

# Bančni vestnik

REVIJA ZA DENARNIŠTVO IN BANČNIŠTVO

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**FROM  
DIGITALISATION TO  
RESILIENCE:  
WHAT AI BRINGS TO  
BANKS, STAFF, AND  
EU COMPETITIVENESS**



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# From Digitalisation to Resilience: What Artificial Intelligence Brings to Banks, Staff, and EU Competitiveness

*Primož Dolenc\**

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he wave of digitalisation that has swept through the European banking industry over the past decade has already significantly reshaped business models, restructured work processes, and challenged long-held assumptions about the role and functioning of banks. Artificial intelligence is accelerating all of this, while also bringing an entirely new dimension of possibilities and risks, both for the banking system and for Europe as a whole.

From a central bank perspective, artificial intelligence is not just a technology story. It is an economic story, a story of financial stability, and it also opens a new chapter in the story of the competitiveness of the European economy. The key question is not whether artificial intelligence will transform banking. That is already clear today. The question is whether Europe will be an active participant in this transformation or merely a passive observer.

EU competitiveness will increasingly depend on digitalisation. In his report on Europe's competitiveness, Mario Draghi warns that the EU is missing opportunities to boost productivity through the digital revolution, citing the technology sector as one of the main reasons for the gap with the United States. Only a handful of leading global tech companies are European, and the European digital ecosystem remains heavily dependent on non-EU software and cloud providers, primarily US firms, creating strategic vulnerabilities.

We do not have to look far to find an example. Lately, the topic of Anthropic's new LLM model Mythos has been dominating the AI and cyber security related headlines. While the new highly advanced large language model, reportedly capable of identifying and exploiting vulnerabilities with unprecedented effectiveness across a wide range of software, has not been made public yet, the model has been shared with approximately fifty firms, all from the United States, that build or maintain critical software infrastructure. No European firms, and even more importantly, neither European supervisors nor regulators have access to the Mythos model yet, meaning we are assessing the risks without direct insight, which makes it more difficult to design appropriate measures. However, supervisory authorities worldwide, including the European Central Bank, have been examining and raising awareness of the risks linked to the use of these emerging technologies for quite some time. While Mythos might be the ice breaker, more such models will come in the future, further exacerbating the structural shift in the cyber threat environment.

This situation underscores the urgency for Europe to move beyond the static industrial structure. We must significantly strengthen our collective efforts to close the innovation gap with the US and China, especially in advanced technologies. We need to accelerate innovation cycles, both to maintain leadership in existing industries and to develop new

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technologies. Europe does not lack ideas or ambition, but the key is to take the next step and start successfully translating innovation into commercialisation. The revolution brought by artificial intelligence offers Europe a new opportunity to address existing weaknesses as well as the strategic autonomy of Europe.

Banking is among the sectors in Europe where artificial intelligence is being adopted the fastest and most extensively. Supervisory data give us a privileged insight into the actual use of these tools, which are already used by almost ninety percent of large European banks, with the trend only accelerating. The human role in the process remains crucial, as AI models currently support decisions but do not yet replace credit officers or fraud investigators. However, caution should not be mistaken for maturity. Data governance frameworks remain incomplete in many institutions, and self-assessments for compliance with the AI Act are still in early stages. The concentration of critical functions among a handful of global technology providers creates systemic interdependencies that were unimaginable a decade ago. Resilience is thus already today inseparably linked to digitalisation. Banks must adapt, transform their business models and processes, and it is crucial that this transformation is accompanied by strong governance, effective risk management, and compliance with an increasingly complex regulatory environment.

Such changes affect not only bank operations but also the people within them. It is therefore not surprising that the impact of artificial intelligence on the labour market is causing significant concern today. As views are often overly simplistic, I would like to add a few thoughts from the perspective of the banking sector. The long-term trend in European banking employment is one of steady decline: the sector lost about a fifth of jobs between 2007 and 2022. This is largely due to digitalisation, consolidation, and the rise of online banking, which have transformed banking even before the rise of artificial intelligence. Importantly, the ECB's research for the period of rapid machine learning development between 2011 and 2019 shows that occupations

most exposed to AI actually saw an increase in employment share, suggesting complementarity rather than simple substitution. The fact is that AI will create new winners and losers in the labour and capital markets. These effects will shape consumption, access to credit, and ultimately how households and firms respond to monetary policy impulses. Policy must therefore go beyond regulation. Sustained investment in skills, enabling reskilling and upskilling of the existing banking workforce, is urgently needed.

The question of distributional effects is, of course, also important for monetary policy and for central banks as the guardians of macroeconomic stability. At central banks, we are not merely observers of digital transformation. We are participants in it. In European central banks, AI is already embedded into economic analyses, forecasting, and supervisory data processing. We also conduct cyber resilience stress tests and build safeguards appropriate for institutions whose credibility depends on the integrity of every data point and every decision. At the same time, we are aware of the limitations and believe that human judgment and critical thinking must remain at the forefront of central bank processes, because trust in monetary institutions ultimately means trust in the people behind them, not in the algorithms that assist them.

Let me conclude with a direct message. The transition from digitalisation to resilience is not automatic. Resilience must be built through better data governance, robust operational frameworks, investment in people, and, last but not least, an appropriate regulatory environment based on principles and proportionality. European ethical and regulatory standards represent a significant advantage in a world that is increasingly sceptical of unregulated artificial intelligence. The key is to turn this advantage into competitive strength and not allow it to become an additional barrier. The importance of AI for European banking sector and the broader economy is immense. We have the institutions, knowledge, and values to take the lead. Now we only need enough ambition and coordination to act with the determination and speed that the situation demands.

# From redistribution to competitiveness? The EU Multiannual Financial Framework 2028–2034

*Mojmir Mrak and Vasja Rant\**

The article analyses the European Commission's proposal for the 2028–2034 Multiannual Financial Framework (MFF) through the lens of a new EU budget trilemma. The proposal seeks simultaneously to increase budgetary flexibility in a more unstable geopolitical environment, strengthen financing for European public goods such as competitiveness, security and technological sovereignty, and accommodate the fiscal legacy of the NextGenerationEU debt repayment. The article argues that the proposed MFF represents a constrained compromise between these competing objectives. It examines the structural transformation of the EU budget from a predominantly redistributive instrument toward a more allocative and competitiveness-oriented framework, with particular attention to the growing role of centralized competitive programmes. The paper also analyses the implications of these changes for Slovenia, focusing on national envelopes, access to centralised instruments and the country's future net budgetary position within the EU budget.

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## 1. Introduction

The negotiations on the Multiannual Financial Framework (MFF) for 2028–2034 take are taking place in an environment that differs fundamentally from the context of earlier rounds of negotiations about the multiannual EU budget. Over the past decade and a half, the European Union has faced a series of major crises, including the euro area crisis, Brexit, the COVID-19 pandemic, Russia's war against Ukraine, and, most recently, the war in Iran. Apart from these crises, the EU has also been confronted with several structural megatrends, including rising geopolitical fragmentation, increasing frequency of climate-related disasters, rapid technological change, and intensifying global competition, particularly between the United States and China. These developments have exposed the limitations of the EU budgetary framework that was historically designed above all to provide predictability and promote cohesion within the EU through the financing of long-standing common policies, while paying less attention to the Union's external competitiveness and its strategic autonomy

At the same time, the EU budget is entering a new fiscal reality. From 2028 onwards, it must accommodate the servicing of debt incurred to finance the post-COVID recovery of EU member states through the specially designed temporary financial instrument, NextGenerationEU (NGEU). The Commission's proposal for the 2028–2034 MFF can therefore be interpreted as an attempt to redesign the EU budget under conditions of mounting strategic demands and structural constraints. The proposal amounts to almost EUR 2 trillion in current prices, or 1.26% of EU gross national income (GNI), and is presented by the Commission as a larger, more flexible and more policy-oriented budget for a more unstable environment (European Commission, 2025a). However, it remains well below the scale of fiscal expansion implied by recent assessments of Europe's strategic investment needs. The Draghi report estimates that the EU requires EUR 750–800 billion in additional annual private and public investment to close its competitiveness gap (Draghi, 2024). At the same time, substantial additional resources have also been discussed in the context of strengthening the EU's defence capabilities, with the recent EU initiatives aiming to mobilise up to EUR 800 billion for defence-re-

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lated purposes over a multi-year period. Taking these investment needs into account, several publications prepared under the auspices of the Bruegel think tank have argued that an EU budget amounting to close to 2% of EU GNI may ultimately be necessary to finance the Union's expanding ambitions in areas such as competitiveness, defence, technological sovereignty, and the climate transition (see, for example, Darvas et al., 2025).

This article argues that the Commission proposal is best understood as a compromise aimed at addressing the EU budget trilemma. *First*, the EU budget needs greater flexibility to respond to repeated crises and unforeseen developments. *Second*, it must devote more resources to European public goods, such as competitiveness, defence- and security-related industrial capacities, technological sovereignty and climate resilience, while preserving the cohesion function that remains central to the political legitimacy of the EU budget. *Third*, it must accommodate the servicing of the debt incurred under NextGenerationEU, in a context where a political agreement among EU member states on substantial new own resources remains politically uncertain.

The article develops this argument in three sections. It first one conceptualises the trilemma that structures the 2028-2034 MFF negotiations and analyses the Commission's proposal as a partial response to this trilemma. It then analyses the implications of the next MFF for Slovenia, distinguishing between national envelopes, where allocations are largely known in advance, and centralised competitive instruments, where Slovenia's outcome will increasingly depend on its capacity to participate successfully in the EU-wide programmes. In the third section, the text discusses the key open issues in the ongoing MFF negotiations and the possible contours of a political compromise which need to be accepted by consensus.

## 2. The EU budget trilemma

The Commission proposal for the 2028-2034 MFF can be understood as a response to three simultaneous pressures that cannot be fully resolved within the traditional logic of the EU budget. *The first concerns flexibility*: the EU budget must be able to respond to crises that are increasingly frequent, complex and difficult to predict. *The second pressure concerns the composition of spending*: the EU must finance more European public goods without excessively undermining cohesion and the political economy of redistribution on which the EU budget has long been based. *The third concerns fiscal space*: from 2028 onwards, the EU budget must absorb regular servicing of the NextGenerationEU debt, even though the introduction of substantial new own

resources remains politically uncertain (Darvas et al., 2025; European Commission, 2025a).

The interaction of these pressures creates a budgetary trilemma. The EU cannot simultaneously preserve the traditional structure of the budget, substantially expand spending on new strategic priorities, and accommodate debt servicing of NextGenerationEU without either increasing resources, changing allocation rules, agreeing new borrowing, or reducing existing policies. Table 1 summarises what could be described as a constrained compromise in response to the EU budget trilemma by comparing the Commission's proposal for 2028-2034 with the current 2021-2027 MFF and NextGenerationEU.

Table 1 shows that the Commission proposal represents a substantial increase relative to the regular 2021-2027 MFF, but not relative to the combined size of the current MFF and NextGenerationEU. In aggregate terms, the proposed MFF reaches 1.26% of EU GNI, compared with 1.24% for the current MFF and NGEU combined.<sup>1</sup> The proposal therefore does not amount to a dramatic fiscal leap, but rather to a partial normalisation of the larger post-pandemic EU budget. Its structural significance lies less in its aggregate size than in its composition. The share of the first heading, covering cohesion, agriculture, fisheries, as well as migration and internal security policies, falls from 71% of the combined MFF and NGEU framework for the 2021-2027 period to 54% in the proposal for the 2028-2034 period. By contrast, the competitiveness, prosperity and security heading rises from 15% to 30%, while the European Competitiveness Fund alone reaches 23% of the proposed MFF from 12% in the 2021-27 period. At the same time, servicing of the NextGenerationEU debt becomes an entirely new and explicit budgetary category, accounting for 8% of the proposal.

In the remainder of this section, each of the three dimensions of the EU budget trilemma is presented and discussed in greater detail.

### 2.1 Flexibility in a permanent crisis environment

The first dimension of the trilemma is the need for greater flexibility. The MFF was designed as a long-term financial planning instrument that provides the Union, member states and beneficiaries with predictability over a seven-year period. This predictability remains valuable, especially for investment planning and for longer-term oriented policies

<sup>1</sup> Originally, following the July 2020 agreement, the combined size of the 2021-2027 MFF and the NextGenerationEU instrument amounted to roughly 1.7% of EU GNI, of which approximately 1.13% of GNI corresponded to the regular MFF. However, higher-than-expected inflation and nominal GNI growth during 2022-2024 reduced the relative size of both instruments, as actual inflation exceeded the fixed 2% deflator used in the conversion of the MFF and NextGenerationEU commitments from constant to current prices.

**Table 1: Comparison of multiannual financial framework 2028-2034 with multinational financial framework 2021-2027 and NextGenerationEU**

Current prices, EUR billion	28-34 MFF	21-27 MFF	21-27 NGEU	21-27 Total	28-34 MFF%	21-27 MFF%	21-27 Total%
<b>1. Economic, social and territorial cohesion, agriculture, rural and maritime prosperity and security</b>	1,062	726	372	1,098	54%	63%	71%
<b>National and Regional Partnership Plans</b>	865	691	372	1,062	44%	60%	69%
<b>Agriculture and fisheries income support</b>	296	278	-	-	15%	24%	-
<b>Less developed regions</b>	218	227	-	-	11%	20%	-
<b>Repayment of NGEU</b>	168	23	-	-	8%	2%	-
<b>2. Competitiveness, prosperity and security</b>	590	221	14	234	30%	19%	15%
<b>European Competitiveness Fund (incl. Horizon Europe and Innovation Fund)</b>	451	164	14	178	23%	14%	12%
<b>3. Global Europe</b>	215	120	-	120	11%	10%	8%
<b>4. Administration</b>	118	85	-	85	6%	7%	6%
<b>TOTAL</b>	1,985	1,151	385	1,537	100%	100%	100%
<b>TOTAL (% GNI)</b>	1.26%	0.93%	0.31%	1.24%	-	-	-

Source: Own calculations based on European Commission.

Notes: The NextGenerationEU (NGEU) figure only includes the grant part. A 2% annual deflator was used to convert constant prices into current prices.

such as cohesion, agriculture and industrial competitiveness. However, recent experience has shown that the EU budget must increasingly operate in an environment of frequent and diverse shocks. Designing an MFF begins several years before its implementation, meaning that expenditure ceilings and programme structures may be set almost a decade before the final years of spending (Thöne, 2024).

The crises the EU has faced over the past decade or so, have repeatedly required ad hoc instruments, reallocations or exceptional mechanisms outside the ordinary budgetary framework. The NextGenerationEU itself was an extraordinary response to the Covid-19 crisis rather than a standard component of the 2021-27 MFF. Similarly, support for Ukraine, energy-related measures, migration pressures and natural disasters have placed additional demands on a budget whose core structure was agreed under very different assumptions. The issue is therefore not merely technical. A rigid MFF can protect long-term development priorities, but it can also make the EU slow to react when strategic circumstances fundamentally change.

The Commission's proposal for the 2028-2034 MFF reflects this experience by embedding flexibility at several levels of the EU budget architecture. *First*, it reduces the number of spending headings from six operational headings, excluding administration, in the current framework to three broader policy headings, while also reducing the number of individual programmes from 52 to 16. This

allows for greater reallocation of resources within headings and reduces rigid compartmentalisation. *Second*, it increases flexibility and promotes national ownership through National and Regional Partnership Plans, which give member states greater discretion in allocating their own national envelopes across policy priorities within a common EU framework. *Third*, it expands dedicated flexibility instruments, including the EU Facility, while maintaining substantial margins under expenditure ceilings and specific instruments outside the MFF ceilings for exceptional needs, including the Flexibility Instrument and the Ukraine Facility. Finally, the proposal strengthens the mid-term review process, potentially enabling more substantial reprioritisation of funding during the implementation period if strategic needs change. Flexibility is therefore no longer confined to emergency responses, but is incorporated into the very design of the budget itself (European Commission, 2025a).

This increased flexibility is not without political cost. From the perspective of member states, and particularly regions, flexibility can also imply reduced predictability, weaker earmarking and greater discretion for the Commission and national governments. While it may improve the EU's capacity to respond to shocks through the reallocation of resources, it also changes the balance between long-term allocation stability and political steering. The first dimension of the trilemma is therefore not simply how to make the budget more flexible, but how to do so without excessively

undermining the predictability on which many beneficiaries and member states depend. In order to partly address this tension, the Commission proposal retains specific earmarkings within the national envelopes, for income-support measures in agriculture and fisheries and for less developed regions.

## 2.2 Increased emphasis on European public goods

The second dimension of the trilemma concerns the changing composition of EU spending. Since the introduction of multiannual budget planning of the EU in 1988, the EU budget has been dominated by two traditional policies: cohesion policy and the common agricultural policy. Cohesion policy has played a particularly important role as a counterbalance to the creation of the Single Market and Economic and Monetary Union in the 1990s, as well as a key integration instrument following the 2004/07 enlargement. Together, these policies perform important economic and political functions: they support convergence, regional development, agricultural incomes, rural areas and food security, while providing visible national and regional returns from EU membership. For many member states, including Slovenia, they remain the most predictable and politically salient component of EU funding.

At the same time, the strategic environment increasingly points toward a different set of priorities. Defence-related industrial capacity, technological sovereignty, research and innovation, energy security, climate change mitigation and adaptation, and resilience against health, supply-chain and food-security shocks all have strong characteristics of European public goods. They often involve cross-border spillovers, economies of scale, coordination failures or strategic dependencies that cannot be efficiently addressed by member states acting alone. This is also the logic behind the growing emphasis on competitiveness and strategic

autonomy in the Commission proposal and in the Draghi and Letta reports. Draghi's report stresses the need for a major increase in investment to close Europe's productivity and innovation gap, while Letta's report frames the future of the Single Market around a "fifth freedom" related to research, innovation, knowledge and education (Draghi, 2024; Letta, 2024).

The above-described dichotomy between the traditional structure of EU budget expenditures, strongly focused on cohesion policy and the Common Agricultural Policy, and the EU's new pressing priorities arising from the new geopolitical reality creates a fundamental political economy trade-off for EU policy makers. If the overall size of the EU budget does not increase significantly, increased spending on European public goods must come at the expense of traditional policies. Conversely, preserving cohesion and agricultural spending implies that any meaningful expansion of funding for European public goods requires a larger budget financed either through new own resources, higher national contributions, or additional borrowing instruments along the lines of NextGenerationEU. The Commission proposal seeks to reconcile these constraints by maintaining a substantial – albeit somewhat reduced – role for cohesion and agriculture, while significantly expanding the competitiveness and strategic priorities heading and proposing new own resources to help close the funding gap. As a result, the structure of the EU budget is shifting from a predominantly redistributive orientation toward a stronger allocative function, with resources increasingly directed to areas where EU-level added value is considered highest (Darvas et al., 2025).

Table 2 provides a more detailed view of how this shift is operationalised within the European Competitiveness Fund. The table shows that the increase in competitiveness spending is not merely a linear expansion of existing research

**Table 2: Detailed composition and growth of the European Competitiveness Fund in the MFF 2028-2034 compared with corresponding expenditure items in the MFF 2021-2027**

Current prices, EUR billion	28-34 MFF	21-27 MFF	Absolute change	Relative change
<b>European Competitiveness Fund, of which:</b>	451	164	287	175%
<b>ECF policy windows</b>	234	47	188	401%
<b>Clean Transition and Industrial Decarbonisation</b>	26	4	22	500%
<b>Resilience and Security, Defence, Industry and Space</b>	131	26	104	396%
<b>Digital Leadership</b>	55	11	44	400%
<b>Health, Biotech, Agriculture and Bioeconomy</b>	23	5	18	349%
<b>Horizon Europe</b>	175	88	87	100%
<b>Innovation fund</b>	41	29	12	40%

Source: Own calculations based on European Commission

Note: A 2% annual deflator was used to convert constant prices into current prices.

instruments. The European Competitiveness Fund rises from EUR 164 billion in the current period to EUR 451 billion in the Commission's proposal – an increase of 175%. The largest relative expansion occurs in the four policy windows of the fund, which increase by approximately 400%. This suggests that the Commission increasingly interprets European public goods through the lens of industrial policy, security, technological capacity, and strategic autonomy. The Resilience and Security, Defence, Industry and Space window alone accounts for EUR 131 billion, while the Digital Leadership and Clean Transition and Industrial Decarbonisation windows also expand sharply (European Commission, 2025a).

The new industrial policy windows primarily focus on the commercialisation, scale-up and industrial deployment of new technologies and are closely linked to Horizon Europe, which remains focused on earlier stages of research, development and innovation. Horizon Europe itself is doubled relative to the 2021–2027 period, although its relative increase remains more moderate than the expansion of the industrial policy windows. In addition, the clean technology window of the European Competitiveness Fund is further reinforced by the planned expansion of the ETS-funded Innovation Fund, which finances large-scale demonstration and early deployment projects in low-carbon and clean technologies.

This composition matters analytically. It indicates that the new MFF is not only shifting resources from redistribution toward competitiveness, but also changing the type of competitiveness policy supported by the EU budget. The emphasis is moving from a predominantly research-oriented logic toward a broader strategic industrial policy approach that draws upon both research and industrial capacities. In practice, this implies greater support for large-scale, cross-border, technology-intensive and often company-led projects. While such programmes are intended to generate higher EU-level added value, their allocation is based on centralised competitive bidding at the European level rather than on territorially pre-allocated national envelopes characteristic of cohesion and agricultural policies.

The second dimension of the trilemma is therefore closely linked to a changing balance of power within the EU budget. As the EU seeks to finance more European public goods, this alters both the distributional logic of the budget and the conditions under which member states can access EU funds. The growing reliance on competitive, innovation- and industry-oriented instruments structurally favours member states with more developed research and innovation ecosystems and stronger industrial bases, that tend to

be concentrated in the more economically advanced parts of the Union. At the same time, the stronger emphasis on centralised allocation mechanisms increases the strategic role of the European Commission in directing EU expenditure. Access to the instruments of the European Competitiveness Fund will therefore depend increasingly on the ability of firms and institutions to integrate into larger cross-border projects and European strategic value chains.

### 2.3 NextGenerationEU debt and fiscal constraints

The third dimension of the trilemma is fiscal. NextGenerationEU transformed the EU budgetary system by introducing large-scale common borrowing to finance grants and loans in the amount of EUR 750 billion (in 2018 prices) in response to the Covid-19 crisis. However, the fiscal consequences of that decision become more visible in the next MFF. While the EU budget already had to accommodate interest payments related to the NextGenerationEU debt in recent years, from 2028 onwards it must also begin repaying the principal associated with the NextGenerationEU grants, with repayment continuing until 2058 under the Own Resources Decision. This will substantially increase the fiscal burden associated with debt servicing relative to the current programming period (Claeys et al., 2023; Grund & Steinbach, 2023).

Debt servicing is not a policy expenditure in the same sense as cohesion, agriculture, research or external action, but rather a legacy obligation arising from past borrowing. As such, it creates a direct trade-off within the EU budget. If accommodated within existing expenditure ceilings, it reduces the fiscal space available for policy programmes. If, on the other hand, it is financed on top of existing spending priorities, it requires additional resources, which – in case that substantial new own resources are not politically agreed and implemented – would have to be provided through higher national contributions (in particular, the GNI resource). In this sense, the fiscal consequences of NextGenerationEU introduce a structural tension between preserving policy expenditure and expanding the overall fiscal capacity of the Union.

The Commission's proposal for the 2028-2034 MFF can be understood as an attempt to manage this tension. Building on the original political logic of NextGenerationEU, it seeks to combine a moderate increase in the overall size of the budget with the introduction of new own resources, thereby supporting debt repayment while limiting both the compression of existing programmes and the increase in national contributions. To this end, the Commission presented a package proposal of five new own resources: two resources linked to EU carbon pricing, based on revenues

from the EU Emissions Trading System (ETS) and the Carbon Border Adjustment Mechanism (CBAM); an own resource based on non-collected e-waste; a tobacco excise duty own resource; and a Corporate Resource for Europe (CORE), based on lump-sum contributions from large companies operating and selling in the EU. The Commission is also proposing changes to the existing own resources, in particular an increase in the call rate of traditional own resources (customs duties) from 75% in the current period to 90% in the 2028–2034 MFF (European Commission, 2025b, 2025c).

As in the previous MFF negotiations when the Commission has proposed new own resources, the current proposal also raises important questions regarding its distributional effects. Compared with the GNI-based resource, which broadly reflects member states' relative economic capacity to contribute to the EU budget, several of the proposed new resources are likely to place a proportionally higher burden on less developed member states, compared with the GNI-based resource. This is particularly relevant for resources linked to emissions, carbon-intensive production and consumption patterns, non-collected waste, and excise duties, where differences in income levels, industrial structure, energy intensity and consumption patterns may translate into more regressive burden-sharing across the Union. At this stage, it is difficult to predict what will ultimately be agreed among the member states, particularly given that consensus is required for the adoption of new own resources.

One possible alternative for EU member states to address the fiscal constraints of the 2028–2034 MFF would be to

modify the repayment profile of the NextGenerationEU debt by rolling over or refinancing part of the maturing debt. Such an approach would ease the immediate fiscal squeeze and reduce pressure on the 2028–2034 MFF, but it would not eliminate the underlying obligation. Rather, it would shift part of the adjustment burden to future MFF periods. This would be politically attractive in the short term, but it would also weaken the credibility of the original political commitment to repay the NextGenerationEU debt within a defined time horizon. The fiscal dimension of the trilemma is therefore not only about finding revenue, but also about the intertemporal distribution of the adjustment burden (Claeys et al., 2023; Grund & Steinbach, 2023).

### 3. Implications of the 2028-2034 multiannual financial framework for Slovenia

The implications of the Commission proposal for Slovenia should be assessed through the same analytical lens. The key question is not only whether Slovenia receives more or less funding in absolute terms, but how the nature of EU funding available to Slovenia changes. Under the traditional EU budget model, Slovenia's position was strongly shaped by national envelopes, especially cohesion and agricultural funds. Under the proposed 2028–2034 architecture, the relative importance of such envelopes declines, while centralised and competitive instruments become more important. This shift has direct consequences for Slovenia's development strategy, institutional coordination and net budgetary position.

**Table 3: Composition of Slovenian national envelope in 2021-27 and 2028-34 (Commission's proposal)**

EUR million, current prices	28-34 MFF	21-27 MFF	21-27 NGEU	21-27 Total
<b>Cohesion</b>	-	3,393	1,915	5,308
<b>Western Slovenia</b>	-	543	0	543
<b>Eastern Slovenia</b>	1,668	1,722	0	1,722
<b>Cohesion Fund</b>	-	940	0	940
<b>Interreg</b>	-	75	0	75
<b>Just transition fund</b>	-	113	145	259
<b>ReactEU</b>	-	0	278	278
<b>Recovery and Resilience Facility</b>	-	0	1,491	1,491
<b>Agriculture and fisheries</b>	-	1,740	73	1,814
<b>Direct payments</b>	1,341 *	921	0	921
<b>Rural development</b>		796	73	869
<b>Fisheries fund</b>		24	0	24
<b>Other (AMIF, BMVI, ISF)</b>	-	239	0	239
<b>TOTAL</b>	5,400	5,372	1,988	7,360

Source: European Commission;

Notes: A 2% annual deflator was used to convert constant prices into current prices; \* the minimal earmarking for CAP and fisheries income support in 2028–2034 includes both direct payments and income support measures under rural development and fisheries.

### 3.1 National envelopes

Table 3 presents the composition of Slovenia's national envelope in the current 2021-2027 period under the MFF and NextGenerationEU, as well as under the Commission's proposal for the 2028-2034 MFF.

The table shows that Slovenia's proposed national envelope for 2028-2034, at EUR 5.4 billion in current prices, is broadly comparable to the regular 2021-2027 MFF envelope. This comparison changes substantially, however, once NextGenerationEU is included. In the current period, Slovenia's combined allocation from the MFF and NGEU amounts to EUR 7.36 billion, of which almost EUR 2 billion comes from the NGEU instruments, particularly the Recovery and Resilience Facility. The proposed 2028-2034 national envelope is therefore broadly comparable to the regular current MFF, but significantly lower than the combined MFF and NGEU package that shaped Slovenia's recent EU funding environment (European Commission, 2025a). In practical terms, this means that under the forthcoming MFF Slovenia will have significantly fewer EU budget funds at its disposal that are allocated to member states through national envelopes.

When comparing the allocation of EU funds to Slovenia in the 2021-2027 period with the Commission's proposal for the 2028-2034 period, this distinction is important. The 2021-2027 period was exceptional because regular MFF allocations were complemented by allocations from temporary crisis-related instruments. The discontinuation of these instruments means that Slovenia cannot evaluate the next MFF solely against the regular 2021-2027 MFF envelope. From the perspective of actual public investment financing, the more relevant comparison is with the combined MFF and NGEU allocation for that period.

Viewed from this perspective, the proposed national envelope represents a normalisation after an exceptional fiscal period, but one that may nevertheless be perceived domestically as a decline in available EU funding. Moreover, once changes in price levels between the two programming periods are taken into account, the real purchasing power of the proposed 2028-2034 allocation is substantially lower even relative to the regular 2021-2027 MFF envelope alone, excluding NGEU.

The internal composition of the Slovenian envelope also matters. The proposal preserves some predictable funding, notably through minimum earmarking of EUR 1,341 million for agriculture and fisheries income support and through EUR 1,668 million funding for less developed regions (Eastern Slovenia). However, the new National and Regional Partnership Plan architecture changes the governance logic. Rather than receiving separate and highly

segmented envelopes under multiple funds and programmes, Slovenia will operate within a broader national framework combining different policy priorities. While this may increase programming flexibility, it also requires clearer prioritisation of policy priorities. The key challenge for policymakers in Slovenia in programming EU budget funds under the forthcoming MFF will be to ensure that greater flexibility does not lead to fragmentation, short-term allocation decisions, or excessive dispersion of resources across too many priorities. In this context, a new national development strategy outlining the country's main development priorities within the changed global reality would represent an important asset in the forthcoming discussions with the Commission on Slovenia's National and Regional Partnership Programme.

### 3.2 Centralised programmes

The most important structural change for Slovenia lies outside the national envelope. The Commission proposal significantly expands centralised instruments, especially the European Competitiveness Fund and Horizon Europe. The funds for these programmes are not pre-allocated to member states. Access to them depends on the ability of firms, research organisations, universities, public agencies and financial institutions to participate successfully in competitive EU-level calls and projects. (European Commission, 2025a).

This changes the strategic meaning of EU funding for Slovenia. Under the traditional model, a substantial proportion of financial inflows to the country from the EU budget was determined by allocation formulas linked to regional development, agricultural land, income levels, and other relatively predictable criteria. Under the emerging model, a growing share of potential EU funding will depend on competitive capacity of economic agents. Slovenia's future position vis-à-vis the EU budget will therefore be determined less by what is negotiated in the national envelope and more on the ability of economic agents, particularly firms, to access EU budget resources through centrally managed competitive calls for high-quality projects in areas such as digital and clean technologies, defence-related industrial capacities, advanced materials, biotechnology, and strategic value chains.

In the past, Slovenia was relatively successful in accessing centrally managed funding under Horizon Europe, both through research institutes, particularly the Jožef Stefan Institute and the National Institute of Chemistry, as well as through universities and their laboratories. Based on executed EU budgets for 2021-2024, Slovenia's share of Horizon Europe funding among the 27 EU member states

amounted to approximately 0.60%. However, this figure cannot be used as a reliable benchmark for the prospective success of Slovenian economic agents in accessing funding from the newly created European Competitiveness Fund, as the structure and objectives of the new instrument differ significantly from those of Horizon Europe. The new fund places greater emphasis on industrial policy windows, large-scale projects, defence and security, and company-led consortia. In addition, the competitiveness heading also includes programmes beyond the European Competitiveness Fund and Horizon Europe.

The proposed MFF *de facto* implies a structural shift from a predominantly redistributive orientation of the EU budget towards a stronger allocative function focused on European public goods. This implies a relative reduction in the importance of territorially pre-allocated policies favouring less developed member states, regions, and agricultural areas, alongside a growing emphasis on centrally managed instruments aimed at competitiveness, innovation, strategic technologies, and industrial policy objectives. As a historically significant beneficiary of redistributive EU policies, Slovenia is therefore likely to face a less favourable funding structure under the new model unless it successfully adapts to the changing logic of EU budget expenditures. At the same time, Slovenia may enter this transition from a comparatively stronger position than some other less developed member states due to its relatively developed research and innovation ecosystem and its previous success in accessing programmes such as Horizon Europe. However, the extent to which these advantages can be translated into success under the new European Competitiveness Fund remains uncertain, given the fund's stronger emphasis on industrial policy, large-scale projects, and company-led consortia (Darvas et al., 2025; Thöne, 2024).

The structural change of the EU budget expenditures with the substantial shift toward centrally managed instruments has clear and strong policy implications for Slovenia. In contrast to the past, when access to EU funds depended primarily on negotiations over nationally pre-allocated envelopes within the MFF, future access to EU funding will increasingly depend on the country's institutional, technological, and industrial capacity to bid successfully for centrally managed funds. This includes the ability to identify strategic niches, participate in large cross-border technological initiatives such as Important Projects of Common European Interest (IPCEIs), connect firms with research institutions, and integrate into broader European industrial ecosystems and strategic value chains. It also requires stronger coordination between the government, development agencies, universities, research institutes, firms, and finan-

cial institutions, supported by clearer strategic steering at the national level. In this context, SID Banka could play an important role as a development finance institution capable of supporting project preparation, blending national and EU resources, and facilitating the participation of Slovenian firms and institutions in larger European consortia.

### 3.3 Own resources and net budgetary balance

Slovenia's contributions to the EU budget in the MFF 2028–2034 are expected to increase substantially due to several factors. *First*, the proposed expansion of the overall size of the budget, driven both by increased spending on European public goods and by the need to accommodate servicing of the NextGenerationEU debt, implies higher own-resources contributions from all member states, including Slovenia. *Second*, the mix of new own resources proposed by the European Commission appears to be less favourable to Slovenia than financing based predominantly on the GNI-based resource, thereby increasing Slovenia's relative share in financing the EU budget. *Finally*, the proposed changes to traditional own resources linked to customs duties are particularly detrimental from Slovenia's perspective. Although customs duties are economically one of the most natural EU own resources given the EU's status as a customs union, Slovenia's contribution through this resource is disproportionately high relative to the size of its economy because of the strategic role of the Port of Koper as an entry point for goods entering the EU market. Any increase in the call rate for traditional own resources therefore has particularly adverse implications for Slovenia. Taken together, these factors point toward a significant increase in Slovenia's gross contributions to the EU budget during the 2028–2034 period. (European Commission, 2025b, 2025c).

Another determinant of Slovenia's net budgetary position vis-à-vis the EU budget in the forthcoming MFF stems from the expenditure side. As shown in Table 2, the Commission's proposal for Slovenia's national envelope within the 2028–2034 MFF amounts to EUR 5.4 billion in current prices. As far as inflows from centrally managed funds are concerned, a useful point of reference may be Slovenia's approximately 0.60% share of Horizon Europe funding among the 27 EU member states. Applying this share to the competitiveness heading as a whole, including the European Competitiveness Fund, suggests that Slovenia could potentially access up to EUR 3.5 billion in centralised funding over the 2028–2034 period. Although such a calculation is subject to significant limitations and uncertainty, it is nevertheless illustrative of the scale of the potential opportunity.

Taken together, the proposed changes on both the revenue and expenditure side imply a deterioration in Slovenia's net budgetary position *vis-à-vis* the EU budget in the 2028–2034 period. To some extent, this applies to all member states, since the next MFF internalises the repayment costs of debt incurred during the current period, while the corresponding NextGenerationEU expenditures have already been largely disbursed. However, the deterioration is likely to be comparatively stronger for member states below the EU average level of development, which have historically benefited more from redistributive expenditures and are generally less well positioned to access competitive, innovation- and industry-oriented instruments. As Slovenia still remains below the EU average in terms of GNI per capita, at around 90% of the EU average, the country is likely to be negatively affected by both trends. At the same time, Slovenia's relatively developed research and innovation ecosystem provides at least a partial opportunity to offset this deterioration through stronger participation in centralised programmes. If Slovenia is able to replicate its Horizon-related performance across the new and much broader set of competitiveness instruments, centralised programmes could partly offset the relative decline in pre-allocated national funding and help mitigate the weakening of Slovenia's overall net budgetary position *vis-à-vis* the EU budget. If, however, the country fails to do so, the shift of the EU budget towards centralised instruments could further accelerate this deterioration.

From a broader perspective, the Slovenian case illustrates the deeper structural transformation of the EU budget. The central issue is no longer only how much funding member states receive, but increasingly under what conditions they are able to access it. The proposed MFF therefore represents not merely a quantitative redistribution of resources, but also a qualitative shift in the logic of EU financing itself.

#### 4. Key issues, negotiation dynamics and possible outcomes

The Commission proposal is now subject to complex negotiations among member states and with the European Parliament. These negotiations are likely to revolve around the same trilemma that structures the proposal itself. The first issue concerns the overall size of the budget. Net contributors and fiscally conservative member states oppose a significant increase in national contributions, particularly in an environment of renewed fiscal consolidation pressures at the national level, and advocate limiting the EU budget to around 1% of EU GNI. At the same time, many member states support higher ambitions in areas

such as defence, competitiveness, digital and clean technologies, migration, enlargement and support for Ukraine. The tension between expanding policy ambitions and the willingness to finance them is therefore likely to remain central to the negotiations.

The second issue concerns the balance between traditional redistributive policies and spending on European public goods. Cohesion and agricultural policies remain politically important because they provide visible, predictable and territorially distributed benefits. At the same time, the strategic rationale for stronger EU-level spending on competitiveness, industrial policy, security and technological sovereignty has strengthened considerably. The likely outcome is therefore not a simple replacement of cohesion by competitiveness spending, but rather a politically contested rebalancing between the two.

The third issue concerns the revenue side of the budget and the question of how to close the gap between political ambitions and available financing. The Commission's proposed new own resources are intended to reduce pressure on GNI-based national contributions and help finance repayment of the NextGenerationEU debt. However, these proposals raise both political and distributional concerns. Although most member states remain reluctant to introduce new own resources, strong resistance to higher national contributions from major member states, including France, makes it difficult to envisage a final agreement without at least some new revenue sources. Another possible avenue could involve some form of debt rollover or extension of the repayment profile for NextGenerationEU borrowing, although such an approach would effectively postpone rather than resolve the underlying fiscal problem.

Several broad negotiation outcomes can be envisaged. A more restrained or "frugal" outcome would reduce the overall size of the proposal, place greater pressure on traditional policies, and risk underfunding new strategic priorities. A status quo-oriented compromise could preserve stronger national envelopes, but at the cost of weakening the EU's ambitions in competitiveness, defence and technological sovereignty. A compromise broadly along the lines of the Commission proposal would preserve the core architecture of the new MFF, including the European Competitiveness Fund and National and Regional Partnership Plans, while adjusting national envelopes, earmarking requirements and flexibility instruments. A more ambitious strategic-budget scenario would require stronger agreement on new own resources or renewed forms of common borrowing, but such an outcome currently appears politically unlikely.

For Slovenia, the preferred outcome should not be defined solely in terms of maximising national envelopes. Slovenia has an interest in preserving cohesion and agricultural funding, but also in an EU budget capable of financing competitiveness, security, technological development and climate resilience. The central Slovenian challenge is therefore to support a budget that remains sufficiently cohesive while becoming more strategic and simultaneously prepare domestically for a funding environment in which success increasingly depends on participation in centralised European programmes.

### 5. Concluding remarks

The Commission's proposal for the 2028–2034 MFF should be understood as a constrained compromise in response to a new EU budget trilemma. It seeks simultaneously to increase flexibility in a more unstable geopolitical and economic environment, redirect resources toward European public goods, and accommodate the fiscal legacy of NextGenerationEU. At the same time, however, it does so without creating a fully-fledged EU fiscal capacity and without fully resolving the tensions between new strategic priorities, traditional redistributive policies and debt repayment obligations. The proposal nevertheless represents a significant departure from earlier multiannual financial frameworks. While preserving an important role for cohesion and agricultural policies, it reduces their relative dominance and shifts greater responsibility for policy prioritisation to member states through the National and Regional Partnership Plans. It strengthens the role of competitiveness, security and strategic priorities, although not at the scale envisaged in the Draghi report. It also proposes a new set of own resources, yet their political feasibility and distributional implications remain uncertain. Similarly, while the proposal embeds greater flexibility into the budget architecture, this may come at the cost of reduced predictability for member states and regions.

For Slovenia, the implications are substantial. Although the national envelope remains important, the broader direction of the EU budget points toward more centralised, competitive and performance-oriented instruments. Slovenia's future EU budgetary position will therefore depend increasingly on its ability to participate successfully in European programmes related to competitiveness, industrial policy, research, innovation and strategic technologies. This implies a shift in domestic policy from the absorption of pre-allocated funds toward more proactive project generation, strategic coordination and integration into the European industrial and technological value chains.

