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Boosting Labor Productivity in Slovenia: What is the Role of Intangible Investments?

Dmitriy Kovtun

SIP/2026/038

IMF Selected Issues Papers are prepared by IMF staff as background documentation for periodic consultations with member countries. It is based on the information available at the time it was completed on January 5, 2026. This paper is also published separately as IMF Country Report No 26/16.

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Labor Productivity in Slovenia: What is the Role of Intangible Investments?

Prepared by Dmitriy Kovtun

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April 2026

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ABSTRACT: Slovenia's labor productivity growth has slowed since the late 2000s, weakening the country's prospects of catching up with more advanced EU members. In addition to the gap in business investment, the composition of investment is also important as intangible investments are increasingly driving productivity in knowledge-based economies. This paper examines the investment gap using the extended definition of intangible investments from the Corrado-Hulten-Sichel (2005) framework, and discusses options for closing the gaps relative to the EU average and EU innovation leaders, highlighting the need for expanding access to finance for intangible investments, strengthening the innovation ecosystem, and enhancing overall business environment.

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SELECTED ISSUES PAPERS

Labor Productivity in Slovenia: What is the Role of Intangible Investments?

Republic of Slovenia

Prepared by Dmitriy Kovtun[1]

[1] The author would like to thank the Slovenian authorities for the constructive discussions and valuable feedback.

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Dmitriy Kovtun (EUR)

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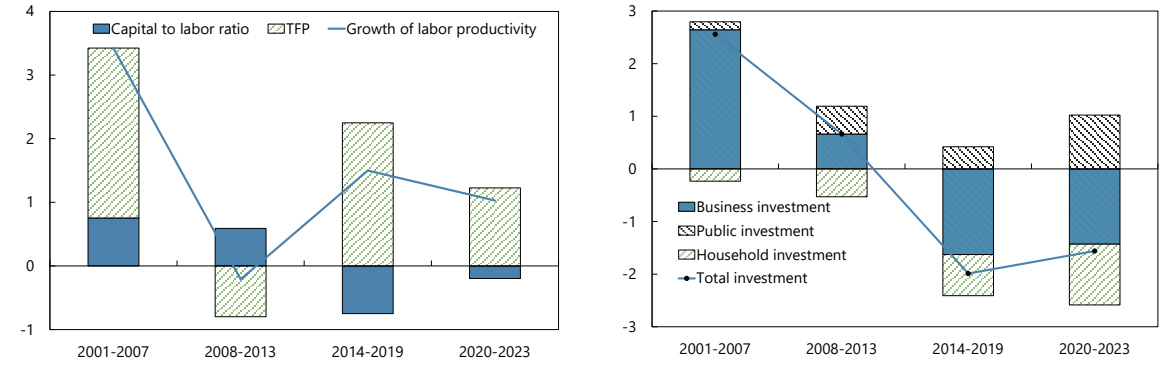
BOOSTING LABOR PRODUCTIVITY IN SLOVENIA: WHAT IS THE ROLE OF INTANGIBLE INVESTMENTS?

Slovenia's labor productivity growth has slowed since the late 2000s, weakening the country's prospects of catching up with more advanced EU members. In addition to the gap in business investment, the composition of investment is also important as intangible investments are increasingly driving productivity in knowledge-based economies. This paper examines the investment gap using the extended definition of intangible investments from the Corrado-Hulten-Sichel (2005) framework, and discusses options for closing the gaps relative to the EU average and EU innovation leaders, highlighting the need for expanding access to finance for intangible investments, strengthening the innovation ecosystem, and enhancing overall business environment.

A. Context

1. Slovenia's labor productivity growth has slowed since the early 2000s. During 2001–2007, labor productivity—measured as output per worker—increased by 3.4 percent annually, driven by capital deepening (growth in capital intensity, measured by the capital-to-labor ratio) and gains in total factor productivity (TFP) (Figure 1). Labor productivity declined during the Global Financial Crisis (GFC) and the ensuing banking crisis, even though capital intensity continued to increase. It recovered in 2014-2019, although with a lower growth rate due to declining capital intensity. Labor productivity growth slowed down in 2020-2023 as capital intensity continued to decline, and TFP weakened. The drop in capital intensity during 2014-23 in turn reflects a fixed investment gap of 1.7 percentage points of GDP compared to the EU average (Figures 1 and 5).

