, overlap and gaps in state funding. The recent merger of two key agencies (Enterprise Estonia and KredEx) into a single agency is expected to establish a clear division of roles and tasks among the different ministries and agencies involved in research and innovation policy, as well as a better alignment of policies and programmes across different sectors.

› **Reinforce linkages between public research and industry to boost innovation throughout the entire economy**. Despite an attractive start-up scene and a growing science base, collaboration between public research and industry is limited, except in the fields of AI, computer science, medicine and genetics. The recently recognised priority to accelerate DeepTech is a step towards stronger co-operation between research and industry, yet co-operation should emerge also in the sectors with less intensive start-up activity, including manufacturing, transportation and energy. Likewise, research capacities within companies need to be leveraged. Knowledge exchange and technology transfer may require additional incentives for firms to strengthen in-house research capacities to be able to fully comprehend and absorb the knowledge generated through these linkages.

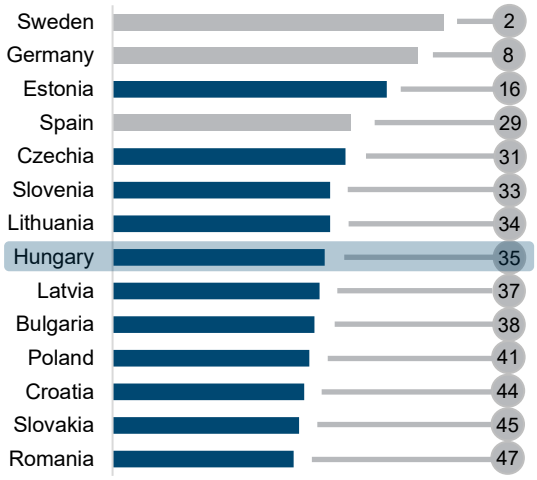
› **Address skills gaps and mismatches, and enhance efforts to attract and retain talents from abroad.** Estonia's innovation potential is severely limited by its ageing population, 'brain drain' and skills gaps. Hence, measures to support the education and training of researchers and entrepreneurs, and to promote their lifelong learning and career development, should remain among the government's top priorities. Furthermore, researchers' remuneration should be more attractive and competitive to enhance public and private research output.

Hungary

INNOVATION LANDSCAPE

Hungary has advanced to a higher innovation performance group in 2023, earning the title of a moderate innovator among EU member states. Its position in the Global Innovation Index is relatively high, at 35th out of 132 economies, although in comparison to other EU-CEE countries this represents only a middle-ranking position. Nevertheless, Hungary has set goals to be among the top 25 global innovators by 2030 and the top 10 by 2040.[57] It also aims to raise research and development (R&D) expenditure to 3% of GDP by 2030. In line with such radical ambitions, Hungary has implemented various initiatives to bolster its national innovation system through, for example, financing start-ups and small and medium-sized enterprises (SMEs), including venture capital (VC) funding. It has also been trying to strengthen links between different system actors, which are currently at moderate levels. This effort includes initiatives such as internationalising the Eötvös Loránd Research Network (ELKH), promoting collaboration between universities and businesses through the Co-operative Doctoral Programme, or revitalisation of science and innovation parks. However, as many of these initiatives have been set up recently, the tangible outcomes are yet to fully materialise and the effectiveness of implementation is still to be seen. Moreover, with R&D spending stagnating at 1.6% of GDP, coupled with economic challenges such as limited absorption of EU funds, deteriorating fiscal space and weak medium-term economic prospects, reaching these targets in such a short period of time is likely unrealistic.

Figure 18 / Global Innovation Index – Hungary - Rank 35 out of 132 countries



Source: GII 2023.

Hungary's innovation strength primarily lies in its innovation outputs. For example, its share of high-tech manufacturing within total manufacturing is well above the EU average, it has a strong export orientation (in both medium and high-tech products, and knowledge-intensive services) and high export complexity. Much of this favourable performance is driven by the country's attraction of inward foreign direct investment (FDI) and R&D expenditures from abroad.

However, the performance of Hungary's education system is below the EU and EU-CEE average. Government spending on tertiary education and the number of graduates, including those in STEM subjects, has been on a declining trend. This is especially problematic, given Hungary's ambition to

[57] John von Neumann Program.

become a knowledge-based economy capable of creating high value added, which will undoubtedly require more software-intensive skills and higher digital technology integration by companies.

A handful of highly innovative, large domestic companies can be found in Hungary, including Gedeon Richter and Egis in the pharmaceutical and life sciences industry, which dedicate significant funds into their R&D activities. Although still below EU and EU-CEE averages, the share of Hungarian SMEs introducing product innovation has seen a dramatic increase over the past decade. This signals the high potential of SMEs, and the need to further facilitate domestic innovation capabilities, especially those of SMEs. This need is also reflected in shrinking activity across several intellectual property indicators (patent, trademark and design applications)[58] and innovative product sales.

Table 11 / Hungary - National Innovation System Indicators

Priority areas	Indicator	Hungary	EU	EU-CEE
Education system	Tertiary education graduates in STEM, share in % (UNESCO)	21.6	24	24.2
	Spending on tertiary education per student, in EUR at PPP (Eurostat)	5,770	7,990	6,600
	PISA scales in reading, maths and science (GII)	479	484	480
Technological capacities of enterprises	R&D (GERD) financed by business, share in % (Eurostat)	50.6	57.7	43.5
	R&D expenditures (GERD) in % of GDP (Eurostat)	1.6	2.3	1.3
	SMEs with product innovations, share in % (EIS)	19.9	27.0	22.8
	SMEs with business process innovations, share in % (EIS)	23.5	41.6	32.4
	Finance for start-ups and scale-ups, average perception scores from 0 to 10 (GII)	5.0	4.3	4.5
Collaborations and linkages	Innovative SMEs collaborating with others, share in % (EIS)	9.9	11.7	10.1
	University-industry R&D collaborations, average perception scores from 0 to 7 (GII)	3.9	4.2	3.8
Innovation outcomes	Granted patents per million inhabitants (WIPO)	64	586	86
	Exports of medium and high-technology products, in % of total product exports (EIS)	65.5	61.2	49.5
	Knowledge-intensive services exports, in % of total services exports (EIS)	55.5	63.6	48.6

Note: data for EU and EU-CEE are simple averages, except for EIS and Eurostat, with original data for EU.
Data for 2021 or the most recent available year; more details on the methodology and data availability to be found in the Annex.
Sources: EIS 2023; Eurostat; GII 2023; UNESCO; WIPO; World Bank, WDI.

[58] PCT patent, trademark and design applications, EIS 2023.

Table 12 / Hungary - Mapping innovation policy initiatives

	Yes/No	Name of the initiative/programme	Comments
Innovation Agency	Yes	National Research, Development and Innovation Office (NRDI Office) National Innovation Agency (NIÜ), to be established	Funding agency with increasing number of clients and expenditure allocation. To be complemented by the establishment of NIÜ as a service provider agency, supporting innovation from idea to commercialisation. NRDI's budget in 2021 was HUF 182bn (~EUR 477m).
Programmes for human capital development	Yes	Cooperative Doctoral Programme for Doctoral Scholarships Postdoctoral and Young Researchers' Excellence Programme and Call for Thematic Research Projects (OTKA)	Cooperative Doctoral Programme encourages PhD students, including in STEM subjects, to do research in collaboration with the business sector. Popular scheme, running since 2020.
Programmes for human capital attraction and retention (e.g. reverse brain drain)	Yes	National Excellence Programme Forefront and Forefront Plus – Research Excellence Programme Internationalisation of Eötvös Loránd Research Network (ELKH) rebranded into Hungarian Research Network Welcome Home programme (Hazaváró programme)	New National Excellence Programme calls, supporting research scholarships for undergraduate, graduate and PhD students, postdoctoral researchers, teachers, researchers at the Hungarian Academy of Sciences, students entering higher education (general programme making higher education more attractive). Forefront, Forefront Plus and internationalisation of ELKH aim to attract Hungarian and foreign researchers to Hungary. A project with a budget of up to HUF 350m (~EUR 900,000) and duration of maximum 60 months undertaken at a Hungarian research centre or university. Welcome Home programme is a general scheme that provides personalised information and administrative assistance to those returning home. Does not differentiate by skills.
Start-up programmes (incubators, dedicated financing, etc.)	Yes	Startup Factory incubator programmes Hungarian Startup University Programme (HSUP) Eurostars: Support for Hungarian participation in the European Partnership on Innovative SMEs Convertible notes and SAFE notes as financing instruments for start-ups (planned)	Startup Factory 2023 granting HUF 5bn (~EUR 13m) to technology incubators: old incubators, specialised incubators, new incubators, defence incubators. Running since 2013, funded about 200 ideas, attracted private and foreign investment. HSUP to create an entrepreneurial ecosystem, improve perception of/educate university students on/create database of start-ups.
Venture capital programmes	Yes	Smart Specialisation Venture Capital Programme National Technology and Intellectual Property Venture Capital Programme	Smart Specialisation Venture Capital Programme supporting high-growth potential startups and early-stage SMEs related to the priorities set out in smart specialisation strategy (S3). Central Hungary region. HUF 5.5bn (~EUR 14 m), 10 projects. National Technology and Intellectual Property Venture Capital Programme supporting high growth potential start-ups and early-stage SMEs in less developed regions of Hungary. Priority to projects related to S3 priorities. HUF 30bn (~EUR 78m), 100-200 projects.

Contd.

Table 12 / Continued

	Yes/No	Name of the initiative/programme	Comments
Cluster programmes	Yes	Territorial Innovation Platforms (TIP) Establishing and Developing Centres of Excellence Review and renewal of Science and Innovation Park Developments, to be undertaken	TIPs are territorial partnerships bringing together university knowledge bases and other actors strengthening local co-operation and influencing and being informed by RDI policy. Establishing and Developing Centres of Excellence to develop industry-service co-operation organisations including development of R&D infrastructure capacity, engaging researchers and students, long-term R&D co-operation with economic partners, developing innovative business models.
Technology-specific policies	Yes	John von Neumann Program (NJP) 2023 Grant for Innovation Projects in Focus Areas	NJP identified a set of four research, development and innovation (RDI) focus areas: health, green transition, digital transition of economy, defence. These four priorities align with Hungary's eight priorities set out in its S3 Strategy, while providing a narrower focus. Grant for Innovation Projects in Focus Areas supports areas identified in NJP. To commercialise near-market innovations.
Tax incentive schemes	Yes	R&D tax allowance in corporate income tax R&D tax allowance in innovation contribution Social Security Contributions (SSC) and Vocational Training Contributions (VTC) exemption KIVA exemption and credit available to small companies (optional small business tax, replacing SSC and corporate income tax) Development tax credit incentive (capital, intangibles)	
Others	Yes	*Strategies*: National Smart Specialisation Strategy (S3) 2021-2027, Research, Development and Innovation (RDI) Strategy 2021-2027, John von Neumann Program (NJP) 2023, SME Strategy, Digitalisation Strategy *IPR*: Grants supporting applications for domestic and international IPR *International co-operation*: Grants supporting participation in Horizon Europe, Horizon Europe Key Digital Technologies partnership, EUREKA, other EU programmes and international co-operation *Scale-up*: Fast Track Programme, Research Excellence 'Proof of Concept' Programme, to be announced *Other*: Establishment and Complex Development of the National Laboratories, Grants supporting the use of international and national research infrastructures, University Innovation Ecosystem Programme	The new S3 Strategy identified eight national economic priorities (e.g. digital economy, cutting-edge tech, health, energy, agriculture, creative industry), which may be too broad in scope. NJP, a strategic action package adopted in 2023, focuses on linking universities and research institutions with the economy, relying on nine key actions (e.g. rebrand and restructure ELKH network into Hungarian Research Network, set up a Research Excellence Council). University Innovation Ecosystem Programme encourages universities to establish units facilitating commercialisation, co-operation between academia and industry, and participation in EU R&D programmes. Includes the creation of an online platform to align RDI services of academia and industry.

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COUNTRY-SPECIFIC POLICY PRIORITIES AND RECOMMENDATIONS

In recent years, Hungary has taken several steps to improve its national innovation system by bringing together different actors into an ecosystem and financing start-ups and SMEs. However, many of these efforts are yet to materialise. Building on its current strategy, we propose a set of policy recommendations to improve Hungary's innovation performance:

› **Clearly define the role of the new National Innovation Agency (NIÜ) and expand its role to include workforce development and training.** As the National Research, Development and Innovation Office (NRDI Office) is well established, with responsibilities for innovation and its funding, there is a need to distinguish the new agency's role to avoid duplication of agendas as well as to create co-ordination mechanisms (see also Recommendation 1.1 of the main report). NIÜ's role, as suggested in Hungary's recent innovation strategy (John von Neumann Program 2023), seems to emulate functions of research and technology organisations (RTOs), as a 'one-stop shop' providing innovation-related services to companies. In order to bring it in line with current best practices, the NIÜ should expand its role to focus on workforce development and training, helping companies to keep up with industrial developments and international trends.

› **Enhance funding efficiency and improve the institutional environment.** Despite Hungary's support for innovation through a number of policy programmes, several initiatives with significant budgets have not yet yielded tangible outcomes, while others have faced efficiency challenges. Instances include start-up and incubator programmes, as well as recent VC initiatives. Thus, Hungary could benefit from enhancing its institutional environment, and engaging a wider variety of stakeholders in policy making. These improvements would also lead to more realistic innovation performance targets, which are more conducive to the development of the innovation system. Moreover, although the NRDI Office has streamlined research and innovation calls across NRDI funding and EU development funds, there is a need for further streamlining, as research and innovation should not be seen separately from other programme calls. The list of Hungary's current programmes is also rather extensive and contains potential overlaps, calling for consolidation.