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# Geopolitical tensions and sustainable public finances: Global trends and implications for Slovenia's public finances

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**Geopolitical tensions are on a rise and becoming a structural issue. As such, they represent a potentially important barrier to economic growth. They may impact fiscal outcomes, both short- and long-term, through several channels. Thus, they add substantially to the already existing numerous significant fiscal pressures. We estimate two alternative scenarios, the results of which confirm such assumptions for Slovenia. In order to cope with these pressures, economic policy will need to adjust. Predominantly, it should create adequate fiscal space, better prioritise public expenditure, apply more targeted policy responses to future shocks, and strengthen national fiscal frameworks.**

JEL D74, H63, E6

## **Rising geopolitical risks and their impact on public finances**

The post-Second World War international economic order established an institutional architecture, which was designed to stabilise the international monetary system and support economic reconstruction (Eichengreen, 2008). The stability of the post-war international economic system has often been interpreted through the lens of hegemonic stability theory, which suggests that the functioning of an open and stable international economic order requires a dominant power willing and able to provide key public goods such as monetary stability, open markets, and security guarantees (Kindleberger, 1986; Keohane, 1984). In the post-war period, the United States acted as a benevolent hegemon, supporting the functioning of international institutions and maintaining the openness of the global economic system (Keohane, 1984). This role strengthened further during the final decade of the twentieth century when, following the collapse of the Soviet Union, the United States emerged as the sole global superpower with decisive influence over international political and economic developments. As a benevolent hegemon, the United States exercised much of its influence through soft power, including multilateral institutions, alliances, and economic leadership.

The rise of new great powers – most notably China and the reassertion of Russia – has gradually transformed the geopolitical environment. The resulting process of delimiting spheres of influence has introduced a higher degree of uncertainty into the international system (IMF, 2024). This transformation also reflects deeper structural tensions within the globalisation process. As Rodrik argues in his analysis of the globalisation trilemma, it is difficult to simultaneously maintain deep economic integration, national sovereignty, and democratic politics (Rodrik, 2011).

Increasing political tensions around globalisation have, therefore, contributed to a shift toward economic nationalism, industrial policy, and strategic autonomy. Moreover, global economic interdependence itself has increasingly become a tool of geopolitical competition. Farrell and Newman describe this phenomenon as “weaponised interdependence”, whereby states exploit their central position in global economic networks—such as financial systems or supply chains—to exert geopolitical influence (Farrell and Newman, 2019). Such dynamics have contributed to the growing use of sanctions, export controls, and financial restrictions as instruments of geopolitical strategy.

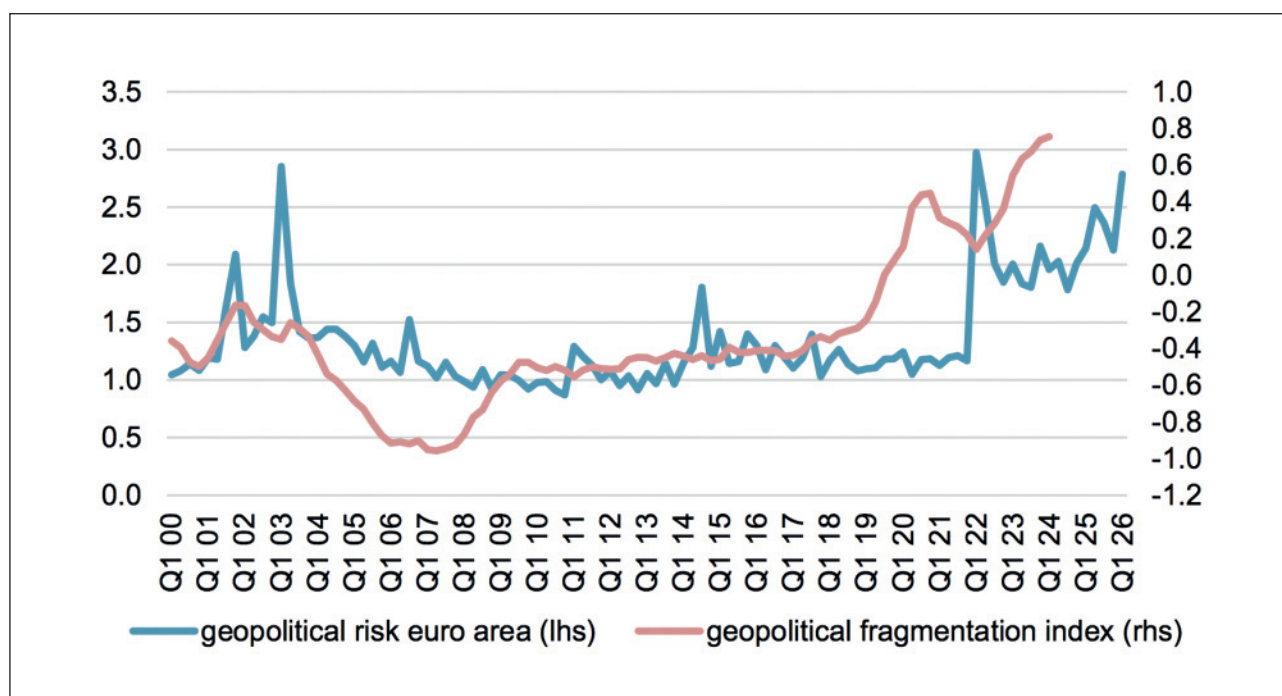
As the system of hegemonic stability gradually weakens and is replaced by a competitive system of major powers, geopolitical risks increase. In their efforts to expand or consolidate their spheres of influence, major powers increasingly resort to military interventions, economic co-

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ercion, and strategic competition. These developments heighten perceptions of insecurity across the international system and increase global economic volatility (BIS, 2025). Trade fragmentation is perhaps the most visible representation of the materialisation of increasing geopolitical tensions. This process of policy-driven reversal of global integration, motivated by strategic, geopolitical, or national security considerations, is referred to as geoeconomic fragmentation or GEF (Aiyar et al., 2023). Unlike earlier phases of globalisation, which emphasized efficiency and integration, GEF prioritizes resilience, autonomy, and security, even at the cost of economic efficiency. This process manifests through trade fragmentation (tariffs, non-tariff barriers, sanctions), technological decoupling, reconfiguration of global value chains, reduced cross-border flows of capital, labour, and knowledge, and strategic industrial and defence policies. Empirical evidence suggests that fragmentation is intensifying and could impose substantial economic costs. In fact, as the process of GEF has intensified since the Global Financial Crisis in 2008, it has already negatively affected economic growth. ECB (2026) uses Growth-at-Risk (GaR) estimates – capturing real GDP growth at the lower tenth percentile – that show that the inclusion of geopolitical indicators lowers expected growth outcomes compared with estimations without such risk factors. Since 2014, the contribution of geopolitical indicators to these dynamics has increasingly acted as a drag on GaR, reducing it by one to

two percentage points. Since the outbreak of the COVID-19 pandemic, GEF intensified even further. According to the IMF's Global Trade Alert database the number of protectionist measures is currently fifty percent higher than before the COVID-19 pandemic (IMF, 2026). Similarly, Global Fragmentation Index (Fernández-Villaverde, Mineyama, Song, 2024), a composite measure of fourteen indicators of geopolitical risk, is at its highest level on record in the last five decades. IMF (2026) staff analysis indicates that a one-standard-deviation shock to the Geopolitical Fragmentation Index is associated with an increase in public debt ratios of about 1.5 percentage points of GDP in the medium term. Since the outbreak of the Ukraine war the value of the index increased by more than that compared to the average of the period before the global financial crisis in 2008. There are also several estimates available of the potential economic cost of GEF. Aiyar et al. (2023) estimate that economic cost of GEF could range from 0.2 percent to up to 7 percent of GDP; with the addition of technological decoupling, the loss in output could reach 8 to 12 percent in some countries. Rising geopolitical tensions and geoeconomic fragmentation are taking place at a time when fiscal resilience is already under pressure and fiscal buffers are limited. IMF estimates that the global fiscal gap – the difference between projected primary balances and the levels needed to stabilize the debt ratio – has all but disappeared, from a cushion of more than 1 percent of GDP a decade ago to near zero today (IMF, 2026). On top of that, since the end

Figure 1: Geopolitical Risk and Fragmentation



Source: [https://github.com/YvesSehueler/EuroAreaGPR/raw/refs/heads/main/EA\\_GPR\\_Paper.xlsx](https://github.com/YvesSehueler/EuroAreaGPR/raw/refs/heads/main/EA_GPR_Paper.xlsx), <https://geopol-fragmentation-index.com/>

of the Cold War there seems to be a systematic orientation towards a more expansionary fiscal discourse as governments avoid policy choices that would not be perceived favourably by the electorate (Gaspar, 2024).

It is necessary to point out that GEF represents a structural and persistent change in the functioning of the world economy. This is also accompanied by regular shocks that exacerbate the economic and consequently fiscal costs. Therefore, it is important to make a distinction between trend implications of GEF and sudden shocks, which are a consequence of rising geopolitical tensions and accompanied by increased uncertainty and volatility. Rising geopolitical risks and accompanied intensified process of GEF have substantial impact on fiscal results. Theoretically, the most affected are countries with high trade openness and high public debt (ECB, 2026). The impact is also not equal within countries as the less well-off part of the population is more adversely impacted (Aiyar et al., 2023). We can broadly make a distinction between indirect and direct channels of impact on fiscal results, although the channels with which GEF impacts fiscal results are heterogeneous and heavily inter-linked. This is because geopolitical risk is multi-faceted and not directly quantifiable as it arises from a range of interconnected political, economic, and social factors spreading across borders and sectors (Behn et al., 2025). Therefore, it is difficult to make a clear distinction between trend and shock related impacts, and direct and indirect impact.

First and from a fiscal standpoint most visible channel of GEFs impact on public finances is higher and from a sustainability viewpoint less effective public expenditure. Governments increasingly deploy subsidies to offset trade barriers or support domestic industries. These measures carry significant fiscal costs, often have uncertain productivity returns and risk misallocation of resources (IMF, 2026). GEF also shifts fiscal priorities. One of the most obvious trends related to GEF is increased defence spending, which constitutes one of the most rigid components of public expenditure (IMF, 2026). This reallocation of fiscal resources towards security and industrial subsidies may also crowd out investments that are more growth-enhancing such as investment in infrastructure and education. This in turn also has a negative long-term effect on potential growth and tax revenue. Furthermore, as fragmentation acts as a negative supply shock it raises production costs and in turn leads to higher inflationary pressures. This results in higher indexation of spending, in particular social benefits and public sector wages. More frequent and intensive fragmentation-induced shocks increase pressure for compensatory fiscal interventions. They mostly take the form of price subsidies and

transfers to firms and households. As they are often broadly constructed and not targeted enough the fiscal costs are greater than needed.

More indirect channel through which GEF impacts fiscal performance is its negative effect on macroeconomic performance. This in turn leads to lower tax revenue and consequently higher public debt. Trade barriers, supply chain disruptions and reduced technological and knowledge diffusion lead to lower investment and reduced productivity, which negatively affects potential growth (Caldara and Iacoviello, 2022; Aiyar et al., 2023). Furthermore, during shocks uncertainty and volatility increase, which results in precautionary lower investment and consumption that also leads to lower growth and lower public revenue. Another indirect channel of GEFs impact on fiscal performance is financial. Namely, geopolitical tensions and fragmentation lead to increased risk premia, which raises borrowing costs. This negatively affects long-term fiscal sustainability as it increases debt servicing costs.

#### **Current and long-term issues of public finance sustainability in Slovenia**

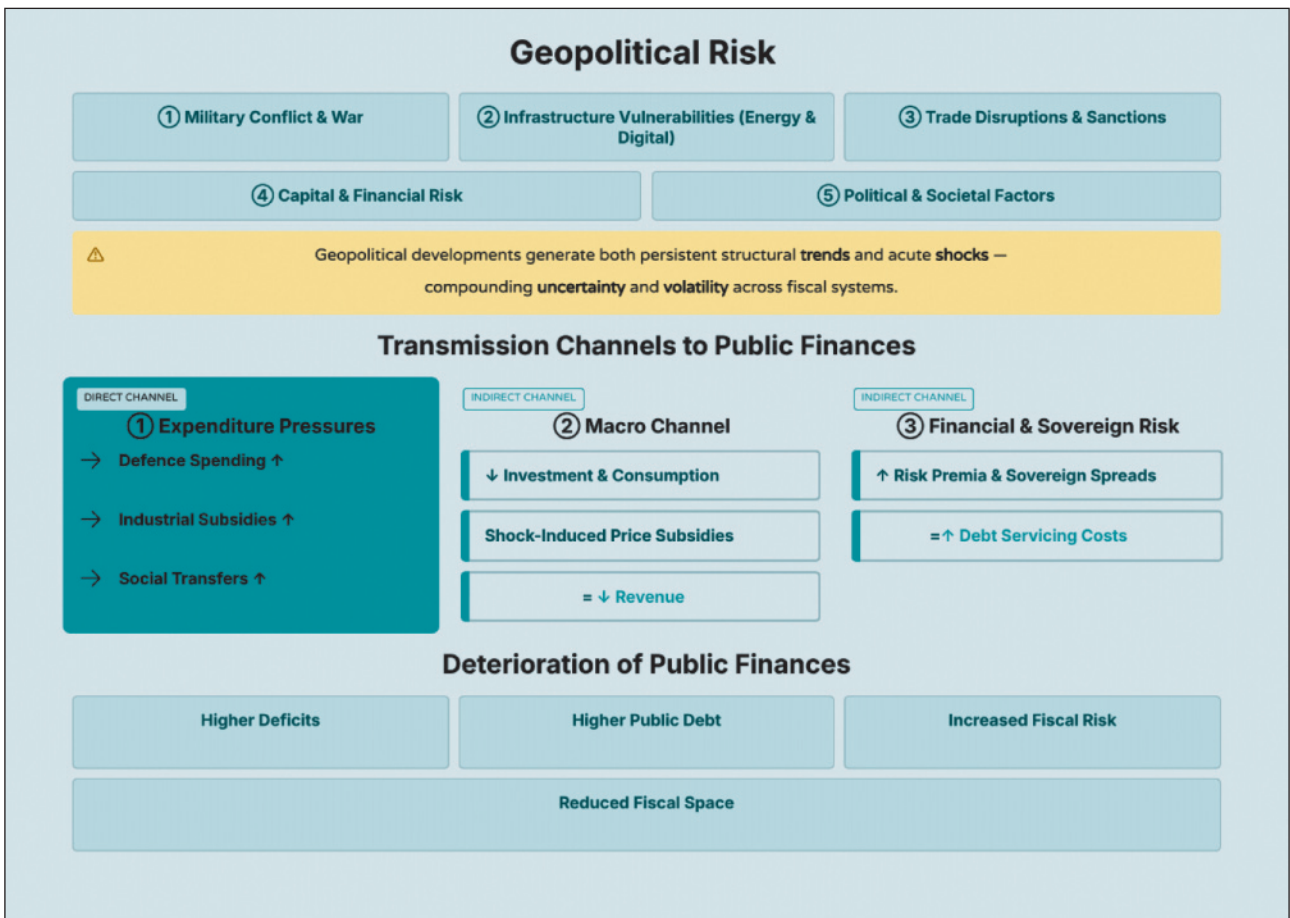
Fiscal sustainability in the euro area will be ensured via dutifully implementing the medium-term fiscal plans. The plans lay out fiscal policy path via pre-defined growth in net expenditure. Following this path ensures a gradual reduction of public debt ratio and thus prevents its further increase even after applying standardised shocks and ensuring a certain probability to provide for this.<sup>1</sup> Accumulating deviations from the plan may endanger the long-term fiscal position and at the same time narrow fiscal space to act when shocks or cyclical downturn occur.

Slovenia currently fails to ensure fiscal sustainability over the medium- and long-term. This has lately been confirmed by both European Commission and Fiscal Council. The latest Debt Sustainability Monitor (DSM; EC, 2026) places Slovenia among six EU countries with highest long-term fiscal risks. The projected rise in cost of ageing is predominantly responsible for the high level of risk.<sup>2</sup> However, the unfavourable initial structural position has contributed most to the worsening of the assessment with respect to the previous edition of DSM. DSM estimates the required adjustment of the primary balance to stabilize public debt over infinite horizon at 6.5 p. p. of GDP, while updated estimate in Milanez (2026) shows required adjustment at 6.1 p.p. of GDP (the difference between required SPB (structural

<sup>1</sup> See Chapter II.1 in EC (2024a) for a description of Debt Sustainability Analysis methodology, on which the set-up of net expenditure path is based.

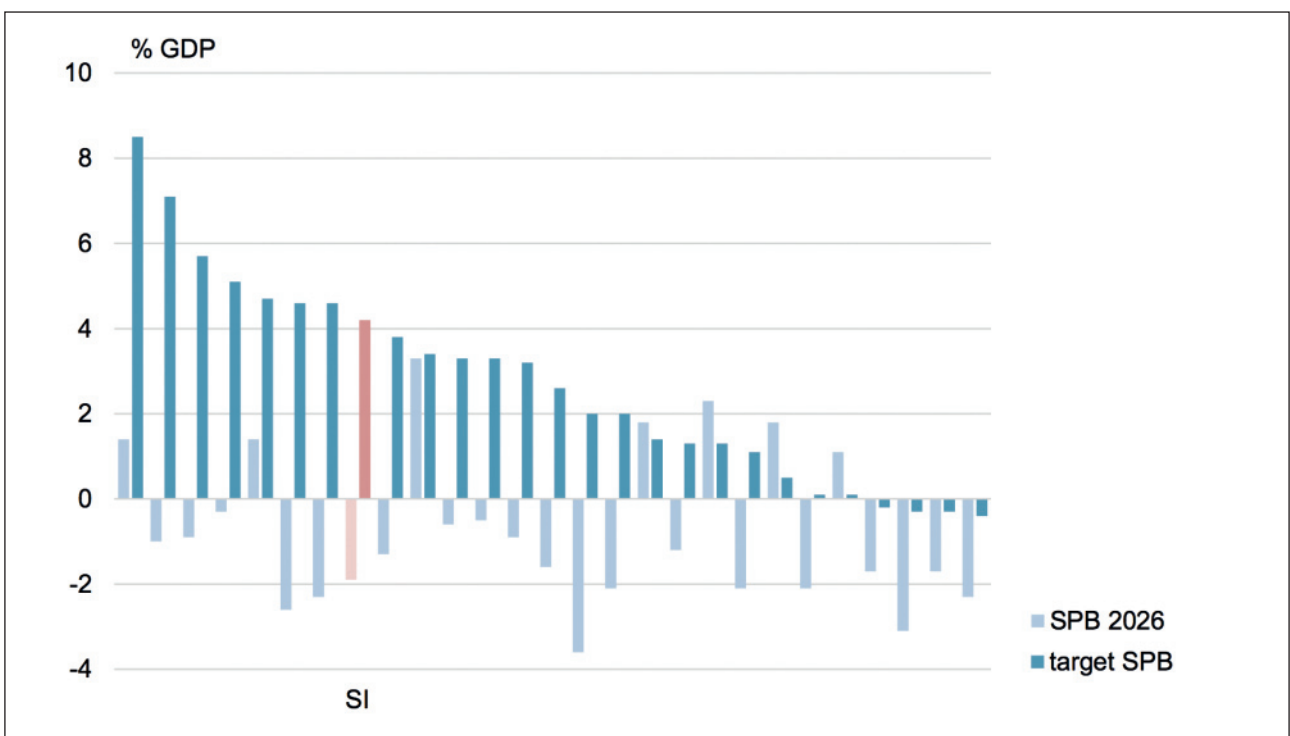
<sup>2</sup> See also list of highest fiscal structural risks in advanced countries (IMF (2026), Figure 1.35).

Figure 2: Geopolitical tensions and channels of impact on public finances



Source: Authors.

Figure 3: Required SPB adjustment



Source: Debt Sustainability Monitor (EC, 2026), Milanez (2026) and authors' calculations.

primary balance) and initial SPB in Figure 3).<sup>3</sup> The implied levels of primary balance surplus at 4–5% of GDP, resulting from such an adjustment, have not been reached in the past. The probability of actually achieving such adjustment is thus estimated at zero – or unrealistic – in DSM. These findings are echoed in the recent Fiscal Council (2026) report. It assesses that the recent strong spending growth episode points to a deviation from fiscal sustainability, with public debt ratio diverging from the path set in Slovenia's medium-term plan. This, coupled with a possibility of a severe geopolitical scenario being materialised under assumption of no policy measures taken, could bring the budget deficit to 5% of GDP, putting public debt on an unsustainable path. Additional spending pressures do not bode well for fiscal sustainability over medium-term. Over the next decades, taking the recently adopted pension reform and a recent update of population projections (EUROPOP 2025, Eurostat, 2026) into account (see Milanez, 2026), age-related costs could increase by around 4 p. p. of GDP. Further long-term fiscal pressures include climate-transition cost, defence spending and large infrastructure projects, such as the new nuclear plant. We estimate that climate-transition costs and higher defence spending could add more than 3 p. p. of GDP to public spending over the next decades. The former takes into account estimates for Slovenia by Brložnik (2022) at around 2 % of GDP. In terms of additional defence spending, the assumption is that current spending at 2 % increases to 3% of GDP. In addition, current estimates of the cost of the new nuclear power plant are in the range of 20 % of GDP, which will be spread through more than a decade. According to authors' calculations, the rise of debt-to-GDP ratio in the case of long maturities of issued bonds and unfavourable financing conditions could exceed 25% of GDP in 20 years following the start of this project. However, even in the most favourable case, the increase in debt could reach close to 15% of GDP.

### By how much do geopolitical tensions affect fiscal sustainability?

Geopolitical tensions could further exacerbate the already existing long-term fiscal pressures. They may impact fiscal sustainability either through changes in the initial fiscal position or via macroeconomic assumptions. In order to assess this impact, we first simulate effects of shocks to uncertainty on macroeconomic developments.

<sup>3</sup> Based on current projections by both Ministry of Finance and Fiscal Council, SPB in 2026, i. e. initial structural position, could be higher (on average at -1.9 % of GDP) than that taken into account in DSM calculations (-1.3 % of GDP). However, positive effects of recent pension reform put the target SPB at lower level (4.2 % of GDP) than DSM (5.1 %). Although the need for a required adjustment is slightly reduced, Slovenia would remain among the high-risk countries.

We build upon two scenarios to analyse the relation between uncertainty and fiscal outcomes for Slovenia.<sup>4</sup> The transmission to budgetary developments runs through macro channel, depicted in Figure 2, via impact on revenue, as the fiscal policy response is switched off when performing simulations. The definition of two scenarios is presented in Figure 4. The first is in line with the uncertainty indicator from "severe shock scenario" of the latest ECB projections.<sup>5</sup> The increase in uncertainty<sup>6</sup>, its level currently close to historically highs, in this scenario is slightly lower compared to a rise during the GFC or epidemic period. After the shock, it is reduced by the end of 2027 to a level, similar to the average since the beginning of the epidemic.<sup>7</sup> In order to take into account the assumed more structural nature of uncertainty, we also simulate a case, where the shock remains high permanently. The "permanent shock scenario" is designed such that uncertainty initially rises by only half the rise in the "severe" scenario but thereafter remains close to that level, corresponding to that reached during the high of the epidemic period. Uncertainty shocks could significantly affect GDP developments. Simulations show that uncertainty affects GDP predominantly via investment. This is in line with theory and other analysis (see ECB, 2016) and may thus also impact the long-term economic potential. The effect on investment is

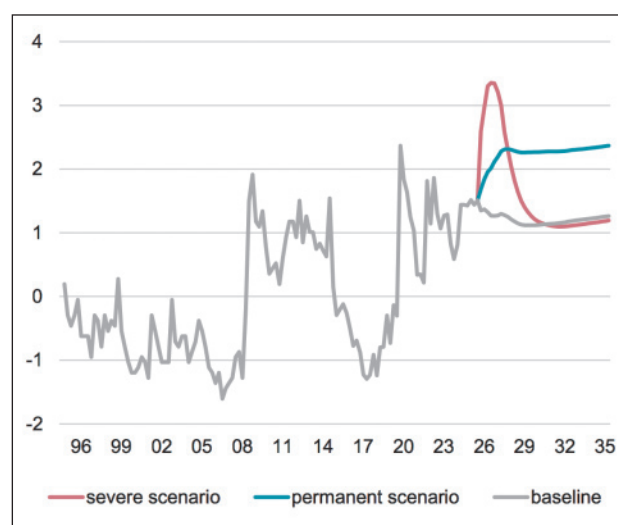
<sup>4</sup> Simulations are performed on a model, constructed by following the approach in Kozamernik and Žumer (2011).

<sup>5</sup> See ECB (2026).

<sup>6</sup> In our model, the »uncertainty« is represented by SORS indicator reflecting »uncertain economic conditions« in the manufacturing sector, being the limiting factor of production as reported by firms.

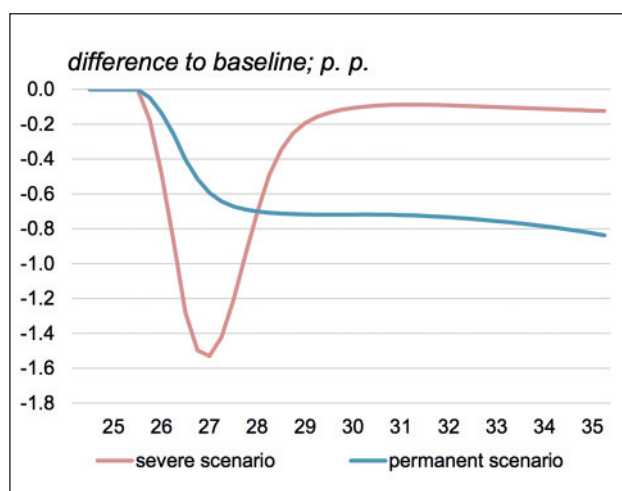
<sup>7</sup> Note that »uncertainty« is endogenous in the model. In order to allow for the dynamic response to take full effect, it is not fixed after the end of the shock.

**Figure 4: Definition of uncertainty scenarios (normalized values)**



Remark: normalized (period 1995-2025)  
Source: SORS: Authors' calculations.

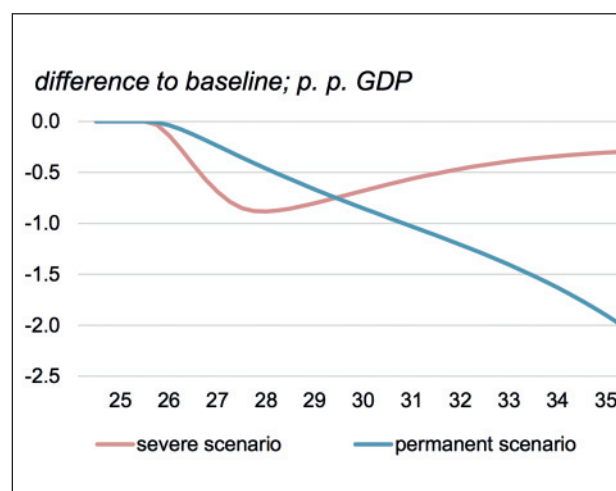
**Figure 5: Uncertainty simulations:  
effect on GDP growth**



Source: Authors' calculations.

threefold stronger than on the household consumption.<sup>8</sup> In case of a "severe" shock, real GDP could be up to 4 % lower than in the baseline over the long-term. This reflects the fact that GDP growth in the first three years following such a shock would lag that of the baseline considerably.<sup>9</sup> The impact is similar to that estimated for largest euro area countries by EC (2024b), but stronger than envisaged for the uncertainty channel in the severe scenario impact on euro area GDP in ECB (2026), probably reflecting higher volatility of investment and small open economy. In case of a "permanent" shock, deviation becomes even more pronounced. Although due to the construction of shock it occurs with a certain delay, GDP growth is reduced by almost 1 p. p. on an annual basis, implying a GDP growth rate at below 1% in 10 years after the shock, while the level of GDP is up to 10 % lower than in the baseline. Such developments would pose a serious strain for the budget balance. In case of the "severe" shock, an increase in deficit would peak in third year after the start of the shock, being roughly 1 p.p. of GDP higher than in the baseline. Results of this simulation, where the size of shock to uncertainty is close to 2 of its standard deviation are similar to those provided in IMF (2026).<sup>10</sup> The latter, however, are surrounded by a wide range of possible outcomes and none of distribution results is on a positive side. In the case of "adverse" scenario akin to that of ECB (2026), where the shock in comparison to "severe" scenario is roughly

**Figure 6: Uncertainty simulations:  
effect on budget balance**



Source: Authors' calculations.

one third lower and expires after one year, the negative effects on both GDP growth and budget balance are significantly more moderate. However, in the case of a "permanent" shock, budget balance would deviate persistently and in a progressive manner.

Simulation results imply that medium-term fiscal sustainability could come under substantial pressure. Compared to the baseline, worse macroeconomic performance and higher deficits would increase general government debt by 7 p. p. of GDP in the "severe" and by 20 p. p. of GDP in the "permanent" scenario over the medium-term. Rises in debt-to-GDP ratio run counter to the requirements of the medium-term fiscal-structural plan, which assumes a gradual decline in debt ratio for Slovenia.

Among other effects, such divergence would also impose more restrictive requirements on government spending, when the new medium-term plan is set up. According to our estimates, the resulting average annual growth rate of net expenditure could be reduced by up to 0.5 p. p. in the "severe" scenario and by up to 1 p. p. in the "permanent" scenario. In line with that, uncertainty thus adds further restrictions on economic activity and worsens fiscal results. If such developments are also followed by a rise in risk premium, this would importantly restrain the provision of fiscal space to counteract frequent shocks.

### Possible fiscal policy responses to growing geopolitical risks

In such an environment, fiscal policy must balance resilience, sustainability, and flexibility. To strengthen fiscal sustainability, it needs to establish credible medium-term fiscal frameworks with clear adjustment paths, prioritize gradual, but sustained debt reduction and preserve or rebuild fiscal

<sup>8</sup> According to EIB (2025) survey, most important barriers to investment are high energy costs, lack of skilled workers and uncertainty. These barriers also feature high for other CEE countries. Financing is not perceived as a limit to investment in Slovenia.

<sup>9</sup> Divergences from the baseline would dissipate in around five years after the shock.

<sup>10</sup> It is worth noting that the simulations therein do not refer directly to geopolitical tensions, but rather to social unrest shocks.

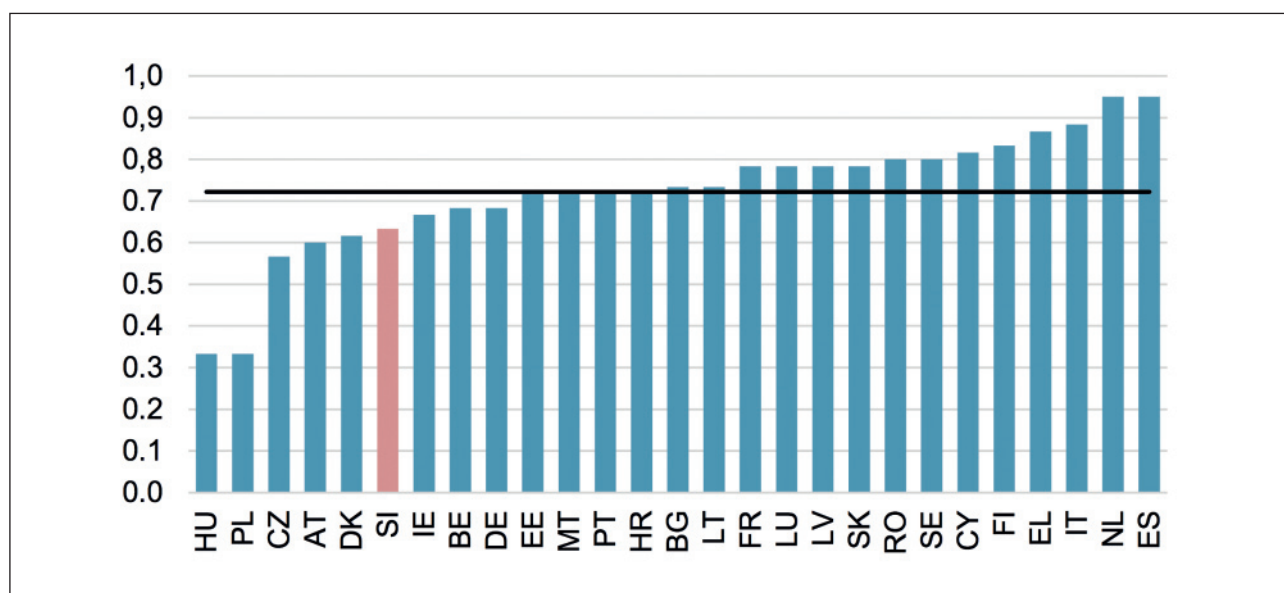
buffers to cope with more frequent shocks (Dabla-Norris and Valdes, 2026). A key challenge is balancing credibility and flexibility, ensuring sustainability without undermining the capacity to respond to crises. Achieving this balance has never been more important or more difficult. As IMF (2026) warns, broad or aspirational commitments to undertake fiscal consolidation are no longer sufficient. Instead, credible adjustment requires specific measures, clear sequencing, and medium-term frameworks resilient to political cycles.

In terms of mitigating consequences of shocks, governments must improve the quality and targeting of crisis-mitigating fiscal measures. Broad-based subsidies need to be replaced with targeted, temporary support for vulnerable households and viable firms (IMF, 2026). Distortionary measures that suppress price signals, particularly in energy markets, must be avoided. In Slovenia, fiscal policymakers have inadequately addressed numerous crises in the last several years. Majority of measures were broad-based, deficit and debt increasing, and have significantly raised expectations among stakeholders of what are the limits of fiscal policy response. This has increased the pressure on fiscal policy even in periods when shocks have receded. On the other hand, an example of a shock intervention that at least partly satisfied the criteria of proper crisis management, as stated by international institutions, is the approach to flood relief. Introducing temporary and dedicated new tax revenue for a specifically designed budgetary fund with a limited time frame of operation, which is relatively transparent, has not increased the deficit and has a negligible effect on macroeconomic performance.

To balance resilience and sustainability, public spending must be reprioritized. Resources need to be shifted toward investments that enhance resilience, in particular guaranteeing energy and digital security. At the same time, growth-enhancing expenditure that impact favourably productivity and external competitiveness, needs to be safeguarded, especially investment in education. In Slovenia most public investment is directed toward traditional infrastructure (roads and railways). On the other hand, a considerable financial gap exists to improve and enhance the electricity distribution network that is necessary to accelerate the transition to more self-sustained and environmentally friendly energy supply. A clear, systematic and medium-term oriented refocus of public investment is, therefore, needed.

From an institutional perspective, public financial management and transparency need to be improved (Dabla-Norris and Valdes, 2026). In Slovenia there is considerable room to improve efficiency of public finance planning and execution. PIMA review (IMF, 2023), has shown significant deficiencies in the field of planning and execution of public investment. There are also no systematic spending reviews in place, tax expenditure is relatively high compared to other EU member countries, and there is considerable room to improve the effectiveness of public procurement (Dela-korda, 2025). Public wage bill needs to be managed more prudently, and impact assessments of proposed policy and legislative measures need to be improved substantially. There is also room to formally improve the medium-term budgetary framework, where Slovenia has one of lowest scores in the EU.

Figure 7: Medium-Term Budgetary Frameworks Index 2024



Source: European Commission

### Conclusions

Rising geopolitical risks and geoeconomic fragmentation are not temporary disruptions, but increasingly structural features of the global economic environment. Thus, they are adding to already numerous long-term fiscal pressures also in Slovenia. Their fiscal implications extend beyond short-term crisis management, as they weaken growth prospects, increase expenditure pressures, and reduce fiscal space. Simulations show a potentially considerable impact of uncertainty on fiscal developments in Slovenia, representing further sustainability challenges. In such an environment, the quality and credibility of fiscal policy become increasingly important. Strengthening fiscal resilience would require better prioritisation of public expenditure, more targeted policy responses to future shocks, and stronger fiscal framework.

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# Demographic change is here - Is productivity the answer?<sup>1</sup>

*Maja Bednaš and Peter Wostner\**

The demographic landscape in Slovenia is changing. Slovenia is facing rapid population ageing, with fewer working-age people and more retirees, putting strong pressure on pensions, healthcare, and long-term care systems. Reforms, especially the 2025 pension reform, aim to improve fiscal sustainability. However, labour shortages remain a major challenge. Higher labour participation, immigration, and better education–job matching will help but will not suffice. In an environment where labour supply growth is structurally constrained, productivity becomes the main margin of adjustment for sustaining economic growth and fiscal capacity. Slovenia must rely on innovation, digitalisation, and stronger human capital to maintain economic growth, finance social protection, and improve living standards.

JEL J11, H55, J24

## Demographic change is here - Is productivity the answer?<sup>2</sup>

Like much of Europe, Slovenia has been experiencing significant demographic shifts for over a decade, and these trends will further accelerate in the near future. These changes are reshaping the population's age structure and the labour market, requiring existing systems and institutions to adapt in order to address emerging challenges while also taking advantage of new opportunities.

### Population in motion: The new demographic reality

Over the past decade, the demographic landscape in Slovenia has changed significantly, and projections indicate an even more rapid aging of the population. A demographic shift is mainly driven by large cohorts getting older (i.e. bigger generations move into the older age group) and increasing life expectancy, but also due to the decline in the birth rate since the early 1980s (from around 2.1 to around 1.5). Consequently, according to EUROPOP 2023 projections, the proportion of the working-age population (20 to 64-year olds) is decreasing and will continue to decrease in the coming decades, while the proportion of older adults (65+) will increase in Slovenia. In other words, the old-age dependency ratio is rising, meaning fewer workers support more retirees.

<sup>1</sup> The article is informed by the Development Report 2026 (UMAR, 2026).

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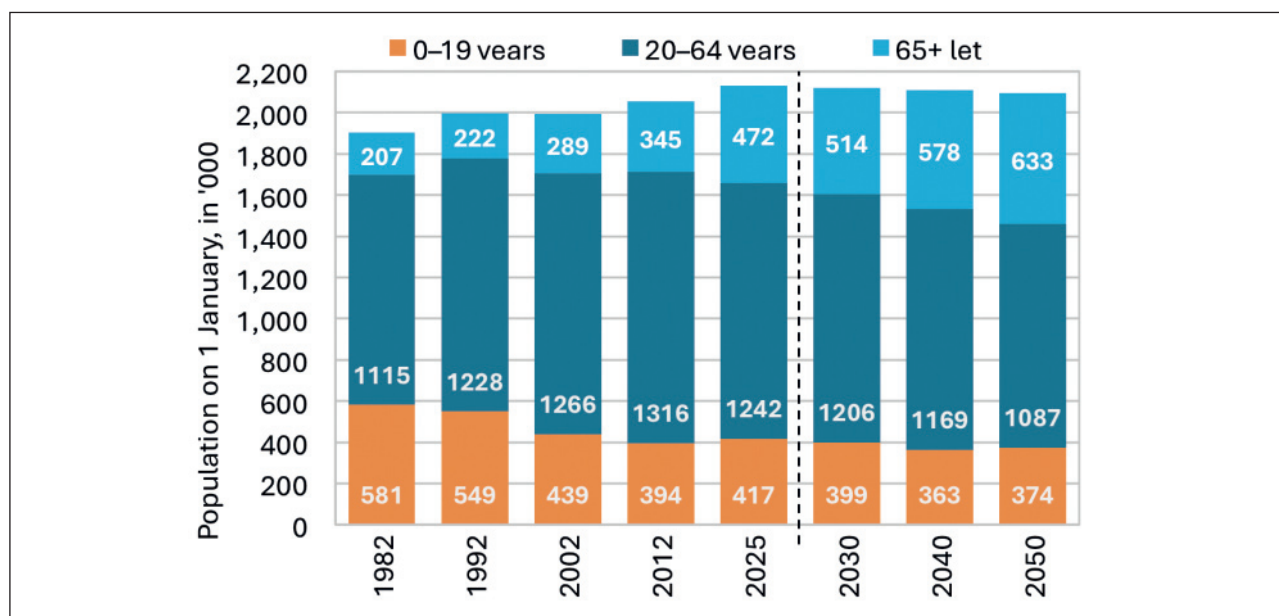
<sup>2</sup> The article is informed by the Development Report 2026 (UMAR, 2026).

### Demographic shift reshapes social protection systems

Demographic change has a major impact on economies and on the welfare and health systems all over Europe. Projections of social protection expenditures due to population aging point to significant long-term fiscal risks in no-policy change scenarios: spending on pensions, healthcare, and long-term care is expected to rise, which, without action, would increase pressure on public finances. Therefore, EU countries, including Slovenia, are implementing various measures to contain expenditure growth while balancing fiscal sustainability with the preservation of income adequacy and the well-being of the population. According to projections in the 2024 Ageing Report (EC, 2024), Slovenia was among the countries with higher fiscal risks, with an above-average increase in these expenditures over the 2022–2070 period relative to the EU (from 22.1% to 27.5% of GDP, EU 24.4% to 25.6% of GDP).

Reforms of social protection systems have therefore been at the forefront of the European Commission's recommendations for several years, but also high on Slovenia's own reform agenda. In recent years, numerous systemic changes have been introduced in these systems to address the challenges of an aging society, particularly through measures to improve access to public services (e.g. strengthening preventive programs, expansion of primary healthcare and family medicine, adoption of the Long-Term Care Act in 2023), while the greatest contribution to the fiscal sustainability of public spending stems from the pension reform adopted in 2025.