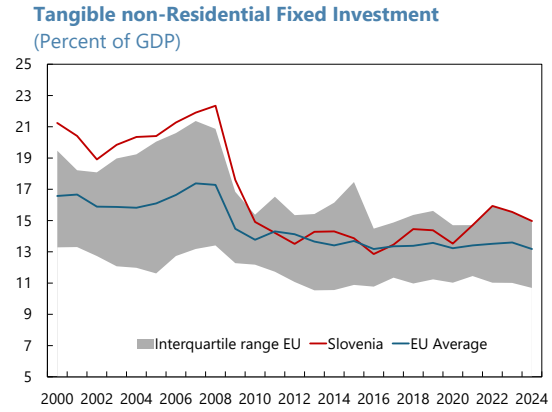
Figure 1. Labor Productivity and Investment

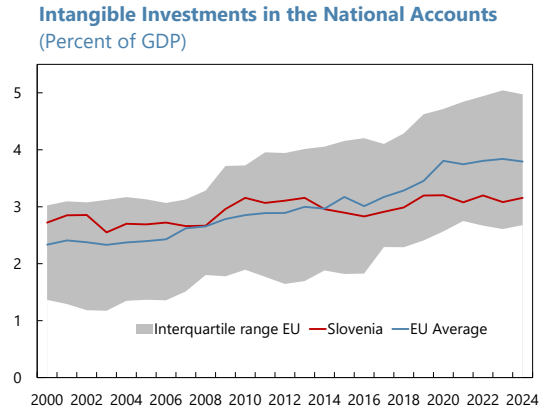


Sources: Eurostat and IMF staff estimates.

2. The shortfall in non-residential fixed investment was particularly pronounced in intangible assets. While investment in non-residential tangible assets (machinery, equipment, and others) in the past 10 years was on par with or even above the EU average, investment in intangible assets recorded in the national accounts (software, databases, and R&D) was lower (Figure 2).

Figure 2. Fixed Investment by Asset Type, 2000-2024





Sources: Eurostat and IMF staff estimates.

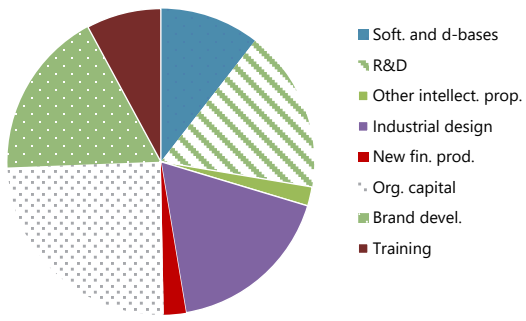
3. As the national accounts capture only part of intangible investment, extending its definition provides better insight into its role in knowledge-based economies. Corrado, Hulten, and Sichel (2005) proposed an extended definition comprising three broad areas—computerized information, innovative property, and economic competencies. Notably, this definition adds industrial design, development of new financial products, building organizational capital, brand development, and training to traditional variables included in the national accounts. The economic argument for including them into capital is that spending on these items represents "know how" that reduces current consumption with the intent of increasing future production. To illustrate the magnitudes, average intangible investments included in Slovenia's national accounts (computerized information, R&D and other intellectual property) in 2000-2024 constituted about 30 percent of total intangibles in the extended definition. Industrial design and development of new financial products contributed 20 percent, and economic competences (a sum of organizational capital, brand development

Intangible Capital: National Accounts vs Extended Definition in CHS (2005) Framework

	National accounts	CHS (2005)
I. Computerized information		
Software	√	√
Databases	√	√
II. Innovative property		
Research and development	√	√
Other intellectual property	√	√
Industrial design	X	√
Developing new fin. prod.	X	√
III. Economic Competencies		
Organizational capital	X	√
Brand development	X	√
Training	X	√

Sources: CHS (2005), and Bontandini et al (2021).