› **Strengthen domestic innovation capabilities by supporting national companies, especially start-ups and SMEs.** For start-ups and SMEs to flourish, they need an enabling environment that encourages and induces innovation. This extends beyond financial support to encompass currently missing services such as helping to access research facilities, locating partners throughout supply chains, developing business models and protecting intellectual property. Such support from the government could signal its interest in entrepreneurship and attract private-sector funding, which is currently low in Hungary. It is necessary to facilitate access to R&D and scale-up facilities (such as research laboratories, pilot lines and testbeds) as a predecessor to commercialisation. Only a limited number of programme calls are presently supporting this stage of innovation.

› **Put more emphasis on linkage creation between foreign-owned subsidiaries and domestic firms.** Large foreign-owned companies are not well connected to the domestic innovation system, limiting the transfer of knowledge and technology into Hungarian firms. This calls for more assertive spill-over promoting policies, such as knowledge and technology transfer agreements going beyond metrics such as number of jobs created, steering foreign investments into existing clusters or innovation hubs to induce collaboration between foreign and domestic firms, establishing networking platforms between

local firms and multinational enterprises (MNEs), or negotiating greater training and collaboration with local education institutions (see the recommendations in Section 5.2 of the main report).

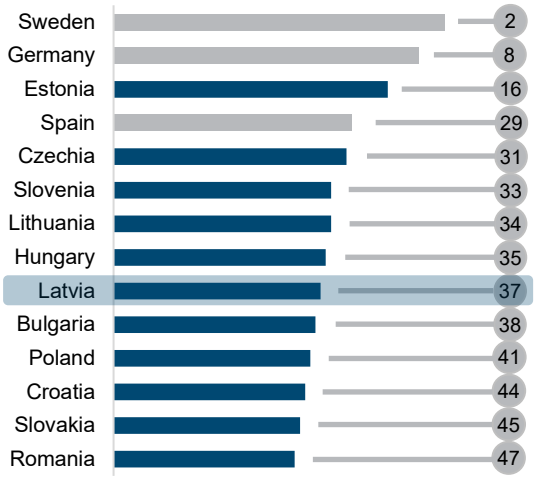
› **Increase spending on education and skills, and redesign curricula in line with evolving market needs.** A highly educated and well-prepared workforce will be the key to achieving Hungary's ambitions to digitalise the economy and accelerate the green transition. This requires dedicated efforts to boost digital skills and ICT literacy, producing more STEM graduates and ICT specialists, making upskilling and reskilling programmes widely available. All of these aspects necessitate increased education spending. Furthermore, to bring the education system closer to the innovation system, there is a need to redesign curricula, taking into consideration industry's evolving needs (see Recommendations 4.1 and 4.3 in the main report). This includes providing more hands-on experience through apprenticeships, dual technical training and dual PhD training. Including entrepreneurship education at an early stage could also contribute to making innovation more attractive, in addition to preparing a pool of future entrepreneurs. Some programmes have started to emerge that focus on these aspects such as the Cooperative Doctoral Programme and the Hungarian Startup University Programme (HSUP), but there is a need to extend these to earlier stages and other types of education.

Latvia

INNOVATION LANDSCAPE

With a performance below the EU average, Latvia is still classified as an emerging innovator by the European Innovation Scoreboard. In global comparison, Latvia is positioned as the 41st most innovative economy, with a ranking that is generally in line with its level of development.[59] However, catching up towards the EU average has not taken place, particularly in recent years. An increasingly vibrant start-up scene, sustained investments in digitalisation within firms and across the population, and an emergent deeptech hub are encouraging signs of Latvia's enhanced innovation efforts. But a number of challenges persist. Latvia is currently lacking STEM graduates and PhD graduates, which would provide a more solid basis for its innovation-based growth model. Extremely low research and development (R&D) expenditures, together with a business sector that engages in R&D only to a very limited extent, have left Latvia unable to produce enough patents and exports of medium and high-tech manufactures. Non-R&D innovation expenditures are also below the EU average and have been on a downward trend in recent years.

Figure 19 / Global Innovation Index – Latvia - Rank 37 out of 132 countries



Source: GII 2023.

The production structure of Latvia remains concentrated on low and medium-tech sectors, which in past years saw limited productivity growth. Some progress is registered in a handful of sectors. For example, in wood processing, biomedicine and pharma, and in services (particularly in the IT sector), there is evidence of some higher value-added product development, in co-operation with external partners and the research sector. Beyond established firms, Latvia's start-ups are increasing in number and expanding in various sectors, owing to strong collaborations with technical universities as well as new policies and initiatives. The most promising firms are found in deeptech (in areas such as quantum physics, smart materials, biomedicine and space technologies), fintech and the drone sector. In deeptech, the most successful start-up is Eventech, a spin-out of Latvia's Institute of Electronics and Computer Science, which is developing and commercialising satellite laser applications. In fintech, TWINO is one of Europe's leading peer-to-peer (P2P) lending platforms.

The Competence Centres programme is considered the most successful public initiative linking research and industry. It covers the five key sectors in which Latvian enterprises are considered to have

[59] According to GII's expected vs. observed innovation performance.

competitive advantages and which became the priority areas of the smart specialisation strategy: knowledge-intensive bioeconomy; biomedicine, medical technologies and pharmacy; smart energy & mobility; ICT and smart cities; photonics, smart materials, technologies and engineering.

Concerning the 'megatrends' of the twin transition, Latvia has, in addition to the above-mentioned positive features, a considerable share of population with at least basic digital skills. As for the green transition, Latvia is lagging behind in many fields (e.g. low circular material use rates, rising greenhouse gas emissions per capita and deteriorating performance in environment-related technologies).

Table 13 / Latvia - National Innovation System Indicators

Priority areas	Indicator	Latvia	EU	EU-CEE
Education system	Tertiary education graduates in STEM, share in % (UNESCO)	19.4	24	24.2
	Spending on tertiary education per student, in EUR at PPP (Eurostat)	4,360	7,990	6,600
	PISA scales in reading, maths and science (GII)	487	484	480
Technological capacities of enterprises	R&D (GERD) financed by business, share in % (Eurostat)	33.5	57.7	43.5
	R&D expenditures (GERD) in % of GDP (Eurostat)	0.7	2.3	1.3
	SMEs with product innovations, share in % (EIS)	13.7	27.0	22.8
	SMEs with business process innovations, share in % (EIS)	24.9	41.6	32.4
	Finance for start-ups and scale-ups, average perception scores from 0 to 10 (GII)	5.0	4.3	4.5
Collaborations and linkages	Innovative SMEs collaborating with others, share in % (EIS)	6.1	11.7	10.1
	University-industry R&D collaborations, average perception scores from 0 to 7 (GII)	3.7	4.2	3.8
Innovation outcomes	Granted patents per million inhabitants (WIPO)	76	586	86
	Exports of medium and high-technology products, in % of total product exports (EIS)	30.2	61.2	49.5
	Knowledge-intensive services exports, in % of total services exports (EIS)	55.6	63.6	48.6

Note: data for EU and EU-CEE are simple averages, except for EIS and Eurostat, with original data for EU.
Data for 2021 or the most recent available year; more details on the methodology and data availability to be found in the Annex.
Sources: EIS 2023; Eurostat; GII 2023; UNESCO; WIPO; World Bank, WDI.

Table 14 / Latvia - Mapping innovation policy initiatives

	Yes/No	Name of the initiative/programme	Comments
Innovation agency	No		LIAA, the Investment and Development Agency of Latvia, has a mandate that encompasses a wide range of areas, starting with export and competitiveness, foreign investments, tourism, and branching out to innovation, technology transfer and start-ups.
Programmes for human capital development	Yes		LIAA provides grants for skill training programmes to promote the adoption of new technologies and increase labour productivity, particularly in manufacturing, ICT, accommodation and catering services.
Programmes for human capital attraction and retention (e.g. reverse brain drain)	Yes	Start-up visas	Start-up visas are available for non-EU entrepreneurs who want to start a business in Latvia.
Start-up programmes (incubators, dedicated financing, etc.)	Yes	Startup Law Benefit Four Acceleration Programmes Magnetic Latvia Business Incubators Loans	Under the Startup Law Benefit, start-ups are given a number of tax reductions (low flat social tax, no individual tax for start-up employees, and 45% co-financing for highly qualified specialists). Four acceleration programmes are active, focusing on different sectors and issues. The Magnetic Latvia Business Incubators programme involves 13 incubators spread across the country. The incubators provide training, mentor support and grants as well as organising events covering general business issues. Loans for start-ups are also provided through Altum, Latvia's state-owned development finance institution.
Venture capital programmes	Yes		To create a venture capital market, the Latvian government is investing funds from both the European Regional Development Fund and the national budget into venture capital funds via its financial arm, Altum.
Cluster programmes	Yes	Competence Centres programme	The Competence Centres programme was launched in 2010. It aims to promote applied research and frontier innovation in sectors aligned with the Smart Specialisation strategy, namely: knowledge-intensive bioeconomy; biomedicine, medical technologies and pharmacy; smart energy and mobility; ICT & smart cities; photonics, smart materials, technologies and engineering. The programme helps to develop new products through strengthened collaborations between the research and business sectors. At least a quarter of their funding must be devoted to experimental development. The centres are based at universities and provide high-end research infrastructure. By the end of 2018, support had been given to almost 150 firms to develop 174 products.
Technology-specific policies	Yes	Deeptech	The newly emerging deeptech industry has attracted government attention. A conference in May 2024 will bring together entrepreneurs, students, companies and all other stakeholders. Its main focus will be quantum, optical fibres and sensors. Additional initiatives can be expected in the near future.
Tax incentive schemes	No		R&D expenditures are treated as any tangible capital investment. R&D tax incentives were abolished in 2018.
Innovation vouchers	Yes		Vouchers for up to EUR 25,000 are available for companies to cover various R&D expenditures (including services from scientific institutes) or to co-finance highly qualified employees.
Initiatives to support commercialisation efforts of scientists	Yes		LIAA organises training and networking workshops to promote commercialisation efforts by scientists, covering topics such as management of intellectual property, technology transfer, and development of new products and technologies.

COUNTRY-SPECIFIC POLICY PRIORITIES AND RECOMMENDATIONS

› **Give more emphasis and allocate more funding to innovation policies.** Latvia is currently lacking an innovation agency focused on the co-ordination and implementation of science, research, technology and innovation policies in the country. By creating a dedicated agency, or by putting innovation policies more firmly at the centre of LIAA's mandate, Latvia could make the first step towards a stronger commitment to innovation policy. This would need to be followed up by specific measures to improve the enabling environment for innovation and also by a coherent innovation policy strategy with a policy mix that addresses all the bottlenecks currently faced by the innovation system. Examples of these measures and policy priorities are provided in the bullet points below. To implement this more coherent policy, higher funding would be necessary. At present, government funding of innovation is insufficient; it should be increased for all firm sizes and in all stages of the innovation process.

› **Provide stronger incentives to students to engage in STEM education and undertake doctoral studies, particularly in relation to ICT.** The expanding high-tech industries such as those around ICT, deeptech and drones require an increasing number of high-quality STEM graduates and PhDs. Scholarships, grants and other incentives to higher education organisations are necessary to promote these studies, make them more attractive and improve their quality. Information campaigns to inform students about the career prospects in these fields might also be an effective way of attracting students and motivating them to complete their studies.

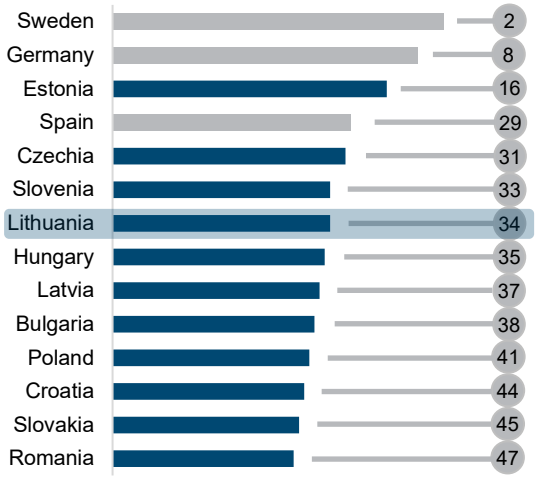
› **Support the nascent start-up ecosystem, while supporting the upgrading of established firms in traditional sectors.** Latvia's current innovation policy mix seems very much skewed towards start-ups, following the trend in the other Baltic countries. All these initiatives should be maintained and developed, for instance by expanding the offer of financial instruments (following the example of neighbouring Lithuania). However, innovation policies cannot be blind to existing firms in more traditional sectors. These firms are responsible for a large part of Latvia's GDP and still employ large shares of the workforce. Many of these firms face important challenges and opportunities as the EU accelerates its transition towards a greener and more digital economy. Although LIIA already provides a number of services to these firms (such as for expert analysis of products and factories, certification costs, adaptation of products/services to foreign markets, and digitalisation of processes), the provision could be expanded to include services to improve business practices, spur the adoption of certain digital technologies such as AI, make products more sustainable, and provide consultancies to help firms identify promising market niches.

Lithuania

INNOVATION LANDSCAPE

Lithuania is classified as a moderate innovator in the European Innovation Scoreboard, with a performance below the EU average. It ranks 34th in the Global Innovation Index, and fourth in the EU-CEE region (after Estonia, Czechia and Slovenia). Owing to steady improvements in several indicators, Lithuania is slowly catching up towards the EU average.

Figure 20 / Global Innovation Index – Lithuania - Rank 34 out of 132 countries



Source: GII 2023.