**Figure 1: Projections indicate that Slovenia's working-age population (20–64 years) will continue to decline, while the number of adults aged 65 and over is expected to rise.**

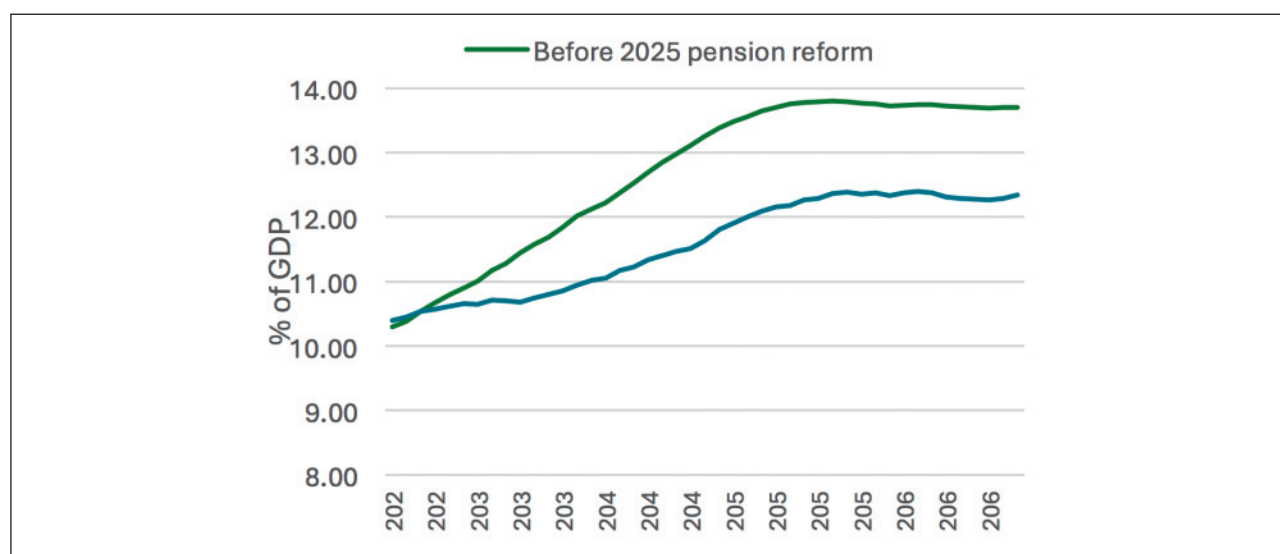


Source: SURS (2026), Eurostat (2026), EUROPOP2023 population projection (March 2023).

Most changes in the pension system will be introduced gradually between 2028 and 2035 (ZPIZ, 2025a, 2025b). The share of pensions relative to GDP, which currently stands at around 10% of GDP, will, due to the reform, remain below 11% until 2040, but will then approach 12% by 2050 due to the retirement of the larger cohorts born in the late 1970s and early 1980s, and stabilize at 12.3% in the 2055–2070 period (Kump et al., 2025). Compared to the pre-reform projections (EC, 2024a), the share in 2070 would be 1.4 percentage points lower than before the reform (13.7%).

A systemic change is also underway in the long-term care sector. The Long-Term Care Act, adopted in 2023, introduced public funding for these services for the first time and reduced direct payments by users of institutional care. It also expanded the range of home care entitlements, which should contribute in the long term to deinstitutionalisation and the development and affordability of these public services. According to OECD (OECD, 2025b), deinstitutionalization also contributes to a more cost-effective care structure, while a well-developed home care system reduces the use of more expensive health services. Under-

**Figure 2: The share of pension expenditure in GDP (before and after the 2025 pension reform)**



Source: Aging Report 2024 and IER

standably, in the early phase of implementing the new home care system, the high volume of applications and staff shortages have resulted in waiting periods for eligibility assessments and for the finalization of personal care plans with home care providers. The effects on service accessibility and the full financial implications of the reform will only become clear in the coming years.

The sustainability of financing of social protection is also influenced by demographic trends as it depends heavily on social contributions. In 2023 (latest data), social contributions financed more than 70% of social protection expenditures in Slovenia, the third-highest share in the EU.<sup>2</sup> Between 2013 and 2023, this share increased, while it decreased on average across the EU. The pay-as-you-go pension system, financed by current contributions, is particularly vulnerable, as the collected funds cover an ever-smaller share of pensions. Similar pressures apply to mandatory health insurance and long-term care insurance, which are predominantly financed by contributions.

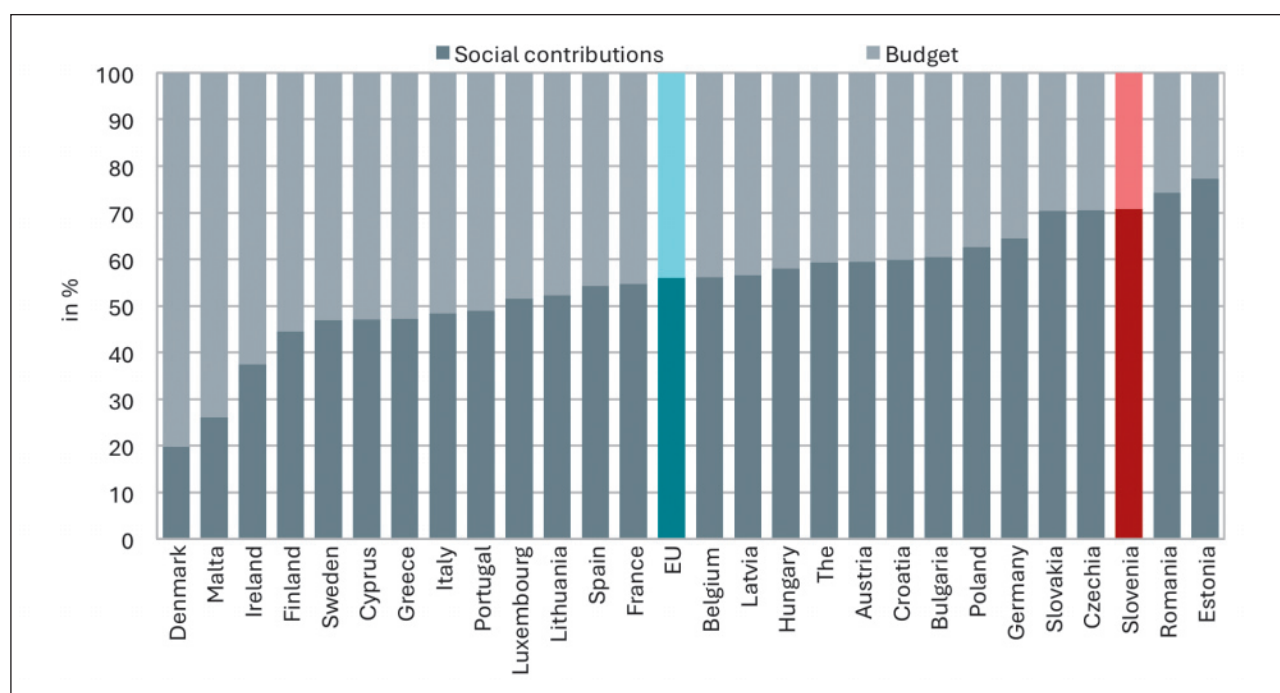
### Changing population composition, changing skills: Rethinking human capital

High labour force participation and positive net immigration help mitigate the effects of demographic trends that

<sup>2</sup> The share of revenue from social contributions relative to GDP increased in 2024 mainly due to the conversion of voluntary health insurance into a mandatory health contribution (an increase of 0.9% of GDP), and in 2025 due to the introduction of a long-term care contribution (0.4% of GDP).

reduce the size of the labour force. The labour force participation rate rose to 78.3% in 2024/2025 and was above EU average (75.8% in 2024). In spite of the negative demographic impact (the aging of the workforce), it was positively influenced by cyclical and structural factors, including the prolongation of working life (increase in retirement age, the introduction of bonuses for later retirement, temporary and occasional work by retirees, employment incentives), the gradual improvement of the educational structure of the working-age population, and the increasing participation of women in the labour market. However, although the overall participation rate is generally high, there are significant differences between groups. Those with above-average labour force participation are aged 30–54 (the highest rate in the EU), highly educated, and male. Those with below-average labour force participation include older adults, young people, individuals with low educational attainment, more often women – particularly foreign nationals – and people with disabilities. Among the latter group, the greatest progress in labour market participation in recent years has been among older adults (55–64 years) and those with low levels of education (two groups that often overlap), though still only half of these individuals remain economically active. But the labour force participation rate among 60- to 64-year-olds remains among the lowest in the EU. The labour force participation rate among young people is also below EU aver-

Figure 3: Social protection expenditures by source of funding, 2023



More than 70% of social protection expenditures in Slovenia was financed by social contributions in 2023, i.e. even before changing voluntary health insurance payments to mandatory health insurance contributions and introducing long-term care contribution  
Source: Aging Report 2024 and IER

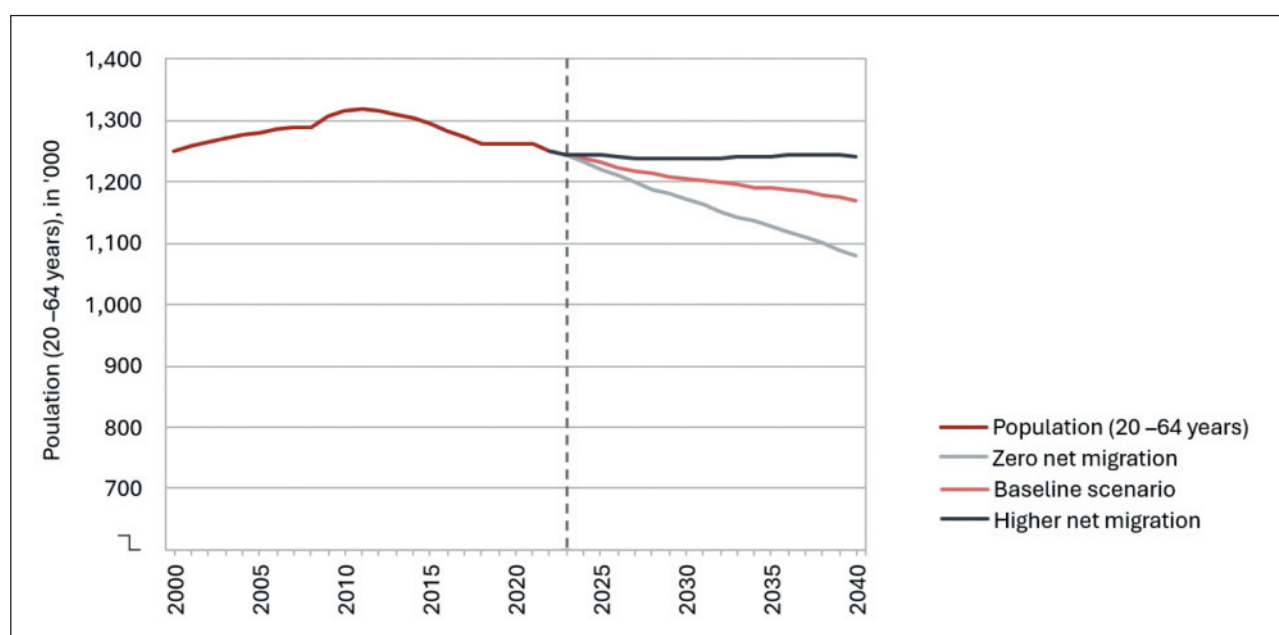
age. It declined especially during covid and did not return to pre-pandemic levels until 2024, while growth stalled in 2025 (as opposed to older workers, where participation increased further). Young people (aged 20–29) remain particularly vulnerable in the labour market, as their situation is often the first to deteriorate during an economic downturn. In addition, they often face a mismatch between their education and labour market needs, are more frequently employed in precarious forms of work, and about one-third of them earn the minimum wage. Despite high enrolment in tertiary education, they complete their studies relatively late and enter the labour market late, which can affect their later independence and result in less work experience.

Within the changing demographic patterns, immigration is critical to offset workforce decline. Given the constraints on the domestic labour supply, immigration has significantly mitigated the labour shortage over the past decade. The share of foreign workers in the total workforce has been growing; by the end of 2025, they accounted for 16%. Over the next ten years, net immigration would need to amount to 100,000 people (or 10,000 per year) to replace the labour shortage resulting from employee retirements. As this is highly optimistic scenario, it is more plausible that the demographic gap will persist in the long term, despite effective mobilisation of the domestic labour force and labour immigration. Also, immigrants' educational profile remains a challenge, with lower skilled foreign workers - workers with a primary school education or

vocational training – currently dominating. Of course, this issue can be addressed with more proactive policymaking. As our analysis shows, the employment of foreign workers with a relatively higher level of education would, with appropriate investments, have a long-term positive effect on economic growth (IMAD, 2023). Therefore, the targeted attraction of experts and other specialized workers from abroad to fill gaps in the domestic labour supply is crucial for long-term growth in productivity, innovation, and the green and digital transitions.

The quality of the domestic labour supply should also be addressed. Over the past decade, the structure of enrolment in educational programmes has come much closer to labour market demand; however, due to smaller younger generations, the demand for workers significantly exceeds the available supply. The structure of labour demand is also changing in some sectors due to digitalisation, new technologies, and AI, leading to a surplus of certain profiles while, at the same time, creating greater demand for specialists, particularly in certain natural science fields and engineering. There is also a shortage of personnel to provide quality public services (healthcare, social welfare, education) and certain social science profiles (e.g., psychologists, lawyers). The insufficient supply of graduates in the labour market is also influenced by the length of study programmes and low graduation rates due to dropout (OECD, 2025a). Furthermore, some graduates spend a long time looking for suitable employment, while many find jobs in occupations requiring at most a high school

**Figure 4: In the medium term, the decline in the working-age population can be mitigated only through substantial net migration.**



Source: SURS (2026), Eurostat (2026), EUROPOP2023 population projection (March 2023).

education (vertical mismatches) or in fields that do not align with their area of study (horizontal mismatches). In 2024, a quarter of university graduates in Slovenia were employed in jobs that did not match their field of study or educational level, indicating inefficient human resource planning; the greatest mismatches were observed among immigrants. Thus, in the context of ongoing demographic changes and technological transformations, the development of human capital is becoming a key strategic driver of productivity, resilience, and prosperity.

Beyond human capital, a well-functioning economy constitutes a fundamental pillar of prosperity. Economic development, underpinned by rising productivity, plays a crucial role in addressing the challenges posed by demographic change. Stronger productivity growth supports income expansion, which in turn forms the basis for contributions that finance social protection systems. When combined with policies that promote equitable income distribution, this dynamic contributes to higher living standards and enhances the overall well-being of the population.

#### **Productivity as the central welfare enhancing mechanism in an ageing society**

In an environment in which labour supply growth is structurally constrained, productivity becomes the main margin of adjustment for sustaining economic growth and fiscal capacity. This is particularly relevant for Slovenia, where employment rates are already high by international standards and demographic projections imply a declining share of the working-age population in the total population. As a result, the scope for future increases in GDP per capita through higher employment is narrowing, and economic catching-up will increasingly depend on raising productivity.

In 2025, Slovenia's GDP per capita (in PPS) reached 91% of the EU average, while labour productivity (GDP per employed person, in PPS) remained 14% below the EU average (IMAD, 2026). The post-crisis pattern is also consistent with broader EU developments: productivity growth has slowed following the pandemic and the energy shock.

In Slovenia, average annual productivity growth declined to around 1.1% per employed person and 1.0% per hour worked in 2020–2024, after stronger growth in 2014–2019 (1.5% per employed person and 2.1% per hour worked). The deceleration was more pronounced in services than in manufacturing. In most market services (e.g., trade, transport and accommodation, and professional and business services), productivity in 2024 was approximately at the 2019 level; by contrast, manufacturing recorded productivity growth comparable to the Visegrad countries and higher than the EU average over 2020–2024. ICT

services remain an important exception within market services, as productivity increased again after several years of decline. Overall, these differences suggest that future gains will depend not only on sustaining resilience in manufacturing, but also – crucially – on lifting productivity in market services.

The short-term macro-financial context also suggests that the window for gradual adjustment may be narrowing. Slovenia has, in recent years, maintained a relatively favourable position in terms of liquidity and overall corporate sector solvency, supported by the post-pandemic recovery and, during successive shocks, by measures that helped preserve production capacity. Pressures are nevertheless visible in indicators of external performance and competitiveness. With labour costs rising faster than productivity in parts of the economy, cost competitiveness has weakened, and profitability has come under strain, particularly in manufacturing exposed to international competition. Export market-share growth has also stalled<sup>3</sup>, with recent data pointing to weaker performance in goods exports and a decline in some service segments relative to the post-epidemic peak. Taken together, these developments indicate that demographic and structural constraints are increasingly translating into near-term pressures, strengthening the case for a faster shift towards higher value-added activities and more innovation-led productivity growth.

#### **The case for an accelerated transition from investment to innovation-driven growth**

These productivity and competitiveness patterns point to a broader strategic issue: Slovenia needs to modernise its development model. A significant share of the business sector remains positioned as a supplier economy within global value chains, competing predominantly on a combination of cost, incremental quality upgrading, reliability, and adaptability to customers' specifications. This model supported convergence in earlier phases of integration, but it is increasingly difficult to sustain in an ageing society with tightening labour supply and structurally faster wage growth, particularly as international competition intensifies. Under these conditions, the scope for preserving competitiveness through price-based adjustment narrows, and the risk of being locked into segments with limited value capture increases, even when firms remain operationally efficient. The alternative is a shift towards innovation-driven growth, where productivity gains stem more systematically from cre-

<sup>3</sup> Following the global financial crisis, Slovenia's global export market share (of goods) grew steadily until 2020 (by 29% between 2012 and 2020). In 2021 and 2022, when supply chain disruptions and the energy crisis occurred, it fell sharply, but by 2024 it had returned to near-pre-crisis levels (0.19%).

ating, diffusing, and scaling knowledge. This requires not only R&D, but also higher investment in software and data, organisational upgrading, and skills—together with business models that enable differentiation including proprietary products, services, and brands (Bogetoft et al., 2024). Viewed through the lens of demographic change, such a shift is not only a long-term aspiration; it is also a near-term requirement for maintaining competitiveness and fiscal capacity. The next section therefore summarises Slovenia’s starting point for this transition by highlighting key strengths (“the good”), the main bottleneck (“the bad”), and the most difficult, yet decisive, constraints (“the ugly”).

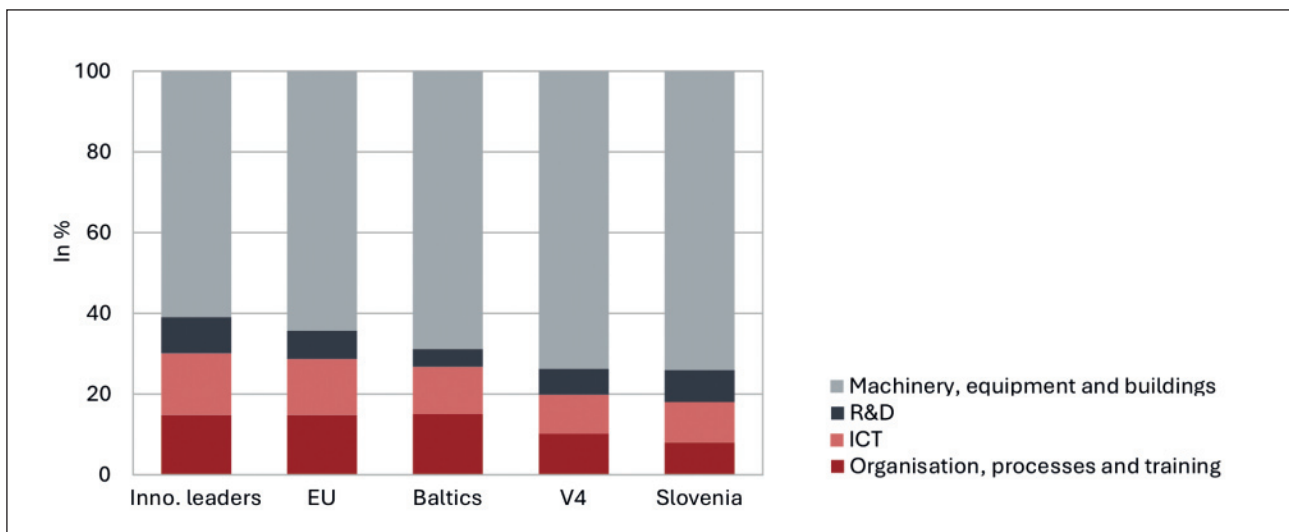
**The good, the bad, and the ugly**

Slovenia’s starting position for a transition to innovation-driven growth is, nevertheless, comparatively strong (“the good”). Along several dimensions of innovation capacity, it continues to outperform its closest peer group in Central Europe, maintaining a structural advantage over the Vise-grad countries, even as the gap with leading EU innovators persists (IMAD, 2026). Recent evidence also points to progress in key innovation-system components: the research system is well embedded in international collaboration networks, and human resources remain a comparative strength, supported by a high level of educational attainment and strong labour-market attachment. Moreover, Slovenia retains robust capabilities associated with “Industry 3.0” competitiveness – most visibly in manufacturing know-how, high levels of industrial robotisation, and deep integration into cross-border supply chains, which provide a platform for upgrading towards Industry 4.0 solutions and higher value added. These strengths are, however,

concentrated in operational excellence and production capabilities, reinforcing the central task of the transition: to complement them with faster diffusion of digital and data-driven practices across firms and functions, and with more ambitious business-model innovation.

The main weakness (“the bad”) lies in the capabilities that determine value capture rather than operational delivery, namely upgrading business models towards customer value creation through differentiated products and services. In practice, this requires a shift from a supplier logic to a solution-and-customer logic, which increasingly depends on digitalisation, the integration of Industry 4.0 technologies, and the emergence of data-driven firms. These technologies do not generate sustained productivity gains on their own; they require complementary changes in strategy, processes, skills, and organisational culture. This is where Slovenia has fallen out of line. Relative to innovation leaders – and increasingly also relative to competing Vise-grad and Baltic economies – Slovenian firms lag behind in both the breadth of digital adoption and the complementary organisational changes required for productivity gains. In 2025, only 32% of Slovenian firms reached at least high digital intensity, placing Slovenia 18th in the EU, with a gap of 6 percentage points to the EU average and as much as 31 percentage points to the leading innovators. Consistent with this, indicators of data-driven transformation remain weak: the use of customer relationship management systems is limited (21% of firms), and Slovenia has been losing ground in the adoption of advanced data analytics, and AI-enabled process automation – areas in which competitors have advanced rapidly. Without faster progress in these domains, the economy’s ability to move up the value

**Figure 5: Structure of business investment, 2025**



The Slovenian business sector still prioritises tangible investment, while underinvesting markedly in intangibles. Source: SURS (2026), Eurostat (2026), EUROPOP2023 population projection (March 2023).

chain, build differentiated offerings, and sustain competitiveness under demographic and cost pressures will remain constrained.

The deepest challenge (“the ugly”) is thus not technological adoption per se, but the transformation capacity of firms and institutions. While investment and uptake in some digital technologies have recently begun to improve, they are doing so from a low base and remain uneven across firm sizes. More critically, Slovenia appears to underinvest in the intangible complements that make digitalisation economically effective—particularly organisational capital (e.g., redesigning processes, strengthening management practices, and organisational innovation) and skills development. This is consistent with evidence that Slovenian firms lag behind most EU peer groups in investment in employee training and in improvements to organisational and business processes, both of which are essential for translating technology into higher customer value and productivity. The binding constraint is therefore less the availability of individual tools and more the ability to embed them in coherent strategies, upgraded workflows, data governance, and organisational cultures that support experimentation and learning.

This transformation is objectively difficult. It requires coordinated investment under uncertainty, capabilities that take time to build (managerial and workforce), and a willingness to reallocate resources away from legacy activities – often in the face of short-term costs and organisa-

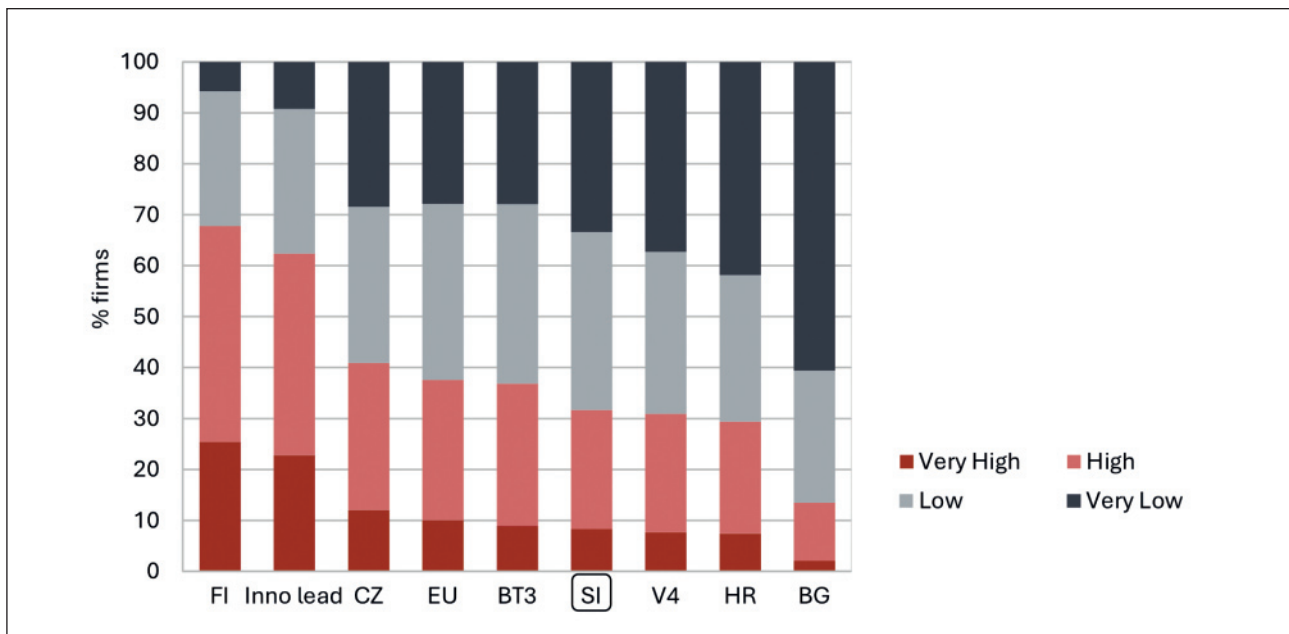
tional resistance. Yet without it, neither the microeconomic equation (firm-level competitiveness under rising labour costs and changing demand) nor the macroeconomic one (sustaining income growth and fiscal capacity in an ageing society) will hold. Strong market mechanisms and institutional settings that support experimentation, entry and scaling, and timely restructuring are therefore critical. Recent evidence for Slovenia indicates that within-sector reallocation between firms has contributed little to aggregate productivity growth, which is consistent with weaker allocative efficiency and slower diffusion of best practices. In a context of labour scarcity, there is also a risk that employment hoarding and broad-based support measures, if insufficiently targeted, further impede the movement of labour and capital towards more productive firms. Strengthening competitive pressure, improving insolvency and restructuring frameworks, and supporting worker transitions thus become integral parts of an innovation-driven growth strategy, rather than mere side conditions.

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**Figure 6: Firm digital intensity, 2025**



Slovenian firms’ digitalisation dynamics are lagging behind peers in the Visegrad and Baltic countries, while the gap to innovation leaders is widening further.

Source: SURS (2026), Eurostat (2026), EUROPOP2023 population projection (March 2023).

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# Slovenia caught between the routine and innovation: structural characteristics and the developmental position of the Slovenian economy

*Tjaša Redek\**

The paper analyses the structure and competitiveness of the Slovenian economy from the perspective of value-added structure, human resource factors, technological intensity of industries. Using official statistical data, register-based micro-data, and survey data, the text examines Slovenia's developmental position among the more developed EU countries, the role of knowledge-intensive human resources (ICT, R&D, and organisational professionals) in value-added creation. The results show that despite a relatively high share of manufacturing activities, the Slovenian economy achieves substantially lower value added per employee than more developed EU countries, indicating that restructuring towards higher value-added activities is slower than desired, and that insufficient investment in intangible capital and occupational restructuring are slow and represent barriers to a more decisive developmental breakthrough.

JEL J24, O33, O52

## 1. 1. Introduction

Since gaining independence in 1991, the Slovenian economy has been undergoing a continuous process of structural transformation. The transition from a planned to a market economy, accession to the European Union in 2004, and the adoption of the euro in 2007 were important milestones that shaped the economic structure as we know it today (see also Bole et al. (2023)). Over the past 15–20 years, and especially in the last decade, the Slovenian economy has been facing new challenges that include the need for a developmental breakthrough, alongside trends such as global digitalisation, climate transition, demographic change, and geopolitical power redistribution (Redek et al., 2019). All these changes require significant adjustments at both the firm level and the level of the institutional framework.

In international comparisons, Slovenia lags behind the EU average in terms of development, and particularly behind Germany and neighbouring Austria, which are frequently used as comparative benchmarks (Mramor et al., 2022). This gap is reflected both in value added per employee and in the structure of the economy, which remains overly dependent on medium- and low-technology-intensive manufacturing activities. At the same time, Slovenia faces acute labour shortages, workforce ageing, and insufficient investment in knowledge factors, all of which constrain its development potential.

The purpose of this article is to analyse the structural characteristics of the Slovenian economy with a particular emphasis on intangible, including human resource factors of productivity and competitiveness growth. To do so, the paper first discusses the performance determinants in theory, followed by a presentation of the situation in Slovenia in order to highlight some of the main challenges and strengths on the path towards developmental shift from routine to innovation-driven economy.

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## 2. Theoretical background:

### determinants of economic and firm performance

Firm performance in the economy is influenced by two broad groups of factors (Table 1): external factors, or the business environment, and firm-level factors. Internal firm factors comprise the volume and structure of capital, efficiency of resource allocation, labour availability, human capital structure and employee competencies, including their fit with the company needs, investment in training and lifelong learning, integration into international value chains, research, development and innovation, technological intensity, adoption of new technologies, digitalisation and artificial intelligence use. Many of the listed factors comprise intangible capital, a driver of productivity growth in modern, developed economies (Corrado *et al.*, 2018, 2022). However, firm performance depends not only on firms themselves but also on the quality of the broader economic, institutional, technological, and social environment in which they operate (Xu, 2011). These factors determine the broader conditions under which firms operate. Key external factors include the quality of the institutional environment, macroeconomic conditions, international trade, exchange rates and foreign direct investment, the technological environment, financial system development and access to capital, economic and development policy, demographic change, social and cultural characteristics, and natural endowments such as geographical location. Research systematically shows that business environment affects firms' behaviour, their revenue and employment growth (Farole *et al.*, 2017), innovation, productivity growth (Gogokhia and Berulava, 2021) and overall performance, including exports, where also an interplay between institutional environment and firm characteristics is important (Commander and Svejnar, 2011).

## 3. Productivity growth in Slovenia and an overview of selected productivity factors in Slovenia at firm level

Productivity at firm level relies on a number of factors, which together determine the performance of a company. In continuing, the discussion of Slovenian productivity determinants at firm level will first provide an overview of productivity differences at national and sector level, then firm level with an overview of selected performance determinants (intangible investment, human resources, new technologies and firm behaviour).

The analysis draws on multiple data sources, the main firm-level sources being: (1) AJPES firm level financial statements data, combined with (2) data on active population (DAK) database for the period January 2010 – December 2024, with nearly 150 million observations in total at monthly level, (3) a survey on skills and the use of artificial intelligence, conducted in August 2025 among 206 middle and upper management representatives in Slovenian firms, drawing on the Global Skills Taxonomy methodology (World Economic Forum, 2025) and the OECD questionnaire on AI adoption (Lane *et al.*, 2023), and (4) European Investment Bank Investment survey (European Investment Bank, 2026)).

### 3.1 Relative performance of Slovenian economy: a macro perspective

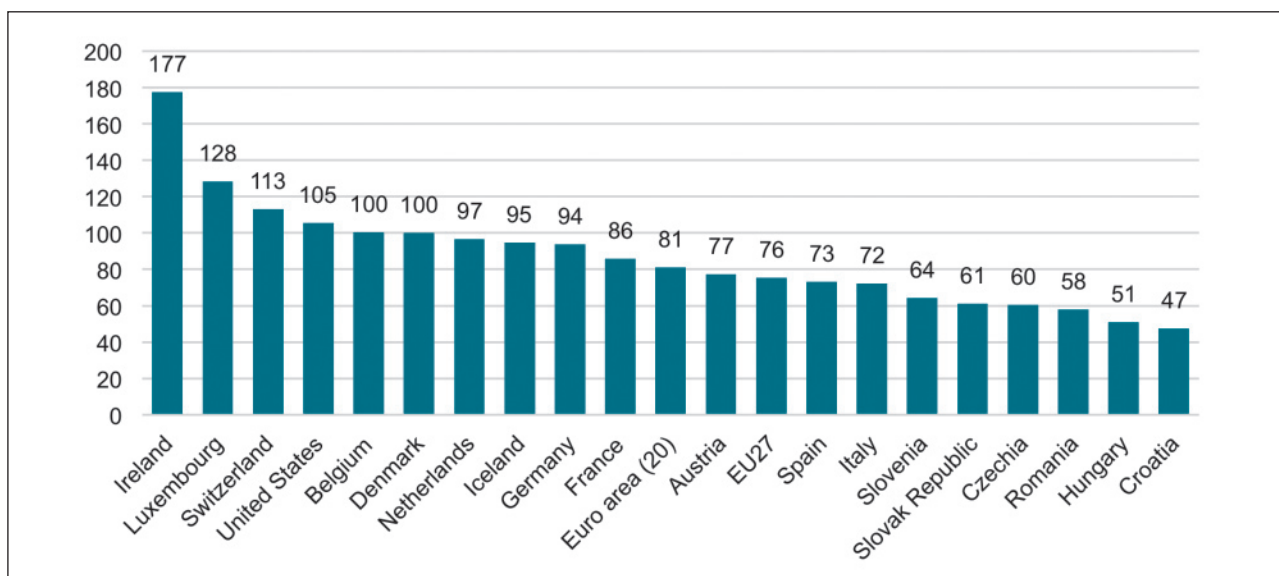
Figure 1 shows that Slovenia is placed in the lower middle part of the comparison in terms of gross value added per hour worked. Its productivity level is clearly below the EU average and also well behind more developed economies such as Austria, Germany, France, Denmark and the Netherlands. At the same time, Slovenia is still positioned slightly above some Central and Eastern European countries, including the Slovak Republic, Czechia, Poland,

**Table 1. Factors of economic and firm performance**

EXTERNAL (BUSINESS ENVIRONMENT)	FIRM-LEVEL FACTORS
Institutional environment	Volume and structure of capital
Macroeconomic environment	Resource allocation
International trade, exchange rates, FDI	Labour quantity, human capital, competencies
Technological environment	Training in an ageing society and lifelong learning
Financial system development and capital access	Integration into international business and GVCs
Economic and development policy	R&D & innovation
Demographic change	Technological intensity of the firm
Social, cultural and other variables	Industry 4.0 / new technologies / AI
Natural endowments (geographical location...)	Intangible capital
Other factors	Other factors

Source: (Redek *et al.*, 2019)

Figure 1. Gross value added per hour worked in US dollars per hour, PPP converted, Current prices, 2025



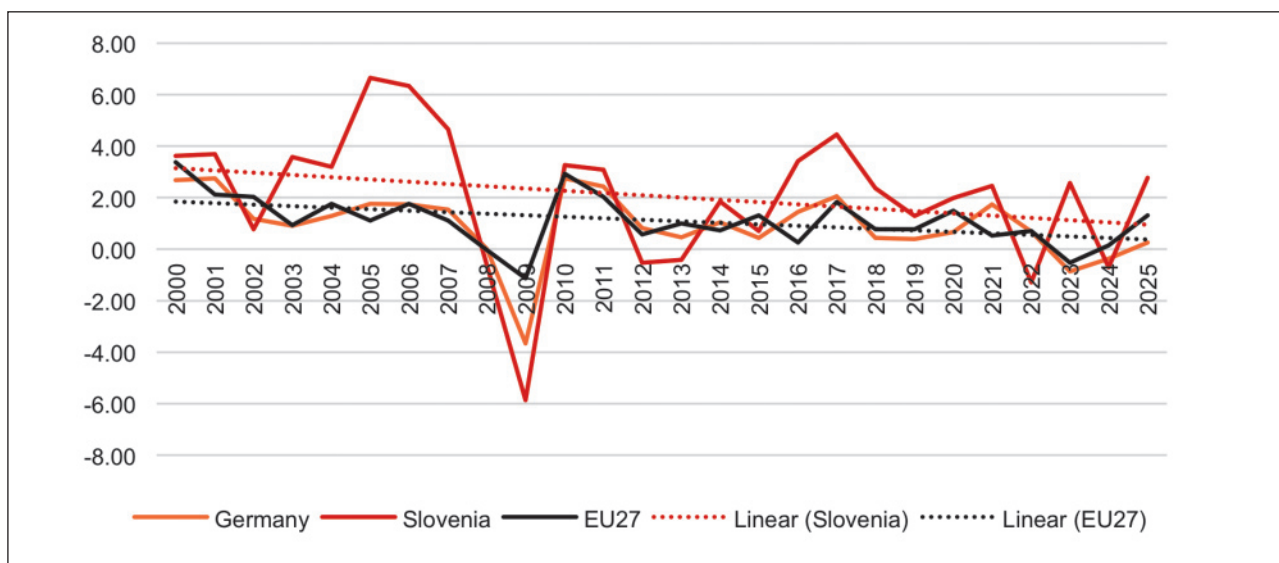
Data: (OECD, 2026)

Hungary and Croatia. This means that Slovenia is not at the bottom of the group, but it still has a visible productivity gap compared with the more advanced European economies. One of Slovenia’s key challenges is thus how to increase value added per hour worked, especially through higher productivity, more innovation, stronger technology use and better efficiency in companies.

Slovenia’s productivity growth was relatively strong in the pre-crisis period, especially compared with Germany and the EU27 (Figure 2), which indicates a process of catching up. During the global financial crisis, however, Slovenia experienced a much stronger fall than the EU27 and Germany (to which Slovenian productivity growth is also relatively well related as visible from the picture). Also, the

recovery after the crisis was slower and less even. In the years after the crisis, Slovenia again recorded several years of higher growth than the EU27, but this did not fully change the longer-term picture, as the trend remained weaker than in the early 2000s. After COVID-19, productivity growth in Slovenia improved again for some years, but this was not a stable acceleration. Slovenia had a stronger catching-up dynamic before the financial crisis, lost part of this momentum during and after the crisis, and after Covid due to external shocks, the growth remained unstable. However, the trend lines show a decline - possibly also because to achieve higher productivity growth, its growth focus must change from routine to more knowledge-driven growth.

Figure 2. Gross value added per hour worked in Slovenia, EU27 and Germany, % change over previous year



Data: (OECD, 2026)

Data for industries for 2024 (in current EUR, non-transformed prices, not in PPP) shows that Slovenia reaches roughly about half of Austrian and German gross value added per hour worked (not adjusted for PPP) in the economy as a whole, but the gap differs strongly by industry (Figure 3). The largest lag is in agriculture, especially compared with Germany, where Slovenia achieves only a small part of German productivity. Very large gaps are also visible in water supply and waste management, administrative and support services, arts and other services, and partly in professional, scientific and technical activities. In manufacturing, which is very important for Slovenia, productivity is still clearly below both Austria and Germany, showing that Slovenian industry remains more focused on lower value-added activities. The position is somewhat better in trade, transport, construction, and accommodation and food services, where Slovenia is closer to Austria and Germany, although still behind. The strongest relative position is in financial and insurance activities, where Slovenia is close to Austria and even above Germany.

### 3.2 Firm performance and structure

Analysis of AJPEs data for 42,000 companies with at least one employee for 2024 (excluding sole proprietors and cooperatives) shows considerable differences in value added per employee across groups of activities by technological intensity. High-technology-intensive manufacturing activities achieve an average value added of EUR 65,400

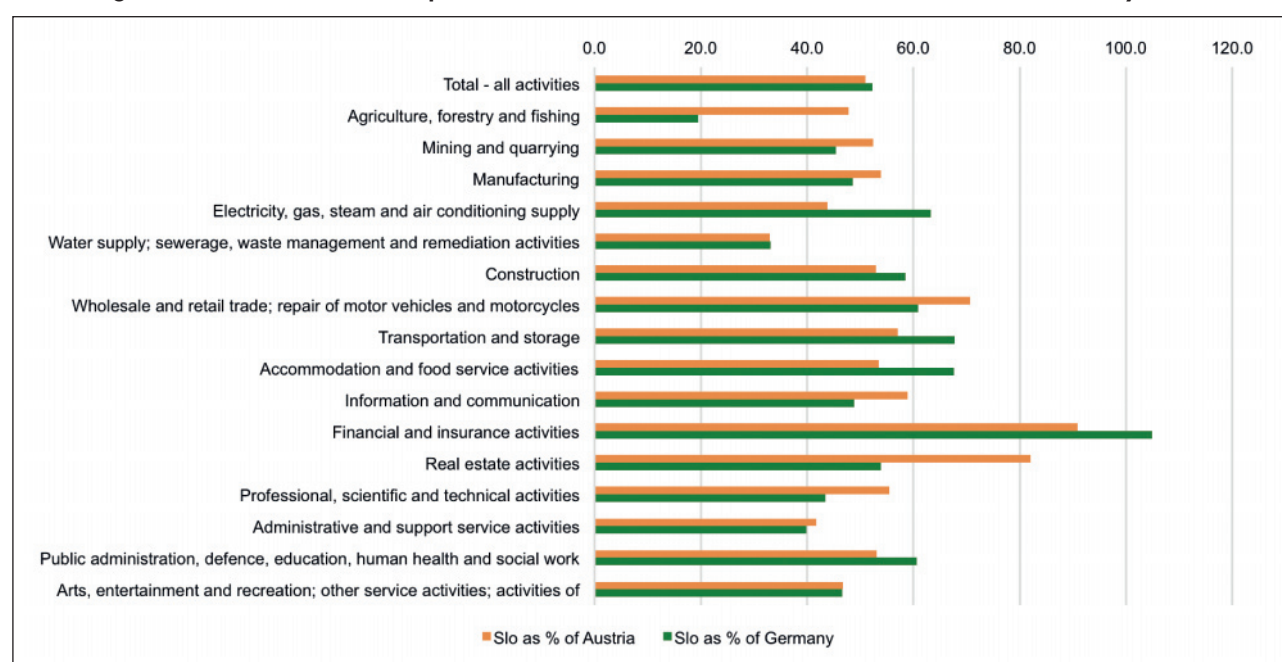
per employee, ICT services EUR 59,766, R&D services EUR 58,712, medium-high-technology manufacturing EUR 57,594, while other services achieve EUR 54,782 and other enterprises EUR 46,759. The lowest value added, at EUR 44,495 per employee, is achieved by low-technology-intensive manufacturing activities.