Structure of Intangible Investment, 2000-2024
(Percent)

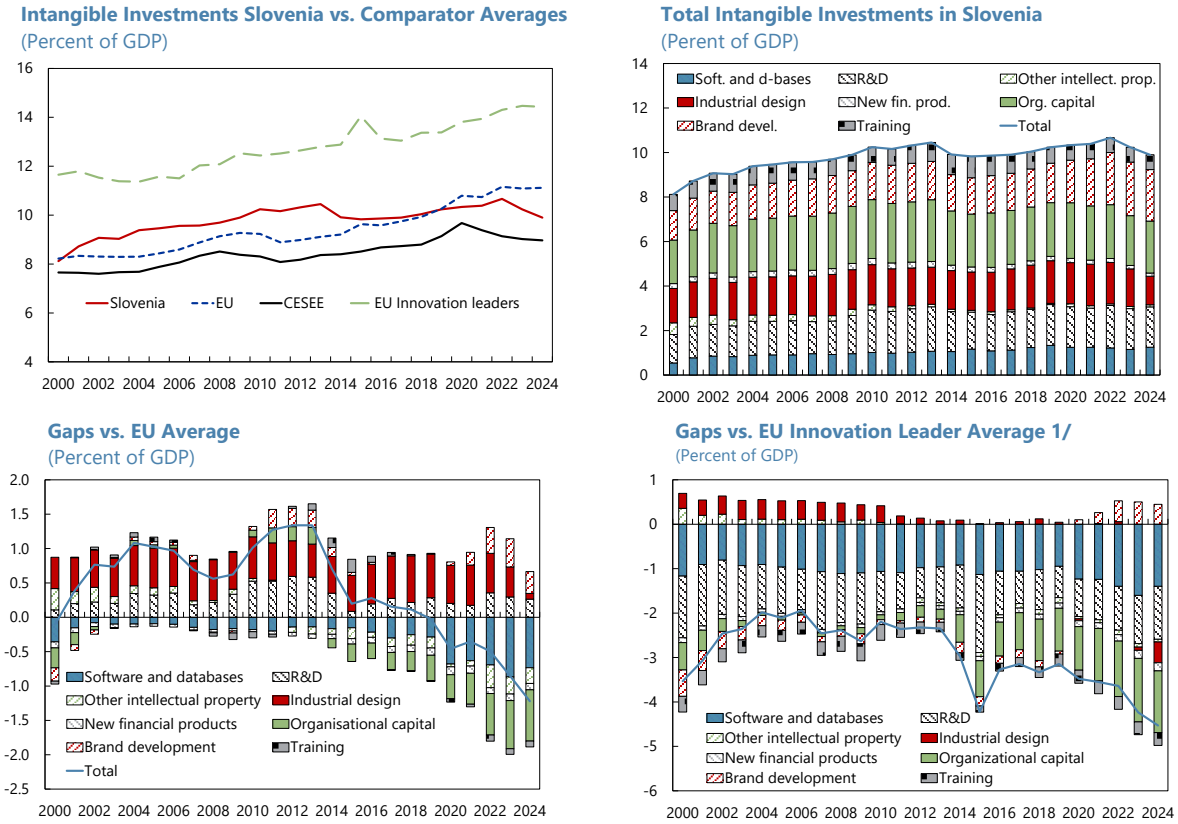


Sources: KLEMS and INTAN databases and IMF staff estimates.

and training) accounted for about half of all intangible investments.[1]

4. In the past 10 years, Slovenia's intangible investment under the extended definition, slowed compared to the EU average, and the gap relative to the EU innovation leaders widened. Slovenia's investment in intangibles had historically exceeded the EU average but declined toward the EU average around 2014-15 (Figure 3). Slovenia invests more in intangibles than the CESEE peers, but significantly less than EU innovation leaders (Denmark, Finland, Netherlands, and Sweden)[2]. The gap with EU innovation leaders widened to about 4.5 percent of GDP in 2024, reflecting largely by lower investment in software and databases, R&D, and organizational capital.