The Lithuanian innovation system can count on a high number of tertiary-educated graduates – particularly in STEM subjects, a high share of small and medium-sized enterprises (SMEs) undertaking product and process innovations, and advances in digitalisation. Like other Baltic countries, Lithuania shows relatively strong progress in this field, although it is still far behind Estonia. A thriving venture capital market and various policy initiatives in support of entrepreneurship promoted the growth of a dynamic start-up ecosystem. The sectors in which Lithuanian start-ups are most active are: business software and HR, fintech, cybertech, healthtech, advanced manufacturing and industry. The largest start-ups, with about 1,000 employees, are Vinted (an online marketplace for second-hand items), Nord Security (active in cybertech) and Wargaming (in the games industry).[60] The first two are 'unicorns', with valuations of about USD 5bn and USD 2bn respectively.

Despite having reached such important milestones, Lithuania's innovation potential is not fully realised. Start-ups remain a marginal component of the economy and are poorly linked to the rest of the productive sector, which is much less sophisticated and innovative. This duality partly explains the low figures in terms of research and development (R&D) expenditures and R&D financed by business, the low shares of exports of medium and high-tech products and knowledge-intensive services, and the low number of patent applications.

Although Lithuania does not perform well in these indicators, its European Innovation Scoreboard profile points to a strong performance in trademark applications and non-R&D innovation expenditures, which suggest that less R&D-intensive forms of innovation are more appropriate for the country. There have also been growing policy efforts on cluster building over recent years. Although most clusters are still in nascent stages, some promising ones are emerging in the areas of smart food and photovoltaic

[60] Startup Lithuania database: https://www.startuplithuania.com/startup/ (accessed 5.12.2023).

technology.[61] A number of alliances between universities and firms are also well established, but are limited to a few sectors (such as laser technologies and biotechnology).

Concerning the 'megatrends' of the twin transition, as highlighted above, Lithuania has made impressive advancements in digitalisation, also partly because of recent policy initiatives and the contribution of its digitally oriented start-ups. As for the green transition, the country is still lagging behind: its performance in environmental-related technologies has been deteriorating since 2022. Nevertheless, the earmarking of 37.4% of the Recovery and Resilience Facility for the green transition, together with a few additional policy initiatives, is a welcome step in the right direction.

Table 15 / Lithuania - National Innovation System Indicators

Priority areas	Indicator	Lithuania	EU	EU-CEE
Education system	Tertiary education graduates in STEM, share in % (UNESCO)	25.8	24	24.2
	Spending on tertiary education per student, in EUR at PPP (Eurostat)	6,390	7,990	6,600
	PISA scales in reading, maths and science (GII)	480	484	480
Technological capacities of enterprises	R&D (GERD) financed by business, share in % (Eurostat)	36.1	57.7	43.5
	R&D expenditures (GERD) in % of GDP (Eurostat)	1.1	2.3	1.3
	SMEs with product innovations, share in % (EIS)	30.5	27.0	22.8
	SMEs with business process innovations, share in % (EIS)	44.8	41.6	32.4
	Finance for start-ups and scale-ups, average perception scores from 0 to 10 (GII)	5.9	4.3	4.5
Collaborations and linkages	Innovative SMEs collaborating with others, share in % (EIS)	14.4	11.7	10.1
	University-industry R&D collaborations, average perception scores from 0 to 7 (GII)	4.4	4.2	3.8
Innovation outcomes	Granted patents per million inhabitants (WIPO)	72	586	86
	Exports of medium and high-technology products, in % of total product exports (EIS)	35.8	61.2	49.5
	Knowledge-intensive services exports, in % of total services exports (EIS)	31.8	63.6	48.6

Note: data for EU and EU-CEE are simple averages, except for EIS and Eurostat, with original data for EU.
Data for 2021 or the most recent available year; more details on the methodology and data availability to be found in the Annex.
Sources: EIS 2023; Eurostat; GII 2023; UNESCO; WIPO; World Bank, WDI.

[61] According to the European Secretariat for Cluster Analysis.

Table 16 / Lithuania - Mapping innovation policy initiatives

	Yes/No	Name of the initiative/programme	Comments
Innovation agency	Yes	Innovation Agency Lithuania	The Innovation Agency Lithuania is the result of the merger of several public business support and innovation promotion agencies, forming a single innovation agency since April 2022, with more than 300 employees. It administers several innovation, digitalisation and other business support measures. It is headquartered in the capital, Vilnius, and operates also through regional offices in 13 Lithuanian cities.
Programmes for human capital development	Yes	Modernisation of VET National Reskilling/ Upskilling Programme Skills for SMEs	Important for skill development is the ongoing modernisation of the VET offer. A rationalisation of existing programmes was undertaken to improve the relevance of VET, align it to labour market needs and ultimately improve the employability of VET-educated workers. Programmes were also made modular, in order to make them more flexible and attractive. The 'National Reskilling/Upskilling Programme' is undertaken by Invest Lithuania. It aims to reskill the workforce via the acquisition of certain digital skills (pre-defined by the government). The programme is only available to firms in three sectors: ICT, engineering and life sciences. The 'Skills for SMEs' programme has just been launched to provide financial support to SMEs to upskill and retrain employees with a particular focus on digital skills. The programme is supported by EU funds.
Programmes for human capital attraction and retention (e.g. reverse brain drain)	Yes	Startup Visa Create Lithuania	Under the 'Startup Visa' programme, visas are made available for non-EU entrepreneurs who want to open a business in Lithuania and for prospective employees of Lithuanian start-ups. Over the past 10 years, the 'Create Lithuania' programme has invited professionals with internationally acquired experience to spend 12 months in public-sector bodies. The programme allows the public sector to benefit from the experience of these highly qualified professionals while enabling them to contribute to the advancement of their country and experience working for government bodies. So far, 282 projects have been implemented in roughly 50 entities, 236 professionals have returned to Lithuania and about 40% of the participants have remained in the public sector.
Start-up programmes (incubators, dedicated financing, etc.)	Yes	Startup Lithuania A variety of programmes and financial instruments offered via INVEGA	Startup Lithuania promotes the national start-up ecosystem, facilitating the linkages between entrepreneurs, venture capital funds, accelerators and the government. It supports the ecosystem by keeping stakeholders informed of relevant news, maintaining a database of start-ups, organising networking events, and cultivating an entrepreneurship culture. Through INVEGA, the national investment institution of Lithuania, the government provides a wide range of grants, soft loans, guarantees and venture capital financial instruments (see also below). A programme that matches the funds raised through crowdfunding is added to the offer of INVEGA. Training, mentoring services, pre-accelerator and accelerator programmes are also provided. These instruments are partly funded by the national budget and EU funds, showing the high level of commitment of the Lithuanian government. Given the high number of start-ups currently active in the country (estimated at 877 by the Startups Database maintained by Startup Lithuania), the incentives offered seem to have been able to create a certain level of dynamism in the local start-up ecosystem.

Contd.

Table 16 / Continued

	Yes/No	Name of the initiative/programme	Comments
Venture capital programmes	Yes	Various programmes under INVEGA	Several venture capital financial instruments are currently active. Some of these are fully financed via EU funds, others fully by national budgets, and others mix the two sources.
Cluster programmes	Yes	InoLink KlasterLT	The InoLink project and the KlasterLT initiative, co-ordinated by the Lithuanian Innovation Agency, promote the integration of firms into clusters, increase the maturity of existing clusters, and promote their international co-operation. Activities include expert consultations, partner searching and networking events, offering targeted support to SMEs as well as foreign enterprises to integrate into Lithuanian clusters. Efforts are also made to align these clusters with smart specialisation priorities. According to the OECD (2021),[62] however, most of the created clusters still lack endogenous strength for innovation.
Technology-specific policies	No		
Tax incentive schemes	Yes	R&D incentive in corporate income tax code	A variety of R&D tax incentives are offered, including triple deduction of R&D costs from income, shorter depreciation period for R&D assets and tax incentives for R&D commercialisation.
Innovations vouchers	Yes	Inno-vouchers	Support for innovative firms and institutions to acquire services from science and study institutions.

COUNTRY-SPECIFIC POLICY PRIORITIES AND RECOMMENDATIONS

› **Improve linkages between start-ups and the rest of the economy.** Existing companies in more traditional sectors could benefit significantly from increased learning opportunities with local start-ups in terms of digital skills and practices, business models, entrepreneurial culture and mindset, and identification of promising market niches. In this regard, increased efforts in cluster building could be envisaged. Grants for collaborative research that could also include technology transfer mechanisms from start-ups to larger firms could also benefit the Lithuanian innovation system. Study tours and programmes for temporary job mobility might also be creatively used to create social ties and learning opportunities.

› **Help larger established firms to contribute more to the innovation performance of the country.** Beyond the spill-overs that stronger linkages with start-ups can unleash, more tangible initiatives are needed to make established firms more innovative. Advisory and mentoring services, currently tailored primarily to start-ups, could also be adapted to larger existing firms, for example by providing technical assistance on how to improve the quality and sustainability of current productions, digitalise businesses, structure a research project, and find new market niches. Similarly, the upskilling and reskilling programmes currently available to a handful of high-tech sectors could be also made available to more traditional sectors and focused on new skills, related for example to the digital and green transitions.

[62] OECD (2021), 'Improving effectiveness of Lithuania's innovation policy', OECD Science, Technology and Industry Policy Papers, No. 123, OECD Publishing, Paris.

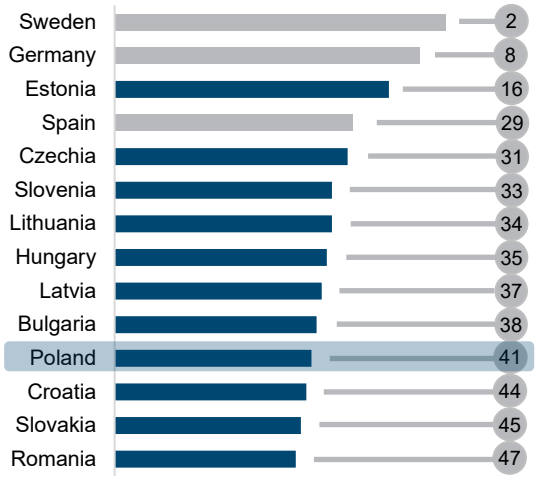
› **Find new approaches and creative solutions to stimulate non-R&D innovations.** As innovation policies are generally aimed at stimulating R&D expenditures, new approaches and policy instruments need to be designed to promote local non-R&D innovations. This type of innovation seems particularly appropriate to the Lithuanian innovation system. In this area, the government will first need to understand where the potential for these innovations currently lies and the barriers that firms face. This could be done, for example, by initiating a dialogue with the business sector of the sort foreseen by the smart specialisation approach (the Entrepreneurial Development Process, EDP). In a second step, targeted policies should be designed to remove the obstacles to innovation and incentivise the generation of new non-R&D innovations, including via grants and new financial instruments.

Poland

INNOVATION LANDSCAPE

Poland, with its robust and dynamic economy, is a significant economic player in Central Europe. Yet it ranks only 41st in the Global Innovation Index, and is in the lowest category of emerging innovators in the European Innovation Scoreboard. These positions are below expectation, given the country's size and level of economic development.[63] This reflects the reality that Poland's growth so far has been driven primarily by production capabilities, rather than innovation capabilities. In general, the Polish government's proactive attitude towards the area of innovation, reflected in the extensive system of institutional and financial support, constitutes a solid basis for the development of the country's innovation system.

Figure 21 / Global Innovation Index – Poland - Rank 41 out of 132 countries



Source: GII 2023.

Poland's main advantage in innovation performance is the quality of its human capital, as reflected by the strong performance of pupils in PISA tests, outperforming the EU on average.[64] Spending on tertiary education also surpasses average EU-CEE levels, although it falls short of the EU average. However, the challenge lies in a below EU-CEE average share of tertiary graduates in STEM fields (19.6%), indicating a potential future shortage of skilled STEM workers. Recent trends also reveal a deterioration in relevant indicators, highlighting the need to defend the quality of Polish human capital.

As the largest economy of the EU-CEE region, Poland also holds the advantage of market size and domestic demand, which can be leveraged to stimulate domestic innovation. A handful of highly innovative national firms have emerged in Poland. When it comes to the EU policy initiative Important Projects of Common European Interest (IPCEI), four Polish companies and one Polish-German firm participate.[65] The EU Industrial R&D Investment Scoreboard's top 1,000 contains three companies from Poland, which makes it a regional leader in this respect.

However, linkages between individual innovation actors remain weak, as exemplified by the low levels of collaboration among innovative small and medium-sized enterprises (SMEs), as well as university-

63 According to GII's expected vs. observed innovation performance.

64 Based on the 2018 survey, latest available at the time of writing.

65 Polish companies Synthos, Orlen, Vigo Photonics, Elemental Strategic Metals, and Polish-German company SGL Carbon.

industry collaborations (see the table below). To improve the interlinkages in the innovation system, clusters – particularly in IT, biotechnology, aviation and energy – have been recognised by the government as vital. They are supported by policy initiatives, but so far remain relatively underdeveloped.

The core challenge lies in the prevalence of foreign capital concentrated in non-innovative activities and insufficient investment in innovation. General research and development (R&D) expenditures in Poland constitute only 1.4% of GDP, far below the EU average; this creates unfavourable conditions for enhancing innovation. SMEs display limited engagement in innovation compared with the EU average, and start-ups are voicing their struggles with skills shortages.[66]

Poland displays rather weak preparedness for the twin transition, which calls for stronger efforts in this direction. The country suffers from a low level of digitalisation, ranking 24th of 27 EU member states in the Digital Economy and Society Index 2022. This is a consequence of multiple factors, such as insufficiently developed infrastructure, low level of digital awareness and limited public spending in this area. Moreover, when it comes to the green transition, Poland ranks next to last in the Eco-Innovation Index, and faces a number of formidable challenges, such as moving away from coal.