Particularly interesting is the within-industry productivity dispersion or the gap between the average firm and the firm at the 90th percentile within the same industry. In manufacturing, the frontier firm generates 1.3 to 2 times more value added with the same inputs than the average firm. In services, this ratio is substantially larger, ranging from 1.5 to 3.5 times, with pronounced spikes in sectors with few firms. This within-industry dispersion also highlights considerable reserves for productivity growth within sectors: productivity growth does not depend solely on shifting towards higher-technology industries but also on raising productivity within existing industries.

The value added in the whole economy is connected with the large weight of activities with only moderate or low productivity in the economy (table 2). Data presents only the companies with at least 1 employee and excludes sole proprietors and cooperatives.

High-tech companies have the highest value added per employee, and also the highest p90 value, which means that the best firms in this group reach much higher productivity levels. However, this group is very small. Medium-high-tech firms also perform relatively well, but they are still limited in

Figure 3. Gross value added per hour worked in Slovenia relative to Austria and Germany, in % \*



\* (calculation based on EUR data by industry, not adjusted for PPP)  
Data: (OECD, 2026)

**Table 2. Value added per employee by activity groups according to technological intensity (2024): mean and 90<sup>th</sup> percentile**

	Value added per employee		Number of companies	Employees (Number)
	Average	p90		
High-tech	65,4	114,824	193	19,267
Medium-high-tech	57,594	92,906	906	58,739
Medium-low-tech	51,037	81,732	3,246	71,044
Low-tech	44,495	71,829	2,227	43,163
Knowledge-intensive services	56,177	93,867	5,601	50,474
ICT services	59,766	103,208	1,86	17,868
R&D services	58,712	100,531	2,594	16,763
Management services	56,155	107,288	1,842	7,51
Other services	54,782	95,793	16,596	177,448
Other companies	46,759	74,812	6,677	73,755

\* The classification is based on two-digit NACE Rev. 2 codes and follows (Bloch et al., 2021). High-tech manufacturing includes NACE 21 and 26; medium-high-tech manufacturing includes NACE 20 and 27–30; medium-low-tech manufacturing includes NACE 19, 22–25 and 33; and low-tech manufacturing includes NACE 10–18 and 31–32. Knowledge-intensive services include NACE 50–51, 58–66, 69–75, 78, 80 and 84–93. Within these, ICT services are NACE 62–63, R&D services are NACE 71–72, and management services are NACE 70. Other services refer to less knowledge-intensive services, including NACE 45–47, 49, 52–53, 55–56, 68, 77, 79, 81–82 and 94–99. Other companies include all remaining activities not classified in the above categories. \*\* Includes 42 thousand companies with at least one employee. Outliers (49) and companies with negative value added (1,200) were excluded from the industry breakdown and group analysis. Sole proprietors and cooperatives are excluded. Value added is calculated according to the AJ PES definition/methodology. Data: AJ PES, 2024, own calculation.

size compared with the whole economy. On the other hand, low-tech manufacturing and other companies have much lower value added per employee, which pulls down the overall performance. Other services represent by far the largest number of companies and employees, while other companies and low-tech activities also employ many people. At the same time, the most productive groups, such as high-tech, ICT, R&D and management services, are still too small to strongly lift the average of the whole economy. There are also important differences within groups. In almost all categories, the p90 value is much higher than the average, which shows that even inside the same technological or service group there are some much more productive firms. This suggests that the problem is not only the sectoral structure, but also the large gap between leading firms and the rest of firms within the same group. Therefore, the key challenge is not only to increase productivity in low- and medium-value activities, but also to expand the share of more knowledge-intensive, technological and innovative firms in employment and business activity.

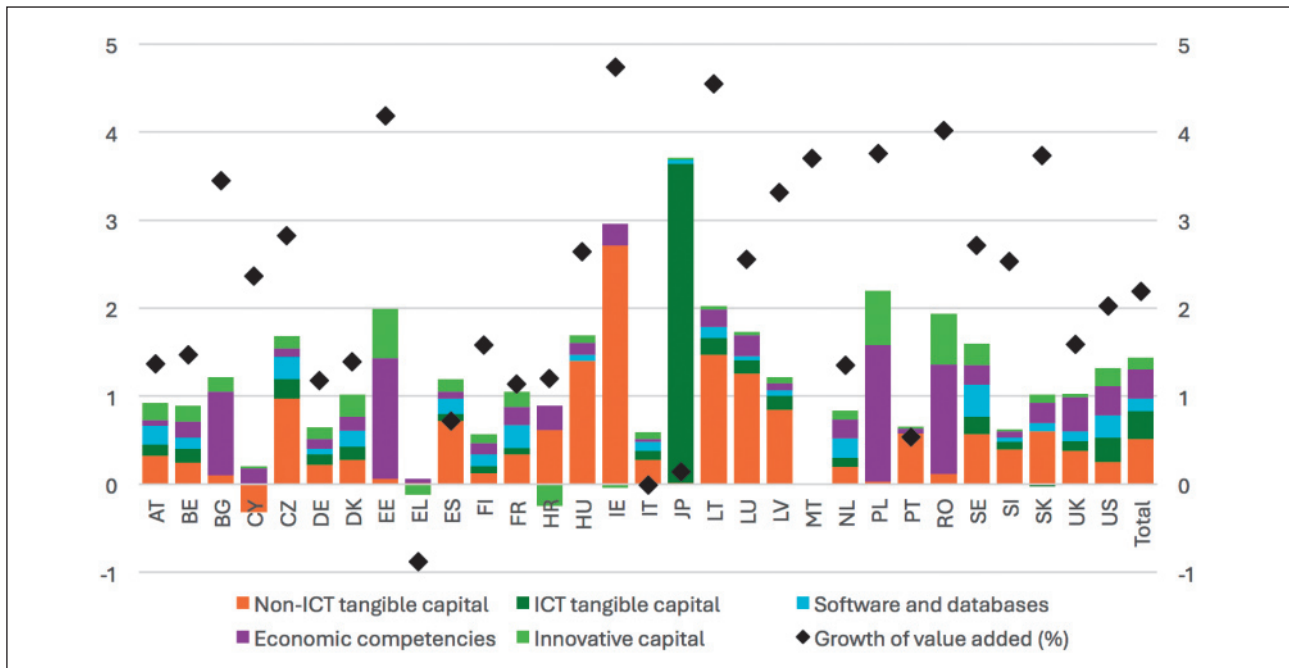
### 3.3 Contributions to growth: Insufficient reliance on knowledge-driven factors

International comparison of contributions of individual factors to aggregate value-added growth between 2000 and 2020 reveals that an insufficient share of growth in Slovenia originates from knowledge factors (Figure 4). Slovenia

records relatively solid growth of value added, however, the contribution of intangible components is rather modest. Non-ICT tangible capital contributes somewhat to growth, but less than in many catching-up economies, while the contribution of ICT capital, software and databases, economic competencies and innovative capital is very low. This suggests that Slovenia's value-added growth is not sufficiently based on digitalisation, intangible investment, innovation and organisational capabilities. The data points that the quality and sources of growth do not contribute strongly enough to long-term productivity upgrading.

The most recent data for the structure of investment expenditure (European Investment Bank, 2026) shows that the trends have not changed and Slovenian economy still invests a relatively small share of total investment into intangible assets compared with most advanced and EU countries (Figure 5). Slovenia is clearly below the EU average and far behind countries such as Ireland, Belgium, Finland, Denmark, Sweden, Austria and Germany, where investment is more oriented toward knowledge, software, organisation, training and R&D. Slovenian firms still invest a very large share into machinery and equipment, which shows a more traditional, physical-capital-based investment structure. While such investment focus can support production capacity, but it is less sufficient for faster productivity growth and higher value added. There are some differences by company size and sector (but unfortunately data

Figure 4. The contribution of selected productivity growth factors to growth of value added between 2000 and 2020 (in percentage points, VA growth in %)

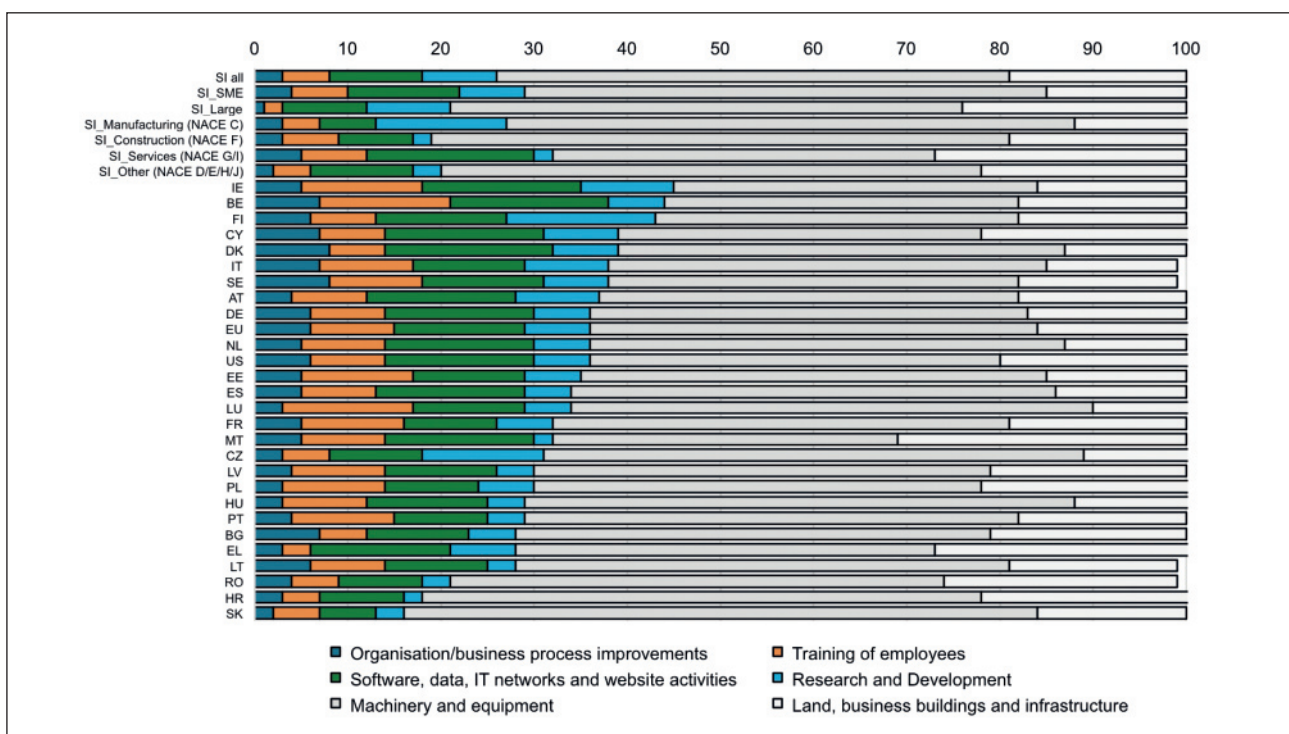


Data: (Lab of European Economics, 2025)

does not allow detailed analysis). On average, SMEs invest a higher share into intangibles than large companies, services have the highest intangible investment share, mainly because of stronger investment in software, data and IT-related activities and manufacturing has a relatively strong

R&D component, but it is still very strongly oriented toward machinery and equipment. In order to achieve a shift in the value added and improve the ability of firms to move toward higher productivity and more knowledge-intensive value creation, this investment structure should change.

Figure 5. Investment structure: share of all total investment, invested into a specific asset type (in % of total investment)\*



\* Due to rounding up, the sum of shares may deviate from 100%. (European Investment Bank, 2026)

Besides the structure of the economy, which is more heavily focused on lower value-added activities, the investment structure as well as the employment structure reflects this structural characteristic. Figure 6 depicts the between the share of experts and value added per employee and highlights the importance of knowledge for high value added, which is confirmed also in the literature (Piekkola *et al.*, 2025) for Slovenia, while higher routines of tasks has been shown to be negatively related to firm performance if measured by value added (Redek in Redek *et al.*, 2025). Activities with a higher concentration of experts, especially ICT, management and high-tech manufacturing, achieve the highest value added per employee. Low-tech and medium-low-tech manufacturing have both lower shares of experts and lower value added per employee, which indicates that activities relying less on skilled labour and knowledge tend to generate lower productivity.

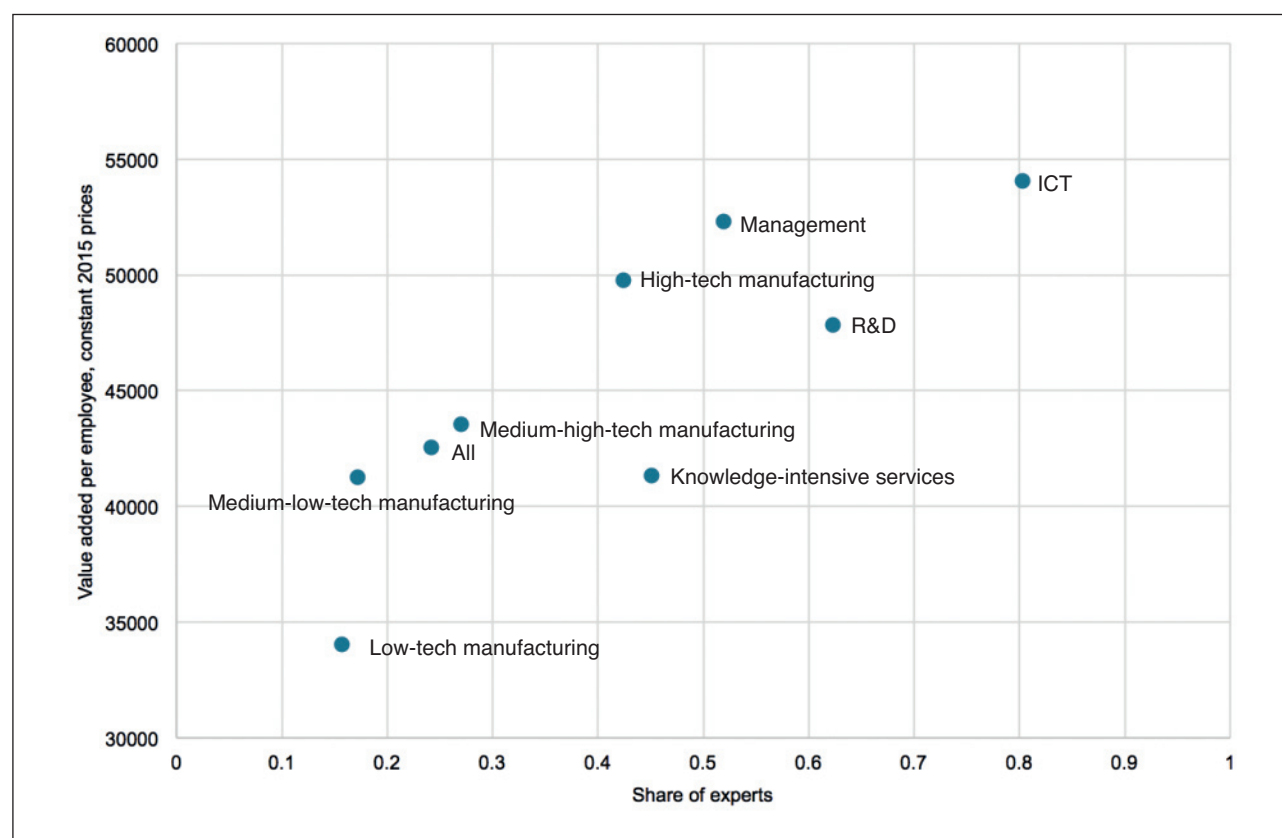
### 3.4 The labour market dynamics and structural change

The number of economically active persons increased from 887 thousand in 2010 to 1,010 thousand in 2024.

Employment growth was fastest in ICT services (109%), R&D services (24%), and management services (56%). Among manufacturing activities, the strongest gains were in medium-high-technology industries (from 42 to 60 thousand) and high-technology industries (21%) (Data: Statistical office of Slovenia, own calculation). On the other hand, in low-tech manufacturing the employment even slightly declined. But despite high relative growth in high-value-added activities, the restructuring was not strong, the lower value-added activities still employ a proportionally small share of all workers, the majority being concentrated in low and medium-low tech manufacturing and other services (not knowledge intense).

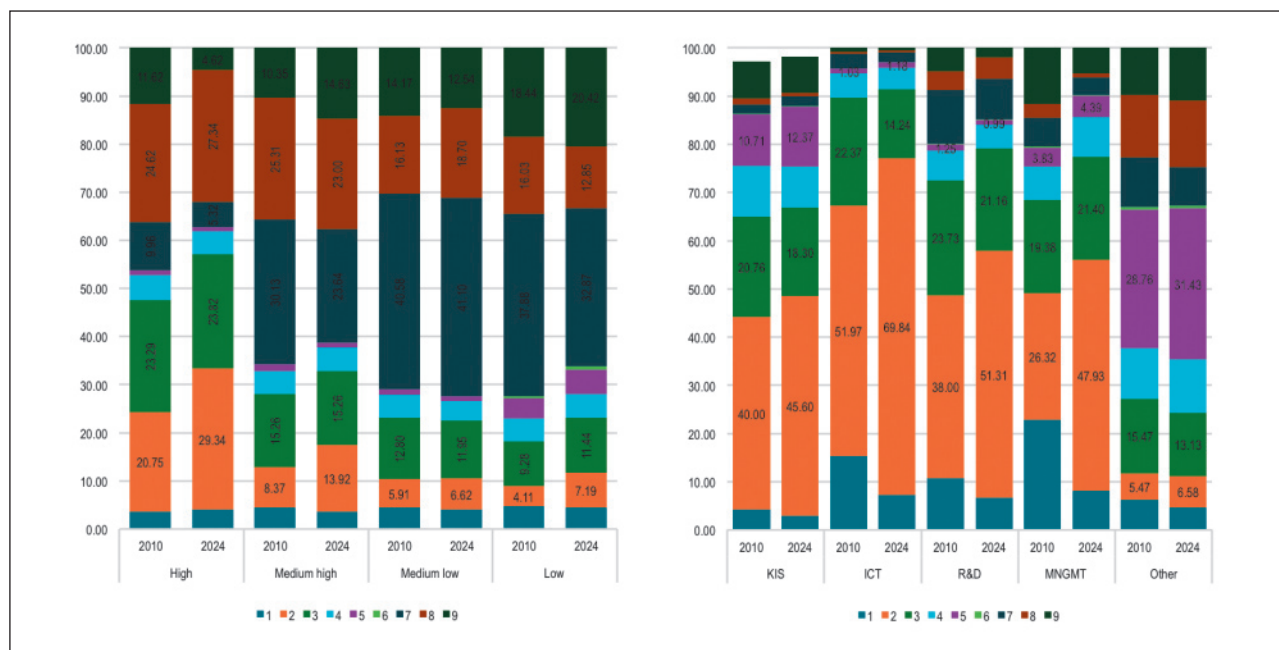
The data also reveals occupational restructuring 2010 and 2024 (Figure 7). The share of more knowledge-intensive occupations increased mainly in high-tech manufacturing and in advanced services, especially ICT and management-related activities. However, in many manufacturing groups the structure remains strongly production-based, and in other services the occupational mix is still heavily focused on occupations with lower required skill sets with their share (and in absolute number) even increasing for example in medium low tech-intense manufacturing, which

**Figure 6. Value added per employee and the share of employed experts (ICT, organisational and R&D and other high educated) by groups**



Data: Statistical office of Slovenia, own calculation. Prepared within V5-24020.

**Figure 7. Share of broad occupational groups (ISCO1-ISCO9) by industry (manufacturing left panel, services right panel) by technology and knowledge intensity in 2010 and 2024**



Data: Statistical office of Slovenia, own calculation. Prepared within V5-24020.

between 2010 and 2024 also increased the number of active by 25% (from 66 to 83 thousand).

Foreign workers have become a structural factor in the Slovenian economy. The share of foreign nationals among the economically active reached 17% by 2024, representing over 148,000 individuals, of whom nearly 130,000 come from countries outside the European Union. Industry-level analysis shows that the share of foreign workers is more pronounced in activities with lower value added (Data: Statistical office of Slovenia, own calculation) and in occupations requiring low and lower qualifications, primarily groups of occupations ISCO 7-ISCO9. This dynamic raises the question of how the economy is maintaining cost competitiveness and what is the role of automation, new technologies and innovation.

### 3.5 Digitalisation

Compared with the EU27, Germany and Austria, Slovenia still has a larger share of firms in the very low and low digital intensity categories and a smaller share in the high and very high categories. Overall, as Eurostat data shows, Slovenia improved between 2021 and 2025, but it still lags behind the EU27, Germany and Austria in the overall distribution of digital intensity. The share of companies with very low digital intensity decreased noticeably by 2025, which is a positive sign and the share of firms with high and very high digital intensity also increased. However, this shift was weaker than in the EU27, Germany

and Austria, especially at the top end of the distribution. The data (Table 3) show data by industry and show that Slovenia has a mixed position in digital intensity of enterprises (companies with at least 10 employees are included in the survey). In manufacturing as a whole, Slovenia is clearly below the EU average and also behind Austria and Germany, which points to a weaker digital base in an important part of the economy. The gap is especially visible in more traditional manufacturing branches, such as food, wood and paper, metals, machinery and furniture-related activities. However, Slovenia performs well in some more advanced or specific sectors, for example computer, electronic and optical products, electrical equipment, and some chemical-related industries, where the distance to Austria, Germany and the EU is much smaller.

In services, digitalisation is strong in trade, accommodation and food services, information and communication, telecommunications, computer programming, and some professional and R&D activities. In several of these sectors, Slovenian firms are close to or even above the EU, Austrian and German levels. The weakest service-related results are in construction, transport, and administrative and support services. Overall, digital intensity is quite uneven across sectors and to increase productivity it will be important to raise digitalisation in traditional manufacturing, construction and support services, because these activities employ many people and have an important impact on productivity and value added in the whole economy.

**Table 3. Share of companies (with at least 10 employees) and at least basic digital intensity**

GEO (Labels)		EU27	DE	AT	SI
C	Manufacturing	71.77	76.73	74.90	62.79
C10-C12	Manufacture of food products beverages and tobacco products	60.91	62.56	63.77	49.24
C13-C15	Manufacture of textiles, wearing apparel, leather and related products	61.82	77.82	:	75.51
C16-C18	Manufacture of wood, paper, printing and reproduction	69.81	77.07	:	45.91
C19-C23	Manufacture of coke, refined petroleum, chemical and basic pharmaceutical products, rubber and plastics, other non-metallic mineral products	78.45	81.33	78.76	76.84
C22_C23	Manufacture of rubber and plastic products and other non-metallic mineral products	74.66	77.53	:	70.53
C24_C25	Manufacture of basic metals and fabricated metal products, except machinery and equipment	70.84	74.25	76.17	57.68
C26	Manufacture of computer, electronic and optical products	91.41	91.72	93.75	88.09
C27	Manufacture of electrical equipment	83.53	85.41	88.39	85.87
C28	Manufacture of machinery and equipment n.e.c.	84.72	84.45	88.70	66.73
C29_C30	Manufacture of motor vehicles, trailers, semi-trailers and of other transport equipment	79.92	82.97	86.32	74.70
C31-C33	Manufacture of furniture jewellery, musical instruments, toys repair and installation of machinery and equipment	72.28	77.74	74.38	60.44
D	Electricity, gas, steam and air conditioning supply	88.37	95.63	:	100.00
E	Water supply sewerage, waste management and remediation activities	73.83	72.04	:	68.38
F	Construction	58.59	60.91	57.82	35.26
G	Wholesale and retail trade repair of motor vehicles and motorcycles	78.46	83.19	79.57	92.39
H	Transportation and storage	59.15	56.44	57.69	53.71
I	Accommodation and food service activities	65.38	62.47	72.83	73.89
J	Information and communication	95.43	98.22	99.21	96.81
J58-J60	Publishing, motion picture, video, television programme production sound recording, programming and broadcasting activities	94.30	97.83	96.13	92.08
J61	Telecommunications	90.75	95.18	100.00	100.00
J62_J63	Computer programming, consultancy, and information service activities	96.04	98.42	99.88	97.83
L	Real estate activities	80.41	87.05	82.21	:
M	Professional, scientific and technical activities	88.34	88.24	84.28	83.04
M69-M71	Legal and accounting activities ....	87.88	87.40	82.18	75.32
M72	Scientific research and development	94.22	91.81	96.02	100.00
M73-M75	Advertising and market research other professional, scientific and technical activities veterinary activities	88.74	91.82	90.94	100.00
N	Administrative and support service activities	67.53	65.90	69.95	58.93

Data: (Eurostat, 2025).

Data show that with regards to digitalisation, Slovenia is strong in terms of large companies, while SMEs lag behind.

Survey among Slovenian firms confirms that more digitally intensive firms are also more successful in business: they achieve higher innovativeness, higher productivity, and more collaboration with top performers (Redek in Redek et

al., 2025). These results are consistent with McKinsey's (2024) findings that leading firms in digitalisation and AI have two to six times higher annual growth rates. However, successful digital transformation requires comprehensiveness and complementarity: success does not originate from technology alone but from the combination and integration of technology, data, people, and processes. In Slovenia,

half of all firms still consider digital transformation non-essential for their business, while 41% of firms cite a lack of appropriate human resources and knowledge as the key barrier (Redek in Redek *et al.*, 2025).

Artificial intelligence is a major technological development. Survey results among Slovenian firms show that firms expect predominantly positive effects of AI: an increase in complex tasks, a reduction in routine tasks, increased employee satisfaction, and higher productivity. Expected negative effects are mild, with non-users of AI being more afraid of workforce reductions than those already using it. Increased demand for various types of professionals is anticipated, while expected negative effects on employment are markedly mild (Redek in Redek *et al.*, 2025). These results are not surprising over the short run due to the lack of available workers.

But new technologies are expected to change also skills demand. A survey among 206 Slovenian management representatives based on the Global Skills Taxonomy (World Economic Forum, 2025c) reveals that the greatest future increases in demand are expected for technological and soft skills (Redek in Redek *et al.*, 2025). In manufacturing, the most prominent skills include technological knowledge and skills, cyber and application security, digital marketing, adaptability to change, quality assurance, and collaboration and productivity software. In services, customer services, customer relationship management, and stress management are also highlighted alongside technological skills. Across all occupational groups, from managers and professionals to production workers, an increase in demand for technical knowledge is expected. At the same time, the importance of motivation, work habits, leadership competencies, and socially responsible behaviour is also growing, indicating that the future cannot be built solely on technical skills but requires a comprehensive approach to competence development.

#### 4. External determinants of productivity growth: business environment and competitiveness in Slovenia

Business environment, which is an important determinant of business performance (Table 4) could also be improved. The IMD World Competitiveness Ranking put Slovenia at the 46th place out of 69 countries in 2025 (IMD, 2025a) – a deterioration relative to the period between 2021 and 2023, when Slovenia was ranked even at the 38th place (IMD, 2025a). The main areas of underperformance include international investment, tax policy, the labour market, corporate financing, management practices, attitudes towards change/values, and the efficiency of public services and administrative burdens (Table 2). The IMD identifies the following key challenges: raising GDP and productivity, stimulating private investment, pension and healthcare reform, labour and talent shortages, and more venture and private capital for innovative firms (IMD, 2025b). On the other hand, international trade, price stability, the social framework, education, health and environment, and quality of life are some of the main strengths of Slovenian business environment (Table 2). Slovenian government also highlights quality of life, international trade, high-tech exports, and environmental sustainability (Republic of Slovenia, 2025).

In the IMD World Digital Competitiveness Ranking 2025, the picture is better than for overall competitiveness but still warrants concern: Slovenia ranks 41st (among 69 economies, Table 3), same as in 2024 but lower than in 2021 when it was 35th (IMD, 2025c). This gradual decline is primarily a consequence of faster progress of other economies in translating digital potential into economic outcomes. Slovenia in general performs best in the knowledge pillar, particularly in education, science/technology graduates, tertiary teacher-student ratios, and AI publications. But it is weaker in technology, especially regulatory frame-

**Table 4. IMD World Competitiveness Ranking 2025 of Slovenia by sub-factors**

Pillar	Sub-factor	Rank
Economic performance	Domestic economy	48
	International trade	10
	International investment	58
	Employment	41
	Prices	17
Government efficiency	Public finance	45
	Tax policy	57
	Institutional framework	45
	Business legislation	51
	Societal framework	20

Pillar	Sub-factor	Rank
Business efficiency	Productivity & efficiency	36
	Labour market	61
	Finance	43
	Management practices	52
	Attitudes & values	64
	Infrastructure	55
Infrastructure	Basic infrastructure	55
	Technological infrastructure	47
	Scientific infrastructure	34
	Health & environment	30
	Education	26

Source: (IMD, 2025b, 2025b)

**Table 5. IMD Digital Competitiveness Ranking 2025 of Slovenia by sub-factors**

Factor	Sub-factor	2021	2022	2023	2024	2025
Knowledge	Talent	37	38	39	42	39
	Training & education	23	18	13	19	26
	Scientific concentration	31	28	29	27	27
Technology	Regulatory framework	45	43	48	55	47
	Capital	39	38	38	49	44
	Technological framework	33	35	41	37	40
Future readiness	Adaptive attitudes	41	45	38	50	54
	Business agility	40	33	39	48	47
	IT integration	35	37	38	46	51
Overall	Overall	35	37	37	41	41

Source: (IMD, 2025c)

work. Overall, the rankings are lowest in the future readiness, where low scores stand out in attracting highly skilled foreign talent, attitudes towards globalisation, adaptability, public-private partnerships, and national cyber capacity (Table 5).

These weaknesses coincide with the results at the firm level that represent obstacles to future growth. It is also a relevant policy challenge, since the country invests in education, however (also firm level data, as presented later) show insufficient translation from knowledge to application, which is highlighted also in the EC's Digital decade report for Slovenia (European Commission, 2025), which recommends increased use of advanced technologies, stronger alignment of higher education curricula with digital needs, and more effective collaboration between industry, universities, and the public sector.

### 5. Discussion and conclusion

Slovenia is on the path from routine-based economy, but it has not yet fully moved into an innovation- and knowledge-based growth model. Its productivity level remains clearly below that of more advanced EU economies, especially Austria and Germany, while productivity growth has lost part of the catching-up momentum that was visible before the global financial crisis. Its development gap is not only cyclical or temporary, but structural. The economy still contains a large share of activities with moderate or low value added, while high-technology manufacturing, ICT, R&D and management-related services, although more productive, remain too small to substantially lift aggregate productivity.

Besides the sectoral structure, also the large productivity dispersion within sectors represent a challenge. The gap between average firms and the best-performing firms within

the same activity group shows that there are considerable reserves for productivity growth even without a complete sectoral shift. This is especially relevant for Slovenia, where many workers are still employed in medium-low technology manufacturing, low-technology manufacturing and less knowledge-intensive services. Therefore, the development challenge should not be understood only as a need to create more high-tech firms, but primarily as a need to upgrade existing firms, including traditional sectors, where the vast majority of employment lies.

The results also confirm the importance of knowledge-intensive human resources for value added creation. Activities with a higher share of experts, such as ICT, R&D, management services and high-tech manufacturing, tend to achieve higher value added per employee. However, occupational restructuring between 2010 and 2024 has been relatively uneven. More knowledge-intensive occupations increased mainly in advanced services and high-tech manufacturing, while many manufacturing and service activities still rely heavily on routine and lower-skilled occupations. This limits the speed of productivity upgrading and makes the economy more dependent on extensive growth, labour availability and cost competitiveness rather than on innovation, digitalisation and organisational capabilities.

A particularly important issue is the role of labour shortages and foreign workers. The inflow of foreign workers has become a structural feature of the Slovenian labour market, but foreign workers are more concentrated in lower value-added activities and lower-skilled occupations. This helps firms solve immediate labour shortages, but it may also reduce pressure for automation, organisational change and movement toward higher value-added activities. In this sense, Slovenia risks remaining in a "human resource trap": labour shortages are solved by adding labour to existing

business models, while the underlying structure of production changes too slowly. This is especially problematic in an ageing society, where long-term growth cannot rely primarily on employment expansion.

The evidence on investment structure further supports this proposition. Slovenian firms still invest relatively more in machinery and equipment and less in intangible assets such as software, data, organisational improvements, training, economic competencies and innovative capital. Tangible investment remains important, especially in manufacturing, however in advanced economies productivity growth increasingly depends on complementarities between technology, skills, data, organisation and innovation. Slovenia's relatively low investment in intangibles therefore limits the ability of firms to transform new technologies into higher productivity. This is also visible in digitalisation: although Slovenia has improved and performs well in some sectors, especially ICT, telecommunications, R&D and some professional services, digital intensity remains uneven and weaker in traditional manufacturing, construction, transport and administrative services.

Digitalisation and artificial intelligence therefore represent both an opportunity and a challenge. On the one hand, more digitally intensive firms are more innovative and productive, and firms generally expect positive effects from AI, especially higher productivity, fewer routine tasks and more complex work. On the other hand, many firms still do not see digital transformation as essential, and a lack of appropriate knowledge and human resources remains one of the main barriers. This means that technology adoption cannot be treated as a purely technical process. It requires changes in business models, work organisation, management practices and skills. The key issue is not only whether firms buy digital tools, but whether they are able to use them to change how value is created.

The external business environment partly reinforces these firm-level weaknesses. Slovenia's IMD competitiveness position shows strengths in areas such as international trade, education, health, environment and quality of life, but weaknesses in labour market functioning, tax policy, international investment, management practices, finance and attitudes toward change. Similarly, in digital competitiveness Slovenia performs relatively better in knowledge, but worse in technology and future readiness. This points to a broader problem of translating knowledge and education into business transformation, innovation, faster firm growth and higher value added. Slovenia has important development assets, but they are not used sufficiently effectively. The results therefore suggest that Slovenia's transition from routine-based to innovation-driven growth requires a com-

bined approach. Structural change toward more knowledge-intensive activities is necessary, but it is not sufficient. Equally important is the upgrading of existing firms. This means stronger investment in intangible capital, faster digital transformation, better management practices, more systematic lifelong learning, stronger cooperation between firms, universities and public institutions, and a business environment that supports experimentation, growth and innovation. Without these changes, Slovenia may continue to achieve moderate growth, but it will find it difficult to close the productivity gap with the most advanced European countries.

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# Deep Tech and competitiveness: Structural drivers and constraints in Slovenia's innovation ecosystem

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**This study synthesises findings from four sectoral analyses of Slovenia's deep tech, bio-tech, green-tech, and space-tech ecosystems, based on 58 semi-structured interviews with firms, investors, research institutions, and public stakeholders. While Slovenia benefits from a strong scientific base and EU integration, a critical financing gap persists in mid-development stages, marked by insufficient patient capital, limited venture debt, weak risk-sharing instruments, slow decision cycles and inflexibility in available public instruments. Further constraints include fragmented innovation lending regulation, poor commercialisation mechanisms, limited shared research infrastructure, and talent shortages. Without coordinated reforms in financing, governance, and technology transfer, Slovenia's high-technology sectors risk remaining peripheral in global value chains and failing to scale into high-value innovation hubs.**

JEL O32, O33, G32

## 1. Introduction

Small open economies face structurally distinctive challenges in high-technology development. While their scientific capabilities may be internationally competitive, the domestic conditions needed to translate research results into scalable, commercially viable ventures are often absent or insufficiently developed. A limited domestic market, scarce availability of risk and patient capital (including venture debt), thin institutional ecosystems for technology and finance, and restricted access to global distribution channels constrain the growth trajectories of knowledge-intensive firms. These constraints are especially acute in deep technology sectors - defined as ventures built on fundamental scientific or engineering breakthroughs and characterised by long development cycles, high capital intensity, and transformative industrial potential (MIT REAP, 2022; European Commission, 2025). For banks and other financial intermediaries, deep-tech financing poses a severe information asymmetry problem: the absence of tangible

collateral, long pre-revenue periods, and high technological uncertainty make conventional credit risk models inadequate (Kerr et al, 2014)

Over the past two decades, Slovenia's economic model has relied heavily on investment-driven productivity growth, but this dynamic has weakened since the global financial crisis (Banka Slovenije, 2025). R&D investment has grown modestly, yet a persistent gap between scientific output and commercial outcomes remains. Slovenia ranks above the EU average on several innovation input indicators particularly human resources and research system attractiveness, but consistently underperforms on venture capital formation and broader commercialisation of knowledge assets (European Commission: Directorate-General for Research and Innovation, 2025)<sup>1</sup>. Its ability to attract and retain deep tech firms is constrained by fragmented policy governance, limited patient capital, and institutional structures that do not

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<sup>1</sup> Slovenia's innovation performance has been improving; the European Innovation Scoreboard 2025 placed Slovenia second of the "Moderate Innovators" group with a summary innovation index of 94.7% of the EU average, up by 3.4 percentage points from 2024 and 16.8 percentage points from 2018 - an above average improvement - and ranking 13th among EU member states (European Commission: Directorate-General for Research and Innovation, 2025).

adequately reward entrepreneurial risk-taking in science-based ventures. From financial perspective, this translates into a missing middle: commercial banks avoid lending at Technology Readiness Levels (TRL) 4–6 due to high perceived risk and lack of credit enhancement mechanisms, while venture capital is too equity-focused and often unavailable at scale.

The importance of addressing these constraints is growing not only for Slovenia but also for the EU. European strategic documents, including the Draghi Report on competitiveness and the European Innovation Council's deep tech agenda, identify the commercialisation of breakthrough technologies as central to restoring EU economic dynamism (European Commission, 2024). For small Member States as Slovenia, the stakes are high. Without active ecosystem development (including bank-based patient capital instruments, public credit guarantees, and hybrid equity-debt products), high-technology sectors risk remaining peripheral within European and global value chains, supplying R&D inputs<sup>2</sup> and niche components to larger economies while failing to capture the value added from their own scientific investment.

This paper responds to these dynamics by synthesising evidence from four sectoral analyses of Slovenia's emerging high-technology ecosystems - deep tech (broadly defined), biotechnology, space technology, and green technology<sup>3</sup> - previously published in the monograph *Exploring the Growth Potential of Deep tech and Other Emerging Technologies in Slovenia* (Domadenik Muren et al., 2025a, Domadenik Muren et al., 2025b, Koman et al., 2025, Farčnik et al., 2025, Končan et al., 2025). Drawing on a multi-method research design that combines a systematic literature review, secondary data analysis, and 58 semi-structured interviews with 55 stakeholders (including firms, investors, financial intermediaries, research institutions, technology transfer offices, and public agencies) that took place in August and September 2025, the study identifies cross-cutting structural patterns, common bottlenecks, and sector-differentiated dynamics shaping Slovenia's high-

technology potential. The design was chosen to situate Slovenia's high-technology ecosystems within their international and theoretical context while generating detailed empirical insight into actor-level experiences, perceptions, and strategic responses. A qualitative approach was prioritised for the primary empirical layer given the exploratory and interpretive nature of the research questions, which concern not only observable outcomes but also the underlying mechanisms, constraints, and reasoning processes that shape ecosystem dynamics (Corbin & Strauss, 2008). This paper aims to advance the empirical understanding of innovation ecosystems in small open economies – a context that has received less systematic attention than large-economy cases – with particular focus on the financing gap at TRL 4–6 and the structural reasons it persists. It further aims to provide a cross-sectoral comparative analysis across deep technology sectors that surfaces structural constraints rather than sector-specific anomalies. Finally, it seeks to develop actionable policy recommendations addressing the governance, financing, and institutional reform dimensions most relevant to a small EU member state.

Several limitations should be acknowledged. The synthesis relies on sectoral analyses conducted by different research teams. Data were collected in a relatively short period of time, which led to minor deviations from the intended optimal sample structure and methodological framework. The qualitative emphasis provides depth of insight into mechanisms and actor perspectives but limits generalisability in the statistical sense.

The paper is structured as follows. Next section presents short literature review. Section 3 presents the integrated empirical findings and final section concludes with policy recommendations.