Figure 3. Intangible Investment in the CHS (2005) Framework, 2000-2024



1/ Average values for Denmark, Finland, Netherlands, and Sweden.

Sources:

(i) 2001-2021: EU KLEMS-INTANprod database.

(ii) 2022-24 intangible investment data included into the national accounts: Eurostat.

(iii) 2022-24 intangible investments not included into the national accounts: INTAN-Invest database, WIPO and Luiss Business School (2025). World Intangible Investment Highlights: June 2025 edition. Geneva and Rome: World Intellectual Property Organization and Luiss Business School.

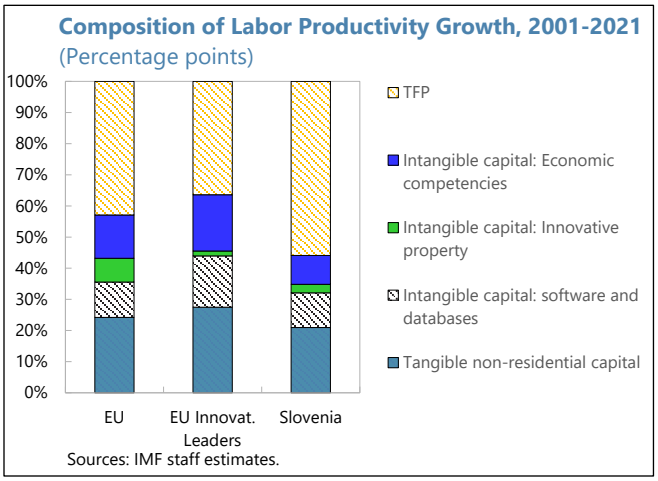
[1] EU KLEMS-INTANprod database, updated in 2025, provides comprehensive data on intangible investments and corresponding capital stocks through 2021. INTAN-Invest database extends intangible investments through 2024, but does not compile capital stocks.

[2] Innovation leaders as defined by the European Innovation Scoreboard (2025).

B. How Much Do Intangibles Contribute to Labor Productivity?

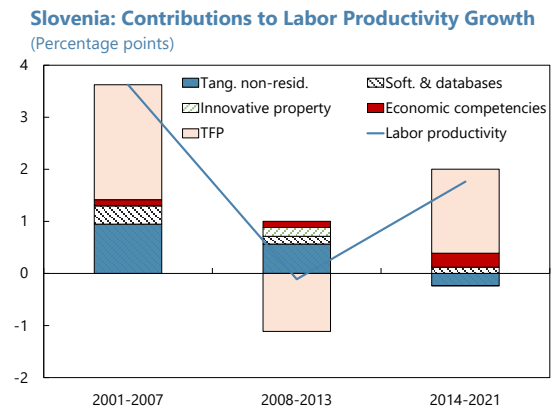
5. Intangible capital has emerged as a critical driver of labor productivity growth. Studies show that intangible capital deepening accounts for approximately 40-50 percent of productivity gains at both aggregate and sectoral levels in European economies. Using the EU KLEMS 2022 dataset covering 14 EU countries from 1995-2019, Roth and Mitra (2024) find that the productivity gap between the EU and United States is largely attributable to insufficient investment in non-R&D intangibles, particularly software, training, and organizational capital, which are crucial drivers of productivity growth in the service sector. Corrado et al. (2022) show that intangible investments in knowledge-based capital produce significant productivity spillovers through mechanisms beyond traditional R&D channels, with complementarities between ICT and intangible capital generating particularly strong effects. The literature reveals sectoral heterogeneities: manufacturing benefits primarily from R&D investments, while market services derive greater productivity gains from organizational capital and software investments. Furthermore, Corrado, Haskel, and Jona-Lasinio (2017) demonstrate that non-R&D intangible capital exhibits higher output elasticities than conventional factor shares, suggesting substantial knowledge spillovers that enhance aggregate productivity. The experience of advanced economies underscores the importance of intangibles. For instance, the UK's post-2010 productivity slowdown was found to be largely driven by reduced investment in intangible capital following the GFC, which stifled innovation and TFP growth.[3]