Table 17 / Poland - National Innovation System Indicators

Priority areas	Indicator	Poland	EU	EU-CEE
Education system	Tertiary education graduates in STEM, share in % (UNESCO)	19.6	24	24.2
	Spending on tertiary education per student, in EUR at PPP (Eurostat)	7,180	7,990	6,600
	PISA scales in reading, maths and science (GII)	513	484	480
Technological capacities of enterprises	R&D (GERD) financed by business, share in % (Eurostat)	51.0	57.7	43.5
	R&D expenditures (GERD) in % of GDP (Eurostat)	1.4	2.3	1.3
	SMEs with product innovations, share in % (EIS)	14.2	27.0	22.8
	SMEs with business process innovations, share in % (EIS)	25.5	41.6	32.4
	Finance for start-ups and scale-ups, average perception scores from 0 to 10 (GII)	4.8	4.3	4.5
Collaborations and linkages	Innovative SMEs collaborating with others, share in % (EIS)	6.7	11.7	10.1
	University-industry R&D collaborations, average perception scores from 0 to 7 (GII)	3.2	4.2	3.8
Innovation outcomes	Granted patents per million inhabitants (WIPO)	120	586	86
	Exports of medium and high-technology products, in % of total product exports (EIS)	49.9	61.2	49.5
	Knowledge-intensive services exports, in % of total services exports (EIS)	49.1	63.6	48.6

Note: data for EU and EU-CEE are simple averages, except for EIS and Eurostat, with original data for EU.
Data for 2021 or the most recent available year; more details on the methodology and data availability to be found in the Annex.
Sources: EIS 2023; Eurostat; GII 2023; UNESCO; WIPO; World Bank, WDI.

[66] According to a report by the Startup Poland Foundation, 52% of start-ups in Poland in 2022 signalled problems with recruiting employees, with a simultaneous rapid increase in the costs of employing them.

Table 18 / Poland - Mapping innovation policy initiatives

	Yes/No	Name of the initiative/programme	Comments
Innovation agency	Yes	The National Centre for Research and Development (NCBiR) Polish Development Fund Group (PFR)	The agenda of the NCBiR overlaps partially with that of PFR. NCBiR covers science and research, connecting R&D with business. PFR is focused on financing innovation activities in the country.
Programmes for human capital development	Yes	A large number of programmes focused on development of human capital	Adopted within the Strategy for Development of Human Capital 2030.
Programmes for human capital attraction and retention (e.g. reverse brain drain)	Yes	Fund for Polish Science offers some grants to foreign as well as Polish scientists abroad, for work in Poland Polish Agency for Enterprise Development (PARP) offers Poland Prize programme aimed at bringing foreign start-ups to Poland	Established programmes.
Start-up programmes (incubators, dedicated financing, etc.)	Yes	PARP offers a set of services focused on development of SMEs, including improving their innovative output Multiple programmes available at PFR School of Pioneers	PARP is a well-established institution.
Venture capital programmes	Yes	Seven available schemes within the PFR Ventures programme (PFR Starter, Biznest, OI, KOFFI, NCBR CVC, Green Hub FoF, PE)	PFR Ventures is the development finance institution dedicated to fund investments.
Cluster programmes	Yes	A variety of national clusters including: Silesia Automotive & Advanced Manufacturing; Silesian NANO Cluster; Silesian Aviation Cluster; West Pomeranian Chemical Cluster Green Chemistry; Pomeranian ICT Cluster Interizon; Bydgoszcz Industrial Cluster Dolina Narzędziowa; Cluster LifeScience Kraków; North-South Logistics and Transport Cluster	
Technology-specific policies	Yes	PFR Tech Hub focused on supporting: Electronics and robotic industries, 5G connectivity and the Internet of Things, AI and digital technologies, advanced chemistry and materials, engineering, drone industry (U-space), space industry	PFR Tech Hub is a strategic programme of the Polish Development Fund, the purpose of which is to support investment in the high-technology sector.
Tax incentive schemes	Yes	R&D tax relief supporting conceptual work on a new product; Prototype tax relief supporting the transfer of the idea into the language of practice and production; Tax relief to support innovative employees, making it easier to compete for specialists with key skills and competences; Tax relief for robotisation, which will facilitate the opening of a production line dedicated to the product; Possibility of simultaneous use of the R&D tax relief and the IP Box tax relief, reducing the burden at the stage of its sale	A large number of tax incentive programmes.

Contd.

Table 18 / Continued

	Yes/No	Name of the initiative/programme	Comments
Others		Various other programmes including: NCBiR schemes supporting participation of Polish institutions in the Horizon Europe programme and supporting IPCEI participation; Vouchers offered by PARP to SMEs for financing R&D spending; Innovation centres recognised and registered by the Ministry of Development of Technology institutions; State purchasing policy 2022-2025	NCBiR conducts joint advisory, information and support activities to support Polish scientific and business community in the European research area. Innovative centres are involved in technology transfer and providing pro-innovation services and co-operation with business. The state purchasing policy outlines ambitious targets for the public procurement of innovation.

COUNTRY-SPECIFIC POLICY PRIORITIES AND RECOMMENDATIONS

› **Make more strategic use of incoming foreign direct investment (FDI), bringing investment promotion programmes closer to innovation objectives.**[67] FDI has played a pivotal role in the economic development of Poland, but this channel has not been leveraged to its full. In most industries, foreign capital continues to be the main driver, with local firms playing more marginal roles. Arguably, some policies even contribute to this mode of development. A rethinking of FDI promotion policy is therefore needed, in a way that is conducive to the upgrading of Poland in value chains and the building up of innovative capacities potential (see also the recommendations in Section 5.2 of the main report). A variety of policy instruments may be used for this purpose: a much more selective approach to tax breaks and subsidies offered to foreign investors is needed, in a way that prioritises investments aligned with Poland's innovation ambitions, tying it together with the priority areas identified within the smart specialisation framework (also refer to the Irish 'innovation by invitation' approach discussed in Section 2.2 of the main report). Furthermore, incentives should be set in a way in which they help to create linkage between the foreign investors and local suppliers, for instance by making contribution to existing clusters, using Polish suppliers, or providing training and collaborating with local education institutions, a precondition for financial support.

› **Tackle the weak performance in green innovation through stepped-up policy efforts.** As noted above, Poland significantly falls behind in the Eco-Innovation Index, ranking next to last in 2022. To turn this weakness into a strength, the Polish government needs to implement policies that more effectively encourage eco-innovation. These can include grants and/or subsidies for companies investing in green technologies, but also joint, private-public funding for R&D projects, sharing resources and expertise, and co-developing sustainable technologies. Another step would be the establishment of an additional key cluster, focused on eco-innovation. Furthermore, establishing of a network of eco-innovators can facilitate knowledge sharing and collaboration. This network can include businesses, research institutions, government agencies and NGOs, working together to foster eco-innovation. Additionally, setting up clear, long-term environmental goals can provide a stable framework for businesses to invest in eco-innovation. Clear goal-setting would allow progress with the general development of eco-strategy for Poland, which at present hardly shadows steps made by

[67] See also the Polish country report in Zavarská et al. (2023), where we discuss this point.

other, more advanced economies. Additional financial and technical incentives for FDI in this area would strengthen available capital and access to new technologies.

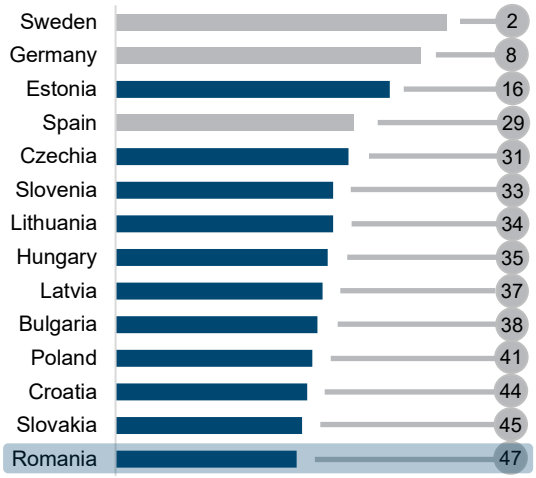
› **Provide access to a motivated and educated workforce in Poland, particularly in areas of innovative technologies.** This involves several key strategies. First, strengthening the education system to focus on STEM subjects is crucial. This includes updating the curriculum to include cutting-edge technologies and practical skills, as well as promoting university programmes and vocational training in fields such as IT, biotechnology, robotics and AI. Second, creating partnerships between educational institutions and technology companies can be beneficial. Internships, apprenticeships and co-operative education programmes can provide students with real-world experience and a pathway to employment in innovative technologies. Third, implementing policies that attract skilled workers from other countries and bring back Polish talent from abroad can enhance the capabilities of the local workforce. This can include easing visa restrictions for skilled workers, offering competitive salaries in the public sector and creating an expatriate-friendly environment. Finally, encouraging continuous learning and professional development for current employees in the tech sector is also vital. This can be achieved through workshops, online courses and conferences to keep the workforce abreast of the latest technological advancements (also see the recommendations in Section 5.4 of the main report).

Romania

INNOVATION LANDSCAPE

Despite significant improvement on multiple fronts, Romania's innovation policy still has a long way to go to improve its lowly (47th) position in the Global Innovation Index. This is also shown by the fact that Romania is an underperformer in innovation, given its GDP per capita level.[68] The main weaknesses include the low level of research and development (R&D) expenditures, amounting to 0.5% of GDP (the lowest among EU-CEE countries); the small number of researchers per million of population and inadequate investment in human capital. These indicators, together with firms' low intangible asset intensity, reflect the 'dependent market economy'-character of Romania's FDI-driven development.

Figure 22 / Global Innovation Index – Romania - Rank 47 out of 132 countries



Source: GII 2023.

Romania's innovation system is excessively fragmented, and the poor predictability of policy interventions exacerbates the weakness of its institutional environment. In contrast, the overall development level of infrastructure, including ICT (access and usage) and environmental performance, is on par with the European average.

Although R&D spending is very low, business enterprises account for a high share of total funding. This explains the fact that Romania can relatively effectively translate innovation inputs into outputs. Effective knowledge creation is substantiated by the higher than the CEE-average share of knowledge-intensive services exports within total services exports, the growing volume of venture capital investment in Romanian technology companies,[69] and the increasing number of start-ups and scale-ups. However, after the IPO of UiPath, Romania has no 'unicorns'[70] and its patent-based innovation performance is still far lower than the CEE average.

Domestic-owned Romanian companies are not present in the EU Industrial R&D Investment Scoreboard's top 1,000 database. The top R&D spenders are the local subsidiaries of global companies.

[68] According to GII's expected vs. observed innovation performance.

[69] ~EUR 102m in 2022 – a 12-fold growth since 2017.

[70] https://www.cbinsights.com/research-unicorn-companies

Romania's 2023 National Reform Programme specifically addresses research, development and innovation (RDI) issues, covering aspects such as emphasising improvements in the legislative framework, public procurement for innovation, development of human resources, R&D infrastructure and R&D centres, and supporting public-private partnerships for innovation. Most recently, there are projects connected to the Recovery and Resilience Plan of Romania, addressing in particular digitalisation-related issues.

Significant regional differences and inequalities characterise the country, and explain the existence of various regional-level programmes and the setting up of innovation hubs. The South-East region particularly supports inter-regional and international co-operation projects and partnerships, including participation in the Horizon Europe programme and within S3 platforms for regional smart specialisation areas.

In recent years, Romania has been converging with the EU in terms of small and medium-sized enterprises (SMEs) with at least a basic level of digital intensity. At the same time, the country has been actively targeting the development of the ICT sector. Nevertheless, adoption of advanced digital technologies (AI, cloud, big data) lags far behind the EU, and only one-tenth of SMEs are capable of selling their offerings online. Romania's performance in the Eco-Innovation Index deteriorated between 2013 and 2022.[71] The only index component showcasing good performance is the number of companies with ISO 14001 certificates, related to environmental management.

Table 19 / Romania - National Innovation System Indicators

Priority areas	Indicator	Romania	EU	EU-CEE
Education system	Tertiary education graduates in STEM, share in % (UNESCO)	29.3	24	24.2
	Spending on tertiary education per student, in EUR at PPP (Eurostat)	6,200	7,990	6,600
	PISA scales in reading, maths and science (GII)	428	484	480
Technological capacities of enterprises	R&D (GERD) financed by business, share in % (Eurostat)	55.2	57.7	43.5
	R&D expenditures (GERD) in % of GDP (Eurostat)	0.5	2.3	1.3
	SMEs with product innovations, share in % (EIS)	6.7	27.0	22.8
	SMEs with business process innovations, share in % (EIS)	5.3	41.6	32.4
	Finance for start-ups and scale-ups, average perception scores from 0 to 10 (GII)	4.1	4.3	4.5
Collaborations and linkages	Innovative SMEs collaborating with others, share in % (EIS)	1.5	11.7	10.1
	University-industry R&D collaborations, average perception scores from 0 to 7 (GII)	3.5	4.2	3.8
Innovation outcomes	Granted patents per million inhabitants (WIPO)	28	586	86
	Exports of medium and high-technology products, in % of total product exports (EIS)	56.0	61.2	49.5
	Knowledge-intensive services exports, in % of total services exports (EIS)	52.9	63.6	48.6

Note: data for EU and EU-CEE are simple averages, except for EIS and Eurostat, with original data for EU.
Data for 2021 or the most recent available year; more details on the methodology and data availability to be found in the Annex.
Sources: EIS 2023; Eurostat; GII 2023; UNESCO; WIPO; World Bank, WDI.