## 2. Literature review

The concept of the innovation ecosystem has become central to understanding how technological knowledge is translated into economic value. Unlike linear models of technology transfer, ecosystem frameworks emphasise the interdependence of multiple actor types - universities, firms, investors, intermediaries, and public institutions - and the importance of their co-evolutionary dynamics (Adner, 2017; Jacobides et al., 2018). Outcomes in such systems depend less on any single organisation and more on the quality of coordination across complementary assets: scientific capability, risk finance, shared infrastructure, regulatory frameworks, and access to lead markets (Cobben et al., 2022). In deep tech, this structural logic is particularly consequential: a research institution may produce ground breaking science, but if the technology transfer offices (TTO) lacks

<sup>2</sup> At the legislative level, Slovenia has taken steps to formalise its commitment to research and innovation funding through the Research and Innovation Act (ZZrID), originally adopted in 2021 and subsequently amended in 2023, 2024, and 2025. The Act sets a statutory target of up to 1.25% of GDP in total public funding for research and innovation, with a legally defined floor of at least 0.8% of GDP for state research funding, and mandates annual increases of at least 0.08 percentage points until the 1% GDP threshold for research is reached. However, actual increases remain contingent on macroeconomic performance, as funding is only required to be maintained at the previous year's nominal level during periods of negative GDP growth or exceptional circumstances.

<sup>3</sup> Each original study was carried out in parallel by dedicated research teams comprising faculty members—professors and students—from the International Master in Business (IMB) programme at the University of Ljubljana, School of Economics and Business. All teams followed a common analytical framework derived from a systematic literature review, enabling consistent identification of cross-cutting patterns, structural commonalities, and sector-differentiated dynamics.

capacity to negotiate intellectual property (IP) terms, if early-stage investors lack sector expertise, and if regulatory pathways are unclear, the science will not become a venture regardless of its intrinsic quality.

For deep tech and other science-based sectors, the commercialisation challenge is amplified by the protracted development pathway - often spanning a decade or more for technology from proof-of-concept to commercial deployment - during which multiple types of market and institutional failures may arise. Technology transfer institutions, specifically technology transfer offices at universities and public research organisations, play a critical intermediary role in translating scientific discoveries into licensable IP or investable spin-off ventures. The empirical evidence documents wide variation in technology transfer office performance across institutions and countries, attributable to differences in mandate clarity, professional capacity, resource endowment, and the broader legal and incentive environment (Nelson, 1993, Siegel et al, 2007). OECD (2022) assessments identify weak TTO capacity as a persistent constraint on commercialisation in CEE innovation systems, including Slovenia, with key weaknesses spanning unstable funding, limited IP management expertise, cumbersome spin-off procedures, and academic incentives that reward publication over commercialisation.

The financing of deep tech ventures presents particular challenges for conventional venture capital (VC) models that typically favours fast-growing, capital-light, software-enabled business models with clear exit horizons, so called "deep tech financing challenge" (Dealroom, 2023). Deep tech ventures, by contrast, require substantial upfront investment in physical R&D infrastructure, face long and uncertain development timelines, and often depend on regulatory approvals or large institutional customers before generating revenue.

Scholars and policymakers have proposed several institutional responses. Blended finance instruments, combining public grants or equity with private co-investment, could lower the risk threshold for private investors while ensuring public accountability for strategic priorities. Milestone-based funding mechanisms, tied to verified technical achievements such as prototype completion or certification success, reduce investor uncertainty and align incentives across development stages. Development bank participation as an anchor investor can provide both capital and a quality signal that attracts international co-investors. Yet even where public support is substantial, the transition between technological readiness level (TRL) stages - particularly from TRL 4 to TRL 7, where laboratory demonstrations must be converted into pilot-scale or market-ready products

- frequently encounters what the literature terms the "valley of death"<sup>4</sup>, a financing gap where government grant programmes have ended but commercial investors are not yet willing to commit (Auerswald & Branscomb, 2003). Empirically, the gap has been documented across European deep tech sectors (Dealroom, 2023). The European Investment Bank has similarly highlighted that deep tech scale-ups struggle to find long-term growth capital due to a cautious investment climate and a shortage of investment teams focused on the sector (European Investment Bank, 2024). Finally, talent and human capital constraints are widely documented as a binding constraint on deep tech ecosystem development (Chaudhuri et al, 2023). The relevant talent challenge in small economies is not simply quantitative - a shortage of STEM graduates - but qualitative: a shortage of the entrepreneurially capable, managerially experienced, and commercially oriented scientists and engineers. This entrepreneurial talent gap is compounded in small economies by brain drain pressures, as internationally mobile researchers and engineers are attracted to larger ecosystems with richer opportunity sets and higher compensation (Science | Business, 2024).

The empirical analysis reveals a consistent structural profile across Slovenia's high-technology sectors. In the continuation we present the findings thematically, identifying both shared patterns and sector-specific variations.

### 3. Findings

#### 3.1 Structural Strengths of Slovene Deep-Tech ecosystem: Scientific Base, EU Integration, and Industrial Tradition

Across all four sectors, interviewees consistently identified three categories of strength that distinguish Slovenia's high-technology ecosystem from other CEE economies. The first is **the quality of Slovenia's scientific and engineering base**. Public research institutions produce internationally competitive research in physics, materials science, biotechnology, and engineering. Slovenia's graduation rate at PhD level is among the highest in the OECD, and its share of STEM graduates in tertiary education exceeded the EU average through the early 2020s (European Commission: DG for Education, Youth and Culture, 2025) This scientific foundation provides a genuine knowledge base from which deep tech ventures can emerge. As one university researcher noted: *"The quality of science we do here is not the problem. The problem is everything that happens after the science."*

<sup>4</sup> This gap is especially severe in hardware-intensive sectors, such as advanced materials, photonics, and life sciences, where capital requirements at the pilot stage far exceed those of software-based ventures.

The second strength is Slovenia's **deep integration into EU research and industrial programmes**. Participation in Horizon Europe, the European Space Agency, the European Innovation Council, and IPCEI frameworks spanning microelectronics, batteries, cloud infrastructure, and health provides Slovenian institutions and firms with access to funding, legitimacy, international networks, and market opportunities that would be unattainable for a small economy operating in isolation. Slovenia's membership in the EuroHPC Joint Undertaking is a particularly relevant case in point: having signed the European Declaration on High Performance Computing as early as 2017 as one of the first nine signatories, Slovenia has secured access to a shared supercomputing infrastructure backed by a budget of approximately €7 billion for 2021–2027 - computational capacities that a small economy could not realistically develop independently and which are directly relevant to deep tech sectors such as AI, quantum computing, and advanced simulation<sup>5</sup>. The accession to full ESA membership in January 2025 was highlighted by space technology stakeholders as a transformative institutional development, both for the direct funding flows it enables through the geographical return principle and for the reputational signal it provides to international partners and investors. Similarly, in biotechnology, EU Horizon grants have been a primary mechanism for early-stage internationalisation of research-intensive firms.

The third strength is **industrial tradition** and the presence of established industrial firms with global market positions and dual-use technological capabilities. Companies such as Dewesoft in space instrumentation and SkyLabs, whose miniaturised on-board data-handling solutions are embedded in more than 60 operational satellite missions<sup>6</sup>, Kolektor in advanced manufacturing, and the Sandoz/Novartis in life sciences serve as anchor institutions that provide market credibility, supply chain linkages, and a talent pool for emerging ventures. The acquisition of BIA Separations by Sartorius for €360 million in 2020 demonstrated that Slovenian biotech ventures can achieve significant exit valuations, providing an important reference point for investors and aspiring entrepreneurs (Biospace, 2020). In the space sector, companies with proven track records in ESA programmes serve as credibility bridges for newer entrants seeking their first institutional contracts. In biotechnology, the anchor presence of major pharmaceutical manufacturers provides a different kind of eco-

system foundation. The Natural Science and Engineering Research industry in Slovenia, encompassing life sciences, pharmaceuticals, biotechnology and medical sciences, reached a market size of approximately €497 million in 2025 (Koman et al, 2025). However, the relationship between large pharmaceutical anchors and the broader biotech start-up ecosystem is underdeveloped: knowledge and talent do not flow freely between large firms and emerging ventures, and the anchor firms' R&D activities are primarily directed by their global parent organisations rather than by the local ecosystem's priorities. The result is a sector with impressive industrial scale but limited entrepreneurial dynamism.

Although these strengths are real and provide a foundation for niche positioning within European value chains, interviewees across all sectors were consistent in describing them as necessary but insufficient conditions for ecosystem development at scale. The constraints identified in the following sections operate systematically to prevent these strengths from translating into commercially scalable outcomes.

### 3.2 Financial Constraints and Shared Infrastructure Deficit: The Mid-Development Financing Gap

The most consistently identified constraint across all four sectors is the absence of adequate patient capital, defined as long-term, risk-tolerant financing that does not require immediate returns for ventures at Technology Readiness Levels (TRL) 4–7. This is the stage at which laboratory proofs of concept must be converted into pilot-scale demonstrations, certified prototypes, or minimum viable products suitable for early commercial deployment. It is precisely at this stage that public grant mechanisms (primarily oriented toward early-stage research and feasibility) have typically expired, while commercial venture capital (VC) remains unwilling to commit given the technical and market uncertainty (Auerswald & Branscomb, 2003; Hall & Lerner, 2010).

The severity of this gap varies by sector. In space technology, the European Space Agency's (ESA) role as an anchor customer and the milestone-based funding logic of its procurement system provides partial mitigation, but interviewees noted that the transition between ESA development contracts and commercial contracts remains poorly bridged. A space tech founder described the challenge: "ESA gives you credibility and your first contracts, but the step from ESA-funded prototype to commercial product requires capital we cannot find domestically, and foreign investors don't know the sector well enough." In biotechnology, the valley of death is particularly acute: regulatory approval timelines mean that capital requirements at the

5 [https://www.eurohpc-ju.europa.eu/about/discover-eurohpc-ju\\_en](https://www.eurohpc-ju.europa.eu/about/discover-eurohpc-ju_en)

6 Yet this success has been achieved primarily through individual firm initiative rather than through systematic ecosystem support, and the transition from a handful of internationally competitive firms to a broader and self-reinforcing cluster has not yet occurred.

pre-clinical and clinical stages far exceed what Slovenian investors can provide, with most ventures depending on foreign capital or strategic partnerships with large pharmaceutical companies (Koman et al., 2025). Green tech interviewees confirmed that “once you get beyond the laboratory and close to commercialisation, the money is simply not there”. In deep tech more broadly, seed tickets of approximately €50,000, typical of domestic instruments, are described as insufficient by a factor of three to four relative to international benchmarks (Domadenik Muren et al, 2025b).

The structural root of this gap lies in the underdevelopment of Slovenia’s domestic venture capital (VC) market. VC assets under management in Slovenia represent a fraction of comparable small economies such as Finland, Denmark, or even Estonia<sup>7</sup>, despite Slovenia’s comparable scientific output. The limited track record of successful exits has historically constrained the formation of experienced fund managers and limited partner appetite (Gompers & Lerner, 2001). While recent initiatives - the Vesna deep tech VC vehicle, the Slovene Equity Growth Investment Program (SEGIP), and a joint guarantee scheme between the European Investment Fund (EIF) and SID Bank - signal genuine policy commitment, interviewees consistently viewed them as undersized relative to the capital demands of a maturing deep tech ecosystem.

A further structural dimension of the financing constraint concerns the international orientation of available capital. The limited number of domestic deep tech investors, and the limited sector expertise of those that exist, creates a dependency on foreign capital for mid- and late-stage venture financing. Foreign investors, while providing capital, may impose internationalisation timelines, governance requirements, or exit preferences that do not align with the long development cycles and domestic ecosystem-building objectives of deep tech ventures. Several interviewees noted instances where promising ventures had been effectively acquired by foreign investors at early stages “exporting our best science at a discount” as noted by one of our interviewees and argued that building domestic investment capacity was as much a strategic sovereignty question as a financing efficiency question.

The performance of Slovenian firms in competitive EU instruments illustrates the depth of the financing challenge. In the first two years of the European Innovation Council (EIC) Accelerator programme (one of the most important EU instruments for deep tech scale-up) Slovenian start-ups ob-

tained only €2.45 million in grants and equity until 2025, among the lowest totals in the EU both in absolute terms and relative to GDP. Adjusted for GDP, Slovenia would have needed approximately €7–8 million to match France and Germany on a proportional basis (Domadenik Muren et al, 2025b). This underperformance reflects both a limited number of applications - itself partly a consequence of the proposal preparation and commercialisation expertise constraints discussed in next section and a weak pipeline of ventures sufficiently developed to compete for mid-stage EIC instruments. Addressing the financing gap and the pipeline development challenge are thus complementary rather than sequential priorities.

An important dimension of the financing constraint is also the quality of capital. Interviewees distinguished between financial investors who provide capital but limited sector understanding, and “smart money” investors who combine financing with strategic value-add through networks, market access, and commercialisation expertise (Gompers et al., 2016). The latter is in particularly short supply in Slovenia, because most sophisticated sector-specific investors are located in other European ecosystems. This suggests that policy interventions aimed at stimulating the domestic VC market should also stimulate the development of sector-specific investment expertise, for example, through co-investment schemes that pair domestic investors with experienced foreign deep tech funds.

Across all four technology sectors, interviewees consistently identified the absence of shared research and pilot-scale infrastructure as a significant constraint on venture development. The specific infrastructure gaps differ by sector - wet laboratories and bioprocessing facilities in biotechnology; precision engineering and testing facilities in space technology; pilot plants and clean rooms in green technology; and high-performance computing and advanced fabrication in deep tech broadly - but the structural pattern is consistent: facilities capable of supporting the transition from laboratory to pilot scale are either absent or inaccessible to early-stage ventures.

The consequences are multifaceted. Firms seeking to conduct mid-stage validation work must either purchase or lease costly dedicated facilities - a prohibitive investment for early-stage ventures - or seek partnerships with foreign institutions that possess the necessary capabilities. The latter option is feasible but creates dependency, increases development timelines, and risk transferring strategic knowledge to foreign partners. One biotechnology researcher described the problem directly: “We have the science. We do not have the place to do the next step. So, we go to Germany or Austria, and they learn what we know.”

<sup>7</sup> <https://www.ebrd.com/home/news-and-events/publications/economics/transition-reports/transition-report-2025-26/country-assessments/ceb.html#customtab-bc9d60004b-item-f73e841601-tab>

International comparisons highlight the gap. Sweden's KTH Innovation fund, with annual capitalisation approximately 500 times that of the UL Innovation Fund, routinely co-funds shared infrastructure for spin-off ventures (KTH Innovation, 2024). Germany's Fraunhofer system provides applied research infrastructure across technology domains, including pilot-scale facilities accessible to SMEs on a fee-for-service basis<sup>8</sup> (Fraunhofer, 2025). In the biotechnology sector specifically, Ireland's national investment in biomanufacturing infrastructure has been cited as a key enabler of its pharmaceutical cluster development (IDA Ireland, 2021). Slovenia has utilised Recovery and Resilience EU funds to upgrade some laboratory and digital research capacity, but OECD assessments identify persistent gaps, particularly in pilot-scale and bioprocessing facilities (OECD, 2022; European Commission, 2024).

### 3.3 Talent Constraints and the Entrepreneurial Skills Gap

Talent constraints take two distinct forms in Slovenia's high-technology ecosystem. The first is quantitative: growing demand for specialised engineers, scientists, and technical professionals in sectors such as quantum technologies, advanced materials, medical device development, and space systems engineering exceeds domestic supply. Several interviewees noted that competition for qualified engineers - not only from domestic competitors but from well-resourced multinational firms and foreign ecosystems - represents a binding constraint on firm growth. The wage premium required to compete with large multinationals such as Novartis or with Swiss and Austrian employers is frequently beyond the reach of early-stage ventures with limited cash flow.

The second, and arguably more consequential, talent constraint is qualitative: a shortage of the entrepreneurially capable scientists and engineers who can bridge technical and commercial domains, and of the experienced managers who can lead scale-up processes. This gap is particularly evident in the relative absence of individuals with experience in international sales, regulatory strategy, clinical development, and investment fundraising - the capabilities most critical for transitioning from prototype to commercial product. The technology transfer officer in one of the interviews summarised the pattern: *"We can produce excellent researchers. We cannot yet produce the person who knows how to take the research to a 50 million Series B."* Green tech stakeholders face shortages of cross-disciplinary profiles capable of bridging electrical systems,

coding, and mechanical engineering simultaneously. Brain drain compounds the talent challenge. Internationally mobile Slovenian researchers and engineers are attracted to larger ecosystems where compensation is higher, research infrastructure is richer, and career progression pathways are more clearly defined (OECD, 2022; Science | Business, 2024). High taxation on performance bonuses and administrative barriers to hiring non-EU experts, on the other hand, further constrain the ability to attract international talent (European Commission, 2025). A structural feature identified across all sectors is the absence of "revolving doors" between academia and industry. In Slovenia, researchers who leave for entrepreneurship face career penalties and find it difficult to return, reducing the stock of entrepreneurially oriented academics. Sabbaticals support scholarly placements<sup>9</sup> rather than business engagement, and joint industry-university curricula remain rare. Academic incentive structures remain primarily oriented toward publication metrics rather than patent activity or spin-off creation, reinforcing this dynamic (Domadenik Muren et al., 2025b). This institutional misalignment is well documented in CEE innovation systems (OECD, 2022).

### 3.4 Weaknesses in institutional and regulatory environment

Across all analysed sectors, the institutional and regulatory environment emerges as a persistent source of frictions that increases the perceived risk of lending to deep tech ventures as uncertain approval timelines and changing compliance requirements directly affect cash flow projections and collateral valuation. Bureaucratic processes slow contracting, IP valuation, spin-off formation, and foreign talent recruitment by months or years. Green tech interviewees described regulatory uncertainty as a direct business risk. *"You cannot build a proper business plan if rules change every year"*, as one respondent from the space-tech industry similarly highlighted. Biotech founders noted that neighbouring countries, Austria, Hungary, Croatia, Italy, have already reformed their frameworks for spin-offs, clinical trials, and technology transfer, leaving Slovenia lagging. Regulatory and governance constraints were identified across all four sectors, though their specific manifestations differ. In biotechnology and pharmaceutical development, EU-level regulatory frameworks - including EMA approval processes and GMP certification requirements - impose substantial compliance costs that are disproportionately burden-

<sup>8</sup> <https://www.iis.fraunhofer.de/en/profil/what-makes-us-special/jb.html>

<sup>9</sup> Several interviewees noted that the absence of a "revolving door" between academia and entrepreneurship - facilitated in other ecosystems (in United States, for example) by sabbatical policies, equity participation norms, and career pathway structures - makes it difficult for researchers to engage entrepreneurially without permanently exiting the academic system.

some for small ventures without in-house regulatory expertise. In space technology, the complexity of ESA procurement procedures, compliance requirements, and dual-use export control regulations creates entry barriers that disadvantage firms without dedicated compliance capacity. In deep tech broadly, the absence of a coherent national data governance framework - particularly around data access for AI applications and digital research infrastructure - constrains the development of data-intensive ventures. At the national level, governance fragmentation is a recurring theme. Policy responsibility for innovation and technology is distributed across multiple ministries - the Ministry of the Economy, the Ministry of Education, the Ministry of Science (till 2026) - with coordination mechanisms characterised by interviewees as insufficient and slow. The 2024 EU Technical Support Instrument diagnostic of Slovenia's R&I governance system documented persistent weaknesses in cross-sector coordination, unstable and fragmented funding streams, and limited strategic prioritisation capacity at the national level (European Commission, 2024). Technology transfer offices at universities operate under restrictive legal frameworks regarding IP ownership and spin-off establishment, with procedures for obtaining government consent for university spin-offs described by multiple interviewees as unnecessarily cumbersome and deterrent to commercialisation<sup>10</sup>.

The IP ownership framework deserves particular attention. Under current Slovenian law, inventions created by university and public research institute employees belong to the employing institution rather than the individual inventor. While this is a common international model, its implementation in Slovenia is characterised by complex, lengthy, and uncertain negotiations over IP licensing terms that reduce investor confidence and slow venture formation. One venture capital investor noted: *"By the time we understand who actually owns what and on what terms, we've often lost months and sometimes lost the deal."* International evidence suggests that clear, fast, and transparent IP licensing procedures are at least as important as the underlying ownership regime (Siegel et al., 2007; European Commission, 2022).

A positive counter-narrative also emerges. Slovenia's small scale is not only a constraint but an asset: *"Here you can call someone in the ministry and have a meeting. There is more personal involvement"*, as one interviewee noted. Policy proximity some of the sectors (space tech and bio tech

for example) and institutional accessibility represent genuine advantages that larger economies cannot replicate.

**3.5 Commercialisation culture and ecosystem maturity**  
A cross-cutting theme in the interview data concerns what several interviewees described as a "commercialisation culture gap" - a relative absence of the entrepreneurial norms, risk tolerance, and success celebration that characterise more mature deep tech ecosystems. While this theme requires careful interpretation - cultural factors are more difficult to specify and measure than institutional or financing constraints - it has been emerging consistently enough across diverse interviewee types and sectors to warrant inclusion in the analysis.

Specific dimensions of this theme include (i) the social stigma of business failure; several interviewees pointed out that in Slovenia, business failure carries a social stigma, whereas both Silicon Valley and—perhaps more surprisingly—even the Estonian tech ecosystem treat failure as a normal part of entrepreneurship;; (ii) the absence of high-profile successful entrepreneurs who serve as visible role models and active mentors for the next generation of founders; (iii) limited industry engagement in university curricula and research programmes; and (iv) a tendency towards what one investor described as "academic risk aversion" - a preference for grant-funded research activities over equity-financed ventures even among researchers who are aware of and interested in commercial applications of their work.

The contrast with Estonia's "snowball effect" - where a critical mass of successful exits created a self-reinforcing cycle of experienced investors, serial entrepreneurs, and normalised risk-taking - was invoked by multiple interviewees as a model Slovenia has not yet achieved. Estonia's experience demonstrates that cultural change follows rather than precedes institutional and financial ecosystem development (Kallas, 2016; Tõnurist & Hanson, 2020). For Slovenia, this implies that addressing financing gaps and regulatory barriers may, over time, normalise entrepreneurial risk-taking and shift cultural norms, but patience is required.

#### 4. Conclusions and policy recommendations

A coherent set of structural reforms that would meaningfully improve Slovenia's capacity to translate scientific excellence into scalable, high value-added innovation are organised around five thematic priorities, each addressing one or more of the cross-cutting constraints identified in the empirical analysis. The recommendations are calibrated to the institutional and fiscal realities of a small EU Member State and draw on international benchmarks where available.

<sup>10</sup> However, a positive institutional development occurred in 2025: the new Higher Education Act (Zakon o visokem šolstvu, 2025) removed the requirement for government consent in the establishment of university spin-offs, addressing a long-standing complaint. Whether this reform will meaningfully accelerate spin-off formation remains to be seen, as other procedural and motivational barriers persist.

Slovenia should **establish a national deep tech investment platform** - modelled on the structure of successful national technology investment vehicles in Denmark (Export and Investment Fund of Denmark, EIFO<sup>11</sup>), Austria (Austria Wirtschaftsservice, AWS<sup>12</sup>), and Finland (Tesi / Finnish Industry Investment<sup>13</sup>) - that combines public anchor capital with private capital (public-private co-investment) and operates through milestone-based disbursement mechanisms. The platform would provide blended financing for ventures at TRL 4–7, with tranches of capital released upon verified achievement of specific technical milestones (prototype completion, certification success, first commercial contract). This approach reduces investor uncertainty while aligning incentives with genuine technical progress. The platform should be capitalised at a scale commensurate with sectoral needs and should be designed to develop sector-specific investment expertise rather than operating as a generalist fund. Partnerships with international deep tech investors who bring sector-specific knowledge in biotechnology, space systems, and green technology would provide the “smart money” dimension that is as important as the capital itself (Gompers et al., 2016).

**Building shared research and pilot-scale infrastructure** for mid-stage technology development in priority sectors - with governance structures that ensure accessibility for early-stage ventures on affordable, transparent terms - is the second recommendation. The fixed costs of pilot-scale facilities are prohibitive for any individual early-stage venture but become manageable when shared across multiple users. Shared infrastructure also creates co-location effects that facilitate knowledge exchange, partnership formation, and the informal interactions from which new venture ideas frequently emerge.

The governance of shared infrastructure is as important as its construction. International experience suggests that facilities governed purely by universities or public research institutes often become captured by the interests of their internal users and fail to serve the external venture community effectively (OECD, 2022). A hybrid governance model, with board representation from both the research community and the entrepreneurial ecosystem, and with service pricing that balances accessibility for early-stage ventures against financial sustainability, is likely to be more effective. The Fraunhofer model<sup>14</sup> in Germany and the Catapult Centres

in the United Kingdom<sup>15</sup> provide a relevant benchmark. Third recommendations would be **reforming technology transfer and IP governance**. Improving the pipeline from public research to commercial venture requires reforms across several dimensions of the technology transfer system. First, the legal framework governing IP ownership and spin-off establishment should be streamlined. Some small steps have been already made with the new Act on higher education in 2025. Internationally, the most effective models either vest IP ownership clearly in the employing institution but with fast, transparent licensing procedures (the US Bayh-Dole model, see Mowery et al., 2001), or give inventors significant rights and corresponding commercialisation responsibilities (the Nordic “professor’s privilege” model, see Jacobsson et al., 2013). Second, TTO capacity must be scaled and professionalised urgently. The University of Ljubljana Innovation Fund’s annual capitalisation of approximately €150,000, providing grants of €5,000–25,000 per project, is inadequate for supporting deep tech ventures. Benchmarking against KTH Innovation Fund in Sweden (approximately €80 million per year) or against even smaller but better-resourced TTOs in the Netherlands (e.g., Innovation Exchange Amsterdam) and Austria (AWS Innovation Fund) illustrates the scale gap (KTH Innovation, 2024). Stable multi-year funding for TTOs, with a mandate to professionalise IP management, deal structuring, and venture development capabilities, would meaningfully improve throughput. The creation of a national TTO network that allows smaller institutions to share expertise and deal flow would further improve efficiency (European Commission, 2022). Third, academic incentive structures should be comprehensively reformed to reward commercial engagement alongside publication activity. The current system, in which academic career progression depends on publication metrics and teaching performance and, to a lesser extent, on patent development, systematically disadvantages researchers who invest time in spin-off creation or industry collaboration. Reforms should include (i) clear and attractive guidelines for researcher equity participation in spin-off ventures; (ii) sabbatical policies that explicitly accommodate temporary transitions between academia and entrepreneurship; and (iii) protected time allocations for researchers with active commercial development activities.

nally, with roughly one third from industry contracts. Their sector-specific institutes provide pilot-scale and testing infrastructure that would be impossible for individual SMEs to replicate. A Slovenian equivalent, necessarily much smaller in absolute scale but potentially structured around the existing network of public research institutes (IJS, KI, NIB), could progressively build applied research capacity in priority domains while providing accessible infrastructure to the venture community. EU instruments, which fund the development of research and innovation excellence, provide a potential funding mechanism for establishing such partnerships with established Fraunhofer or equivalent institutes in other EU member states.

<sup>15</sup> <https://catapult.org.uk/about-us/our-centres/>

<sup>11</sup> <https://eifo.dk/media/3141sier/eifo-annual-report-2024.pdf>

<sup>12</sup> <https://www.aws.at/en/>

<sup>13</sup> <https://tesi.fi/en/about-tesi/>

<sup>14</sup> The Fraunhofer model, a network of applied research institutes providing both proprietary contract R&D and shared infrastructure access to SMEs on a fee-for-service basis, offers the most directly relevant international benchmark for Slovenia’s situation. Germany’s 76 Fraunhofer institutes collectively employ over 32,000 researchers and generate approximately €3 billion an-

Fourth, Slovenia should actively deepen the relationship between its large industrial anchors - particularly the major pharmaceutical manufacturers - and the broader start-up ecosystem. Formal mechanisms for technology licensing, research collaboration, and talent secondment remain underdeveloped, yet represent some of the most effective channels through which anchor firms can transfer knowledge, open markets, and build absorptive capacity within an emerging ecosystem. Corporate venture capital arms, sponsored research agreements, and structured mobility pathways between start-ups and large firms have proven effective in more mature contexts (Chesbrough, 2003; Gompers & Lerner, 2001). Critically, policy incentives - including R&D tax credits - should be made explicitly conditional on such collaborations, ensuring that public support actively drives ecosystem integration rather than subsidising firms in isolation.

The fourth recommendation addresses **talent attraction, retention, and entrepreneurial skill development**.

Slovenia's talent challenge requires a response that operates simultaneously across different horizons: near-term measures to address immediate shortages, medium-term structural reforms to reorient education and career pathways, and longer-term cultural investments to shift norms around entrepreneurial risk-taking. These horizons are not sequential but should be pursued in parallel,

In the near term, immigration facilitation (fast-track visa and work permit, reduced administrative burden and processing time) is a positive step but not sufficient. Additional measures should include (i) preferential tax treatment of start-up equity compensation (employee share option plans, ESOPs), (ii) tax relief for angel investors (e.g., UK's Seed Enterprise Investment Scheme) and (iii) R&D tax credits structured to benefit pre-revenue ventures as well as established firms (similar to Ireland's R&D Tax Credit; see Irish Revenue, 2024). These would collectively improve the financial attractiveness of the domestic deep tech ecosystem relative to foreign alternatives.

In the medium term, deeper structural linkages between universities and the deep tech industry are the most important talent development lever. Joint doctoral supervision - reviving the logic of Slovenia's discontinued young researchers from practice scheme - would produce researchers who combine scientific rigour with commercial orientation. Curriculum reform should address systematic misalignment between graduate profiles and industry needs, with practitioners involved in design and delivery. Entrepreneurship education embedded within PhD programmes - covering venture formation, equity financing, and IP management - would target the population most likely to produce deep tech founders (Feld, 2012).

In the longer term, Slovenia should invest deliberately in the development of a serial entrepreneurship culture by supporting successful founders as angels, mentors, and ecosystem connectors once they exit or scale their ventures. Programmes modelled on the EIC Mentors network, which pairs experienced deep tech entrepreneurs with emerging ventures and provides both practical guidance and network access, could be adapted at the national and international level (EIC, 2015). Public narratives that normalise failure and celebrate success in equal measure would, over time, reinforce the cultural conditions that structural reforms depend on.

The final recommendation is **strengthening governance coordination and strategic prioritisation**. A high-level inter-ministerial body - co-chaired at ministerial level and backed by a professional secretariat - should align instruments across ministries and the Slovenian Research and Innovation Agency, commission independent ecosystem diagnostics, evaluate programme effectiveness, and propose regulatory reforms. Crucially, it must function as a genuine decision-making mechanism rather than a consultative forum (European Commission, 2024; OECD, 2022). Slovenia should also adopt binding strategic specialisation commitments in its smart specialisation strategy update, concentrating investment on two or three deep tech domains selected based on scientific strength, industrial anchors, competitive positioning, and alignment with EU priorities. International examples include Finland's focus on quantum and biotech, Austria's focus on space and automation, and Estonia's focus on digital government and AI (European Commission, 2025).

Third, the development of a national bid-support office for EU deep tech programmes is a high-return, low-cost intervention that should be implemented rapidly. Analogous to the role played by national contact points for Horizon Europe - but specifically oriented toward competitive deep tech instruments requiring substantial proposal development capacity (e.g., EIC Accelerator, Pathfinder, Transition)- such an office would provide application coaching, consortium-building support, and proposal review services similar to the support that is provided by the Space Office at the Ministry of the Economy. Finally, performance measurement and public accountability for ecosystem development should be embedded in the governance framework from the outset. Setting quantitative targets (e.g., number of spin-offs, volume of venture debt issued, EIC success rate) and reporting annually on progress against these targets would create political accountability for ecosystem development outcomes and enable course correction where interventions are not delivering expected results. The absence of such accountability mechanisms in Slovenia's current innovation policy has contributed to the

persistence of known weaknesses across multiple policy cycles without the structural reforms required to address them (European Commission, 2024).

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# The (in)convenient status quo of Slovenian household savings

Igor Lončarski\*

The Slovenian banking system funds itself to an unusual degree from household deposits, which stand at approximately EUR 28 billion and finances close to half of bank liabilities, mostly in sight accounts at a composite rate of 0.23 percent. With a loan-to-deposit ratio below 70 percent against the euro area aggregate near 105 percent, the system sits at the deposit-funded extreme of the Union. This article assesses the risk should that base erode, through the consumption of an ageing population and a shift into assets with a non-negative real return. A bank-type-specific convex cost model is used to simulate the effect of the outflow on bank profitability. In that calibrated exercise, a realistic outflow of EUR 10 to 12 billion over a generation would reduce system profit by an estimated 27 to 33 percent of a normalised baseline, concentrated on small domestic banks. The estimates indicate the direction and scale of the risk rather than precise outcomes. The article draws the implications for bank funding strategy and supervision.

JEL G21, G51, E21, G23

## 1. Introduction

The Slovenian banking system rests on an unusually narrow funding base. Deposits from the non-banking sector account for more than three-quarters of total bank liabilities, the highest ratio in the euro area, and household deposits alone fund close to half of the system (Bank of Slovenia, 2025b). At the end of 2025, households held approximately EUR 28 billion in bank deposits, 86 percent of it in sight accounts earning 0.04 percent and the rest in term deposits earning 1.40 percent, a composite weighted rate of 0.23 percent. This pool of cheap and stable retail funding has underwritten Slovenian bank profitability through a decade of balance sheet repair. It is also a concentration of risk, because a funding base this cheap is a funding base with a great deal to lose.

This article assesses the risk to the banking system if that base erodes. The real return on the composite deposit is approximately -1.77 percent<sup>1</sup>, so households have a clear incentive to act. The question is not whether the deposits could move but how they would move, what would set the movement in train, and what the consequences would be for bank funding costs and profitability.

Two pressures can carry household deposits out of the banks, and both are strengthening. The first is consumption, as an ageing population draws down balances and a contracting workforce slows the formation of new deposits, so the base erodes structurally from the demographic side.

The second is a portfolio shift into financial assets that offer a non-negative real return, catalysed over the past year by the Individual Investment Account introduced in March 2026, the European Savings and Investments Union, and the prospect of a mandatory funded pension pillar. The two channels are not equivalent for the banks, since a part of each reshapes the funding structure within the system, while a part leaves it entirely.

Section 2 sizes the deposit base and sets the Slovenian funding structure against the euro area. Sections 3 and 4 examine the two outflow channels and their catalysts. Section 5 develops the cost to the banking sector and is the analytical core. Section 6 sets that cost against the household welfare gain and draws the implications, and Section 7 concludes.

## 2. The deposit base and the banking system's exposure

Slovenian households held approximately EUR 28 billion in bank deposits at the end of 2025, a sum equal to roughly 40 percent of GDP. The composition is heavily

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<sup>1</sup> The real return is the nominal composite deposit rate of 0.23 percent less HICP inflation of 2.0 percent, that is  $0.23\% - 2.0\% = -1.77\%$ . The nominal composite rate is the sight and term deposit rates weighted by their shares of the stock,  $0.86 \times 0.04\% + 0.14 \times 1.40\% = 0.23\%$ .

weighted toward overnight money. About 86 percent of the stock sits in sight accounts earning approximately 0.04 percent, and about 14 percent in term deposits earning approximately 1.40 percent, giving a composite weighted rate of 0.23% (European Central Bank, 2026b).

This rate is the outcome of a deposit market that the ECB's rate-hiking cycle bypassed almost entirely. Between 2022 and 2025, the ECB deposit facility rate rose from negative 0.50 percent to 4.00 percent before declining to 2.00 percent, and yet Slovenian household deposit rates barely moved, since with no institutional alternative absorbing household savings at scale, banks had no incentive to compete. At HICP inflation of 2.0 percent, the deposit stock loses approximately EUR 495 million per year in real purchasing power, a real return of approximately negative 1.77 percent. The maturity composition matters for the risk. A base that is 86 percent overnight is a base that can move quickly, because it offers the banks none of the buffer that a term structure would provide.

However, the depositors' base is uneven. The ECB Distributional Wealth Accounts (European Central Bank, 2024), which reconcile household survey data to the macroeconomic sector accounts and correct for the under-coverage of wealthy households, provide the calibrated distribution. For Slovenia, in the third quarter of 2025, they place total household deposits at EUR 32.0 billion on a financial-accounts basis, a perimeter wider than the EUR 28 billion monetary-statistics measure used elsewhere here, and the distributional shares transfer to either total. Table 1 sets out the distribution by net wealth quintile.

The top wealth quintile holds 59.3 percent of household deposits, and the top two quintiles' 76.3 percent. By work status, employee households hold 44.0 percent of the stock, retired households' 26.3 percent, and self-employed households' 11.4 percent, and by housing status, owner-occupiers hold 89.5 percent. For the banking system, the concentration is itself a vulnerability. A base spread evenly across many small accounts moves slowly, because most

**Table 1. Household deposits by net wealth quintile.**  
Source: European Central Bank (2024), *Distributional Wealth Accounts, third quarter 2025*.

Net wealth quintile	Deposits (EUR bn)	Share of household deposits
Q1 (bottom)	1.45	4.5 percent
Q2	2.68	8.4 percent
Q3	3.43	10.7 percent
Q4	5.45	17.0 percent
Q5 (top)	18.97	59.3 percent

balances are too small to repay the effort of moving, while a base in which three-fifths of the value sits with the top quintile can shift materially on the decisions of a small number of relatively sophisticated households.

Slovenian banks have grown unusually dependent on this base. The post-2008 GFC banking crisis of 2012 triggered a restructuring that shifted the system from corporate-lending-dominated to household-deposit-funded. Banking system total assets stood at EUR 54.2 billion at the end of 2024 (Bank of Slovenia, 2025a), lending to non-financial corporations contracted from approximately EUR 18 billion in 2008 to approximately EUR 10 billion in 2025, and the loan-to-deposit ratio, which exceeded 150 percent in 2008, has fallen below 70 percent.

This reliance is extreme by euro area standards. A loan-to-deposit ratio below 70 percent stands against a euro area aggregate of approximately 105 percent at the end of 2025 (European Banking Authority, 2025), which means Slovenian banks hold deposits well in excess of the loans they extend, rather than funding their lending at the margin from wholesale and market sources. On the share of bank assets funded by customer deposits, Slovenia is one of only three European Union countries, alongside Lithuania and Greece, where that share reaches or exceeds 80 percent (European Banking Federation, 2023). The Slovenian system, therefore, sits at the deposit-funded extreme of the Union, and its exposure to a deposit outflow is correspondingly greater than that of a system funded through a more diversified mix.

The system is concentrated around three structural types, each of which faces a different adjustment path if deposits leave. The first is a traditional large domestic bank with international operations, with approximately 30 percent of system assets. The second is the group of foreign-owned subsidiaries of major European banking groups, at approximately 45 percent. The third is the small and niche domestic banks focused on regional and small-enterprise lending, at approximately 25 percent.

The base has held because a self-reinforcing equilibrium has held, in which households default to deposits, banks fund themselves cheaply and have no reason to compete, and firms self-finance through retained earnings rather than bank credit, so no actor has an incentive to move first. Three mechanisms have sustained the household side of this equilibrium. The post-socialist legacy of the 1990s privatisation and the 2013 subordinated-bond bail-in left a durable association between non-deposit assets and loss, the mechanism by which experienced financial loss shifts risk attitudes toward safety (Malmendier and Nagel, 2011). The absence of a mandatory funded pension

system means no automatic channel carries savings into capital markets. And an asset-class home bias toward deposits combines with low financial literacy (Lusardi and Mitchell, 2014). These mechanisms explain why the base has been stable, but an equilibrium is a balance of forces rather than a law. The catalysts examined in Sections 3 and 4 are now bearing on the household side at the same time, and the predominantly overnight composition of the base means that once the balance tips, the adjustment need not be gradual.

### 3. The consumption and decumulation channel

The household deposit base does not replenish itself automatically. It grows when the working population saves out of wage income and shrinks when households consume out of accumulated balances, and demographics with a progressively aging population are now tilting that against the banks, slowly but irreversibly.

The retired cohort is the visible part of the channel. The Distributional Wealth Accounts place deposits held by retired households at approximately EUR 8.4 billion, or 26.3 percent of the stock, and these households are in the decumulation phase of the life cycle. The pace of that decumulation is the decisive parameter, and it is slower than the simple life-cycle theory predicts. The empirical literature on the retirement-consumption puzzle documents that retirees draw down financial wealth slowly, holding it against health and long-term-care costs and for bequests. In Slovenia, the tendency is reinforced because the elderly own their homes outright, so housing costs do not force decumulation, and the pay-as-you-go pension covers routine living costs for the median retiree. The deposit balance functions as a precautionary buffer rather than as spending money. A reasonable working assumption is that over a 20-to-25-year horizon, only a minority of the EUR 8.4 billion retiree pool is consumed, on the order of EUR 3 to 4 billion, with the larger part remaining a buffer that is ultimately bequeathed.

Where the consumed part goes matters for the banks. When a retiree spends a deposit, the balance passes to a domestic firm, where it becomes a corporate deposit that is larger, more rate-sensitive, and less stable than a household deposit, or it passes abroad through imported goods and services. The bequeathed part passes to heirs aged roughly 40 to 60, who may retain it as a deposit or redirect it into investment vehicles, which connects this channel to the portfolio shift of Section 4.

The quieter part of the channel is the workforce. The working-age population is projected to decline by approximately 0.5 percent per year over the next two

decades (European Commission, 2024). Fewer workers means a slower flow of new wage-based saving into deposits, and the household-sector saving rate also tends to fall as the age structure shifts toward retirement. The base loses inflow at the same time as the retired cohort that draws on it grows.