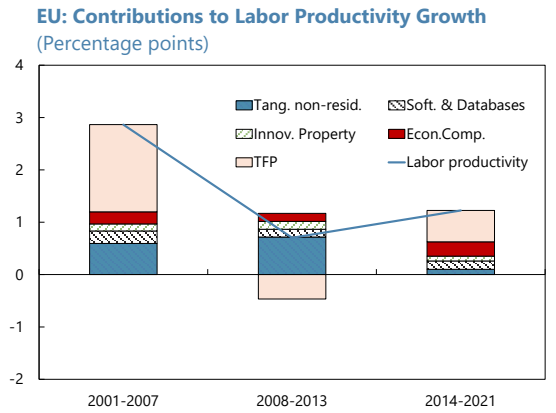
6. Updated growth contributions calculated using EU-KLEMS and elasticities obtained from panel regressions (Box 1) suggest that intangible capital remains a significant driver of labor productivity growth. During 2001-2021, the share of intangibles amounted to about one-third of overall productivity growth in the EU, higher than one-fourth contributed by the non-residential tangible investment. Averages for EU innovation leaders are slightly higher in both intangible investments and non-residential tangible investments. In Slovenia, intangible investments accounted for about 20 percent of labor productivity growth, and tangible investment accounted for about 21 percent.



[3] See 2025 United Kingdom Selected Issues Paper "Bridging the Gap: Understanding the UK-US Productivity Decoupling".

Figure 4. Factors of Labor Productivity Growth, 2001-2021



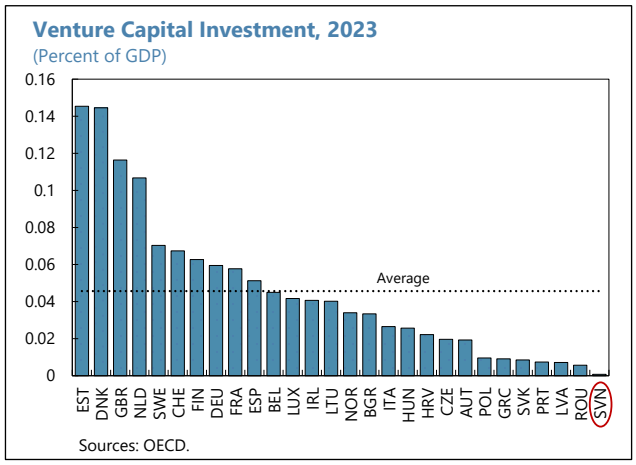


Sources: EU-KLEMS database and IMF staff estimates.

C. Supporting Intangible Investments: Challenges and Policy Options

7. To boost labor productivity growth, Slovenia needs to invest more in intangibles. The gap analysis (Section A) shows that, to close the gap with the EU average, investments in software, databases, and organizational capital should be increased. To close the gap with innovation leaders, an across-the-board increase in investment would be needed. This requires improving finance access for intangibles, strengthening the innovation and entrepreneurship ecosystem, investing in skills and human capital, and removing barriers to investment overall.

8. Lack of venture capital (VC) and fragmented entrepreneurship and innovation systems impede intangible investments in Slovenia. As intangible investments often lack collateral, traditional banking systems are not well suited for financing them. Yet, the financial system in Slovenia, like those in many other EU members, is bank-centric and the European capital markets are shallow and nationally segmented. Moreover, venture capital is virtually non-existent in Slovenia, although the national development bank (SID Bank)[4] and the Slovenian Enterprise



Sources: OECD.

[4] SID Bank offers seed capital and convertible loans to support early-stage development, product commercialization, and scaling up of technology-driven businesses. In 2017, the SID Bank, in a partnership with the European Investment Bank, established the Slovenian Capital Growth Investment Program (SEGIP), which was expanded to 0.3 percent of GDP in 2021-2022 and is supporting research institutes and universities through its Technology Transfer Fund, SMEs in start-up and growth phases through Venture Capital Fund, and SMEs and mid-cap companies through the Succession Fund.