[71] https://www.eea.europa.eu/en/analysis/indicators/eco-innovation-index-8th-eap

Table 20 / Romania - Mapping innovation policy initiatives

	Yes/No	Name of the initiative/programme	Comments
Innovation agency	Yes	UEFISCDI - Executive Agency for Higher Education, Research, Development and Innovation Funding	Covers higher education, research, development and innovation, under the authority of the Romanian Ministry of Education, Research, Youth and Sport.
Programmes for human capital development	Yes	CRED (improvement of digital skills of teachers); PROF (digital training for teachers) UEFISCDI programme PNCDI IV – 5.2 Human resources	Specific programmes for researchers and teachers.[72]
Programmes for human capital attraction and retention (e.g. reverse brain drain)	Yes	UEFISCDI programme PNCDI IV – 5.1 Ideas and PNCDI IV – 5.2 Human resources	Programmes include measures to attract and maintain human resources from the country and abroad, to strengthen the national RDI system through grants for financing research projects and workshops;[73] to reduce brain drain and attract researchers from abroad;[74] to provide scholarships and research grants to support the mobility of young and experienced *diaspora* researchers; supporting their participation in meetings, visits and scientific events organised by research organisations in Romania.
Start-up programmes (incubators, dedicated financing, etc.)	Yes	UEFISCDI programme PNCDI IV – 5.7 Partnership for innovation COP, Action 1.2.1 – Stimulating enterprises' demand for innovation through RDI projects SGDFIP, Priority 1, Action 1.1. – Support for the private sector and for collaboration between actors from the public system and the business environment in the field of RDI	Specific support for innovative SMEs (for finance and patents)[75] e.g. seed capital matching fund or 'incubator' grant or pre-spin-off funds. One interesting part is the innovation vouchers programme, the aim of which is to finance the purchase of RDI services from RDI organisations for SMEs. The budget allocated for this action is Lei 5m (more than EUR 1m) for 2023. De minimis rules apply; a company can receive a maximum of EUR 200,000 in three consecutive years.
Venture capital programmes	Yes	Part of RRF/PNRR: Recovery Equity Fund of Funds	Financial instrument for the private sector, EUR 400m: to finance SMEs, mid-caps and infrastructure projects via fund partners.[76]
Cluster programmes	Yes	Support for industrial parks and support for organisation and development of innovative cluster UEFISCDI ONCDI IV Subprogramme 5.7.1 and support for organisation and development of innovative cluster UEFISCDI ONCDI IV Subprogramme 5.7.1	Investors setting up manufacturing locations or offices in an industrial, scientific or technological park benefit from: exemption on land tax, building tax and urban planning tax; and exemption on taxes charged for changing the land destination for plots located within industrial parks. Furthermore, according to EU evaluation, there is no consistent and dedicated cluster policy, although various elements are present in development programmes.[77]

Contd.

[72] https://uefiscdi.gov.ro/pncdi-iv-program-2

[73] https://uefiscdi.gov.ro/pncdi-iv-program-1

[74] https://uefiscdi.gov.ro/pncdi-iv-program-2

[75] https://uefiscdi.gov.ro/pncdi-iv-program-7

[76] https://www.eif.org/what_we_do/resources/rrf-romania/index.htm

[77] https://clustercollaboration.eu/sites/default/files/2021-12/eccp-factsheet-romania.pdf

Table 20 / Continued

	Yes/No	Name of the initiative/programme	Comments
Technology-specific policies	Yes	Cyber Security Strategy plus Action Plan COP, PA 1, Action 1.1.1. – Large R&D infrastructures ERDF	COP: in strategic areas (public and private infrastructure with critical importance for national security). European Regional Development Fund: innovation hubs in areas of strategic interest (e.g. Romanian Artificial Intelligence Hub).
Tax incentive schemes	Yes	Tax reductions/abolitions for R&D and innovation-related activities	0% income tax for employees working in IT&C companies, in compliance with current Romanian legislation. 0% profit tax on reinvested profit in new technological equipment used for business purposes. 0% income tax for employees working in R&D companies. 0% profit tax for the first 10 years of activity. Specific deduction in case of R&D eligible expenses: – accelerated depreciation of R&D equipment; – additional corporate tax deduction of 50% of the eligible expenditure for these activities.
Others		RO-NET: IT infrastructure development Romanian Artificial Intelligence Hub: AI resources; ION: AI-based governmental counsellor UEFISCDI PNCDI IV: other elements RRF UEFISCDI PNCDI IV: other elements RRF	UEFISCDI PNCDI IV: Innovation vouchers.[78] Patent voucher (with no details given). RRF: participation in IPCEI (microelectronics) supported: UEFISCDI PNCDI IV: Innovation vouchers.[79] UEFISCDI participates in NCP WIDERA.net to improve opportunities under the Framework programmes.[80] Patent voucher (with no details given). RRF: participation in IPCEI (microelectronics) supported.[81] UEFISCDI participates in NCP WIDERA.net to improve opportunities under the Framework programmes.[82]

Sources: European Commission (2023), 'Digital Decade Country Report 2023, Romania'; UEFISCDI; InvestRomania,[83] National Reform Programme.[84]

78 https://uefiscdi.gov.ro/voucher-cec-de-inovare

79 https://uefiscdi.gov.ro/voucher-cec-de-inovare

80 https://uefiscdi.gov.ro/ro-ncp_widera-net-0

81 https://ec.europa.eu/commission/presscorner/detail/en/ip_21_4876

82 https://uefiscdi.gov.ro/ro-ncp_widera-net-0

83 http://investromania.gov.ro/web/doing-business/fiscal-incentives/

84 https://commission.europa.eu/system/files/2023-09/ROMANIA%20NRP%202023%20EN.pdf

COUNTRY-SPECIFIC POLICY PRIORITIES AND RECOMMENDATIONS

Although the development level of the Romanian innovation landscape is far behind the EU average in multiple respects, innovation policy interventions need to avoid being overly fragmented. A focused policy needs to target some low-hanging fruits and at the same time implement a consistent long-term strategy, in the case of which progress will be slow and gradual. Specifically, we propose the following measures.

› **Avoid 'indicator targeting' by radically increasing the overall research budget**. This runs the risk of deteriorating the effectiveness of translating innovation inputs into outputs – a current strength of the Romanian system. There is a need to be selective. Although the lagging innovation landscape of Romania in multiple respects has to be acknowledged, innovation policy interventions need to avoid trying to address too many deficiencies at the same time. One area where ambitious targets are needed, however, is the improvement of the education system at all levels. This requires the implementation of a well-funded and carefully drafted long-term strategy. This covers a wide variety of aspects, such as enhancing the appeal and quality of vocational training, reviewing the regulatory frameworks governing publicly funded research institutions, and motivating greater cross-border collaborations of universities (see recommendations in Sections 5.3 and 5.4 of the main report)

› **Revise the mix of policy instruments used, to give greater emphasis to intangible investments.** Romania dedicates a disproportionate share of its funds – and also EU funds – to tangible investments, underemphasising the role of intangibles, which are particularly important in innovation capacity building (see Recommendation 1.2 of the main report). This calls for a re-evaluation of how available funds are being spent, shifting the weight from supporting investment in tangible research infrastructure, to facilitating enterprises' investment in intangible assets (e.g. company-specific software and digital solutions) created in the framework of innovation collaboration. This will foster the commercialisation of innovative actors' research outputs. As one of the poorest countries of the EU-CEE, it is crucial for Romania to leverage all available EU financial instruments to these goals, necessitating enhancements in the absorption of funds.

› **Promote R&D collaboration between foreign-owned subsidiaries and local SMEs or research institutes.** It is vital to boost linkages between foreign firms, which are the top R&D spenders in the country, and local enterprises. As we emphasised in the main report (see recommendation in Section 5.2), there are a variety of policy instruments that may be used for this purpose, such as implementing FDI promotion policies that prioritise sectors aligned with a country's innovation goals (such as priority areas identified in S3), steering foreign investments into existing clusters or innovation hubs to induce collaboration between foreign and domestic firms, establishing networking platforms between local suppliers and multinational enterprises (MNEs), or negotiating greater training and collaboration with local education institutions.

› **Gradually tackle the issue of innovation policy fragmentation through institutional improvements, avoiding quick fixes**. Although a number of external experts have urged Romania to implement a radical reorganisation and consolidation of the fragmented public research system, we propose not to consider such drastic organisational restructuring as a means of cutting costs. This is because the restructuring of the system – especially in environments of low institutional quality – often involves larger than expected costs and can potentially have a devastating effect on the performance

of the country's key resources: researchers. Instead, prioritising institutional improvements by setting clear expectations in terms of research outputs, promoting meritocracy, removing superfluous regulatory restrictions, and reducing the administrative burden are more likely to prove effective in combating the fragmented policy landscape.

› **Support the wider adoption of digital technologies by enterprises, combined with investments in digital skills**. Romania has been aiming to position itself as a preferred digital outsourcing destination, and a handful of local competitive enterprises have emerged in the digital sector. However, as we discussed above, the digitalisation of the economy and society remains weak. Although low taxation in the IT&C sector offers a competitive edge in attracting FDI, investors need better digital infrastructure, a higher-qualified workforce and digital public services to bring more sophisticated technology into the country.[85] Therefore, it is necessary for Romania to support private-sector digital skills programmes, incentivising SME employees' participation in advanced courses that cover data science, machine learning or cybersecurity. At the same time, including basic digital skills training in primary school curriculums is called for, so that the use of common software and critical thinking about internet content is gradually picked up by the wider Romanian population from a young age.

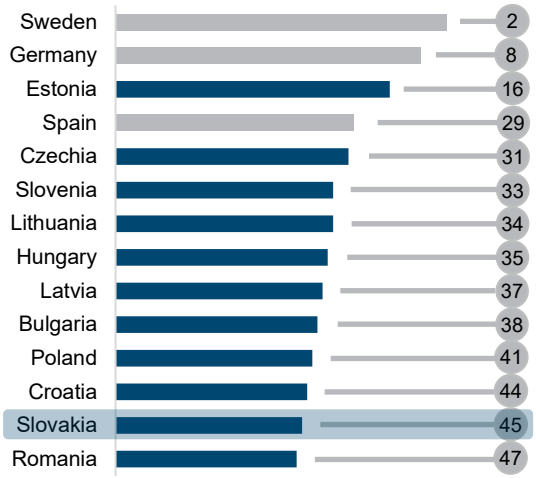
[85] See also the Romanian country chapter in Zavarská et al. (2023).

Slovakia

INNOVATION LANDSCAPE

Slovakia ranks rather low in international rankings of innovation performance. In the Global Innovation Index, Slovakia, in 45th place, lags behind all EU-CEE countries except for Romania. This represents an outcome below expectations for the country's development level.[86] In the European Innovation Scoreboard, the country is classified in the lowest category as an 'emerging innovator'; the gap with the EU has widened over time (below the EU increase overall, with a strong decrease in environment-related technologies). There are significant regional disparities, however, with the Bratislava (capital city) region performing better than other parts of the country.

Figure 23 / Global Innovation Index – Slovakia - Rank 45 out of 132 countries



Source: GII 2023.

The core strength of Slovakia when it comes to innovation performance relates to one output indicator, the share of medium and high-technology exports in total exports. Fuelled by the country's strong FDI-led value chain integration, Slovakia performs well above the EU average in this regard. This is because of the automotive industry (classified as a medium-high-technology industry), which plays a huge role in the country. Although large original equipment manufacturers (OEMs) have not invested in Slovakia with the primary aim of conducting research and development (R&D) activities, some car parts companies in the sector have started to locate their R&D departments in Slovakia (e.g. Adient Slovakia, HELLA Slovakia Lighting). Large OEMs contribute to process innovation,[87] and share best practices within other plants of the group. Volkswagen, for example, launched its own dual education facility with other companies. Even so, domestic supplier networks are not well developed and there are only weak spill-overs outside the multinational enterprises (MNEs).

Looking at the company landscape, Slovakia has no 'unicorn', but does have several notable innovative firms in the fields of e-mobility, waste management and social innovations.[88] A number of Slovak companies participate in Important Projects of Common European Interest (IPCEI, an EU policy initiative) related to green innovations, pointing to some advancements in this area. In IPCEI hydrogen value chain (IPCEIHy2Tech), Slovak company NAFTA participated in the field of storage, transportation

[86] According to GII's expected vs. observed innovation performance.

[87] https://spectator.sme.sk/c/22536781/process-innovations-allow-slovak-innovators-to-shine.html

[88] https://spectator.sme.sk/c/23189835/slovakia-closing-in-on-first-unicorn.html

and distribution technology. In IPCEI hydrogen value chain (IPCEI HY2Use), the EU approved funds for projects recently, one participant is from Slovakia. A project by the RONA company aims to apply hydrogen in industry. The IPCEI European battery innovation includes three Slovak companies (ENERGO-AQUA, InoBat Energy, ZTS).

Košice and the surrounding area in the economically lagging east of Slovakia is gradually evolving into an up-and-coming region: it hosts a strong IT cluster (as do Bratislava and Žilina also), ambitions for a space cluster emerged in September 2023, and the new Volvo plant creates the opportunity for an e-mobility hub there. Currently, the European Commission grants a Cluster Management Excellence gold label certificate to the Košice IT Valley, a silver certificate to the Slovak Plastic Cluster, and 18 clusters hold an active bronze label, with activities including energy and environment, creative industries, production and engineering, the food industry, ICT and biotechnology.[89] Two important examples are the Slovak National Hydrogen Association Cluster (since 2015) and the Slovak Battery Alliance (since October 2019).

The Recovery and Resilience Fund (RRF) is a great opportunity for Slovakia to improve its lagging innovation landscape, as it includes substantial efforts to advance the policy agenda in the country. As part of the RRF, the National Research, Development & Innovation Strategy 2030, endorsed in March 2023, represents a very promising development and is a quite a well-rounded innovation policy document.