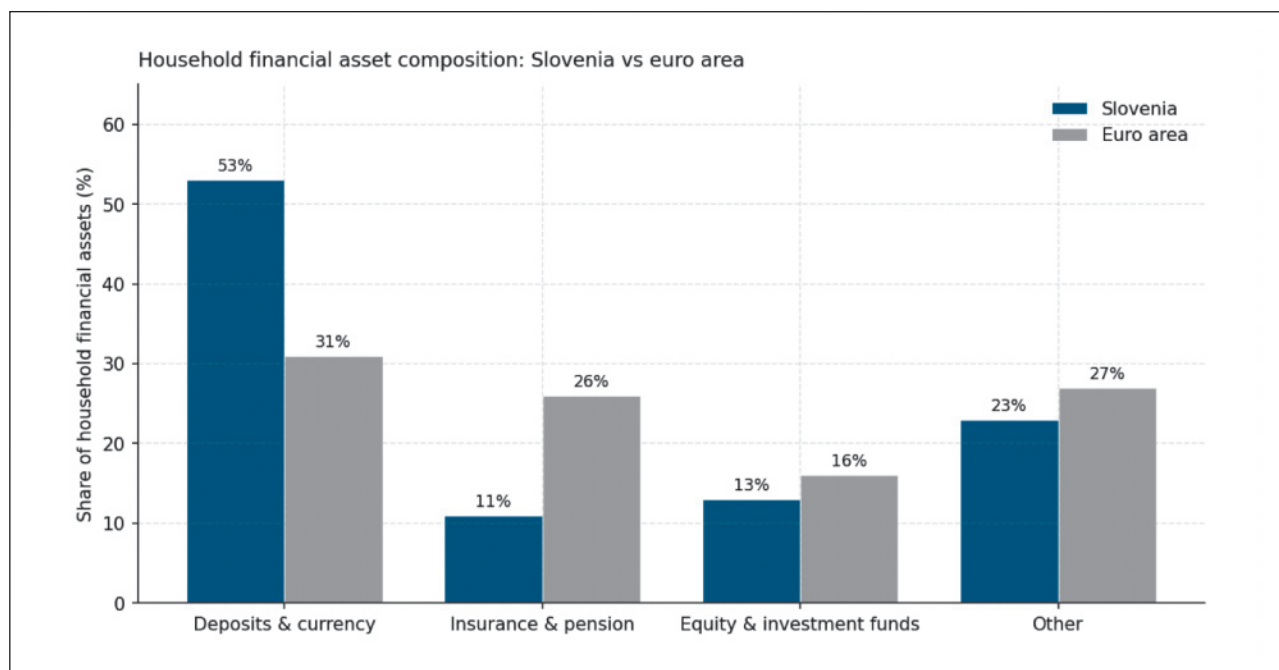
The catalyst for this channel is demographic. It is not a policy choice and cannot be reversed by any instrument available to a central bank or a finance ministry. Its economic potential is a slow structural drain rather than a run. Over a generation, the magnitude is the consumed portion of the retiree pool, on the order of EUR 3 to 4 billion, together with the foregone growth the base would have enjoyed from an expanding workforce. For the banks, the significance is not a sudden loss but a sinking floor, as a deposit base that has grown reliably for two decades stops growing and begins to contract from the demographic side alone.

### 4. The portfolio-shift channel

The second channel is faster than the first and, unlike it, is policy based. It operates when households move deposits into financial assets that offer a non-negative real return. The driving force is the return gap itself, since the composite deposit earns approximately negative 1.77 percent in real terms while a balanced portfolio earns roughly positive 2 percent, a differential close to 3.77 percentage points. What has changed over the past year is that the institutional means to act on that gap have arrived. As shown in Figure 1, the Slovenian household financial portfolio held 53 percent of its assets in deposits at the end of 2025, against a euro area average of 31 percent, and 11 percent in insurance and pension claims against a euro area average of 26 percent. The distance between the Slovenian portfolio and the euro area norm is the space into which deposits can move.

There are four drivers of this channel. The first and most direct is the Individual Investment Account, introduced on 5 March 2026, which exempts holdings from taxation during the holding period, grants full exemption after fifteen years, and caps lifetime contributions at EUR 150,000. Its design mirrors the Swedish *Investeringssparkonto* and the United Kingdom Individual Savings Account, with the Hungarian “*Tartós Befektetési Számla*” the closest central-European analogue (Magyar Nemzeti Bank, 2025). Take-up has been strong in the western templates, with approximately 9.3 million UK ISA subscribers in the first year of the scheme (HM Revenue and Customs, 2020) and roughly one-fifth of the Swedish population within three years of the launch of the ISK (Riksdagen, 2018), but considerably

Figure 1. Household financial asset composition, Slovenia versus the euro area, end of 2025.



Source: ECB Quarterly Sector Accounts (European Central Bank, 2026a).

slower in the central-European cases. The Polish “Indywidualne Konto Emerytalne”, which is retirement-locked and capped at a much lower contribution level, holds under one million active accounts after twenty years (Komisja Nadzoru Finansowego, 2025). A take-up that tracks the central-European pace rather than the western European one gives approximately 80,000 to 150,000 accounts within five years, and with a per-account contribution drawn substantially from existing balances of approximately EUR 30,000 to 40,000 (a level consistent with the Swedish per-account stock by the end of the third year), the implied stock conversion is EUR 3 to 5 billion over five to seven years. The second catalyst is the European Savings and Investments Union (European Commission, 2025), which widens the menu of investment options and adds an expected recommendation for default enrolment in retirement savings. For a small open economy, the strategy is structurally asymmetric, since it lowers the cost of Slovenian savings flowing to lower-cost fund platforms in Luxembourg or Ireland by more than it raises the supply of capital to Slovenian issuers, so it catalyses the shift and biases it toward genuine outflow. The third catalyst is the prospect of a mandatory funded pension pillar, which does not move the existing stock directly but diverts new wage-based saving away from deposit accumulation, with indirect deposit displacement on the order of EUR 4 billion over twenty-five years. The fourth is the negative real return itself, which becomes harder to ignore the longer it persists.

The economic potential of the channel depends on how much of the shift leaves the domestic system. A purchase of a domestically issued security or a domestically held fund keeps the money in a Slovenian bank even as the household deposit base falls, while a purchase of a foreign asset or a foreign-domiciled fund removes it entirely, and because the Savings and Investments Union makes the foreign route cheaper, a material part of this channel is genuine outflow. Taken together, the catalysts could move EUR 5 to 12 billion of the existing stock over a 10 to 25-year horizon. This is the larger part of the total risk, and it can act faster than the demographic channel because the incentive is sharp and the catalysts are concrete and recent.

### 5. The banking sector risk

This section develops the cost to the banking sector of the deposit outflow that the two channels generate, using a bank-type-specific convex cost model. The exercise is a computational one. Its inputs are calibrated to the most realistic values the available data allow, but its outputs are indicative orders of magnitude rather than precise forecasts and should not be over-interpreted. If deposits flow out, a bank faces two simultaneous costs. Under the funding replacement channel, a fraction  $\alpha_i$  of lost deposits is replaced with wholesale funding at a rate  $r_{W,i}$  above the deposit rate  $r_D$ , raising funding costs. Under the balance sheet shrinkage channel, the remaining fraction  $(1 - \alpha_i)$

is lost lending volume and the foregone intermediation margin ( $r_L - r_D$ ). A convex term  $\gamma_i(\Delta D_i)^1$  captures the non-linearities from an upward-sloping wholesale supply curve, repricing regime shifts, and regulatory threshold effects. The profit loss for the bank type  $i$  facing an outflow  $\Delta D_i$  in EUR billions is

$$\Delta\pi = c_i \cdot \Delta D_i - \gamma_i(\Delta D_i)^2, \quad c_i = \alpha_i (r_L - r_{W,i}) - (r_L - r_D)$$

where the deposit spread  $r_L - r_D = 3.00\% - 0.23\% = 2.77\%$  is the margin a bank earns on each euro of deposit-funded lending. The three bank types replace lost deposits with very different success, as Table 2 shows.

Each parameter reflects the type's funding profile. The replacement share  $\alpha$ , the fraction of an outflow refinanced in wholesale markets, is 0.80 for Type B thanks to parent-group liquidity lines, 0.75 for Type A through covered-bond and senior unsecured programmes, and 0.10 for Type C, which lacks both. The wholesale rate  $r_W$  is 2.40 percent for B and 2.60 percent for A, modest spreads over the ECB deposit facility rate of 2.00 percent. Type C's  $r_W$  of 4.00 percent reflects a 200 basis point spread for a small unrated issuer. Since this exceeds the lending rate of 3.00 percent, every euro replaced loses money on the margin, which is precisely why  $\alpha$  is set at 0.10. The convexity  $\gamma$  rises from 0.25 for B and 0.35 for A to 2.00 for C, reflecting C's tighter capital headroom and

escalating issuance costs at scale. The linear coefficient  $c$  follows by construction, dominated by the lost-lending term  $r_L - r_D = 2.77$  percent, giving values of -2.47, -2.29, and -2.87. The calibration draws on Bank of Slovenia (2025a) for the funding structure of the three bank types, on FDIC (2020) for the scale economies and wholesale-funding constraints that anchor Type C's high  $\gamma$  and low  $\alpha$ , and on iBoxx EUR Banks Senior spreads in the first quarter of 2026 (S&P Global, 2026), together with the ECB deposit facility reference rate (European Central Bank, 2026b) for the  $r_W$  levels. The system loss is the sum of the three per-type losses. A cumulative outflow  $D$  is taken to fall on Types A, B and C in shares of roughly 35, 50, and 15 percent, reflecting that the deposits most likely to move are held by the wealthier households who bank disproportionately at the larger Type A and Type B institutions. Summing the per-type responses under this distribution, the system profit loss at a cumulative outflow of  $D$  billion euros is approximated by  $y(D) = 24.4D + 0.15D^2$  in EUR million. The split is an assumption rather than an observed quantity, so  $y(D)$  remains an indicative magnitude consistent with the per-type model. Table 3 reports the result against a normalised system profit of approximately EUR 950 million, a level set between the 2024 net profit of EUR 1,075 million and the 2025 net profit of EUR 882 million as the interest margin normalises with declining policy rates (Bank of Slovenia, 2025b).

**Table 2. Bank-type parameters for the convex cost model.**

Parameter	Type A (large domestic, 30%)	Type B (foreign-owned, 45%)	Type C (small and niche, 25%)
Replacement share $\alpha$	0.75 [0.65, 0.85]	0.80 [0.70, 0.90]	0.10 [0.05, 0.15]
Wholesale rate $r_W$ (%)	2.60 [2.10, 3.10]	2.40 [1.90, 2.90]	4.00 [3.00, 5.00]
Convexity $\gamma$	0.35 [0.18, 0.53]	0.25 [0.13, 0.38]	2.00 [1.00, 3.00]
Linear term $c$ (pp)	-2.47 [-2.86, -2.01]	-2.29 [-2.70, -1.78]	-2.87 [-3.07, -2.77]

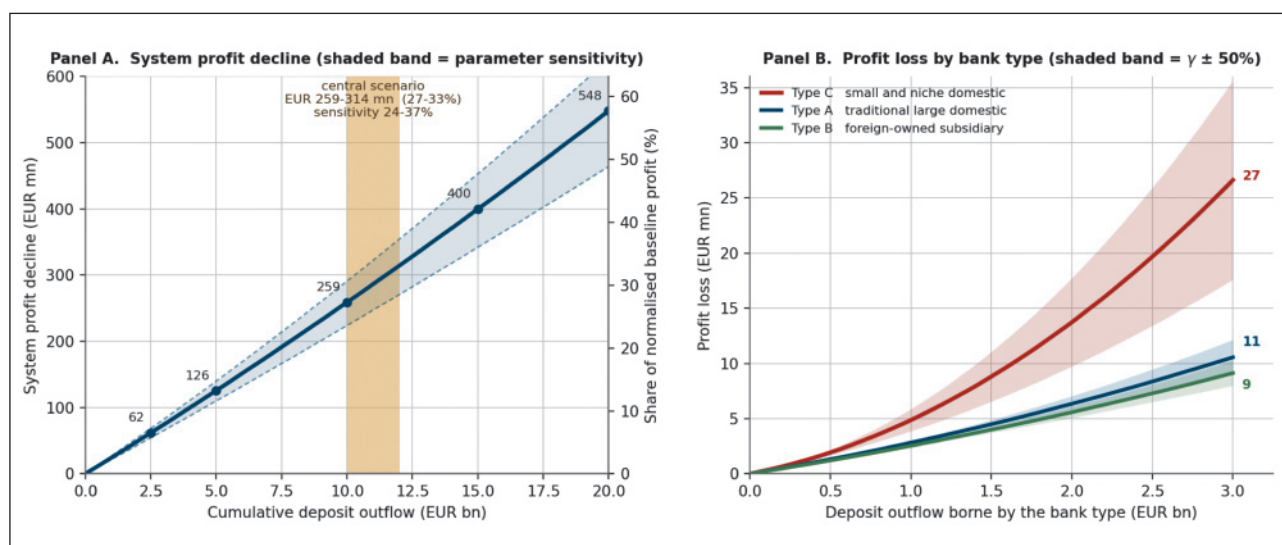
Brackets show the sensitivity ranges used in Section 5, with  $\alpha$  varied by  $\pm 0.10$ ,  $r_W$  by  $\pm 50$  basis points ( $\pm 100$  for Type C),  $\gamma$  by  $\pm 50$  percent of the base value, and following from joint variation of  $\alpha$  and  $r_W$ . Source: Author calibration based on European Central Bank (2026b), Bank of Slovenia (2025a, 2025b), iBoxx EUR Banks Senior (S&P Global, 2026), and FDIC (2020).

**Table 3. System profit decline by cumulative deposit outflow.**

Cumulative outflow	System profit decline	Percent of EUR 950 mn baseline
EUR 2.5 billion	EUR 62 million [55, 69]	6.5 percent [5.8, 7.3]
EUR 5 billion	EUR 126 million [110, 140]	13.3 percent [11.6, 14.7]
EUR 10 billion	EUR 259 million [224, 291]	27.3 percent [23.6, 30.6]
EUR 15 billion	EUR 400 million [342, 453]	42.1 percent [36.0, 47.7]
EUR 20 billion	EUR 548 million [464, 626]	57.7 percent [48.8, 65.9]

Brackets show the sensitivity range, namely  $y(D) = 21.6 D + 0.08 D^2$  at the cost-minimising end of the joint parameter variation and  $y(D) = 26.9 D + 0.22 D^2$  at the cost-maximising end. Source: Author calculations from the convex cost model.

Figure 2. The banking sector cost of a deposit outflow.



Panel A traces the system profit decline against cumulative outflow, with the EUR 10 to 12 billion central scenario shaded and the right axis showing the share of the normalised baseline profit. Panel B traces the profit loss for each bank type against the outflow the type itself absorbs, and places the small and niche domestic banks on a markedly steeper and more convex path than the large and foreign-owned banks. Source: Author calculations from the convex cost model.

Figure 2 presents this schedule in Panel A and shows in Panel B how unevenly the same outflow falls across the three bank types.

The two outflow channels feed this cost on different scales. The consumption channel of Section 3 is a slow drain, on the order of EUR 3 to 4 billion of consumed retiree balances over the horizon, near EUR 90 million per year spread across decades. The portfolio-shift channel of Section 4 is the larger contributor, with the potential to move EUR 5 to 12 billion. Combining the slow consumption drain with a mid-range outcome for the larger portfolio shift, a realistic central scenario for cumulative outflow over a generation is EUR 10 to 12 billion, giving a system profit decline of approximately EUR 259 to 314 million per year, or roughly 27 to 33 percent of the normalised baseline. This range is a model output conditional on the calibration and the outflow scenario, best read as an order of magnitude. Each parameter is itself uncertain. Varying the replacement share  $\alpha$  by  $\pm 0.10$  of its base value, the wholesale rate  $r_w$  by  $\pm 50$  basis points for Types A and B and  $\pm 100$  basis points for the less certain Type C, and the convexity  $\gamma$  by roughly  $\pm 50$  percent of its base value, each single-parameter perturbation shifts the central scenario by at most 2 to 3 percentage points around the 27 to 33 percent baseline. The dominant single-parameter sensitivity is to  $\gamma$  for Type B, since Type B carries the highest weight in the convex term. Type C's wholesale rate, the least certain calibration, shifts the headline by less than one percentage point alone, because Type C takes only 15 percent of the outflow.

The linear coefficient is determined by  $\alpha$ ,  $r_w$ , and the spreads, so its sensitivity is the joint sensitivity to those.

Taken together, across joint variations that move all parameters to the cost-maximising end of their bands, the central scenario rises to about 31 to 37 percent of baseline, and at the cost-minimising end it falls to about 24 to 28 percent, so the 27 to 33 percent point estimate sits near the middle of a 24 to 37 percent range. Spread over a 10 to 25 year horizon it is a substantial but not an existential cost for the system as a whole, and the qualifier conceals a sharp distributional problem.

The distributional problem is that the three bank types do not share the cost in proportion to their size, as Panel B of Figure 2 shows. Because the outflow falls mainly on Types A and B, the direct customer loss is concentrated at the banks best able to absorb it, while the small Type C banks face less direct outflow but are the most exposed, since their trigger is repricing competition for the residual stock. As deposits leave the system, banks raise rates on the deposits that remain in order to stem further outflow, which is the deposits channel of Drechsler, Savov, and Schnabl (2017) running in reverse, and it is self-amplifying. A repricing of 25 basis points on a residual stock of EUR 18 billion transfers approximately EUR 45 million per year from shareholders to depositors. For Type A and Type B this is a margin reduction, but for Type C, which cannot replace lost volume and operates closer to its capital thresholds, the same repricing is a threat to viability at outflows above approximately EUR 5 billion.

The Type C problem is not contained within the banking system. Small and niche domestic banks are the principal lenders to the regional small and medium-sized enterprises they serve, and if they contract lending in response to margin compression, those firms face a credit supply reduction that the larger banks, with different risk appetites and lending processes, do not readily fill. The concurrent wave of artificial-intelligence-driven cost reduction in banking offers a partial offset, but it is concentrated in Types A and B and so widens rather than narrows the competitive gap (Morgan Stanley, 2025). A deposit outflow that is manageable for the banking system as an aggregate can therefore still impose a real cost on small-enterprise financing through the weakest segment of the system, and any policy response has to be accompanied by explicit small-enterprise credit safeguards.

#### 6. The other side of the ledger and the implications

The pressures developed here are sometimes discussed as a problem to be resisted, but they are not. The outflow that costs the banks is, from the household side, an escape from a guaranteed loss of purchasing power. A household moving EUR 1 billion in aggregate from deposits to a balanced portfolio earns approximately EUR 38 million per year of additional real return at the 3.77 percentage point differential, so a realistic mobilisation of EUR 10 to 12 billion generates a gross household gain on the order of EUR 380 to 450 million per year. Set against the EUR 259 to 314 million banking sector cost developed in Section 5, the gain to the households who own the deposits exceeds the cost to the banks that hold them, and the societal balance of the reallocation is positive before any account is taken of the further retirement income that a funded pension pillar would build. The implication is not that the banks should welcome the outflow but that they cannot expect the stickiness of the base to hold, because the force pressing against it is the rational self-interest of the households that own the deposits. The risk is structural, not cyclical, and it will not dissipate on its own.

A structural risk calls for a structural response. For bank management, the first element is funding diversification, since a base that is 86 percent overnight offers no buffer against an outflow, and banks have an interest in lengthening the maturity structure of their deposits and developing covered bond and wholesale funding capacity before they need it. The second is a deliberate deposit-pricing strategy, because the repricing dynamic is most damaging when it is reactive. The third is the small-bank question, since the analysis suggests the status quo funding model is not robust for Type C banks, and that

consolidation or a deliberate shift to a different funding model is the realistic path.

For supervisors, the analysis suggests four priorities. The first is monitoring deposit migration and the residual-stock repricing dynamic, which is the early-warning indicator of the self-amplifying phase. The second is attention to Type C viability, since the system-level numbers conceal the segment where the outflow is genuinely dangerous. The third is small-enterprise credit, where guarantee programmes through SID banka or pooled securitisation vehicles can offset a Type C lending contraction. The fourth is sequencing, since the outflow spread over a 10 to 25 year horizon is an adjustment the system can absorb only if it is anticipated and phased. If a mandatory funded pension pillar is introduced as one of the catalysts, the institutional safeguards that the Croatian experience identifies (HANFA, 2025), namely constitutional protection of fund assets, governance insulated from political cycles, and separation of transition financing from regular fiscal accounting, are the conditions under which the catalyst strengthens the financial system rather than destabilising it.

#### 7. Conclusion

The Slovenian banking system rests on a household deposit base of approximately EUR 28 billion that is cheap, predominantly overnight, and concentrated on wealthy, working, and home-owning households. With a loan-to-deposit ratio below 70 percent against the euro area aggregate near 105 percent, the system sits at the deposit-funded extreme of the Union, and the self-reinforcing equilibrium that has held the base in place is not permanent. There are two potential structural pressures. One, the consumption channel is a slow demographic drain, as an ageing population decumulates savings and a contracting workforce slows the formation of new deposits. Second, the portfolio-shift channel is faster and policy-catalysed, set in motion by the Individual Investment Account, the European Savings and Investments Union, and the prospect of a mandatory funded pension pillar, and it has the potential to move EUR 5 to 12 billion of the deposit stock.

In the calibrated simulation developed here, a realistic combined outflow of EUR 10 to 12 billion over a generation would reduce system profit by roughly 27 to 33 percent of a normalised baseline. That figure is an indicative magnitude rather than a precise forecast and should not be over-interpreted, though its direction and scale are robust. The cost is feasible for the system as an aggregate over a long adjustment horizon, but it falls hardest on the small domestic banks that cannot replace

deposit funding and on the small enterprises that depend on them. The outflow is, for households, an escape from a negative real return, so the pressure is economically rational and structural, and the banking system cannot expect it to fade. The appropriate response is not to resist the outflow but to prepare for it through funding diversification, a deliberate pricing strategy, attention to the small-bank segment, and supervisory safeguards for small-enterprise credit. The cost of an unanticipated adjustment far exceeds the cost of a prepared one.

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# Stablecoins and the changing landscape of money, banking and finance

*Vasja Rant\**

The article discusses the emergence of stablecoins within the broader transformation of finance toward tokenised and programmable infrastructures and examines their implications for the banking system, financial intermediation, financial markets and the architecture of the monetary system. While tokenisation of finance promises efficiency gains, stablecoins could disrupt the traditional financial system through deposit substitution, narrow-banking dynamics and the reinforced role of the U.S. dollar within tokenised finance, while potentially undermining the singleness, elasticity and integrity of money. The article argues that stablecoins should be understood not merely as a new category of crypto-assets, but as part of a broader structural transformation of monetary and financial systems. It additionally concludes that emerging EU and U.S. regulatory responses increasingly reflect competing institutional visions regarding the future relationship between public and private money within tokenised finance.

JEL E42, E44, E51, G21, G28, O33

## 1. Introduction

The rapid growth of stablecoins in recent years has triggered growing interest among central banks, regulators and the broader financial community. Initially developed primarily to facilitate trading within crypto markets, stablecoins increasingly act as a bridge between tokenised (on-chain) and traditional (off-chain) finance, with their use gradually expanding toward international payments and potentially also retail payments. At the same time, policymakers and traditional financial actors are increasingly exploring how programmable financial infrastructures based on distributed-ledger technologies (DLT) and tokenization of assets may reshape the organization of money, payments and financial intermediation.

These developments raise broader questions extending far beyond the crypto-asset ecosystem itself. Because stablecoins are increasingly able to perform the basic functions of money, they may affect banks, financial markets and the architecture of the monetary system more broadly. Since they are issued by private entities operating largely outside the traditional regulatory perimeter of the two-tier banking system, they raise important questions regarding financial stability, the future relationship between public and private money, and the role of central bank infrastructures within tokenised finance. At the same time, the rapid growth and

dominance of USD-denominated stablecoins could have important implications for monetary sovereignty in the euro area and for the future international role of the U.S. dollar within increasingly tokenised financial systems.

Against this background, the article addresses four inter-related questions: what are stablecoins and tokenised finance; what implications they may have for the traditional financial system; how this could affect the future architecture of the monetary system; and how regulators and policymakers are responding to these developments. The central argument of the article is that stablecoins should be understood not merely as a new category of crypto-assets, but as the first large-scale tokenised monetary instruments linking emerging on-chain finance with traditional financial systems.

The remainder of the article is organized as follows. The second section discusses the emergence of stablecoins and the broader transformation toward tokenised finance. The third section analyses the implications of stablecoins for the banking system and financial markets. The fourth section examines the relationship between stablecoins and the traditional two-tier monetary system, focusing particularly on the singleness, elasticity and integrity of money. The final section discusses emerging institutional and regulatory responses, with particular attention devoted to the differing European and American approaches toward tokenised finance and public digital money.

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## 2. Stablecoins and the emergence of tokenised finance

### 2.1 Stablecoins as tokenised private money

Stablecoins emerged in recent years as a distinct and rapidly growing category of crypto assets, reaching a market capitalization of USD 317 billion in early May 2026 (Learner et al., 2026). Stablecoins are digital tokens,<sup>1</sup> issued by private entities on public blockchains.<sup>2</sup> Their defining feature is their aim to maintain a stable nominal value relative to a reference asset or basket of assets, most commonly fiat currencies, but also other financial assets, crypto-assets or commodities. This distinguishes them from native crypto-assets such as Bitcoin, whose value is determined endogenously, without an explicit stability mechanism or link to another asset (Adrian et al., 2025).

Stablecoins can broadly be categorised based on the mechanism used to maintain par value relative to the reference asset. *Asset-backed stablecoins* account for the vast majority of all stablecoins and maintain their peg through reserve assets, with fiat-backed stablecoins, particularly those linked to the US dollar, representing the overwhelmingly dominant segment of the market. Fiat-backed stablecoins are typically backed on a 1-to-1 basis by high-quality

reserve assets, particularly short-term government bonds, denominated in the currency of the peg. A second, considerably smaller category consists of *algorithmic stablecoins*, which attempt to maintain stable value through algorithms managing the supply and demand of the stablecoin itself rather than through reserve backing. The collapse of Terra/LUNA in 2022 highlighted the fragility of such models and accelerated the shift toward reserve-backed stablecoins (Adrian et al., 2025).

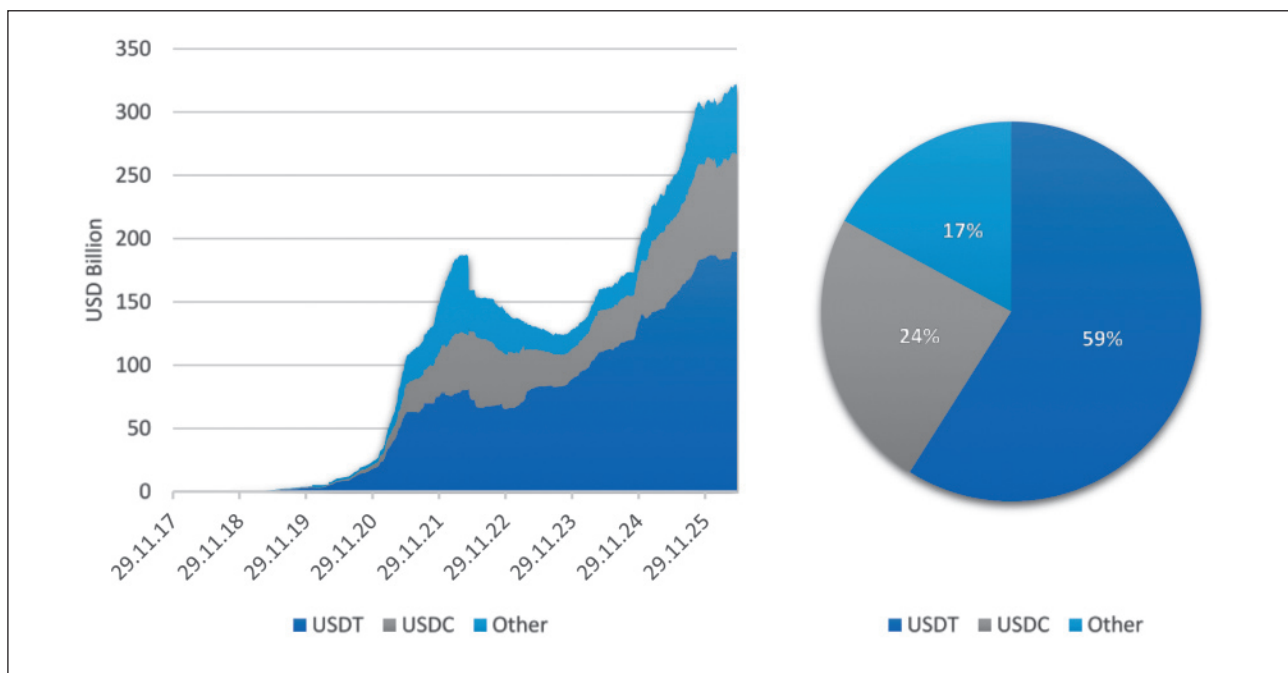
A key significance of stablecoins lies in their role as payment instrument, settlement asset and store of value for liquidity management within the crypto ecosystem, effectively making them a form of private tokenised money. While their current use remains concentrated within the crypto world, stablecoins are increasingly emerging as instruments for cross-border payments. Furthermore, traditional payment service providers and platforms are gradually beginning to integrate stablecoin-based payment functionalities into existing payment infrastructures, potentially expanding their use toward retail (merchant) payments (Bindseil, 2026).

As shown in Figure 1, the stablecoin market is highly concentrated, with USD-denominated stablecoins accounting for 99% of total stablecoin supply in circulation and the two largest stablecoins, Tether (USDT) and USD Coin (USDC), representing close to 85% of total market capitalization (Learner et al., 2026). The dominance of USD-backed stablecoins exceeds the global role of the US dollar in international trade, foreign exchange transactions

<sup>1</sup> Digital tokens are digitally represented units recorded and transferred on blockchain or other distributed-ledger infrastructures that can represent value, ownership, financial claims or access rights.

<sup>2</sup> Blockchains are the dominant form of distributed ledger technology (DLT) in which transactions are grouped into cryptographically linked blocks forming a chronological and largely immutable chain of records. The ledger is decentralized, shared and synchronized across network participants, eliminating the need for centralized record-keeping and data reconciliation.

Figure 1: Growth of stablecoin market capitalization and USDT and USDC market shares (22.5.2026)



Source: DeFillama

and foreign exchange reserves. This reflects a structural advantage of the US dollar as a basis for stablecoin issuance, stemming from the depth and liquidity of the U.S. Treasury market, as U.S. Treasuries, reverse repos and cash constitute the primary reserve assets of both major USD-backed stablecoin issuers. At the same time, network externalities in the use of USD-backed stablecoins may reinforce their dominance and further strengthen the international role of the US dollar. The growing scale of the USD stablecoin market implies that stablecoin issuers have already become significant buyers of U.S. government debt, comparable in size to large money market funds or major foreign sovereign holders (Aerts et al., 2025). Their systemic relevance is likely to increase further in the coming years, with the stablecoin market projected to expand to USD 2-3 trillion by 2028-2030; Learner et al., 2026; Rey, 2025).

## 2.2 Stablecoins and the broader tokenization of finance

The rise of stablecoins should be understood within the broader transformation of financial system infrastructure toward tokenised finance. In this context, stablecoins are not merely a new category of crypto-assets, but increasingly represent a monetary layer interacting with tokenised financial assets, market infrastructures and settlement processes. While early discussions around stablecoins focused primarily on crypto trading, their role has gradually expanded toward serving as settlement assets, liquidity instruments, and collateral mechanisms within broader on-chain financial ecosystems.

Tokenization refers to the process of creating digital representations of financial or real-world assets on programmable digital infrastructures, most commonly based on distributed ledger technology (DLT). Unlike conventional financial systems, where security issuance, trading, clearing, settlement, and custody are typically organised across separate institutional entities that require reconciliation across multiple ledgers, tokenised finance aims to integrate these functions on shared programmable infrastructures. Such infrastructures may simultaneously host different forms of money, financial assets, and settlement applications (BIS & CPMI, 2024).

The technological significance of DLT infrastructures lies not merely in the digitalization of assets, but in functionalities such as programmability, interoperability and composability. Programmability allows transactions and transfers to be automatically executed when predefined conditions are met through smart contracts. Interoperability enables different infrastructures, tokens and applications to exchange in-

formation and interact with one another, while composability allows new financial services and applications to be built and combined on top of shared programmable infrastructures. These features create the possibility of more integrated financial architectures in which money, settlement and financial assets coexist within common digital infrastructures.

One of the most frequently highlighted implications is the possibility of atomic settlement, whereby transfers of assets and payments occur simultaneously within a single integrated process. In traditional finance, settlement often requires multiple intermediaries, reconciliation procedures and time delays across separate ledgers. Tokenised finance, by contrast, may enable delivery-versus-payment transactions to be executed in near real time, potentially reducing counterparty risks, operational frictions and settlement costs by compressing intermediation chains. In addition, DLT-based infrastructures may facilitate continuous 24/7 market operation and more efficient collateral management (BIS & CPMI, 2024; GFMA, 2026)

These developments are increasingly extending beyond crypto-native markets into mainstream finance. Tokenization initiatives have expanded toward government bonds, equities, and money-market fund shares. Such tokenised securities digitally represent claims on traditional securities while enabling transfers and settlement on DLT-based systems. At the same time, central banks, commercial banks and financial market operators, such as exchanges, custodians, central securities depositories (CSDs) and settlement networks, are experimenting with central bank digital currencies (CBDCs), tokenised deposits and DLT-based settlement systems as potential monetary and settlement layers for future tokenised financial markets (GFMA, 2026; Maechler, 2025).

Within this broader transformation, stablecoins currently occupy an important position because they became the first large-scale tokenised monetary instruments operating across DLT networks in the absence of wider adoption of other forms of tokenised money, such as CBDCs and tokenised deposits. Initially created primarily to support crypto trading, stablecoins increasingly function as transactional and settlement assets within broader tokenised financial ecosystems, including tokenised securities transactions, fund subscriptions, and collateral-related operations. In this sense, stablecoins are not a peripheral crypto phenomenon. They effectively link emerging on-chain finance with traditional off-chain financial systems, accelerating the broader integration of tokenised finance with mainstream financial markets and institutions (GFMA, 2026).

### 3. Implications of stablecoins for traditional finance

#### 3.1 Stablecoins and the banking system

The growing use of stablecoins raises broader questions regarding the future structure of financial intermediation and the role of commercial banks within the monetary system. Traditionally, commercial bank deposits have occupied a central position in modern financial systems by simultaneously functioning as payment instruments, liquidity and savings instruments, and a primary funding source for bank lending. Stablecoins, particularly if increasingly integrated into broader payment and tokenised financial infrastructures, may gradually begin competing with some of these functions.

The first major implication concerns the possibility of *deposit substitution*. The extent of such substitution depends importantly on the design and functionality of stablecoins themselves. Non-interest-bearing stablecoins may primarily function as transactional instruments facilitating payments, liquidity management, and settlement within tokenised financial ecosystems. Their implications for bank intermediation may therefore remain relatively limited if their use is concentrated primarily in transactional balances. Interest-bearing stablecoins, however, could increasingly compete not only with bank deposits, but also with money market funds and other short-term savings instruments. In a scenario of widespread stablecoin adoption, parts of household and corporate liquidity could migrate away from the traditional banking system toward tokenised monetary instruments operating outside conventional bank balance sheets. Alternatively, competitive pressures from stablecoins may induce banks to raise deposit interest rates in order to retain retail funding (Wang, 2025).

Deposit substitution could in turn contribute to forms of *credit disintermediation*. Since commercial banks rely heavily on retail deposits as a stable and relatively low-cost funding source, large-scale migration toward stablecoins could increase dependence on wholesale funding and potentially constrain credit creation through more expensive and less stable funding structures. More fundamentally, tokenised finance may contribute to a gradual *functional unbundling* of banking by separating payments, settlement and liquidity provision from traditional banking functions of credit intermediation and maturity transformation, thereby weakening banks' role in qualitative asset transformation. Stablecoins and tokenised financial infrastructures could therefore potentially reshape the process of financial intermediation rather than merely compete with deposits (Wang, 2025).

Such developments may contribute to forms of *narrow banking dynamics* in which privately issued tokenised

money outside the regulated banking system, backed primarily by safe liquid assets such as short-term government securities, shifts financial intermediation away from bank-based credit provision to the non-financial sector toward financing government debt. Since the overwhelming majority of stablecoins are USD-backed and invest predominantly in U.S. government securities, increased stablecoin use within the euro area could therefore redirect parts of domestic savings and liquidity from euro-area credit intermediation toward financing U.S. government debt (Bindseil, 2026; Wang, 2025).

Proliferation of stablecoins could also increase *financial and banking-system instability*. Unlike commercial banks, stablecoin issuers lack direct access to central bank liquidity facilities, deposit insurance schemes and other public backstops supporting confidence in the banking system. Their stability therefore depends heavily on confidence in the issuer's operational resilience, the quality and liquidity of reserve assets, and the credibility and transparency of redemption arrangements and reserve custody. Under stressed conditions, concerns about these elements could generate rapid redemption pressures and destabilising stablecoin runs, particularly given the speed and continuous operation of digital financial infrastructures. To the extent that stablecoin issuers maintain links to bank balance sheets through wholesale deposits or other banking exposures, stablecoin runs could also transmit instability into the banking system itself (Adrian et al., 2025; Aerts et al., 2025).

These risks should nevertheless be weighed against the potential efficiency gains associated with stablecoins and tokenised money. Programmable settlement, atomic transactions, continuous market operation and greater integration of payments with financial transactions could improve settlement efficiency, collateral mobility and cross-border payments. The challenge for regulators and financial institutions is therefore not simply whether tokenised money should emerge, but rather which forms of tokenised money will become integrated into the future tokenised financial system and under what institutional arrangements.

One important banking-system response to stablecoins has been the emergence of tokenised deposits, which seek to preserve the role of commercial bank money within tokenised financial ecosystems. These instruments could potentially allow banks to participate in tokenised finance while remaining integrated into existing banking regulation, central bank settlement infrastructures and the traditional two-tier monetary system linking commercial bank money to central bank reserves and public backstops. More broadly, the growing discussion surrounding central bank digital currencies and tokenised deposits reflects a fundamental ques-

tion regarding the future of tokenised finance. Namely, whether its monetary layer will primarily rely on privately issued stablecoins operating outside the traditional two-tier banking system or remain anchored in established forms of public (central bank) and private (commercial bank) money (GFMA, 2026; Maechler, 2025).

### 3.2 Stablecoins and financial markets

The implications of stablecoins extend beyond banking intermediation toward reserve asset markets and the broader organization of global financial markets. Since USD-denominated stablecoins invest predominantly in short-term U.S. government securities, their continued growth may reinforce structural demand for U.S. safe assets and strengthen the role of the dollar within tokenised finance. Emerging empirical evidence suggests that stablecoin inflows can compress short-term Treasury yields, while large outflows could amplify stress in Treasury and repo markets. As tokenised finance expands, and if stablecoins increasingly evolve into a settlement, liquidity and collateral layer for tokenised financial ecosystems, the dominance of USD-denominated stablecoins could contribute to the gradual migration of liquidity, collateral management and settlement activity toward dollar-denominated tokenised financial networks (Aerts et al., 2025; Rey, 2025).

These developments additionally highlight important structural asymmetries between the US and European financial systems. Unlike the United States, the euro area lacks a large unified safe asset market comparable in scale, liquidity and institutional role to the U.S. Treasury market, reflecting the absence of a fiscal union and a fully integrated capital markets union. This potentially limits the scalability, liquidity and attractiveness of EUR-denominated stablecoins and market-based euro tokenised liquidity networks relative to their USD-denominated counterparts. In this sense, tokenised financial architectures centred primarily around privately issued stablecoins may reinforce existing asymmetries between US and European financial systems. The European response to tokenised finance should therefore differ structurally from the American approach by relying more strongly on public money, regulated intermediaries and central bank settlement infrastructures as anchors of trust and as the monetary and settlement foundation of tokenised financial ecosystems.

## 4. Stablecoins and the future architecture of the monetary system

### 4.1 Stablecoins and the two-tier monetary system

Modern monetary systems are based on a two-tier structure combining public money issued by the central bank with private money issued by commercial banks. Central bank

money, consisting primarily of reserves and cash, functions as the ultimate settlement asset and anchor of trust within the monetary system, while commercial bank deposits provide the dominant form of money used by households and firms in everyday economic activity. The coexistence of public and private money allows the monetary system to combine the stability and credibility of central bank money with the elasticity of bank-based credit creation and financial intermediation.

The functioning of this system depends on a broader set of institutional and regulatory arrangements that underpin the singleness, elasticity and integrity of money (BIS, 2025). Singleness refers to the principle that different forms of money denominated in the same currency remain seamlessly interchangeable at par value regardless of the issuing institution. Within the current two-tier monetary system, singleness is guaranteed through commercial banks' access to central bank reserves as the ultimate settlement asset. It is additionally supported by confidence in commercial banks and the banking system, which is reinforced through deposit insurance and multiple layers of prudential regulation and supervision, including capital and liquidity requirements, leverage rules, resolution frameworks and supervisory oversight. Elasticity refers to the ability of the monetary system to expand liquidity and credit in response to the needs of the economy. Within the current two-tier system, this is achieved primarily through fractional-reserve commercial banking within prudential constraints designed to limit excessive risk-taking. Integrity in money and payment systems encompasses the prevention of fraud and other illicit activities through effective regulatory and compliance frameworks, including know your customer (KYC), anti-money laundering (AML) and countering the financing of terrorism (CFT) safeguards (Maechler, 2025; McLeay et al., 2014).