Fund (SEF)[5] are filling a part of the gap, supporting innovative investments by providing concessional loans, guarantees, and equity financing. As a result, firms often have to rely on their own resources to finance these investments. The ability to finance intangible investments is additionally constrained by Slovenia's high proportion of small firms, including SMEs and micro-enterprises, which are more financially constrained than larger firms. Finally, the entrepreneurship and innovation ecosystem is fragmented: despite a large number of support organizations, their roles and relationships across them are not clear and they have limited intellectual property competences (National Intellectual Property Strategy 2030).

9. The Slovenian authorities have been taking measures to support innovation and intangible investments. Adopted in 2022, the National Research and Innovation Strategy 2030 set out the objective to increase investment in research and innovation to 3½ percent of GDP by 2030 (of which 1¼ percent of GDP in the public sector) and called for better commercialization of research. In 2023, the Public Agency for Scientific Research and Innovation (ARIS) was set up to facilitate the transfer of academic knowledge into the economy and society. In 2024, the authorities adopted the National Intellectual Property Strategy 2030, which aims to enhance intellectual property valuation capacity and develop intellectual property-backed financing.[6] They are also preparing a new Startup Strategy that will: (i) spell out measures to strengthen the support environment for start-ups and scale-ups, (ii) develop the VC market with public incentives to strengthen private and pension fund investments in VC, (iii) introduce an internationally comparable framework for implementing employee stock options and profit-sharing, (iv) introduce a start-up visa to attract global tech talent, and (v) develop a new simplified legal form tailored for start-ups. The authorities are planning additional grants and financial instruments of about 0.9 percent of GDP, primarily financed by European cohesion funds, for supporting RDI, entrepreneurship and investments, circular economy, tourism and space.[7]

10. Actively supporting EU-level initiatives aimed at deepening EU capital markets and strengthening its domestic innovation financing infrastructure will help Slovenia expand its access to innovation finance. Through a larger pool of capital, a stronger European Capital Markets Union (CMU) can offer young, innovative firms broadened options of funding (e.g., venture capital) and exit strategies (e.g., stock market or private equity). Slovenia can expand the pool of capital by further developing of its Pillar 2 pension scheme and implementing the new law on individual savings accounts that aims to foster retail investment. To help channel savings to early-

[5] Since 2006, the SEF has been focused on supporting young innovative companies through start-up grants. SEF is currently involved in Central Europe Fund of Funds (CEFoF), that was designed by the EIF in close cooperation with the authorities from Slovenia, Austria, Czech Republic, Slovakia, and Hungary. It aims to increase venture capital investments in SMEs in the Central European region. The CEFoF has €87 million, for which it leverages private investments, increasing total available volume close to €700 million, implying a multiplier of 8.6 relative to commitments under the CEFoF.

[6] Under this strategy, Slovenia is developing a system for valuing patents and other intangibles and is launching a pilot credit line (through the state development bank, SID) allowing SMEs to use intellectual property rights as loan collateral.

[7] The government is planning to set up two loan funds for investments in the amount of 0.7 of GDP each to support investments and anti-crisis support, which may also indirectly support investments into intangibles.

stage, risky assets, regulations should not unduly restrict institutional investors from investing in these projects, while familiarity with the venture capital asset class can be improved through public initiatives (e.g., Tesi in Finland) (Arnold and others, 2025). Finally, strengthening Slovenia's domestic innovation financing infrastructure—such as establishing an efficient, cost-effective mix of instruments, improving SME access to EU programs like InvestEU, and improving financial literacy—will prepare the country to benefit more from a stronger CMU and address intangible investment gap. In light of the ongoing initiatives to support innovation and productivity, it is important to ensure that industrial policy be focused on addressing specific market failures and not add inefficiency or lean against structural transformation. It should also be targeted, time-bound, consistent with WTO rules, and coordinated at the EU level.