Table 21 / Slovakia - National Innovation System Indicators

Priority areas	Indicator	Slovakia	EU	EU-CEE
Education system	Tertiary education graduates in STEM, share in % (UNESCO)	21.3	24	24.2
	Spending on tertiary education per student, in EUR at PPP (Eurostat)	7,590	7,990	6,600
	PISA scales in reading, maths and science (GII)	469	484	480
Technological capacities of enterprises	R&D (GERD) financed by business, share in % (Eurostat)	45.7	57.7	43.5
	R&D expenditures (GERD) in % of GDP (Eurostat)	0.9	2.3	1.3
	SMEs with product innovations, share in % (EIS)	14.1	27.0	22.8
	SMEs with business process innovations, share in % (EIS)	26.1	41.6	32.4
	Finance for start-ups and scale-ups, average perception scores from 0 to 10 (GII)	4.7	4.3	4.5
Collaborations and linkages	Innovative SMEs collaborating with others, share in % (EIS)	7.5	11.7	10.1
	University-industry R&D collaborations, average perception scores from 0 to 7 (GII)	3.2	4.2	3.8
Innovation outcomes	Granted patents per million inhabitants (WIPO)	56	586	86
	Exports of medium and high-technology products, in % of total product exports (EIS)	70.5	61.2	49.5
	Knowledge-intensive services exports, in % of total services exports (EIS)	46.3	63.6	48.6

Note: data for EU and EU-CEE are simple averages, except for EIS and Eurostat, with original data for EU.
Data for 2021 or the most recent available year; more details on the methodology and data availability to be found in the Annex.
Sources: EIS 2023; Eurostat; GII 2023; UNESCO; WIPO; World Bank, WDI.

89 https://www.cluster-analysis.org/benchmarked-clusters/listing?country=f4a697f2429d43bbafced4ffee8fec23

Table 22 / Slovakia - Mapping innovation policy initiatives

	Yes/No	Name of the initiative/programme	Comments
Innovation agency	Yes	Research and Innovation Authority (VAIA) at the Government Office www.vaia.gov.sk Government Council for Science, Technology and Innovation Slovak Innovation & Energy Agency (SIEA) www.siea.sk (under the Ministry of Economy)	National Research, Development & Innovation Strategy 2030 endorsed in March 2023; part of the Recovery and Resilience Plan; 91 specific measures; aims to simplify burdensome regulation and improve the labour force. The new innovation policy seeks to reduce the fragmentation of the support ecosystem. However, there still appear to be many actors in this field.
Programmes for human capital development	Yes	Reforms and investments under the Slovak Recovery and Resilience Plan	Reform of pre-primary education. New curriculum for primary and lower-secondary education. Introduction of performance contracts in higher education. Launch of several calls for support for research and innovation.
Programmes for human capital attraction and retention (e.g. reverse brain drain)	Yes	National Research, Development & Innovation Strategy 2030	Including diaspora engagement, fellowships for skilled professionals/researchers, Martin Filko Scholarship for post-graduate students abroad.
Start-up programmes (incubators, dedicated financing, etc.)	No	No explicit, stand-alone programmes targeting start-ups	For an overview of sectors and success stories, see: https://innovateslovakia.sk/en/startup-insights/sectors/
Venture capital programmes	Yes	(1) Venture to Future Fund (2) Microloan programme: for small businesses employing up to 50 people (3) Slovak Business Agency provides venture capital through a specialised subsidiary company – the National Holding Fund (Národný holdingový fond s.r.o.).	(1) Joint initiative of the EIB, the Ministry of Finance of the Slovak Republic and the Slovak Investment Holding (it is the first VC fund of its kind in the CEE region that has attracted EIB's capital). (2,3) See Slovak Business Agency. Several active VC funds are based in Slovakia.[90]
Cluster programmes	Yes	Subsidies for cluster development	Support for increasing the competitiveness of clusters, intended at new clusters. Administrated by SIEA.
Technology-specific policies	Yes	National Hydrogen Strategy and Action Plan	Public funds allocated to support hydrogen technologies in Slovakia.[91]
Tax incentive schemes	Yes	(1) Special R&D tax regime: R&D Super deduction (2) Patent Box	(1) Companies located in Slovakia can deduct additional 100% of their R&D costs from their corporate income tax base. (2) Special tax regime for intellectual property rights related income. Patent Box exempts income resulting from intellectual property acquired through companies' own R&D activities.
Others	Yes	(1) Voucher support scheme under RRF (2) Matching grants support to augment participation in EU-wide initiatives (3) Investment aid according to regions, in order to decrease regional disparities	(1) Differentiation between innovation voucher, a digital voucher and a patent voucher. (3) Aid intensities depend on the GDP per capita of the respective region (30% for Western Slovakia; 40% for Central Slovakia, 50% for Eastern Slovakia; Bratislava region excluded).

[90] For an overview on funding opportunities in Slovakia, see: https://innovateslovakia.sk/en/resources-tools/startup-guide/#funding-and-investors

[91] https://www.mhsr.sk/nvs

COUNTRY-SPECIFIC POLICY PRIORITIES AND RECOMMENDATIONS

Slovakia significantly lags in its innovation performance and needs to improve its innovation landscape to reach at least the level of performance expected for its development level. The new National Research, Development & Innovation Strategy 2030 provides a good starting-point and opportunity; its effective implementation should be carefully monitored.

› **Reduce innovation policy fragmentation.**
The Slovak innovation support ecosystem has long been highly fragmented, and the new National Research, Development & Innovation Strategy 2030 aims at its improved integration. A new governance structure was recently set up: The Research and Innovation Authority (VAIA) at the Government Office has been defined as a 'single cross-ministerial owner and co-ordinator'. The Government Council for Science, Technology and Innovation serves as an advisory body. Nevertheless, numerous agents with partly overlapping agendas continue to exist, which has several negative effects. One of these is the low disbursement of EU funds. In the last funding periods of the EU's Multiannual Financial Framework, Slovakia's absorption rate lagged significantly behind that of its peers. Therefore, the continued implementation of the National Research, Development & Innovation Strategy should be overseen, and the innovation strategy and industrial strategy of the country should be consolidated and more closely aligned. Greater emphasis on the smart specialisation framework is called for, particularly at the regional level (see also Recommendations 1.1, 1.2 and 1.3 in the main report). In less developed parts of the country, capacity-building and technical support need to be made widely available, so that these locations have the ability to design and implement successful development strategies.

› **Dedicate more policy attention to spill-over creation and linkages between foreign and domestic companies.**
Large foreign OEMs dominate the automotive sector, with foreign ownership also prominent in other sectors. Yet the transfer of technology and knowledge between foreign companies and domestic ones remains weak, and there is much potential to be found in supplier development. Hence, beyond the promotion of new ventures that the current innovation strategy skews towards, greater emphasis on secondary forms of innovation is recommended (see Recommendations 2.1 and 2.3 in the main report). Best practice cases could provide new ideas in this respect: For example, more investment support could be provided to a foreign investor when a domestic partner is involved or when effective co-operation with a research institute is created.[92] Building on the matchmaking platform of the Slovak Investment and Trade Development Agency (SARIO), more networking platforms between foreign enterprises and domestic enterprises should be integrated into the innovation strategy, entailing co-ordination and collaboration on innovation and FDI policy between SARIO and VAIA. In addition, grants or innovation vouchers targeted at foreign enterprises collaborating with domestic universities could be considered, as well as training schemes aimed at enhancing the organisational and management capabilities of domestic suppliers.

› **Adapt all levels of the education system to meet current market needs.**
Setting the education system in a way that allows the country to absorb imported knowledge and capacities is particularly important in the Slovak context. The skills and needs of the market should be considered more closely via greater work-based learning in vocational training. Slovakia can build on

[92] See, for example, the new 'Tecxport-Tailored Innovation Initiative' in Austria: https://www.ffg.at/ausschreibung/TecxportTailoredInnovation-2023

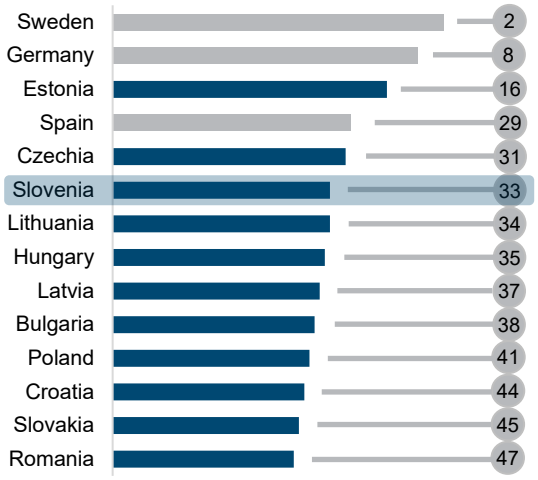
the presence of MNEs to strengthen apprenticeship and internship programmes, career exploration programmes, and mentorship initiatives, to ensure that students get hands-on experiences from a relatively early age. Incorporating industry representatives into the dialogue on the development of curriculum frameworks can further align labour market needs with the skills being taught at schools. An example for best practice is the bilateral co-operation between Slovakia and Austria in vocational training, which started in 2014. Greater promotion of such cross-border learning would be beneficial. Meanwhile, the higher education system should also be brought closer to 'reality'. The establishment of technology transfer offices at universities should be promoted, and regulatory frameworks reviewed in a way that encourages commercialisation of intellectual property. Beyond pushing for international excellence, it is important to simultaneously motivate more locally embedded research, inducing downstream collaboration of universities, closer to the stages of technology or innovation application (see also recommendations in Sections 5.3 and 5.4 of the main report).

Slovenia

INNOVATION LANDSCAPE

Slovenia is an average innovator by EU standards: stronger than most of EU-CEE, but still well behind the front-runners of Western Europe. Its innovation ranking is generally in line with its development level.[93] However, in recent years, the pace of improvement in Slovenia's innovation performance has slowed. Although its performance, ranked by the European Innovation Scoreboard, has improved for three years in a row since 2019, the gap to the most innovative European countries remains large. Slovenia is improving at a slower pace than the EU on average and more slowly than some other EU-CEE countries. Based on the 2023 Global Innovation Index, Slovenia ranks 33rd, behind Estonia and Czechia.

Figure 24 / Global Innovation Index – Slovenia - Rank 33 out of 132 countries



Source: GII 2023.

Despite the decelerating trend, Slovenia still performs well above the EU-CEE average in various innovation system indicators. Slovenia's key strength is its human capital, shown by a high share of the population with a tertiary education, high scores in PISA rankings and solid academic output in terms of doctorates and publications.

Slovenia's export-oriented economy produces a relatively high share of medium and high-tech exports, slightly above the EU average. The domestic pharmaceutical industry can be seen as a success in this regard. The domestically owned pharmaceutical company Krka ranked 179th in the 2022 EU Industrial R&D Investment Scoreboard's top 1,000, and second in EU-CEE. The pharmaceutical company Lek acts as the innovation centre for the corporation Sandoz, an example of successful positioning in global value chains (GVCs). However, there is a lack of large-scale participation in future-oriented value chains, as shown by the lack of participation in the EU policy initiative Important Projects of Common European Interest (IPCEI).

The key strength of Slovenian small and medium-sized enterprises (SMEs) lies in cutting-edge engineering and product innovation, as shown by examples of highly innovative SMEs in various sectors, such as satellite technology, plastics and automotive components. However, the success of these firms has more to do with the technical expertise of founders, and participation in GVCs, rather

[93] According to GII's expected vs. observed innovation performance.

than being the result of support policies. Meanwhile, the export of knowledge-intensive services lags far behind the EU-CEE average.

Slovenia's key weakness is chronic underinvestment in innovation, both public and private. In 2021, public research and development (R&D) expenditure reached 2.14% of GDP, its highest share to date. However, this is still almost 0.5 percentage points lower than that of the leading innovators in the EU. The corporate sector has only slowly been increasing its share of R&D investment as a share of GDP, while also underperforming in non-R&D innovation expenditure. The issue of underinvestment is also related to the lack of domestic options for innovation financing, including access to credit and venture capital funding for start-ups.

In the context of innovation connected to the twin transition, Slovenia performs moderately well. Considering its strategic aims to support the development of the green economy, Slovenia performs averagely in terms of eco-innovation, scoring above the EU average in terms of outputs, but shows a relative weakness in terms of producing eco-innovation related patents.[94] Slovenia is also performing averagely in terms of the digital transition. There are several areas where Slovenia is either stagnating or losing its relative advantage to the rest of the EU, including human resources and digitalisation of the economy, where it nevertheless performs well in terms of use of digital sales channels and robotics. On a positive note, Slovenia has set up a Digital Innovation Hub to provide advice and mentoring for SMEs.[95]

Table 23 / Slovenia - National Innovation System Indicators

Priority areas	Indicator	Slovenia	EU	EU-CEE
Education system	Tertiary education graduates in STEM, share in % (UNESCO)	28.1	24	24.2
	Spending on tertiary education per student, in EUR at PPP (Eurostat)	8,430	7,990	6,600
	PISA scales in reading, maths and science (GII)	504	484	480
Technological capacities of enterprises	R&D (GERD) financed by business, share in % (Eurostat)	48.7	57.7	43.5
	R&D expenditures (GERD) in % of GDP (Eurostat)	2.1	2.3	1.3
	SMEs with product innovations, share in % (EIS)	34.8	27.0	22.8
	SMEs with business process innovations, share in % (EIS)	41.6	41.6	32.4
	Finance for start-ups and scale-ups, average perception scores from 0 to 10 (GII)	4.8	4.3	4.5
Collaborations and linkages	Innovative SMEs collaborating with others, share in % (EIS)	13.1	11.7	10.1
	University-industry R&D collaborations, average perception scores from 0 to 7 (GII)	3.9	4.2	3.8
Innovation outcomes	Granted patents per million inhabitants (WIPO)	245	586	86
	Exports of medium and high-technology products, in % of total product exports (EIS)	63.6	61.2	49.5
	Knowledge-intensive services exports, in % of total services exports (EIS)	42.6	63.6	48.6

Note: data for EU and EU-CEE are simple averages, except for EIS and Eurostat, with original data for EU.
Data for 2021 or the most recent available year; more details on the methodology and data availability to be found in the Annex.
Sources: EIS 2023; Eurostat; GII 2023; UNESCO; WIPO; World Bank, WDI.