Against this background, stablecoins and tokenised finance potentially challenge important features of the traditional monetary architecture. Unlike commercial bank deposits, privately issued stablecoins circulate on programmable digital infrastructures outside the traditional institutional architecture linking money to central bank reserves, lender-of-last-resort facilities and public backstops. Although stablecoins are increasingly becoming subject to dedicated regulatory frameworks (see Section 5), these frameworks overlap only partially with the much broader institutional and regulatory arrangements underpinning the current two-tier monetary system. This may have important implications for the singleness, elasticity and integrity of money. From the perspective of singleness, stablecoins represent claims on different private issuers with differing reserve

structures, regulatory arrangements, redemption mechanisms and degrees of transparency. While regulatory frameworks have recently begun to converge around key requirements such as 1-to-1 backing with high-quality liquid assets, segregation and safeguarding of reserves, and statutory redemption rights, stablecoins do not generally settle in central bank money and remain exposed to issuer-specific risks without the broader public backstops underpinning commercial bank money. These differences may weaken the seamless interchangeability between forms of money that characterises the traditional two-tier monetary system. Under stressed conditions, such differences could contribute to liquidity fragmentation and deviations from par value across different forms of tokenised money. Empirical evidence shows that the two largest stablecoins, USDT and USDC, have experienced temporary, albeit small, deviations from par value. (BIS, 2025; Aerts et al., 2025)

Stablecoins also differ from traditional bank money in terms of elasticity. Whereas commercial bank money is created elastically through fractional-reserve bank lending,<sup>3</sup> stablecoins expand primarily through pre-funded reserve accumulation. Their monetary elasticity therefore depends on inflows into the stablecoin ecosystem and the availability of eligible reserve assets rather than on bank-based credit creation. This difference in money creation mechanisms also has an important qualitative implication. Because stablecoin reserves are generally required to be held in high-quality liquid assets, especially short-term government securities, monetary expansion through stablecoins tends to channel liquidity toward safe public debt rather than toward credit provision to the private sector. A large-scale shift toward tokenised money fully backed by reserves could consequently contribute to more rigid forms of liquidity creation, reinforce narrow-banking-type dynamics and weaken the link between monetary expansion and credit intermediation to the real economy. (BIS, 2025; Maechler, 2025)

Finally, stablecoins may also pose challenges for the integrity of the monetary and financial system. In traditional account-based financial systems, regulated intermediaries perform know-your-customer (KYC), anti-money laundering (AML) and countering-the-financing-of-terrorism (CFT) checks on users and transactions. While similar safeguards can in principle be implemented for stablecoins held through hosted (custodial) wallets<sup>4</sup> by requiring com-

pliance from crypto-asset service providers, enforcement becomes more difficult in the case of unhosted (self-custodied) wallets<sup>5</sup> operating on public blockchains (Adrian et al., 2025). The pseudonymous nature of blockchain addresses and the peer-to-peer transferability of stablecoins may complicate the identification of users and the monitoring of illicit transactions, particularly across borders. As a result, concerns related to financial integrity remain an important part of the broader policy debate surrounding stablecoins and public blockchain-based financial infrastructures. These concerns have become increasingly prominent as stablecoins reportedly accounted for 84% of identified illicit crypto-transaction volume in 2025. (BIS, 2025; Chainalysis, 2026)

#### 4.2 Competing models of tokenised monetary architecture

The emergence of stablecoins, tokenised deposits and central bank digital currencies has initiated a broader debate regarding the future architecture of tokenised monetary systems. One possible model is centred around privately issued stablecoins operating on public blockchains and increasingly functioning as settlement, liquidity and collateral instruments within tokenised financial ecosystems. While such a model could support innovation, interoperability and global 24/7 financial activity, it could also contribute to greater fragmentation of money and payments, stronger dependence on private issuers and increased dominance of dollar-denominated tokenised financial networks. To the extent that stablecoins continue to operate outside the traditional two-tier banking architecture without access to central bank liquidity, this model may weaken the role of public money as the central anchor of monetary trust and settlement finality (BIS, 2025).

A second model is anchored in public money and the current two-tier banking system. Under this approach, tokenised finance could develop around central bank digital currencies, including digital cash as retail public money and tokenised central bank reserves as wholesale public money, together with tokenised deposits issued by commercial banks and integrated with central bank settlement systems and DLT-based arrangements. Rather than replacing the existing monetary architecture, tokenization would in this model primarily extend existing institutional arrangements into programmable digital environments. Such an approach places greater emphasis on preserving the singleness, elasticity and integrity of money, monetary sovereignty, financial stability and the role of public money

<sup>3</sup> As stated in the influential Bank of England study *Money creation in the modern economy: "bank lending creates deposits"* (McLeay et al., 2014).

<sup>4</sup> Hosted wallets are managed by a third-party service provider on behalf of the user, typically including crypto exchanges, crypto-asset service providers (CASPs), fintech payment applications or banks offering crypto custody services.

<sup>5</sup> Unhosted wallets are controlled directly by users themselves.

as the ultimate anchor of trust within tokenised financial systems (BIS & CPMI, 2024; GFMA, 2026).

In practice, the future monetary architecture is likely to evolve toward a hybrid model combining elements of both systems. Stablecoins, tokenised deposits, and central bank digital currencies may coexist within increasingly interconnected tokenised financial ecosystems, each serving different functions and use cases. Stablecoins may remain important in global public-blockchain-based financial activity and cross-border liquidity provision, while tokenised deposits and central bank money may play a more important role in regulated domestic financial systems and institutional settlement infrastructures. The central question may therefore not be whether tokenised money will emerge, but rather which forms of tokenised money will dominate different parts of the financial system and how strongly they remain connected to public money and central bank infrastructures.

Different jurisdictions may additionally evolve toward different institutional equilibria depending on the structure of their financial systems and broader strategic priorities. The US system, supported by deep capital markets and the global role of U.S. Treasury securities, may naturally favour greater expansion of private stablecoins operating on market-based tokenised infrastructures. By contrast, the European approach may place greater emphasis on preserving public-money anchoring, regulated intermediaries and integration with central bank settlement infrastructures, particularly through the development of the digital euro. In this sense, stablecoins, tokenised deposits and CBDCs should be understood as competing or complementary institutional mechanisms for integrating on-chain finance with the traditional monetary system.

### 5. 5. Institutional and regulatory responses to stablecoins

The growing role of stablecoins and tokenised finance has triggered a range of institutional and regulatory responses across jurisdictions. Importantly, these responses increasingly reflect competing visions regarding the future architecture of money, payments and financial intermediation in a tokenised financial system. In particular, the emerging EU and U.S. approaches reveal important differences regarding the role of public versus private money, the institutional embedding of stablecoins and the future relationship between tokenised finance and sovereign monetary systems. In the European Union, the Markets in Crypto-Assets Regulation (MiCA) established one of the world's first comprehensive regulatory frameworks for crypto-assets. While MiCA covers the broader crypto-asset ecosystem, it de-

votes particular attention to stable crypto-assets through the categories of asset-referenced tokens (ARTs) and e-money tokens (EMTs). Fiat-backed stablecoins referencing a single official currency generally fall under the EMT framework, while ARTs cover crypto-assets referencing baskets of assets, multiple currencies or other value references. EMTs may be issued only by authorised credit institutions or electronic money institutions, thereby embedding fiat-backed stablecoin issuance within the existing regulated monetary and payment-system architecture. MiCA requires stablecoins to be fully backed by reserve assets subject to prudential requirements governing reserve quality, liquidity, diversification, safeguarding, disclosure and institutional supervision, while also granting stablecoin holders statutory redemption rights and prohibiting interest payments. Unlike the more prescriptive US approach, MiCA does not define a narrow list of reserve assets closely tied to a single sovereign safe-asset market, reflecting the more fragmented structure of European sovereign debt and capital markets. Foreign issuers seeking to offer stablecoins within the European Union must operate within the EU regulatory perimeter and comply with MiCA requirements. In this sense, MiCA reflects a broader European preference for embedding tokenised money within a regulated institutional architecture designed to preserve monetary sovereignty, financial stability and the singleness of money. At the same time, recent ECB discussions suggest that even comprehensive regulatory frameworks may face limitations in globally fragmented stablecoin arrangements, particularly where the same stablecoin is issued by EU and non-EU entities (so called *multi-issuers*) operating under different regulatory regimes (European Parliament and Council of the European Union, 2023; Aerts et al., 2025; Bindseil, 2026). The US approach has evolved more narrowly around stablecoins themselves. The GENIUS Act focuses specifically on payment stablecoins and establishes requirements for reserve backing, redemption policies, disclosure, custody, governance and broader financial integrity and compliance requirements. Like MiCA, it requires stablecoins to be fully backed by high-quality liquid reserve assets and prohibits issuers from paying interest or yield to stablecoin holders. Unlike MiCA, however, the GENIUS Act is considerably more explicit regarding reserve composition, permitting reserves such as cash, insured deposits, short-dated Treasury bills, Treasury-backed repos and government money market funds. This creates a particularly strong institutional link between USD-backed stablecoin growth and demand for US government safe assets. Furthermore, the GENIUS Act establishes three stablecoin issuer regimes: a federal regime for depository-institution subsidi-

aries and federally approved nonbank issuers, a state regime for smaller nonbank issuers operating under substantially similar state frameworks, and a foreign issuer regime for qualifying issuers from comparable jurisdictions, which may facilitate the alignment of large foreign-based stablecoin issuers<sup>6</sup> with US regulatory standards. Together, these features make the US framework more explicitly oriented toward scaling privately issued USD-backed stablecoins as an extension of dollar-based financial infrastructure closely linked to the depth, liquidity and global role of U.S. Treasury markets (Congressional Research Service, 2025; Bindseil, 2026).

The European response additionally increasingly extends beyond stablecoin regulation toward the development of public digital money and DLT-based settlement infrastructures. In particular, the digital euro project is increasingly presented not merely as a new payment instrument, but as part of a broader European strategy to preserve the role of public money, monetary sovereignty and the singleness of money within an increasingly tokenised financial system. The current project primarily focuses on a retail digital euro conceived as a digital form of central bank cash complementing physical banknotes and distributed through regulated intermediaries within the existing two-tier monetary system. At the same time, the Eurosystem is also increasingly exploring DLT-based wholesale settlement arrangements involving tokenised central bank reserves and integration with tokenised financial markets. Recent ECB initiatives involving DLT-based settlement experiments, collateral frameworks and interoperability with TARGET infrastructures suggest that euro area policy increasingly seeks to anchor tokenised finance in central bank money and regulated financial institutions rather than relying predominantly on privately issued stablecoins. According to the ECB's current timeline, the legislative framework for the digital euro could potentially be adopted during 2026, pilot transactions may begin around 2027 and the Eurosystem aims to be technically prepared for a possible first issuance around 2029, although the final issuance decision remains subject to political and legislative approval (European Central Bank, 2025; Lane, 2025).

## 6. Concluding remarks

Stablecoins are the first large-scale private tokenised monetary instruments linking emerging on-chain finance with the traditional financial system. Their rapid growth may reflect the broader transformation of financial infrastructures to-

ward tokenised and programmable forms of finance in which money, settlement and financial assets increasingly coexist on shared digital infrastructures. In this context, stablecoins already perform important functions of money within emerging tokenised ecosystems and may gradually expand further into cross-border and potentially retail payments.

The article has argued that the implications of stablecoins extend far beyond the crypto ecosystem itself. Their growth could reshape the structure of banking and financial intermediation by contributing to deposit substitution, greater reliance on market-based liquidity structures and forms of narrow-banking dynamics centred around reserve-backed tokenised money. At the same time, stablecoins may improve settlement efficiency, collateral mobility and interoperability within increasingly digital financial markets. Their continued expansion therefore reflects a broader tension between innovation and efficiency on the one hand, and financial stability, monetary sovereignty and institutional coherence on the other.

From a monetary perspective, stablecoins challenge important features of the traditional two-tier monetary system. Because they operate outside the institutional architecture linking commercial bank money to central bank reserves and public backstops, they may weaken the singleness, elasticity and integrity of money that underpin modern monetary systems. These tensions are particularly relevant in the euro area, where the dominance of USD-denominated stablecoins may reinforce the international role of the dollar and strengthen structural asymmetries between US and EU financial systems.

The emerging regulatory responses increasingly reflect competing visions of the future monetary order. The United States appears more inclined toward market-based tokenised finance centred around privately issued stablecoins closely linked to U.S. Treasury markets, while the European approach places greater emphasis on public-money anchoring, regulated intermediaries and central bank infrastructures, including the digital euro. The future monetary architecture will therefore likely evolve toward a hybrid system in which stablecoins, tokenised deposits and central bank digital money coexist.

Nevertheless, stable and widely accepted monetary systems have historically remained closely linked to the institutional capacity of sovereign states and central banks to provide trust, liquidity and settlement finality. The long-term sustainability of tokenised monetary systems may therefore depend not only on technological innovation, but also on the extent to which tokenised money remains credibly anchored in stable public money.

<sup>6</sup> The issuer of the largest USD-backed stablecoin, Tether, is based in El Salvador.

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# Rethinking the money: Properties of money in the digital age

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Over the past two decades, technological progress has changed not only how people pay, but also how they think about money itself. Cards, mobile wallets, instant payments, crypto-assets, stablecoins and the prospect of a digital euro have widened the menu of instruments that can be used to transfer value. Yet broader choice has also created confusion. The fact that something is digital, fast or programmable does not automatically make it money in the full economic sense. This paper revisits the traditional properties of money and asks how they should be interpreted in a world shaped by platforms, real-time payments, and tokenised claims. It argues that the classical functions of money remain valid, but that in the twenty-first century they must be complemented by institutional properties such as convertibility at par, settlement finality, resilience under stress, privacy protection, and interoperability. Against this benchmark, the paper compares commercial bank deposits, crypto-assets, stablecoins, tokenised deposits and central bank digital currencies, with particular attention to the digital euro. The central conclusion is that digital innovation is changing the form of money far more than its essence. Good money in the twenty-first century is still money that is trusted, stable, widely accepted and embedded in a credible public framework. From that perspective, the digital euro is best understood not as a technological fashion, but as a strategic attempt to preserve public money in a digital economy.

JEL E42, E58, G28, O33

## 1. Introduction

The history of money is also a history of changing expectations. At different moments, societies have wanted money to be durable, portable, universally accepted, easy to verify and stable enough to support contracts over time. In each period, the dominant form of money shaped which of those properties seemed most important. When money took the form of metal, physical durability mattered greatly. When banknotes spread, trust in the issuer became more important. When bank deposits became the main means of payment, account infrastructure, bank regulation, and settlement arrangements moved to the centre of the story. The last two decades have brought another step in this long evolution. In everyday life, money has become less visible and more embedded in digital interfaces. Consumers tap a phone or watch rather than hand over cash. Firms settle invoices through automated platforms. Cross-border commerce increasingly takes place in digital environments where users hardly see the underlying payment architecture. At the same time, private innovators have proposed new forms of digital value transfer that explicitly challenge

older distinctions between money, payments, and financial assets. Crypto-assets promised “money without the state”. Stablecoins promised internet-native digital cash. Central banks responded by re-examining whether public money also needs a digital form.

These developments have revived an old question in a very modern setting: what makes money, money? Classical monetary theory still offers a useful starting point. Money is expected to serve as a medium of exchange, a store of value and a unit of account; it also supports deferred payment and financial contracting. But a purely functional definition is no longer fully sufficient. In digital systems, an instrument may perform one or two monetary functions while still failing as money in a broader public sense. A token may be easy to transfer but too volatile to store value. A private digital claim may be accepted on one platform yet unusable outside it. A payment instrument may be fast and programmable while still depending on conversion into a more trusted form of money.

The framework proposed by Hull and Sattath (2021) shows that digitalisation has expanded the set of relevant monetary properties. In a world of digital networks, attention must also be paid to privacy, security, scalability, pro-

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grammability, latency, and governance. The contribution of this article is not to repeat their entire taxonomy, but to use it as a bridge between classical monetary thinking and current policy debates. The aim is to show that good money in the twenty-first century cannot be judged by technology alone. It must be assessed against both traditional functions and modern institutional expectations.

Digital innovation has unquestionably improved the way money moves, it has not, however, automatically improved the properties of the money. This distinction matters, as we need to keep in mind that money remains a social institution before it is a technical object. Money works because users trust that it will be accepted tomorrow, that its value will not collapse overnight, and that it fits into a legal and institutional environment capable of supporting large-scale exchange.

## 2. From cash to code: how the properties of money have changed

Money did not begin as a line of code, and it did not even begin as a state monopoly. Early forms of money emerged because barter is costly. Search models in monetary economics formalised this intuition by showing how a generally accepted medium of exchange can arise when direct exchange is too cumbersome (Kiyotaki & Wright, 1989; Lagos & Wright, 2005). In such settings, money is valued not primarily because of what it is made of, but because other people are willing to accept it. That insight remains relevant today.

Still, the material form of money has always influenced public expectations. Commodity money placed a premium on intrinsic scarcity. Coins emphasised uniformity and recognisability. Banknotes shifted attention toward the issuing authority and, historically, toward convertibility into specie. In the twentieth century, however, there was a sharp move into dematerialisation of money, which saw the monetary centre of gravity moved decisively toward bank deposits. Most money used in advanced economies is now private bank money, created and circulated within a framework of regulation, prudential oversight, and settlement in central bank reserves (McLeay et al., 2014).

As money becomes less tangible, institutional trust becomes more important. A bank deposit is not valuable because of its physical form. It is valuable because people expect that it will be redeemable at par, that it can be used to settle obligations, and that public institutions will support the integrity of the system in which it circulates. Brunnermeier and Niepelt (2019) describe this relationship elegantly by showing that private and public money can appear equivalent under certain conditions. But those conditions

include the existence of a credible public anchor. Put differently, private money works best when it remains closely tied to public money.

The digital era has deepened rather than overturned this logic. On the surface, digital payments look like a story about interfaces: contactless cards, mobile apps, QR codes, e-commerce checkouts, instant peer-to-peer transfers. Underneath, however, these innovations mainly change the rails over which existing money moves. A mobile phone payment may feel radically different from cash, but in most cases it still transfers a bank deposit, which can be in turn exchanged for central bank money. The technology is new; the underlying money is not.

This distinction prevents an exaggerated reading of recent change. Faster payments are not automatically a new type of money. Better wallets are not new units of account. At the same time, digitalisation does alter what the public expects from money. Users increasingly assume that money should be available at any hour, transferable almost instantly, integrated into digital commerce, and compatible with cross-border online activity. Hull and Sattath (2021) capture this shift by showing that modern monetary properties include not only the classical triad of exchange, storage and accounting, but also design features that matter specifically in digital systems.

The first traditional function, medium of exchange, has become inseparable from interoperability and convenience. Money must still be accepted by others,

but today acceptability is shaped by digital ecosystems, networks, and standards. The second function, store of value, has acquired a more explicitly institutional dimension. In the modern world, preserving value is less about metallic backing and more about macroeconomic credibility, legal certainty and financial stability. The third function, unit of account, remains the most stubbornly traditional.

Prices, wages, taxes, and contracts continue to be denominated overwhelmingly in sovereign currency.

A further property, often implicit in older literature, is resilience under stress. Money should work not only in normal times but also and especially when confidence is tested. This is where many digital claims encounter difficulty. During stable periods, users may treat a private digital instrument as money if it is convenient and cheap. But if redemption becomes uncertain, if its market price falls sharply, or if platform access is disrupted, the illusion of full monetary equivalence disappears quickly. Historical experience with bank runs and shadow banking reminds us that apparently safe and liquid private claims can become fragile when confidence turns (Diamond & Dybvig, 1983; Schmidt et al., 2016).

Digitalisation adds one more layer: the politics of data. In a twenty-first century monetary system, users increasingly care not only about whether money is accepted and stable, but also about what happens to the data generated by its use. Privacy is therefore no longer a side issue. For cash, privacy was built into the instrument. For digital payments, it must be designed into the system. The same applies to cybersecurity. A form of money that is theoretically elegant but operationally vulnerable will not satisfy public expectations for long.

The upshot is that the properties of money have not been replaced, but they have been reweighted. Classical monetary theory still gives us the right core. Yet in a digital economy, good money must also be interoperable, secure, scalable, and governed in a way that preserves trust.

### 3. New monetary forms and the return of the hierarchy of money

Once the properties of money are stated in this broader way, the current landscape becomes easier to interpret. What looks like a confusing proliferation of “digital monies” can instead be understood as a set of instruments occupying different positions in a monetary hierarchy. Some are already money in a well-established sense. Some are close substitutes. Some are payment technologies rather than new money. And some are speculative assets wearing monetary language.

A clear starting point for a discussion on monetary forms is physical cash: public money issued by the central bank. In some jurisdictions, including Slovenia, cash still represents more than half of all point-of-sale payments. Cash also always works, independently of any communication infrastructure. However, the very physical nature of cash necessitates physical contract for it to work, limiting its portability and making it only conditionally suitable for the increasing share of e-commerce.

Commercial bank deposits remain the benchmark private form of money in most advanced economies. We use the term commercial bank deposits for a wide array of payment rails, from card payments, mobile payments, and regular and instant transfers. They are all digital, widely accepted and deeply integrated into commerce. Their success is not accidental. Deposits combine everyday usability with institutional support. They are anchored in a legal framework, integrated with settlement systems and supported by prudential regulation, supervision and central bank liquidity backstops. In normal conditions they perform the functions of money extremely well. Their weakness is not in daily use but in stress scenarios, where the distinction between private bank money and public central bank money can re-emerge. Instant payment systems are not new money, but they may do more to modernise everyday monetary use than many more glamorous innovations. By making existing bank money faster, more available and more convenient, they address a large part of what users actually want. Sometimes the most effective monetary innovation is not to invent a new instrument, but to improve the rails of the existing one.

Tokenised deposits should be understood largely as an extension of this same logic. They are not a new monetary universe but a different technological representation of conventional bank liabilities. We still treat them as a new and emerging monetary form because they add a layer of programmability, automation and the possibility of integrating payments more closely with digital platforms, smart contracts and tokenised financial markets. Their strength is precisely that they do not try to reinvent money from scratch. If redeemability at par and prudential safeguards are preserved, they can offer technological innovation without destabilizing the monetary hierarchy. At the moment they still suffer from poor interoperability with other system and the legal framework for its use is not yet in place.

**Table 1. A practical comparison of the main monetary forms**

Instrument	Main strength	Main weakness	Best description
Physical Cash	Oldest and most trusted form of money	Low transferability, not adapted for the digital age	Archetypical public money
Commercial bank deposits	Widely accepted, convenient, deeply integrated into daily payments	Depend on banking regulation and public backstops	Private money anchored in public money
Tokenised deposits	Programmability and easier use in digital platforms	Need interoperability and clear legal treatment	Technological upgrade of bank money
Stablecoins	Potentially useful in niche digital ecosystems	Redemption, reserve, and governance risk	Private money-like claim with conditional stability
Crypto-assets	Transferability in decentralised networks	High volatility and weak monetary use	Speculative digital asset rather than money
Digital euro	Public backing, broad acceptance, strong trust base	Design trade-offs around privacy, scale and intermediation	Digital form of public money

Stablecoins are more ambiguous. Their promise is easy to understand. They attempt to combine the convenience of internet-native digital transfer with a more stable value than conventional crypto-assets. Some aim to maintain that stability by holding reserves in sovereign money and safe assets. At first glance, stablecoins look like a natural response to digital commerce. Yet their very design reveals an important truth: they do not create a new unit of account. They borrow credibility from an existing one. A euro-denominated or dollar-denominated stablecoin is stable only to the extent that users trust the reserve structure, governance, redemption mechanism, and legal enforceability behind it.

That trust problem is not trivial. Experience from shadow banking and money market funds suggests that private claims marketed as cash-like can become unstable under pressure. Newer work on stablecoins reaches a similar conclusion. Public information about reserves, the quality of collateral and the governance of issuers can matter sharply for run risk (Ahmed et al., 2024). This does not mean stablecoins are irrelevant. They may play useful roles in specific ecosystems, especially where users value always-on functionality or smoother movement between tokenised environments and conventional finance. But they are not neutral innovations. They can create new forms of fragility and new dependencies on large private infrastructures.

Crypto-assets such as Bitcoin present a different case. Their advocates often describe them as money of the future, but in economic terms they remain unconvincing. Bitcoin's design solves a particular technical problem: how to transfer a scarce digital object in a decentralised system without relying on a central operator. That is an important innovation in distributed systems. It does not, by itself, solve the economic problem of money. As empirical work has shown, Bitcoin behaves much more like a speculative asset than a stable medium of exchange or store of value (Baur et al., 2018; Liu & Tsyvinski, 2021). Its purchasing power is highly volatile. Everyday pricing in Bitcoin is extremely limited. Most users still think of it in terms of gains and losses measured in a sovereign currency.

The practical weakness of crypto-assets can be summarised simply. As a medium of exchange, they are a niche. As a store of value, they are unstable. As a unit of account, they are almost absent. Even when economic models allow privately issued currencies to coexist with sovereign money, it is a long way from proving that actual cryptocurrencies perform the social and institutional role of money in real economies (Schilling & Uhlig, 2019; Benigno, 2023).

#### 4. Why the digital euro matters

The case for the digital euro does not rest on a claim that existing money has failed. It rests on the recognition that the environment in which money is used is changing. For central banks, this is a subtle but important difference. The question is not whether public money should replace private money in retail payments. The euro area already relies successfully on a two-tier monetary system in which public money anchors a large universe of private bank money. The question is whether, in a world where payments are increasingly digital, platform-based and sometimes dependent on non-European providers, public money should remain directly available in a digital form. The European Central Bank's public communication on the digital euro makes this objective clear. The project is presented as an electronic means of payment that would be available free of charge for basic use, accepted across the euro area, and usable online or offline, through a phone or a card (ECB, 2026). The ECB also emphasises privacy, noting that the Eurosystem would not be able to identify users or their purchases from the payment data it receives, and it frames the digital euro as a complement to cash rather than a replacement (ECB, 2026). The European Commission's legislative package places the same idea into a broader public-policy context: the digital euro would provide an additional means of paying with public money in a digital form while preserving the role of cash and supporting resilience, acceptance, and strategic autonomy in payments (European Commission, 2023).

Why does that matter? The first answer is monetary sovereignty. In daily life, users often care little about the identity of the infrastructure provider. But from a public-policy perspective, it matters if a monetary area becomes highly dependent on a small number of private, sometimes foreign, payment schemes and platforms. Payment dependence can create vulnerabilities related to resilience, market power, pricing, and strategic autonomy. A digital euro would not eliminate private providers, but it could strengthen the public core of the system.

The second answer is trust. A central bank digital currency would represent a direct claim on the central bank. In that sense, it would preserve in digital form what cash provides physically: access to public money for the general public. This matters symbolically and operationally. Symbolically, it reinforces the idea that money remains a public good even in a highly digital economy. Operationally, it creates an option for digital payments that does not depend on the balance-sheet strength or business model of a private intermediary.

The third answer is contestability and innovation. A public digital option can support private innovation rather than suppress it. If the digital euro is designed as a common standard that private intermediaries use to build services, it may create a level playing field and reduce dependence on a few dominant private networks. Much depends on design. A poorly designed retail CBDC could crowd out bank intermediation or create operational burdens. A well-designed one could support competition at the interface layer while preserving financial stability.

This is where the trade-offs become real. The digital euro is attractive partly because it could combine several properties that users increasingly want: digital convenience, broad acceptance, public backing, resilience, and privacy protections. Yet those same goals can conflict with one another. Strong privacy protections may be difficult to reconcile with anti-money laundering and compliance obligations. Broad accessibility and safety may increase attractiveness in stress situations and therefore raise questions about deposit shifts from banks to central bank money. Programmability can enable useful new services but may also create concern that money could become conditional. Monetary sovereignty can be strengthened by a public digital option, but only if adoption is meaningful and the user experience is genuinely competitive.

The academic literature on central bank digital currency makes these trade-offs clear. Williamson (2022) shows that a CBDC can improve welfare under certain conditions, especially where it offers a safe asset that competes with other payment instruments. At the same time, the impact on bank funding and monetary transmission depends heavily on design. More recent work has stressed that large-scale CBDC adoption could affect the structure of deposits, reserves, and the operational framework of monetary policy, even if the overall macro-financial consequences are manageable under prudent design assumptions (Abad et al., 2025; Schilling et al., 2024). This is why central banks rarely discuss CBDC in simple pro-innovation terms. For them, the issue is not novelty; it is system design.

Against other digital options, the digital euro has one central advantage: it does not need to import trust from elsewhere. Stablecoins depend on reserves and issuer governance. Crypto-assets depend on market narratives and speculative demand. Tokenised deposits depend on the existing banking framework. A digital euro would be public money by construction. That does not mean it would automatically be better for every use case. But it does mean that when users ask the most basic monetary question – will this still be worth one euro tomorrow, and will everyone treat it as one euro? – the answer is unusually

straightforward: if this is true for a euro coin or a banknote, it must be true for their digital twin as well.

There is also a practical point that is sometimes overlooked. For many users, what matters is not ideological preference but confidence that payments will continue to work in a fragmented, increasingly digital world. In that sense, the digital euro is less a futuristic gadget than a continuity project. It aims to keep the basic qualities of public money available under new technological conditions.

### 5. Rethinking good money in the digital age

What, then, counts as good money today? The answer is not radically different from what earlier generations would have recognised, but it is broader. Good money must still be stable, widely accepted and usable as the main unit in which the economy thinks and contracts. Yet in the twenty-first century, users also expect money to be seamlessly available in digital environments, secure against technical disruption, compatible with modern payment habits and respectful of legitimate privacy concerns. Good money is therefore both a monetary instrument and a service environment.

This updated view has several implications. First, it suggests that the line between money and payments should be kept conceptually clear, even when the two are operationally intertwined. Much public confusion arises because people encounter money mainly through payment interfaces. If the interface is smooth, the underlying instrument is assumed to be good money. But this is only partly true. A beautifully designed app can sit on top of a weak claim. A clumsy interface can sit on top of a very strong one. Policymakers need to care about both layers.

Second, the updated view puts public trust back at the centre of monetary analysis. Digital enthusiasts often emphasise decentralisation, programmability or speed. These features are important, but none substitutes for the expectation that a monetary instrument will remain stable, accepted and redeemable when conditions deteriorate. In fact, the more digital and frictionless payments become, the more damaging any sudden loss of trust can be. A run on a digital instrument can move much faster than a run in a physical world. This is why governance and institutional design matter more, not less, in digital money.

Third, the updated view suggests that policy should not be technologically neutral in a naïve sense. Different instruments perform different social functions and create different risks. A regulated bank deposit, a euro-backed stablecoin and a speculative crypto-asset should not be treated as if they were interchangeable merely because all are digitally transferable. The proper regulatory question is

functional: what monetary role does the instrument actually play, and what public obligations should follow from that role? The closer a private instrument comes to acting like money, the stronger the case for robust requirements on reserves, liquidity, transparency, redemption and operational resilience.

Fourth, the updated view highlights a productive middle ground between public monopoly and private fragmentation. The best future monetary order is unlikely to be one in which the state does everything directly, nor one in which public money retreats completely behind private platforms. A more plausible model is one in which public money remains the anchor, while private actors innovate around it in ways that preserve par convertibility, interoperability, and financial stability. The digital euro fits naturally into this vision. So do instant payment systems and, under the right legal framework, tokenised deposits.

Fifth, good money in the twenty-first century must be compatible with democratic expectations about privacy and control. This is a delicate area. Cash provided privacy by default. Digital systems cannot reproduce that fully without raising concerns about illicit activity and compliance. At the same time, a fully traceable payments environment can erode public trust. The challenge is therefore institutional rather than purely technical: to design systems where the collection and use of payments data are limited, justified and governed in a way that people can trust.

Finally, the updated view should make us more cautious about claims that monetary innovation is necessarily disruptive. Many improvements that users want – faster settlement, easier integration into e-commerce, better user interfaces, cross-border usability – can be delivered by upgrading the existing system rather than by replacing it. This is one reason why instant payments deserve a more central place in discussions about the future of money. They show that substantial innovation is possible without weakening the link between private money and the public monetary anchor.

The practical policy conclusion is therefore balanced but firm. Central banks should continue to modernise payment infrastructures, support competition and interoperability, and prepare public money for a more digital environment. Regulators should distinguish more clearly between digital assets, payment instruments and monetary substitutes, and should subject money-like private claims to money-like standards. Banks should view the digital euro not only as a potential competitor, but also as a catalyst for improving European payments and for building new services on a more resilient base. And the wider public should be encouraged to ask a slightly better question than whether a new

digital instrument is “the future”. The better question is whether it improves on the qualities that have always made money useful.

Money is not good because it is new. It is good because people can rely on it. In the digital age, reliability means even more than it once did. It means convenience, cybersecurity, legal clarity, data protection and broad digital usability. But what makes any money good money still begins with the old foundations: stability, acceptance and trust.

## 6. Conclusion

Digitalisation has changed the appearance of money quicker than it has changed its essence. We argued that the traditional functions of money remain the right starting point for understanding new monetary forms, but that they need to be complemented by a broader set of digital-era expectations. In the digital age, good money must be not only a medium of exchange, store of value and unit of account, but also secure, interoperable, resilient, privacy-conscious and embedded in a credible institutional framework. Seen through that lens, the current monetary landscape looks less revolutionary than many public narratives suggest. Commercial bank deposits remain the main operational money of modern economies. Instant payments improve how that money moves. Tokenised deposits may improve how it can be used in digital environments. Stablecoins may have a role in specialised ecosystems, but their monetary quality is conditional, and their stability depends on governance and redemption structures. Crypto-assets, despite their technological interest, do not perform the core social role of money well enough to qualify as good money for the wider economy.

The digital euro stands out because it addresses a different question. It is not mainly an attempt to imitate private innovation or to create a fashionable new payment product. It is an attempt to preserve the role of public money as economies become more digital, more platform-based and more exposed to fragmented payment infrastructures. That makes the digital euro less radical than its critics fear and more important than its supporters sometimes explain. Its value lies in continuity under changed technological conditions.

Rethinking money today therefore does not require abandoning old theory. It requires us to update that theory with new assumptions. The most important lesson is that money remains a public institution even when it is delivered through private interfaces and digital networks. A society may innovate endlessly in the ways it moves money, but it cannot do without a trusted monetary anchor. In the twenty-first century, the challenge is to make sure that anchor remains fit for a digital world.

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# X–Y–Z Intragenerational Bridges in the Labour Market in Times of Global Disruption

Vesna Milošević Zupančič\*

In the light of the labour shortage, demographical changes, AI influence and global disruption the importance of understanding and cooperation of all generations on the labour market is crucial. The empirical analysis based on two large-scale surveys (n = 6,942) shows that despite all changes, core labour market expectations remain relatively stable across generations, while differences arise primarily from career stage and experience. Generation Z demonstrates a stronger orientation toward promotion and advancement, job security, interpersonal relationships, work-life balance and learning and development. In contrast, older generations place greater emphasis on job security, interpersonal relationships, autonomy and flexible working hours. Hybrid work form and in-person interaction are prevalent across all cohorts. The results show that there are more factors that connect generations than what divides them.

JEL G21, J11, J24

## Introduction

The world is changing abruptly in the recent years with **different macro trends** shaping our lives. The labour market is affected by technological changes (including big transformations by the models of artificial intelligence (AI)), economic uncertainty, geo-political tensions, demographic challenges, green transition etc. (WEF, 2025). The world is no longer unipolar structure, but is quickly changing to multipolar, which brings many tensions to the political and economic centres of power, with the main process of changing global economic governance from “rule-based system” into a “transaction-based system” (Mrak, 2025, p. 16). Narrowing down to Slovenia, among **major economic and social challenges Slovenia** faces are rapid decrease of the working population, high cost of transitioning to a carbon-free society, costly geo-strategic changes that have occurred due to the armed conflicts, the costs of monetary and fiscal policy in Europe and Slovenia and major technological changes such as digitalization, AI, robotization, etc. (Domadenik Muren et al., 2023, p. 37).

**The demographic trends** in Slovenia are not in favour of the employers. The generations that are currently retiring are much bigger than the generations entering the labour market. “Retirements have exceeded the annual number

of new Slovenian citizens with their first job since at least 2019, which will intensify in the future and cause a greater mismatch between supply and demand, especially for qualified workers” (Capriolo, 2025). The impact of population aging on the labour market in Slovenia is already seen as problematic and will be increasingly pronounced in the future (Capriolo, 2025).

Therefore, one of the biggest issues on the labour market is the **labour shortage**, which is on upward-trend in the last years (Ivanc, 2025, p. 6). Although Slovenian labour market is gradually easing and cooling, largely owing to structural constraints, most of the Slovenian employers have issues with labour shortage (Banka Slovenije, 2026, pp. 5, 15–16). “The year-on year decline reflects a contraction in employment in the private sector, specially manufacturing and construction, while employment in public services continues to increase and remains relatively high” (Banka Slovenije, pp. 15–16).

**The unemployment rate** in Slovenia is still low. The current figures for statistical unemployment being at 4.1 % in the third quarter of 2025 (SURS, 2026 a) and for the registered unemployment being at 5 % in January 2026 (ZRSZ, 2026). Due to high number of retirements and low numbers of unemployed people more than half of first-time employed persons are foreign citizens (SURS, 2026 b). The share of foreign workers among employed persons is 16.2 % in December 2025 (Banka Slovenije, 2026, pp- 15–16).

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**The number of employed persons** in Slovenia has been stagnant for several months, and in the eleven months it was down by 0.4% year-on-year (UMAR, 2026, p. 3), however it is still very high, compared to the numbers in the last decades - since Slovenia became independent in 1991. In a country with 2,133,852 inhabitants, the number of employed persons in the Labour Force Survey (in the 4th quarter of 2025) is 996,000 and the number of persons in employment by register, included in the Statistical Register of Employment, is 938,412 in February 2026 (SURS, 2026 a).

Despite demography not being in favour of the Slovenian labour market, there is still great uncertainty including the **emerging trends in AI** and the consequences it is about to bring. The changes brought by the AI to the labour market include changing jobs, with certain jobs disappearing and new jobs emerging, on the other hand also the importance of developing new competencies (Pavlin and Svetlik, 2024, p. 849). The World Economic Forum predicts the emergence of 170 million new jobs and 92 million jobs being unnecessary from 2025 to 2030, which will amount to 22% of today's total jobs (WEF, 2025, p. 5).

In the light of the labour shortage, AI influence and global disruption the importance of **understanding and intragenerational cooperation of all generations on the labour market** is crucial to ensure sufficient labour market supply, less frictions among employed persons, more productivity and great working environment.

### Literature review

Generational studies divide people into age cohorts based on their year of birth. The definition of **generation** in this article is seen as a birth cohort, which defines a generation as a group of people born at approximately the same time in history (Alwin and McCammon, 2007, pp. 219–221), or as a common location in a social and historical process (Goodwin and O'Connor, 2009, pp. 22). Therefore, they share the same worldview and common points of reference (Giddens and Sutton, 2016, pp. 346–347).

Currently there are four different generations on the labour market simultaneously, therefore certain tensions can arise from this fact. The youngest of them on the labour market – generation Z or shorter GenZ is the cohort of people born between years of 1995/1997 and 2012 (Harari et al., 2023; Kim et al., 2024). Next, the members of generation Y or millennials were born between 1981 and 1995/7, the members of generation X were born between 1965 and 1980 and the baby boomers were born in between 1946 and 1964 (Harari et al., 2023; Kim et al., 2024). Generation alpha, however, has not entered the labour

market yet as they are not legally old enough to do so. The oldest generation on the labour market, **Baby Boomers**, are typically described as optimistic, duty-oriented, and strongly committed to work, with a preference for teamwork and clearly defined organizational structures, whereas **Generation X** demonstrates a high degree of independence, self-reliance, and pragmatism, often engaging in calculated risk-taking and prioritizing work as a means to support life rather than dominate it (Christensen, 2018; Kanste et al., 2025). **Millennials or Generation Y** are commonly identified as technologically proficient early adopters who place importance on social connections, expect continuous and immediate feedback, and seek a balance between professional and personal life (Christensen, 2018; Kanste et al., 2025).

The literature suggests that **GenZ** is quite different from the previous generations, with their world views, worries and expectations from the employers causing frictions on the jobs. The views and personality of GenZ have been formed by current trends such as advancement of technology (and therefore they have short attention span), uncertainty, economic crises, covid-19 pandemic, mobility, terrorism, (Magano et al., 2020), hyper-connectivity, economic uncertainty, global environmental threats (Ambhore, 2025) and political uncertainty. Their main concerns showed in “2025 Gen Z and Millennial Survey”, that collected the responses of 23,482 respondents from 44 countries, include the cost of living (39 %), mental health (21 %), unemployment (18 %), crime/personal safety (18 %), protecting the environment (17 %) and political instability (16 %) (Deloitte, 2025, p. 29).

In contrast to Baby Boomers, Generation X and Millennials, GenZ is marked by an even stronger integration of technology into daily functioning, a tendency toward communication via social media platforms, and a preference for flexible, mobile work arrangements combined with expectations of rapid rewards (Christensen, 2018; Kanste et al., 2025). So, GenZ appreciates freedom and flexibility offered by the employers on the workplace and they are perceived as emphatic and self-confident (Kanste et al., 2025). GenZ place strong emphasis on career advancement, however, attaining formal leadership roles is not their primary motivator (Deloitte, 2025). Their preferences are more strongly oriented toward work-life balance and continuous learning and development; while financial compensation remains an important factor, equal weight is given to meaningful work and overall well-being (Deloitte, 2025). Therefore, what keeps them satisfied in their workplace is the combination of money, meaning and well-being (Deloitte, 2025, p. 25).