11. Apart from financing, it is also necessary to enhance the business environment and skills availability. Heavy regulatory and administrative burdens and slow procedures (e.g., lengthy permitting, complex regulations) increase the costs of operating business and hinder the dynamism of the business sector (OECD 2022). It is also important to improve skills availability, which is critical for improving investment in general. To improve skills availability, Slovenia could expand vocational and tertiary education programs in STEM fields, strengthen lifelong learning and reskilling initiatives, and promote closer collaboration between industry and educational institutions to align curricula with evolving labor market needs. Additionally, streamlining the recognition of foreign qualifications and facilitating the integration of skilled migrants could help address immediate shortages.

12. Closing Slovenia's productivity gap with EU innovation leaders requires strengthening connections within the innovation ecosystem—especially between firms and academia, and between MNEs and SMEs. While Slovenia performs above the EU average in public-private co-publications, its science-industry collaboration remains fragmented, with limited long-term institutional partnerships. Strengthening these linkages would accelerate knowledge diffusion, technology adoption and innovation across the economy. Policy options include expanding collaborative R&D funding, developing industrial PhD programs, and developing innovation hubs and clusters that embed universities, MNEs and SMEs in shared research agendas. To provide an EU example, the Tyndall National Institute in Ireland is a research center bringing together leading global companies and Irish SMEs in semiconductors technology and related areas, thus promoting startups and facilitating the creation of high-value-added jobs.[8] Drawing on this model, Slovenia could explore developing institutional mechanisms that leverage its existing multinational presence in sectors such as automotive (Revoz/Renault), pharmaceuticals (Lek/Sandoz), and manufacturing to catalyze domestic innovation and entrepreneurship. By institutionalizing cooperation across the ecosystem, Slovenia can unlock the full potential of its knowledge base and raise its innovation capacity to the level of EU's leaders.

[8] See IMF Country Report No. 2025/128 (2025 Article IV Consultation with Ireland).

Box 1. Estimating the Link Between Intangible Investments and Productivity

What does the latest available update of the EU-KLEMS database suggest about the role of intangible investments for labor productivity? To answer this question, we calculate contributions to labor productivity growth of distinct types of investments based on estimated elasticities. The estimation, broadly following Felix (2022), is motivated by the Cobb-Douglas production function with multiple types of capital (Equation 1), converted into the intensive form by dividing both sides by labor (Lt), which yields labor productivity (Equation 2). Taking logs (Equation 3) and differencing gives rise to a specification that can be used for estimating elasticities, which can in turn be used for calculating contributions to growth of labor productivity.

$$Y_t = A_t K_{1t}^{\alpha_1} K_{2t}^{\alpha_2} \dots K_{Nt}^{\alpha_N} L_t^{N - \Sigma \alpha_i}, \quad (1)$$

$$y_t = A_t k_{1t}^{\alpha_1} k_{2t}^{\alpha_2} \dots k_{Nt}^{\alpha_N} \quad (2)$$

$$\ln(y_t) = \ln(A_t) + \alpha_1 \ln(k_{1t}) + \alpha_2 \ln(k_{2t}) + \cdots + \alpha_N \ln(k_{Nt}) \quad (3)$$

Table 1 summarizes several panel specifications that were estimated using a differenced equation (3) on EU-KLEMS dataset. The dataset includes EU countries, UK, and the US and contains data from 1995 to 2021, although many countries have data only from 2001. The first specification divides total capital stock into tangible non-residential part and intangible part. The second specification separates intangible capital into three major parts in line with the CHS (2005) framework (computerized information, innovative property, and economic competencies). The third specification breaks down economic competencies into organizational capital, brand development, and training. All regressions include two control variables: the differenced output gap is included to control for fluctuations in output resulting from business cycle, and a distance to the leader in per capita income captures the convergence effect. All specifications are estimated using Arellano-Bond dynamic estimation procedure to control for possible endogeneity. All coefficients have expected signs and nearly all of them are statistically significant at 1 percent level. Specification (1) suggests that increasing intangible capital by one percent would contribute about 0.14 percentage points to productivity growth. It is interesting to note that training has a large elasticity, suggesting that improving training expenditure by one percent would contribute 0.12 percentage points to productivity growth.