[94] See the Eco-Innovation Scoreboard.

[95] See Digital Economy and Society Index Country profile 2022.

Table 24 / Slovenia - Mapping innovation policy initiatives

	Yes/No	Name of the initiative/programme	Comments
Innovation agency	Yes	Slovenia Business Development Agency (SPIRIT)	Not purely an innovation agency, but also offers various services aimed at innovation (facilitation of learning, funding calls, support for international business, etc.), as well as investment, entrepreneurship and internationalisation support.
Programmes for human capital development	Yes	Public Scholarship, Development, Disability and Maintenance Fund of the Republic of Slovenia	Develops projects funded through Cohesion Funds; projects for 2021-2027 have not been developed yet; one example is Competence Centres for Human Resources Development, which provided training for employees (now completed).
Programmes for human capital attraction and retention (e.g. reverse brain drain)		2023 amendments to the Aliens Act	Aimed at accelerating the administrative procedures for hiring foreign workers.
Start-up programmes (incubators, dedicated financing, etc.)	Yes	Slovenian Entrepreneurship Fund (SPIS), SPIRIT	Issue yearly calls for funding start-ups.
Venture capital programmes	Yes	Slovenian Entrepreneurship Fund with the Slovenian Development Bank (SID)	Via the Central Europe Fund of Funds – CEFoF and the European Cohesion Funds.
Cluster programmes	Yes	Strategic Research & Innovation Partnership, part of the national smart specialisation strategy	10 clusters connecting private, public and academic actors around priority themes.
Technology-specific policies	Yes	Strategy of Digital Transformation of the Economy (in planning); formation of the Digital Innovation Hub (DIH)	Strategy is still in development.
Tax incentive schemes	Yes	Corporate Income Tax Act	Tax incentives for R&D investment (100%), investments for equipment and for non-material assets (40%).
Funding mechanisms	Yes	Loans for R&I in SMEs from the European Cohesion Funds, offered by the Slovenian Development Bank (SID)	Loans for R&I, covered by guarantees by the SID.
Digital innovation agency	Yes	Digital Innovation Hub Slovenia	Provides advice and mentoring for SMEs.

COUNTRY-SPECIFIC POLICY PRIORITIES AND RECOMMENDATIONS

Slovenia provides a solid foundation for innovation in terms of education, infrastructure, and connection to GVCs. It offers a multitude of support policies, and has improved in terms of digitalisation both in the private and the public sector. However, the gap to the most innovative EU countries remains large and is not closing. Despite the numerous positive developments and policies in place, it is clear that 'business as usual' will not provide the developmental jump the country seeks. Although underinvestment is seen as a key issue, the impact that the recent series of crises has had on Slovenia's fiscal space should also be noted. With the 2023 floods (which will channel large amounts of public money into reconstruction) and the return of EU fiscal rules, policy makers will need to be creative in providing targeted support in areas which will reap the largest benefits in terms of improved innovation performance. To this end, we propose the following measures.

› **Increase direct funding and co-investment opportunities aiming to improve the innovation output of SMEs**.
Targeted funding should be provided for start-ups and SMEs via a specialised state capital fund that will support companies in bridging the 'death valley' between patent stage and commercialisation (TLR4-TLR7). Financing should pursue tangible goals, such as increasing the number of patents, scaling of innovative solutions and bringing innovations to market. Investments should also serve as a de-risking instrument to leverage private capital from domestic sources, including large companies that might be interested in acquiring high-potential start-ups.

› **Streamline immigration procedures for highly skilled workers and provide tax incentives to bring back talent.**
Although progress has been made, the rigid legislation and slow administrative procedures (coupled with high taxes on high earners) make Slovenia a relatively unattractive option for top talent, both domestic and foreign, despite its positive traits in form of quality of life, security and education system. Temporary tax incentives on returning professionals and PhDs could make the domestic labour market more attractive for domestic top talent. Accelerating procedures to acquire citizenship and long-term living security could increase its attractiveness for foreign professionals. As many of Slovenia's largest and most technologically advanced companies are part of international ownership groups, tax incentives should be provided to ensure that more innovation-focused activities take place in Slovenia.

› **Co-ordinate industrial policy and climate strategies more effectively to accelerate the green transition via domestic innovation.**
Both energy-intensive large companies and SMEs providing semi or end products to automotive value chains will need to transform, the latter to adapt to the gradual shift towards electric vehicles, and the former to decarbonise production and switch to non-fossil fuel energy inputs. This represents an opportunity for companies investing in the green transition as well as to companies providing solutions and services. Grants, channelled through the national Climate Change Fund should tie R&D closer to green technology adoption to improve the rate of eco-innovation. The Climate Change Fund should also provide instruments to fund technical assistance for large companies to develop R&D projects that will successfully compete for EU funding sources aimed at innovative low-carbon technologies, such as the Innovation Fund or the Modernisation Fund. Innovative instruments, such as carbon contracts for difference, could provide a degree of long-term stability for large-scale green innovation that would make projects more attractive for additional private and EU sources of funding.

› **Accelerate the rate of the digital transformation of the economy.**
Slovenia has been losing ground relative to the Visegrád countries, as well as to 'high innovating' countries according to the Digital Economy and Society Index (DESI), both in the uptake of new technologies and human resources. Slovenia still has competitive advantages in specific technologies, such as artificial intelligence. Targeted programmes, such as for-purpose digital vouchers, are needed to ensure that large companies accelerate their digital transformation processes. In addition, training and information should be provided to SMEs (outside high-tech sectors), via the SPIRIT agency or other established public structures, so that they can understand the potential of AI and other new technologies. Instruments, similar to innovation vouchers, could be used to fund smaller investments in skills and equipment needed to explore cutting-edge technologies.

References

Aiyar, S., A. Ilyina et al. (2023), 'Geoeconomic fragmentation and the future of multilateralism', Staff Discussion Note SDN/2023/001, International Monetary Fund, Washington, DC.

Appelt, S., M. Bajgar, C. Criscuolo and F. Galindo-Rueda (2020), 'The effects of R&D tax incentives and their role in the innovation policy mix: Findings from the OECD microBeRD project, 2016-19', OECD Science, Technology and Industry Policy Papers, No. 92, OECD Publishing, Paris.

Astrov, V., S. Leitner, R. Grieveson, D. Hanzl-Weiss, I. Mara and H. Vidovic (2021),'How do economies in EU-CEE cope with labour shortages?', wiiw Research Report No. 452, The Vienna Institute for International Economic Studies (wiiw), Vienna, February.

Astrov, V., Stehrer, R., Zavarská, Z. (2022). Recovery and Resilience Facility funding in the Visegrád countries and its impact on Austria, Policy Notes and Reports, No. 56, The Vienna Institute for International Economic Studies (wiiw), Vienna

Blažek, J. (2016), 'Towards a typology of repositioning strategies of GVC/GPN suppliers: the case of functional upgrading and downgrading', *Journal of Economic Geography*, Vol. 16(4), pp. 849-869.

Borrás, S. and M. Laatsit (2019), 'Towards system oriented innovation policy evaluation? Evidence from EU28 member states', *Research Policy*, Vol. 48(1), pp. 312-321.

Bradley, J. (2006), 'An island economy or island economies? Ireland after the Belfast agreement', Working Paper No. 22, Institute for British-Irish Studies, Dublin.

Buckley, P.J. and F. Ruane (2006), 'Foreign direct investment in Ireland: Policy implications for emerging economies', *The World Economy*, Vol. *29*(11), pp. 1611-1628.

Business.gov.lv (2023), Innovation Vouchers. https://business.gov.lv/en/node/13683

Cedzová, N., J. Dovčík, K. Gardoňová, M. Hulényi, V. Rybanská, Z. Zavarská and V. Zlaczká (2021), 'Report on productivity and competitiveness of the Slovak Republic 2020', National Productivity Board of the Slovak Republic.

Coe, N.M. and M. Perry (2004), 'Promoting linkage to foreign transnational in a "tiger" state: Singapore and the Local Industry Upgrading Programme', *Environment and Planning C: Politics and Space*, Vol. 22(3), pp. 363-382.

Correia, A., B. Bilbao-Osorio, M. Kollar, A. Gereben and C. Weiss (2018), 'Innovation investment in Central, Eastern and South-Eastern Europe: Building future prosperity and setting the ground for sustainable upward convergence', Publications Office of the European Union.

Di Cataldo, M., V. Monastiriotis and A. Rodríguez-Pose (2022), 'How "smart" are smart specialization strategies?', *JCMS: Journal of Common Market Studies*, Vol. 60(5), pp. 1272-1298.

Easterly, W. and R. Levine (2001), 'What have we learned from a decade of empirical research on growth? It's not factor accumulation: Stylized facts and growth models', *The World Bank Economic Review*, Vol. 15(2), pp. 177-219.

Engel, J., H. Hamirani and K. Saklatvala (2016), 'Pursuing innovation: Sovereign wealth funds and technology investment'. Available at SSRN: https://ssrn.com/abstract=2864853

European Commission (2023a), 'PSF to support early stages of innovation and science-business linkages in Croatia. Final report', Directorate-General for Research and Innovation.

European Commission (2023b), 'European Innovation Scoreboard 2023'.

European Commission (2023c), 'European Innovation Scoreboard 2023 Methodology report'.

European Commission (2022), 'Country review of the Romanian research and innovation system', Directorate-General for Research and Innovation.

European Commission (2020), 'Science, research and innovation performance of the EU (SRIP) report', Directorate-General for Research and Innovation.

European Commission (2019), 'Peer review of the Estonian R&I system. Final report', Directorate-General for Research and Innovation.

Ewens, M., R. Nanda and M. Rhodes-Kropf (2018), 'Cost of experimentation and the evolution of venture capital', *Journal of Financial Economics*, Vol. 128(3), pp. 422-442.

Fagerberg, J. and B. Verspagen (2021), 'Technological revolutions, structural change, and catching up', in: L. Alcorta, N. Foster-McGregor, B. Verspagen and A. Szirmai (eds), *New Perspectives on Structural Change: Causes and Consequences of Structural Change in the Global Economy*, Oxford University Press, Oxford, pp. 131-155.

Grieveson, R., A. Bykova, D. Hanzl-Weiss, G. Hunya, N. Korpar, L. Podkaminer, R. Stehrer and R. Stöllinger (2021), 'Avoiding a trap and embracing the megatrends: Proposals for a new growth model in EU-CEE, wiiw Research Report No. 458, The Vienna Institute for International Economic Studies (wiiw), Vienna, November.

Grimsby, G. (2018), 'Partly risky, partly solid – performance study of public innovation loans', *Research Policy*, Vol. 47(7), pp. 1344-1365.

Heavin, C., B. Fitzgerald and E.M.Trauth (2003), 'Factors influencing Ireland's software industry: Lessons for economic development through IT', in: M. Korpela, R. Montealgre and A. Poluymenakou (eds), *Organizational Information Systems in the Context of Globalization*: *IFIP TC8 & TC9/WG8. 2 & WG9. 4 Working Conference on Information Systems Perspectives and Challenges in the Context of Globalization June 15-17, 2003, Athens, Greece*, Springer, New York, pp. 235-252.

Karo, E., R. Kattel and A. Cepilovs (2017), 'Can smart specialization and entrepreneurial discovery be organized by the government? Lessons from Central and Eastern Europe', in: S. Radosevic, A, Curaj, R. Gheorghiu, L. Andreescu and I. Wade (eds), *Advances in the Theory and Practice of Smart Specialization,* Elsevier, Amsterdam, pp. 269-292.

Landesmann, M.A. and R. Stöllinger (2019), 'Structural change, trade and global production networks: An "appropriate industrial policy" for peripheral and catching-up economies', *Structural Change and Economic Dynamics*, Vol. 48, pp. 7-23.

Lember, V., A. Cepilovs and R. Kattel (2013), 'Demand-side innovation policy in Estonia: rationales, limits and future paths', Working Papers in Technology Governance and Economic Dynamics, No. 56, Tallinn University of Technology, Ragnar Nurkse School of Innovation and Governance.

Lerner, J. and R. Nanda (2020), 'Venture capital's role in financing innovation: What we know and how much we still need to learn', *Journal of Economic Perspectives,* Vol. 34(3), pp. 237-261.

Lin, G.T.-R., Y.-H. Chang and Y.-C. Shen (2010), 'Innovation policy analysis and learning: Comparing Ireland and Taiwan', *Entrepreneurship & Regional Development*, Vol. 22(7-8), pp. 731-762.

Loewen, B. and S. Schulz (2019), 'Questioning the convergence of cohesion and innovation policies in Central and Eastern Europe', in: T. Lang and F. Görmar (eds), *Regional and Local Development in Times of Polarisation: Re-thinking Spatial Policies in Europe*, Palgrave Macmillan, London, pp. 121-148.

Lucut, C. (2022), 'Infrastructura de cercetare în sănătate, nefolosită din cauza costurilor mari! UMF Cluj și MedFUTURE au găsit soluția pentru a fi utilizată la potențial maxim', *Monitorulcj.ro*. 24 October 2022. https://www.monitorulcj.ro/sanatate/103727-umf-cluj-si-laboratorul-medfuture-exemplu-de-bune-practici-privind-utilizarea-infrastructurii-de-cercetare

Mazzucato, M. (2013), *The Entrepreneurial State: Debunking Public vs. Private Sector Myths*, Anthem Press, London.

McKinsey (2020), 'Digital challengers in the next normal: Central and Eastern Europe on a path to digitally-led growth'.

OECD (2023a), 'The impact of R&D tax incentives: Results from the OECD MicroBeRD+ project', OECD Science, Technology and Industry Policy Paper No. 159, OECD Publishing, Paris.

OECD (2023b), 'Education at a glance 2023: OECD indicators', OECD Publishing, Paris. https://doi.org/10.1787/e13bef63-en

OECD (2021), 'SME and entrepreneurship policy in the Slovak Republic', OECD Studies on SMEs and Entrepreneurship, OECD Publishing, Paris. https://doi.org/10.1787/9097a251-en

OECD (2019), 'University-industry collaboration: New evidence and policy options', OECD Publishing, Paris.

OECD (2016), 'OECD reviews of innovation policy: Lithuania 2016', OECD Publishing, Paris. http://dx.doi.org/10.1787/9789264259089-en

OECD (2017), *Public Procurement for Innovation: Good Practices and Strategies*, OECD Public Governance Reviews, OECD Publishing, Paris, https://doi.org/10.1787/9789264265820-en.

O'Malley, E., S. Roper and N. Hewitt-Dundas (2008), 'High growth and innovation with low R&D: Ireland', in: C. Edquist and L. Hommen (eds), *Small Country Innovation Systems: Globalization, Change and Policy in Asia and Europe*, Edward Elgar, Cheltenham, pp. 156-193.

Perez, C. (2002), *Technological Revolutions and Financial Capital: the Dynamics of Bubbles and Golden Ages*, Edward Elgar, Cheltenham.

Prognos and CSIL (2022), 'Analysis of key parameters of smart specialisation strategies (S3). Final report', Contract No 2021CE160AT062, July.

Prognos and CSIL (2021), 'Study on prioritisation in smart specialisation strategies in the EU. Study on behalf of the European Commission. https://ec.europa.eu/regional_policy/en/information/publications/studies/2021/study-on- prioritisation-in-smart-specialisation-strategies-in-the-eu

Radosevic, S. (2017a) 'Assessing EU smart specialization policy in a comparative perspective', in: in: S. Radosevic, A, Curaj, R. Gheorghiu, L. Andreescu and I. Wade (eds), *Advances in the Theory and Practice of Smart Specialization,* Elsevier, Amsterdam, pp. 1-36.

Radosevic, S. (2017b), 'Upgrading technology in Central and Eastern European economies', IZA World of Labor.

Radosevic, S. (1998), 'The transformation of national systems of innovation in Eastern Europe: between restructuring and erosion', *Industrial and Corporate Change*, Vol. 7(1), pp. 77-108.

Radosevic, S. and K. Ciampi Stancova (2018), 'Internationalising smart specialisation: Assessment and issues in the case of EU new member states', *Journal of the Knowledge Economy*, Vol. 9 (1), pp. 263-293.

Radosevic, S. and K. Ciampi Stancova (2015), 'External dimensions of smart specialisation: Opportunities and challenges for trans-regional and transnational collaboration in the EU-13', JRC Technical Reports S3 Working Paper Series, No. 09/2015.

Rusu, D. (2022), 'How commercialization is helping unlock the innovation potential of research infrastructure in Romania', *World Bank Blogs – Eurasian Perspectives*. https://blogs.worldbank.org/europeandcentralasia/how-commercialization-helping-unlock-innovation-potential-research

Sabha, Y., Y. Liu and W. Douw (2020), 'Promoting technology transfer and productivity spillovers from foreign direct investment (FDI)', World Bank, Washington, DC.

Sharif, N. (2006), 'Emergence and development of the National Innovation Systems concept. *Research Policy*, Vol. 35(3), pp. 745-766.

Silvestri, R. (2019), 'Unlocking the potential of capital markets in Central and Eastern European countries', *Market Integrity Insights*, CFA Institute, Charlottesville, Virginia.

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

Stojčić, N., S. Srhoj and A. Coad (2020), 'Innovation procurement as capability-building: Evaluating innovation policies in eight Central and Eastern European countries', *European Economic Review*, Vol. 121: 103330.

Suurna, M. and R. Kattel (2010), 'Europeanization of innovation policy in Central and Eastern Europe', *Science and Public Policy*, Vol. 37(9), pp. 646-664.

Szczygielski, K. (2019), 'Innovation policy in Poland', ifo DICE Report, ISSN 2511-7823, ifo Institut – Leibniz-Institut für Wirtschaftsforschung an der Universität München, Vol. 17(4), pp. 7-9.

UNCTAD (2011), 'Best practices in investment for development. How to integrate FDI and skill development: Lessons from Canada and Singapore', United Nations, New york and Geneva.

van Elkan, R. (1995), 'Singapore's Development Strategy', in: K. Bercuson (ed.), *Singapore A Case Study in Rapid Development*, International Monetary Fund, Washington, DC.

Vejdovová, A. (2022), 'Daňové slevy na výzkum dostávají firmy do potíží. Nepomohla ani novela zákona', *Ekonom*, 24 November 2022. https://ekonom.cz/c1-67141400-danove-slevy-na-vyzkum-dostavaji-firmy-do-potizi-nepomohla-ani-novela-zakona

Verspagen, B. (2004), 'Innovation and economic growth', in: J. Fagerberg, D.C. Mowery and R.R. Nelson (eds.), *The Oxford Handbook of Innovation*, Oxford University Press, Oxford, pp. 487-513.

WIPO (2023), 'Global Innovation Index 2023: Innovation in the face of uncertainty', World Intellectual Property Organization, Geneva. doi:10.34667/tind.48220

Wishlade, F., R. Michie, P. Robertson and P. Vernon (2017), 'Improving the take-up and effectiveness of financial instruments'. https://op.europa.eu/en/publication-detail/-/publication/1f3899cf-982e-11e7-b92d-01aa75ed71a1/language-en

Wong, P.K. (2003). "From using to creating technology: the evolution of Singapore's national innovation system and the changing role of public policy". In S. Lall and S. Urata (eds): *Competitiveness, FDI and Technological Activity in East Asia*. Cheltenham, UK: Edward Elgar (pp. 191-238).

Wong, P.K. and A. Singh (2008), 'From technology adopter to innovator: Singapore', in: C. Edquist and L. Hommen (eds), *Small Country Innovation Systems: Globalization, Change and Policy in Asia and Europe*, Edward Elgar, Cheltenham, pp. 71-112.

World Bank (2019), 'Czech Republic: Assessment of the SME policy mix'.

Yeo, P. (2016). "Chapter 3. Going Beyond Comparative Advantage: How Singapore Did It". In R. Cherif, F. Hasanov, and M. Zou (Eds): *Breaking the Oil Spell: The Gulf Falcons' Path to Diversification*. Washington D.C.: International Monetary Fund.

Zavarská, Z., A. Bykova, R. Grieveson, D. Hanzl-Weiss and O. Sankot (2023), 'Industrial policies for a new growth model: a toolbox for EU-CEE countries', wiiw Research Report No. 469. The Vienna Institute for International Economic Studies (wiiw), Vienna, July.

Appendix

This annex provides information on the definition of indicators used in country report table ***National Innovation System Indicators*** and respective data sources by country. In general, values of the baseline indicators from the European Innovation Scoreboard (EIS) or Global Innovation Index 2003 scores have been used as a main source. Please use respective methodological reports for the detailed explanations about background methodologies.[96] When necessary, they have been enhanced by various international data sources such as WIPO, WDI, UNESCO and Eurostat. For Eurostat data, the code for variables is also provided.

Table A1 / Data sources for the National Innovation System Indicators table in the country reports

Indicator	Data sources
Tertiary education graduates in STEM, share in %	UNESCO; UIS.Stat, Dataset: Other policy relevant indicators, Indicator: Percentage of graduates from Science, Technology, Engineering and Mathematics programmes in tertiary education, both sexes (%); data extracted on 17.10.2023. Data for 2021 for all countries, except Bulgaria (2020) and Croatia (2020). EU average is calculated as a simple average over 27 countries.
Spending on tertiary education per student, in EUR at PPP	Eurostat, calculated as spending divided by number of students. Spending: Total educational expenditure by education level, programme orientation and type of source (EDUC_UOE_FINE01), General government, Tertiary education (levels 5-8), Million purchasing power standards (PPS). Students: Students enrolled in tertiary education by education level, programme orientation, sex, type of institution and intensity of participation (EDUC_UOE_ENRT01), Tertiary education (levels 5-8); data extracted on 06.10.2023. Data for 2020 for all countries except for Czechia (2019), Croatia (2019) and Latvia (2019). Data extracted on 06.10.2023. Original EU data.
PISA scales in reading, maths and science	GII values for this indicator for 2018 according to WIPO (2023). EU average is calculated as a simple average over 27 countries.
R&D (GERD) financed by business, share in %	Eurostat, GERD by sector of performance and source of funds (rd_e_gerdfund), Business enterprise sector (BES), recalculation as a share of total; data extracted on 17.10.2023. Data for 2021. Original EU data.
R&D expenditures (GERD), in % of GDP	Eurostat, GERD by sector of performance and source of funds (rd_e_gerdfund); data extracted on 17.10.2023. Data for 2021. Original EU data.
SMEs with product innovations, share in %	EIS 2023 values, baseline data – Eurostat, Community Innovation Survey data for 2018 (inn_cis12_bas). Number of SMEs introducing at least one product innovation either new to the enterprise or new to their market divided by total number of SMEs (enterprises with 10 to 249 employees). Interpretation in the EIS Methodology report: 'Product innovation is a key ingredient to innovation as they can create new markets and improve competitiveness. Higher shares of product innovators reflect a higher level of innovation activities'. Original EU data.
SMEs with business process innovations, share in % (EIS)	EIS 2023 values, baseline data: Eurostat, Community Innovation Survey data for 2018 (inn_cis12_spec). Number of SMEs introducing at least one business process innovation either new to the enterprise or new to their market divided by total number of SMEs (enterprises with 10 to 249 employees). Interpretation in the EIS Methodology report: 'Many firms innovate not by improving new products but by improving their business processes. Business process innovations include process, marketing and organisational innovation'. Original EU data.

Contd.

[96] European Commission (2023c); WIPO (2023).

Table A1 / Continued

Indicator	Data sources
Finance for start-ups and scale-ups, average perception scores from 0 to 10	GII 2023 values, baseline data: Global Entrepreneurship Monitor (GEM), National Expert Survey (NES). Survey based indicator showing average perception scores (five-year average for 2015-2022) of experts on finance for starting and growing firms, ranging from 0 to 10. EU average is calculated as a simple average over 27 countries.
Innovative SMEs collaborating with others, share in %	EIS 2023 values, baseline data: Eurostat, Community Innovation Survey data for 2018 (inn_cis12_co). Number of SMEs with innovation co-operation activities including all enterprises that had any co-operation agreements on innovation activities with other enterprises or institutions in the three years of the survey period dived by total number of SMEs (enterprises with 10 to 249 employees). Interpretation in the EIS Methodology report: 'This indicator measures the degree to which SMEs are involved in innovation co-operation. Complex innovations, in particular in ICT, often depend on the ability to draw on diverse sources of information and knowledge, or to collaborate in the development of an innovation. This indicator measures the flow of knowledge between public research institutions and firms, and between firms and other firms. The indicator is limited to SMEs, because almost all large firms are involved in innovation co-operation.' Original EU data.
University-industry R&D collaborations, average perception scores from 0 to 7	GII 2023 values, baseline data: World Economic Forum, Executive Opinion Survey 2022, data for 2018-2022. Answer to question: 'In your country, to what extent do businesses and universities collaborate on research and development (R&D)', ranging from 1 (not at all) to 7 (to a great extent). EU average is calculated as a simple average over 27 countries.
Granted patents per million inhabitants	Indicator calculated as a ratio of granted patents to population. Numerator: WIPO statistics database, Indicator :2 - Total patent grants (direct and PCT national phase entries); data extracted on 17.10.2023. EU average is calculated as a sum over 27 countries. Denominator: World Bank, World Development Indicators, Total population, code: SP.POP.TOTL; data extracted on 17.10.2023. Data for 2021. EU average is calculated as a sum over 27 countries.
Exports of medium and high-technology products, in % of total product exports	EIS 2023 values, baseline data: Eurostat, ComExt - DS-018995. Exports of medium and high-technology products as a sum of exports of respective product codes. Interpretation in the EIS Methodology report: 'The indicator measures the technological competitiveness of the EU, i.e. the ability to commercialise the results of research and development (R&D) and innovation in international markets. It also reflects product specialisation by country. Creating, exploiting and commercialising new technologies are vital for the competitiveness of a country in the modern economy. Medium and high-technology products are key drivers for economic growth, productivity and welfare, and are generally a source of high value added and well-paid employment'. Original EU data.
Knowledge-intensive services exports, in % of total services exports	EIS 2023 values, baseline data: Joint Research Centre: Innovation Output Indicator; complemented with data from Eurostat (variable code: bop_its6_det). Exports of knowledge-intensive services is defined as the sum of credits in EBOPS 2011 (Extended Balance of Payments Services Classification) items: SC1 (Sea transport); SC2 (Air transport); SC3A (Space transport); SF (Insurance and pension services); SG (Financial services); SH (Charges for the use of intellectual property); SI (Telecommunications, computer and information services); SJ (Other business services); SK1 (Audio-visual and related services). Interpretation in the EIS Methodology report: 'The indicator measures the competitiveness of the knowledge-intensive services sector. Competitiveness-enhancing measures and innovation strategies can be mutually reinforcing for the growth of employment, export shares, and turnover at the firm level. The indicator reflects the ability of an economy, notably resulting from innovation, to export services with high levels of value added, and successfully take part in knowledge-intensive global value chains'. Original EU data.

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