Box 1. Estimating the Link Between Intangible Investments and Productivity (Concluded)

Table 1. Panel Regression: Labor Productivity and Capital Stock, 1995-2021

Dependent variable: Growth rate of labor productivity per worker	(1)	(2)	(3)
Tangible capital, % change	0.300	0.279	0.272
	(0.023)***	(0.023)***	(0.023)
Intangible capital, % change	0.138	…	…
	(0.015)***		
Software and databases, % change	…	0.028	0.029
		(0.006)***	(0.005)***
Innovative property, % change	…	0.058	0.054
		(0.012)***	(0.012)***
Economic competencies, % change	…	0.094	…
		(0.014)***	
Organizational capital, % change	…	…	0.029
			(0.01)**
Brand, % change	…	…	0.013
			(0.009)
Training, % change	…	…	0.117
			(0.014)***
Lagged labor productivity growth	-0.106	-0.119	-0.127
	(0.020)***	(0.020)***	(0.019)***
Output gap (differenced)	0.862	0.856	0.858
	(0.020)***	(0.020)***	(0.02)***
Distance to per capita income leader	0.011	0.011	0.010
	(0.001)***	(0.001)***	(0.001)***
Constant	-1.625	-1.746	-1.469
	(0.235)***	(0.235)***	(0.225)***
Number of observations	615	592	615

Notes: Standard errors are reported in parentheses and stars indicate p-values (* p<0.1; ** p<0.05; *** p<0.01).

References

Arnold, Nathaniel, Allan Dizioli, Alexandra Fotiou, Jan-Martin Frie, Burcu Hacibedel, Tara Iyer, Huidan Lin, Malhar S Nabar, Hui Tong, and Frederik G Toscani, 2025, "Lifting Binding Constraints on Growth in Europe: Actionable Priorities to Deepen the Single Market", IMF Working Paper 2025/113, 113

Corrado, Carol, Charles Hulten, and Daniel Sichel, 2005, "Measuring Capital and Technology: An Expanded Framework." In *Measuring Capital in the New Economy*, Vol. 66, Studies in Income and Wealth, edited by Carol Corrado, John Haltiwanger, and Daniel Sichel, 11-46. Chicago: NBER, University of Chicago Press.

Carol Corrado & Jonathan Haskel & Cecilia Jona-Lasinio, 2017. "Knowledge Spillovers, ICT and Productivity Growth," Oxford Bulletin of Economics and Statistics, Department of Economics, University of Oxford, vol. 79(4), pages 592-618, August.

Corrado, Carel, Jonathan Haskel, Cecilia Jona-Lasinio, and Massimiliano Iommi, 2022, "Intangible Capital and Modern Economies", Journal of Economic Perspectives, Volume 36, Number 3.

European Commission, 2018, Horizon 2020 Policy Support Facility: Specific Support to Slovenia – Fostering the Innovation Ecosystem and Science-Industry Cooperation. Brussels: Directorate-General for Research and Innovation.

OECD (2022), OECD Economic Surveys: Slovenia 2022, OECD Publishing, Paris.

Roth, Felix. 2022, Intangible Capital and Growth. Essays on Labor Productivity, Monetary Economics, and Political Economy, Vol. 1

Roth, Felix, 2022, Intangible Capital and Labor Productivity Growth – Revisiting the Evidence: An Update, Hamburg Discussion Papers in International Economics, No. 11, University of Hamburg, Chair of International Economics, Hamburg

Roth, Felix; Mitra, Alessio, 2024, EU Competitiveness: The Critical Role of Intangible Assets in EU Labour Productivity Growth, Hamburg Discussion Papers in International Economics, No. 19, University of Hamburg, Department of Economics, Senior Lectureship in International Economics, Hamburg.