The Slovenian employers see genZ as “demanding, irresponsible, unresponsive, disrespectful, spoiled” on the one hand, but also “sincere, full of energy, ready to learn, environmentally responsible, digital masters” on the other hand (Milošević Zupančič & Goršak, 2024, p. 50). **A survey of Slovenian employers** (Milošević Zupančič & Goršak, 2024, p. 50–51) identifies a ranked set of attributes valued in young candidates: The most frequently cited characteristic is “knowledge of ICT, social media, and modern technologies (46%)”, followed by “willingness to learn (41%)”, “good knowledge of foreign languages (38%)” and “energy/drive (38%)”. These are followed by “honesty and direct response (35%)” and “self-confidence and determination (33%)”. What employers highlight as positive traits in genZ are “acceptance of diversity (culture, nationality, religion, race, sexual orientation) (26%)”, and “willingness to change (24%)”. Lower-ranked but still relevant factors include “newer knowledge from schools and faculties (17%)”, “orientation toward experimentation and innovative solutions (16%)” and “concern for social good and the environment (15%)” (ibid). On the other hand, Slovenian employers’ perceptions of Gen Z highlight negative aspects of GenZ and a concentration of concerns related to “lack of work habits (74%)”, followed by “high expectations regarding salary, promotion, and title (51%)”, “overestimation of their knowledge and abilities (39%)” and “lack of independence at work (need for instructions and guidance) (38%)” (Milošević Zupančič & Goršak, 2024, p. 52–53). Employers also report “poorly developed communication skills (34%)”, “irresponsibility, lack of seriousness, unreliability (34%)”, “expectation that companies adapt to their wishes (29%)” and behavioural patterns such as “constant phone use (28%)” (ibid). Challenges related to hierarchy and motivation are noted, particularly “difficulty accepting authority (26%)” and “desire for quick results and impatience (they give up quickly) (24%)”; lower-ranked but relevant issues include “disloyalty – switching fields/employers (14%)” and “need for more validation, praise, and motivation (12%)” (ibid).

And what are the numbers of employed people in **the banking sector**? The dynamics of the number of jobs by activity in Standard Classification of Activities (SKD) indicates that in the period 2019 – 2024 the number of employed people decreased in the financial and insurance activities (category K), the category in which banking sector is included (Capriolo, 2025, p. 13). According to the Statistical Office of the Republic of Slovenia (Bajželj, 2025), the number of employed persons in activity K “Financial and insurance activities” amounted to 18,518 in August 2025,

from that in subcategory K64 “Financial service activities, except insurance and pension funding,” there are 10,088 employed persons in Slovenia. Of those employed in the K64 activity, **33% are men and 67% are women; their average age is 44.8 years for men and 45.6 years for women, with more than 70 % of all having post-secondary or tertiary education** (Bajželj, 2025). In terms of age distribution, 1,605 employees are aged 25–34, 2,987 are aged 35–44, 3,489 are aged 45–54, and 1,965 are aged 55 and over; over the past decade, employment has declined across all age groups except the oldest cohort (ibid). The financial sector is among the **highest-paying industries** in Slovenia, alongside IT, energy, and pharmaceuticals; according to data from the Statistical Office of the Republic of Slovenia (Bajželj, 2025), average wages in the financial sector (subcategory K64) exceed the national average by approximately 25–45%, positioning it well above the overall wage level in the economy. Wages in the banking sector are associated with higher productivity, regulatory requirements, and a greater concentration of highly educated employees; at the same time, in the context of intergenerational collaboration, they imply increased competition for talent (particularly GenZ) and greater pressure on intergenerational knowledge management.

### Method Presentation

**Research Design:** The empirical part of the study is based on two large-scale survey datasets, designed to capture attitudes, expectations, and behavioural patterns related to the labour market in Slovenia, with a specific focus on intergenerational dynamics and Generation Z. Both surveys were conducted in Slovenia in March–April 2026 by the biggest private employment agency mediating student work in Slovenia, e-Študentski Servis. Together provide a combined sample of 6,942 respondents, enabling robust descriptive and comparative analysis. Data collection method was online survey. Sampling is Non-probability, voluntary participation (self-selection), where large sample sizes partially mitigate selection bias but do not ensure full representativeness. The survey data and sample are represented in Table 1.

Youth and the Labour Market survey with its dataset represents the core empirical basis for analysing Generation Z, with a sufficiently large sample size to ensure high statistical reliability and internal consistency of findings. Generations in the Workplace survey enables comparative analysis across generations, providing a broader organizational and labour market context beyond the youth segment. **The limitations** of the surveys include sampling bias; due to vol-

Table 1: Survey Overview

Name of the survey	Field period	Sample size	Target population
Youth and the Labour Market (Mladi in trg dela)	31 March 2026 - 20 April 2026	5,780 completed questionnaires	GenZ: Secondary school students and tertiary students doing student work in Slovenia (majority 15-26 years of age)
Generations in the Workplace (Generacije na delovnem mestu)	27 March 2026 - 20 April 2026	1,162 completed questionnaires	Multi-generational workforce, including employees from different age cohorts

Source Table 1s: e-Študentski Servis (2026).

untary participation, results may overrepresent more engaged or digitally active individuals. Furthermore, generational groupings may oversimplify intra-cohort heterogeneity.

#### Key socio-demographic characteristics of the sample:

The age distribution of respondents in the *Youth and the Labour Market Survey* is as follows: 15–17 years (1,201; 20.8%), 18–20 years (2,047; 35.4%), 21–24 years (2,149; 37.2%), and 25 years or older (383; 6.6%). The gender structure of the sample shows a notable overrepresentation of female respondents, with a total of 3,908 respondents (67.6%) are female, and 1,837 respondents (31.8%) are male and 35 respondents (0.6%) do not want to answer that question. This deviates from the population baseline but is consistent with established survey participation patterns, particularly in online surveys and research related to education and labour market topics, where female response rates are typically higher. A total of 5,278 respondents are citizens of the Republic of Slovenia (91.3%), while 502 (8.7%) are foreign nationals. Out of 5,780 respondents, 2,560 are secondary school students (44.3%) and 3,220 are tertiary students (55.7%).

The generational structure of respondents in the *Generations in the Workplace Survey* is dominated by Generation X, followed by Millennials, while Generation Z and Baby Boomers are less represented: 46–61 years (Generation X) account for 53% (616 respondents), 30–45 years (Millennials) for 34.9% (405 respondents), 18–29 years (Generation Z) for 7.9% (92 respondents), and 62–80 years (Baby Boomers) for 4.1% (48 respondents). The gender distribution of respondents is highly skewed towards female participants: 82.0% are women (953 respondents), 17.6% are men (204 respondents), and 0.4% (5 respondents) preferred not to disclose their gender. The employment status of respondents indicates a strong predominance of stable employment, with 78.2% (909 respondents) employed on permanent contracts. A further 4.6% (53) are employed on fixed-term contracts, while

14.4% (167) are self-employed. Unemployment is marginal at 0.7% (8 respondents). Additionally, 1.5% (18) are retired but remain active in the labour market, and 0.6% (7) are engaged in other forms of work, such as freelance, contract-based, or platform work.

#### Results and Discussion

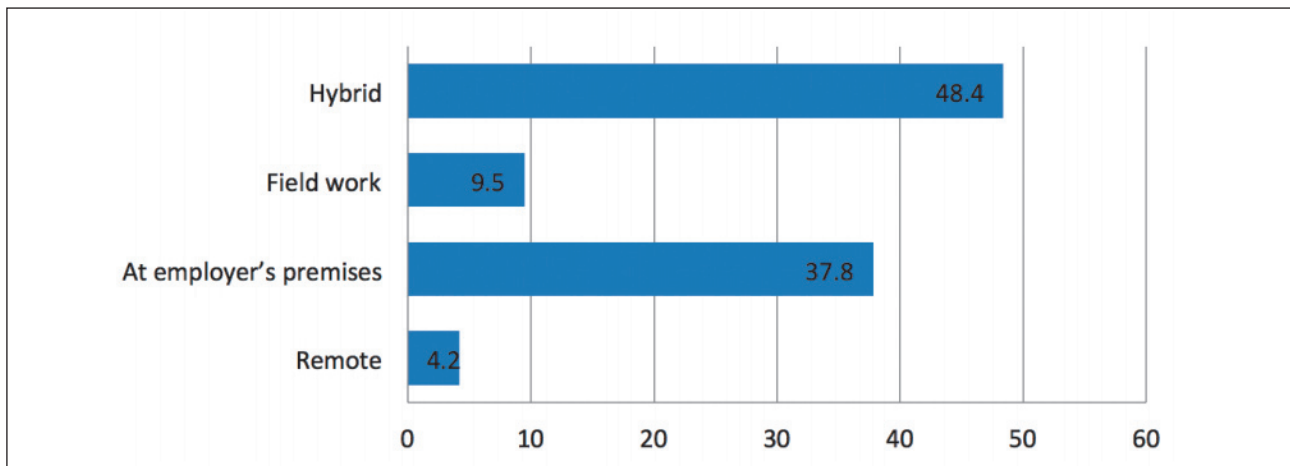
##### Hybrid work is the dominant preference in all generations.

The results of *Youth and the Labour Market Survey* show the answers of GenZ (secondary school students and tertiary students) in Slovenia when asked how they envision their work after obtaining regular employment or completing their education ( $n = 5,780$ ). Respondents most frequently prefer a hybrid model: 48.4% (2,800) indicate a combination of remote work and work at the employer's premises. This is followed by 37.8% (2,187) who prefer working on-site at the employer's location, 9.5% (549) who envision field work, and 4.2% (244) who prefer fully remote work.

On the other hand, the *Generations in the Workplace Survey* shows what multi-generational workforce, including employees from different age cohorts, answered when asked how they would prefer to perform their work if given a choice ( $n = 1,162$ ). The majority of respondents favour a hybrid model: 56.8% (660) prefer a combination of remote work and work at the employer's premises. This is followed by 22.8% (265) who prefer working on-site, 6.1% (71) who would choose fully remote work, and 3.0% (35) who prefer field work. Additionally, 11.3% (131) report that the nature of their work does not allow for such flexibility.

A comparison between Generation Z and older cohorts reveals a shared preference for hybrid work as the dominant model; however, notable differences emerge in secondary preferences. Generation Z demonstrates a significantly higher inclination towards on-site and field work, likely reflecting early career needs for learning, mentorship and integration, while older generations exhibit a stronger preference for flexible arrangements.

Figure 1: Preferred Work Arrangement: GenZ in %



Source Figure 1: Youth and the Labour Market Survey (e-Študentski Servis, 2026).

### **Permanent employment is still number one choice of all generations.**

When asked about their preferred form of employment after completing their education (n = 5,780), nearly half of genZ respondents (49.7%; 2,871) prefer permanent employment. This is followed by 22.0% (1,273) who aspire to start their own business (sole trader, limited liability company etc.), and 9.8% (564) who prefer fixed-term employment. A notable share, 15.7% (909), report that they have not yet considered this question. Smaller proportions prefer freelance or contract-based work (1.2%; 68), platform work (0.9%; 54), or other forms of employment (0.7%; 41). When asked about their preferred form of employment (n = 1,162), a strong majority of other generation respondents (77.9%; 905) prefer permanent employment. This is followed by 12.1% (141) who would choose to run their own business (sole trader, limited liability company etc.). A smaller share has not yet considered this question (7.0%;

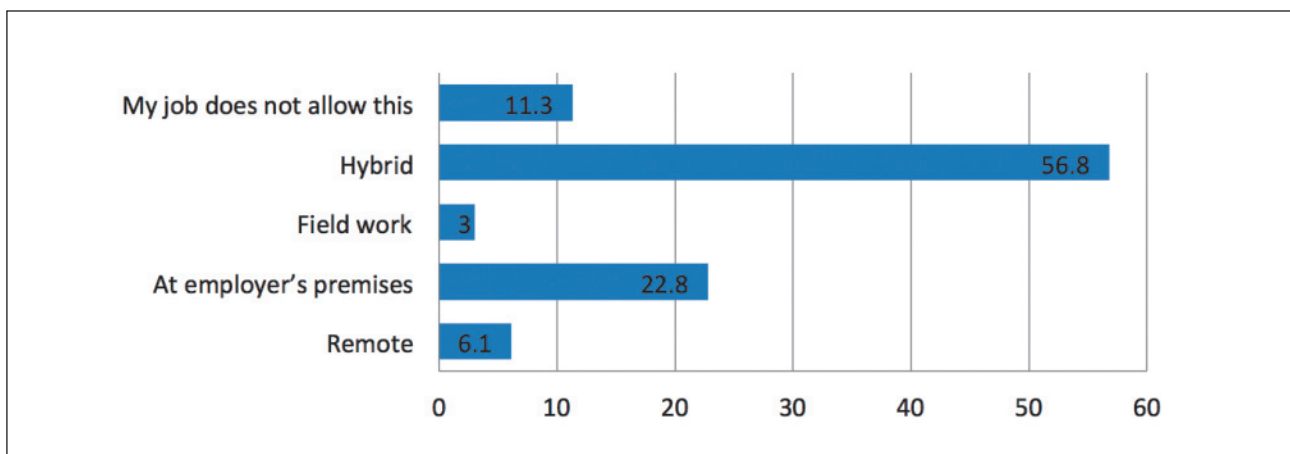
81). Other forms are marginally represented, including fixed-term employment (0.9%; 11), freelance or contract-based work (0.7%; 8), platform work (0.5%; 6), and other arrangements (0.9%; 10).

The comparison highlights a clear generational divide: while older cohorts strongly prioritize employment stability, Generation Z demonstrates a more diversified preference structure, with significantly higher entrepreneurial aspirations and a lower reliance on permanent employment. At the same time, a larger share of undecided respondents among Gen Z reflects the transitional nature of early career decision-making. However, permanent employment is still number one choice of all generations.

### **Preferred communication at the workplace is in person for all generations.**

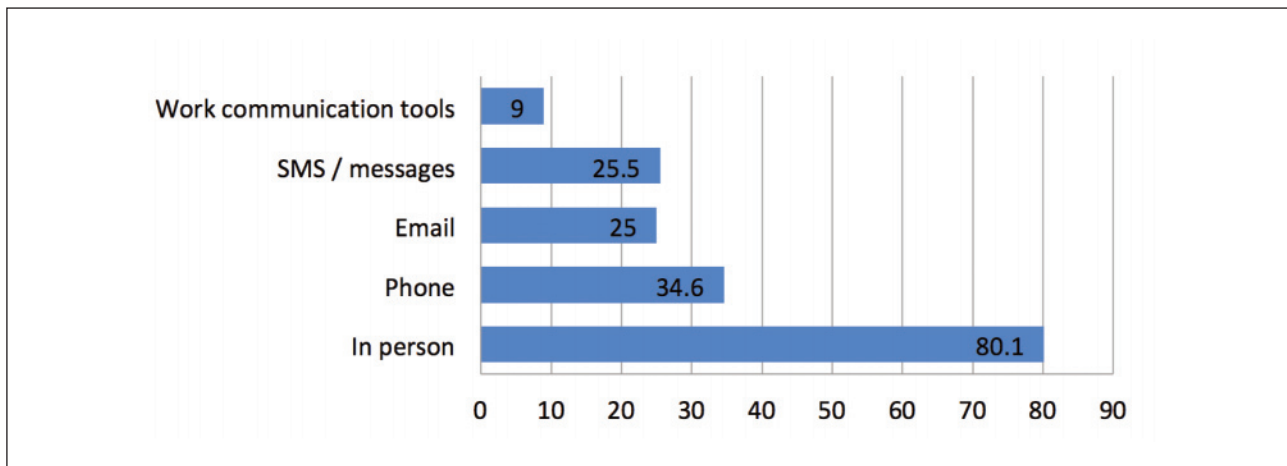
The findings in Youth and Labour Market Survey indicate a strong preference for in-person communication (80.1%)

Figure 2: Preferred Work Arrangement: All generations in %



Source Figure 2: Generations in the Workplace Survey: (e-Študentski Servis, 2026).

Figure 3: Preferred communication at the workplace (GenZ) in %



Source Figure 3: Youth and the Labour Market Survey (e-Študentski Servis, 2026).

among GenZ respondents, indicating that despite high digital literacy, face-to-face interaction remains central to effective workplace communication. Digital channels such as phone (34.6%), messaging (25.5%), and email (25.0%) are used in a complementary and context-dependent manner. Formal workplace communication tools are comparatively less preferred (9.0%).

Results from Generations in the Workplace Survey show that in-person communication remains the dominant mode with other generations (72.8%), while email (52.2%) plays a central role as the primary formal communication channel. Phone communication is moderately used (35.4%), whereas informal messaging (5.0%) and workplace communication tools (10.8%) remain relatively marginal.

Compared to Generation Z, older cohorts rely more heavily on formal communication channels, particularly email (52.2% vs. 25.0%), while placing less emphasis on informal messaging (5.0% vs. 25.5%). However, in-person

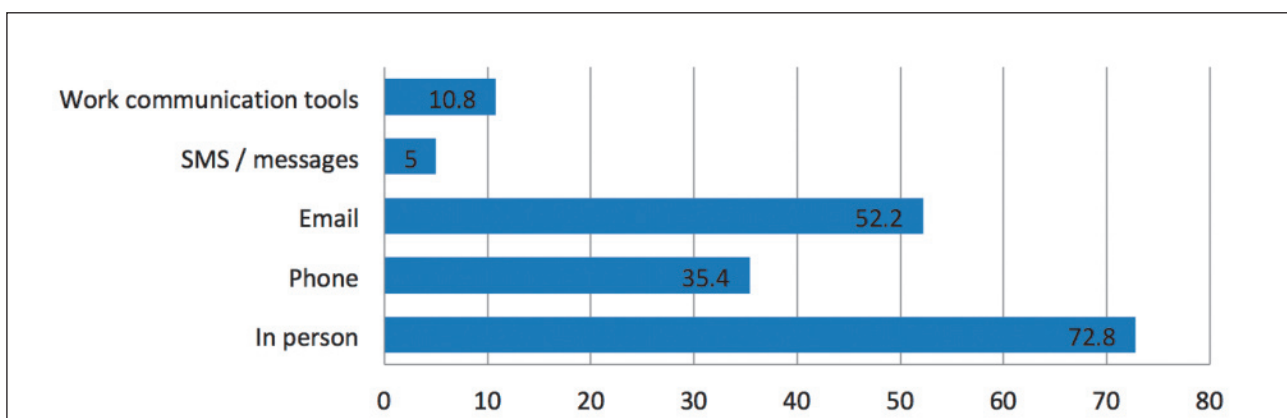
communication remains the dominant mode across generations.

#### **Most important factors on the workplace differ among generations.**

Results from Youth and Labour Market Survey indicate that GenZ prioritizes career progression – promotion and advancement (60.5%) and job security (59.2%), followed by interpersonal relationships (50.4%) and work-life balance (44.2%). Development-oriented factors such as learning opportunities (43.6%) are also highly valued. In contrast, traditional external signals such as employer reputation (4.4%) and regular feedback (4.9%) are of relatively low importance. Overall, the pattern suggests a combination of security-oriented and development-driven preferences, with a strong emphasis on workplace relationships and long-term career growth.

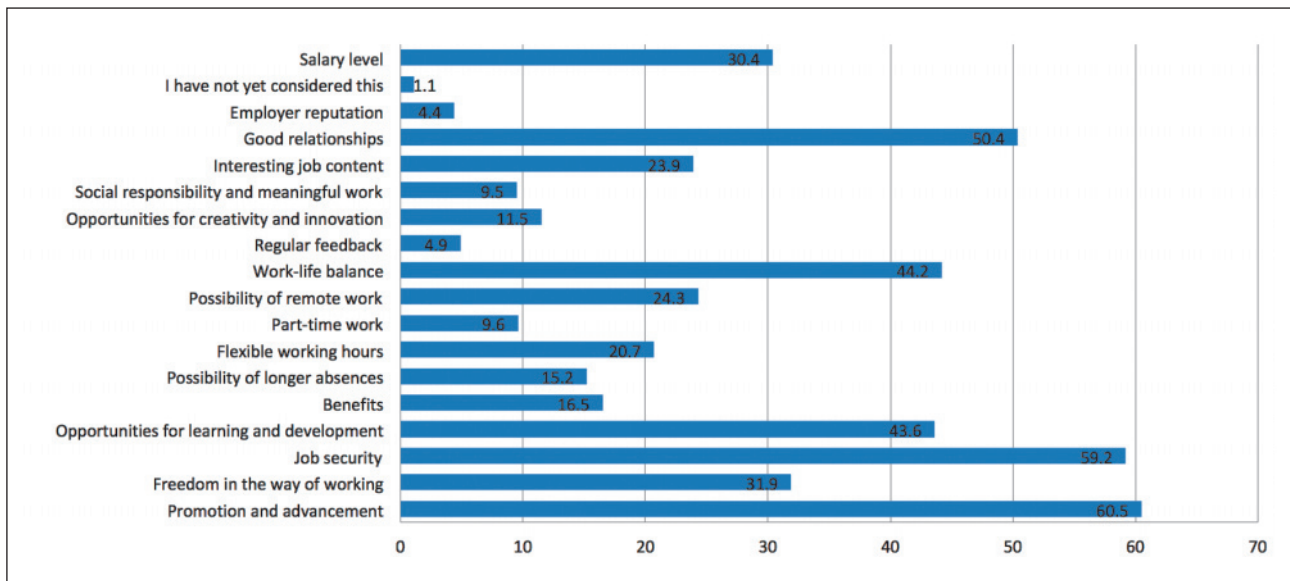
The findings in Generations in the Workplace Survey show that older generations prioritize good relationships

Figure 4: Preferred communication at the workplace (All generations) in %



Source Figure 4: Generations in the Workplace Survey: (e-Študentski Servis, 2026).

Figure 5: Most important factors on the workplace (GenZ) in %



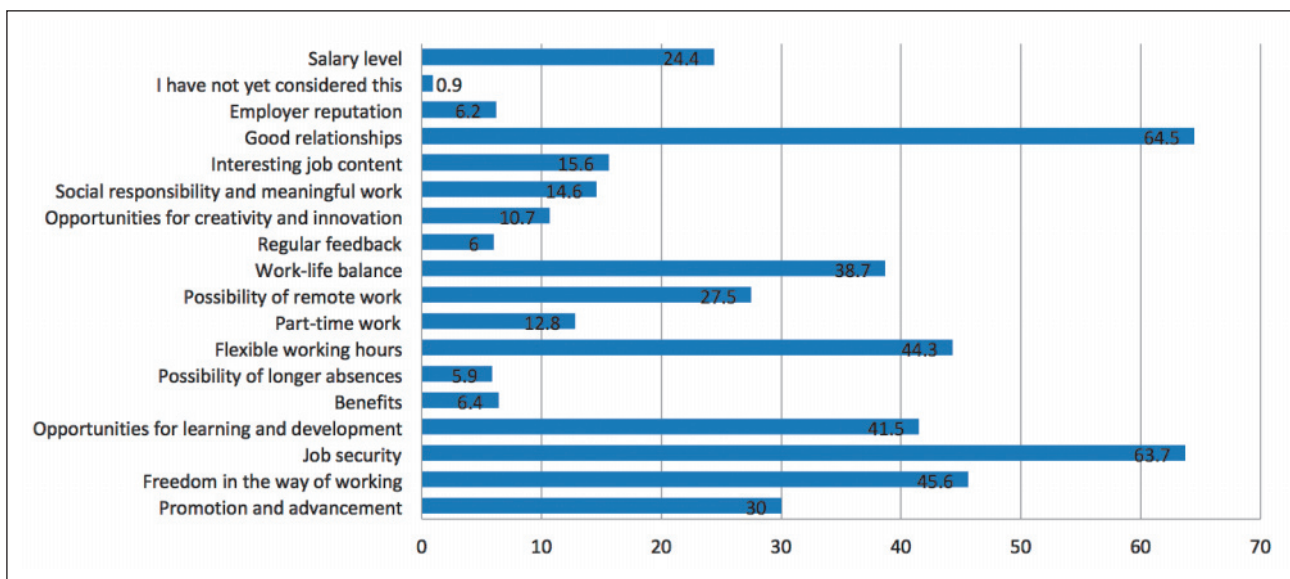
Source Figure 5: Youth and the Labour Market Survey (e-Študentski Servis, 2026).

(64.5%) and job security (63.7%), followed by flexibility-related factors, such as *freedom in work* (45.6%) and *flexible working hours* (44.3%). Development-related aspects (41.5%) and work-life balance (38.7%) remain important but secondary. Compared to Generation Z, there is a stronger emphasis on stability and interpersonal environment, while career advancement (30.0%) and salary (24.4%) are relatively less prominent.

A comparison of work-related priorities reveals both convergence and divergence between Generation Z and older cohorts. While both groups highly value job security (Gen Z: 59.2%; others: 63.7%) and good rela-

tionships (50.4% vs. 64.5%), Generation Z places significantly greater emphasis on career advancement (60.5% vs. 30.0%) and slightly more on salary (30.4% vs. 24.4%). In contrast, older generations prioritize flexibility-related factors, such as freedom in the way of working (45.6% vs. 31.9%) and flexible working hours (44.3% vs. 20.7%). Development opportunities and work-life balance are important for both groups, though relatively balanced. Overall, Generation Z appears more growth and career-oriented, while older cohorts emphasize stability, relationships, and flexibility in established work contexts.

Figure 6: Most important factors on the workplace (other generations) in %



Source Figure 6: Generations in the Workplace Survey: (e-Študentski Servis, 2026).

### Conclusion

The empirical analysis based on two large-scale surveys (n = 6,942) shows that despite quick technological change and the growing role of artificial intelligence, core labour market expectations remain relatively stable across generations, while differences arise primarily from career stage and experience.

GenZ is more oriented toward career advancement and promotion, also appreciates job security, stresses learning and development and work-life balance. In contrast, older generations place greater emphasis on job security, good relationships at work, and autonomy – freedom in the way of working – and flexible working hours. Preferences regarding work organization converge around hybrid models as the dominant form for all generations. Furthermore, communication patterns reveal the continued importance of in-person interaction across all cohorts, however there are generational differences in the use of formal (e-mail) versus informal (messaging) channels. The preferred type of work for all cohorts is permanent employment, moreover, GenZ has significantly higher entrepreneurial aspirations. Additionally, the banking sector context highlights high wage levels and a strong demand for highly educated talent, which is further intensifying competition for GenZ candidates. Overall, the findings indicate that intergenerational differences are not so pronounced. Therefore, the competitive advantage for organizations lies in understanding all generations and mutual cooperation between them through integration of diverse expectations, adaptation of career development pathways and intergenerational knowledge transfer.

Despite many talks about differences of people belonging to different generations the data from the surveys shows that people from different generations are similar in many aspects. There is more that connects us than what divides us.

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# You can buy the AI. You cannot buy the leadership to deploy it.

Why human capability – Not technology – Is the final competitive differentiator in banking

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Artificial intelligence is reshaping banking at an unprecedented pace, with McKinsey estimating that generative AI alone could add \$200–340 billion annually to global banking revenues. Yet, amid this technological acceleration, the most decisive competitive differentiator is not the technology itself—it is the quality of leadership and people strategy surrounding its deployment. Drawing on research from McKinsey, Deloitte, the World Economic Forum, PwC, Gallup, Boston Consulting Group, EY, and Korn Ferry, this article argues that European banking leaders must urgently reframe AI transformation as a people-centred organisational challenge rather than a purely technological one. It examines how AI is reshaping banking competitiveness and workforce dynamics, why employee trust and engagement are becoming measurable strategic assets, and which leadership competencies—psychological resilience, emotional intelligence, coaching-based leadership, and a genuine change mindset—are now essential. The article concludes with practical priorities for CEOs and boards seeking to build human-centred AI strategies that generate lasting competitive advantage.

JEL O33, G21, J24, M53

## 1. Introduction: The AI inflection point in banking

Banking has always been a knowledge-intensive industry built on trust, analytical rigour, and the management of complex risk. Today, artificial intelligence is adding an entirely new dimension to this equation—one that is simultaneously the greatest opportunity and the most misunderstood challenge facing the sector.

By early 2025, the world's fifty largest banks had announced more than 160 documented AI use cases (McKinsey, 2024a). Results are beginning to materialise. One US bank that deployed AI agents to transform credit risk memo creation reported a 20–60% productivity increase and a 30% improvement in credit turnaround times (McKinsey, 2024a). A major Dutch financial institution applied AI to its Know Your Customer (KYC) and compliance processes, achieving a 90% reduction in onboarding time and cutting staff workload by 30% (Neurons Lab, 2026). These are not marginal efficiency gains – they represent structural shifts in how core banking functions are organised and delivered.

Yet for every success story, there is an organisation still struggling with fragmented pilots, unclear governance,

cultural resistance, and a workforce deeply anxious about what AI means for their careers. Boston Consulting Group (BCG, 2025) found that only one in four banks worldwide is actively using AI to gain a competitive advantage.

McKinsey warns that banks which fail to adapt face a 30% likelihood that AI will substantially reshape the sector, potentially placing \$170 billion in global profits at risk for institutions that do not evolve their business models (McKinsey, 2024a).

The competitive divide is sharpening. According to International Data Corporation (IDC) data cited in Neurons Lab (2026), frontier firms leading in AI adoption achieve returns of 2.84 times on their AI investments, compared to just 0.84 times for laggards. The question for European bank leaders is no longer *whether* to adopt AI, but *how* to do so in a way that builds genuine, durable competitive advantage—while keeping the organisation's most valuable asset, its people, motivated, trusted, and capable.

This article addresses four interconnected dimensions of this challenge: the strategic context of AI in banking; the human dimension of transformation, including employee trust, engagement, and fear; the leadership competencies essential for this era; and the specific professional skills that banking employees must develop to remain competitive and relevant.

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## 2. AI and banking competitiveness:

### Beyond the technology

#### 2.1 The strategic value at stake

The financial case for AI in banking is compelling. McKinsey (2024b) estimates that generative AI could add \$200–340 billion annually to global banking revenue – a 2.8–4.7% increase in industry profits. Pairing AI with human roles in sales, marketing, and customer service could lift revenues by as much as 6% over three years. KPMG analysis, drawing on research across more than 17 million firms, estimates that agentic AI—autonomous systems capable of executing complex, multi-step workflows—will contribute \$3 trillion in corporate productivity globally, delivering a 5.4% EBITDA improvement annually (Neurons Lab, 2026).

McKinsey's December 2025 analysis of corporate and investment banking notes that attention has shifted decisively from generative AI pilots to agentic AI: systems capable of executing multi-step tasks with minimal human intervention across front-office coverage, transaction processing, onboarding, settlements, surveillance, and portfolio optimisation (McKinsey, 2025b). This represents not an incremental efficiency improvement but a fundamental reorganisation of how banking work is structured and performed.

The banks succeeding in AI transformation share a common characteristic: they treat AI as a strategic business priority, not a technology initiative. McKinsey (2024a) identifies three hallmarks of leading banks: they embed AI into strategic planning across every business unit, they focus investment on high-impact core-strategy areas rather than peripheral experiments, and they establish the right data and technology platforms to enable scalability.

#### 2.2 The human gap in AI strategies

Despite its promise, most AI transformation in banking falls short of potential—and the reason is rarely technological. McKinsey's 2025 global AI survey found that while nearly nine out of ten organisations now regularly use AI, only 1% have achieved mature, enterprise-wide deployment delivering meaningful financial results. High-performing organisations are nearly three times as likely as others to have fundamentally redesigned individual workflows to integrate AI (McKinsey, 2025a).

The organisational and human factors – leadership alignment, change management, workforce readiness, and cultural transformation – are the bottlenecks separating leaders from laggards. McKinsey (2026) explicitly identifies the ability to 'bring the whole workforce along' as a critical success factor, citing JPMorgan Chase's approach of broad communication, transparent adoption metrics, and

continuous employee education as a model for transformation at scale.

For European banks, the regulatory environment adds further complexity. AI governance, model interpretability, unbiased decision-making, and responsible AI principles must be embedded into transformation roadmaps from the outset. This requires not only technical expertise but strong leadership judgment, ethical reasoning, and the ability to navigate ambiguity under regulatory scrutiny – distinctly human competencies.

## 3. The human dimension: Trust, engagement, and fear in AI transformation

### 3.1 The anxiety beneath the surface

Behind every dashboard of AI productivity metrics are people navigating significant uncertainty about their professional futures. Gallup's *State of the Global Workplace 2025* found that only around one in five workers feels truly engaged at work – a figure that becomes more alarming when considered in the context of accelerating technological change (Gallup, 2025). PwC's 2025 Global Workforce Hopes and Fears Survey confirms that barely half of surveyed employees across industries trust their top management (PwC, 2025).

Trust matters enormously for performance: workers who trust their direct managers are 72% more motivated than those with the lowest levels of trust, while workers with the highest trust in senior leadership are 63% more motivated than those with the least (PwC, 2025). In a sector as performance-driven as banking, this motivational gap translates directly into productivity, client service quality, and innovation capacity.

More than half of PwC's (2025) survey respondents report dealing with financial strain, and nearly as many report fatigue – an environment in which AI-driven uncertainty amplifies existing anxieties. PwC concludes that building trust, alignment, and psychological safety is not a soft HR aspiration but an ongoing strategic priority with measurable business consequences.

### 3.2 The BANI World: A new framework for banking leaders

The VUCA framework – volatile, uncertain, complex, ambiguous – has long been used to describe the business environment. For banking executives navigating AI transformation in 2025 and 2026, the more accurate descriptor is the BANI model: brittle, anxious, non-linear, and incomprehensible (Cascio, 2020). Organisations appear stable until they suddenly fracture; anxiety pervades decision-making; cause-and-effect relationships break

down; and the pace of change can exceed human comprehension.

In this context, the role of leadership changes fundamentally. A leader's primary function is no longer to have all the answers – it is to create the conditions in which teams can function effectively amid uncertainty. This means maintaining emotional stability, modelling calm and purposeful behaviour, communicating with radical transparency, and cultivating psychological safety: the shared belief across a team that it is safe to take risks, voice concerns, and acknowledge mistakes without fear of punishment (Edmondson, 1999).

In executive coaching practice with banking CEOs and senior managers, the most recurring challenge is not technical – it is relational. Leaders often struggle to acknowledge their own anxiety about AI-driven change while projecting confidence to their teams. They face pressure to implement transformation at speed while managing the human cost of disruption. The most effective leaders are those who have developed an inner leadership framework: self-awareness, emotional regulation, and the capacity to lead authentically through uncertainty.

### 3.3 Engagement as a competitive asset

Gallup's long-standing finding that 70% of employee engagement is attributable to the quality of direct management has never been more consequential (Gallup, 2025). As AI automates routine tasks and augments analytical work, what remains irreducibly human – relationship management, ethical judgment, client empathy, and creative problem-solving – must be nurtured deliberately.

EY's (2025) research on banking workforce transformation argues that cost-cutting is not the answer at a time of critical talent shortages in key domains. Banks should redirect talent investments to drive strategic value and build high-impact HR functions. EY identifies clear career development pathways, meaningful work, and robust upskilling programmes as the foundations of competitive talent strategy in banking.

This is consistent with the lived experience of executive coaching. Senior banking professionals who consider leaving their organisations rarely cite compensation as the primary driver. More commonly, they leave because of misalignment between stated values and actual behaviour, a lack of autonomy in decision-making, or the sense that their development is not being invested in. The most capable candidates—those best equipped to navigate AI-driven transformation—have options. Retaining them requires authentic leadership, genuine development opportunities, and a culture of trust.

## 4. Leadership competencies for the AI era in banking

### 4.1 Psychological Resilience: The New Leadership Currency

If the past decade elevated emotional intelligence as a leadership imperative, the current decade is elevating psychological resilience. Resilience is not stoicism or the suppression of difficulty. It is the capacity to acknowledge reality without denial, process challenging emotions constructively, maintain strategic orientation under pressure, and recover from setbacks with renewed clarity and purpose (Persolog, 2023).

Gallup's (2025) research shows that teams with high adaptability – a close companion of resilience – are 36% more productive and 32% more engaged than their less adaptable peers. The World Economic Forum's *Future of Jobs Report 2025*, drawing on over 1,000 leading global employers representing more than 14 million workers, identifies resilience, flexibility, and agility as the second most sought-after skill cluster globally, after analytical thinking (WEF, 2025).

In banking, psychological resilience is particularly critical because the sector is navigating simultaneous disruptions: AI-driven automation, competitive pressure from neobanks and fintech platforms, evolving regulatory frameworks, geopolitical volatility, and persistent talent scarcity. Korn Ferry research consistently finds that 65% of leadership failures occur not because of technical incompetence but because of deficits in emotional intelligence and resilience (Korn Ferry, 2024).

A useful analogy can be drawn from macroeconomic research. Kearney's (2023) analysis of economic resilience found that the world's most resilient economies – including the United States, Germany, and Singapore – are not necessarily those with the greatest resources, but those with the highest adaptability and capacity for rapid recovery. Psychological resilience in banking leaders operates on the same principle: it is not about avoiding difficulty, but about recovering faster, adapting more effectively, and inspiring teams to see disruption as an opportunity.

### 4.2 Emotional intelligence and the relational dimension of AI leadership

Emotional intelligence (EI) – the ability to recognise, understand, and manage one's own emotions while reading and influencing the emotions of others – is not diminished by AI. It is made more important. As AI systems absorb routine analytical and administrative tasks, the premium on distinctly human capabilities rises: empathy, relationship management, ethical reasoning, and creative judgment (Goleman, 1995).

Harvard Business Review's 2025 research found that 73% of employees identify collaborative leadership as the most important trait in their manager (HBR, 2025). The skills of active listening, empathetic communication, and constructive emotion management – core dimensions of EI – are precisely what enable leaders to guide anxious teams through AI-driven transitions without losing either performance or people.

In banking specifically, EI has direct commercial value. Wealth management, corporate banking, and advisory services are fundamentally trust-based relationships. The client experience in complex or high-stakes situations depends on the empathetic competence of the banker managing the relationship. AI can analyse risk, model scenarios, and personalise product recommendations, but it cannot replace the human judgment and relational quality that builds enduring client loyalty.

#### 4.3 From directive to developmental leadership

The traditional leadership model in banking – hierarchical, directive, control-oriented – is poorly suited to AI-era organisational needs. The AI era demands a shift toward developmental, coaching-based leadership: leaders who create conditions for autonomous problem-solving, facilitate continuous learning, and build psychological safety rather than enforcing compliance (Whitmore, 2017).

The WEF (2025) emphasises that effective leadership in this era requires navigating complexity and ambiguity while maintaining strategic direction, fostering environments that encourage innovation and calculated risk-taking, and building trust during periods of significant change. These are coaching competencies – and banks that invest in coaching culture within their leadership development programmes significantly outperform their peers on talent retention and change agility.

From executive coaching practice, a consistent pattern emerges: the most effective banking CEOs combine business acuity with genuine curiosity about the people they lead. They invest time in understanding what motivates each team member, what fears they carry about AI-driven change, and what career aspirations they hold. This relational investment is not a distraction from performance – it is the foundation of sustained performance.

There is also a particular loneliness at the top that banking leaders must address. CEOs and C-suite executives have few peers with whom they can openly discuss their deepest professional doubts, fears about strategic decisions, or personal concerns about whether they are leading well. Executive coaching provides a confidential, professionally rigorous space for exactly this reflection. Almost every

highly effective banking executive who sustains performance over time has some form of structured thinking partnership: a coach, a trusted advisor, or a peer network that provides honest, non-hierarchical feedback.

#### 4.4 The change mindset: Embracing continuous transformation

The concept of a change mindset, rooted in Dweck's (2006) growth mindset research, is directly relevant to AI leadership in banking. A change mindset goes beyond acceptance of disruption. It encompasses active curiosity, a bias toward experimentation and learning, the capacity to act decisively without complete information, and the ability to inspire others to see change as an opportunity for personal and organisational growth.

For banking leaders, cultivating a change mindset across the organisation requires moving beyond announcing AI strategy toward modelling the desired behaviour. Leaders who openly experiment with AI tools, share what they are learning, acknowledge early failures constructively, and celebrate the team's progress in capability-building create the psychological conditions for broader adoption. Those who delegate AI transformation to a technology team while remaining personally disengaged signal, unintentionally but powerfully, that this is not a genuine strategic priority.

### 5. 5. Essential competencies for banking professionals in the AI era

#### 5.1 The competency landscape

The WEF (2025) projects that by 2030, 59 out of every 100 workers will require some form of reskilling or upskilling. Nearly 40% of existing job skills are expected to change, and 63% of employers identify the skills gap as their primary barrier to business transformation. In banking, where the combination of regulatory complexity, client relationship management, and technological sophistication is especially demanding, this challenge is acute.

Six competency domains emerge from the research as essential for banking professionals navigating AI-driven transformation:

**Critical and strategic thinking.** AI systems excel at pattern recognition and optimisation within defined parameters. What they cannot do is reframe the question, challenge assumptions embedded in data, or make strategic judgments that account for context, ethics, and long-term consequences. Forbes (2024) identifies critical and strategic thinking among the ten most sought-after competencies globally. For banking professionals, this means developing the capacity to interrogate AI outputs rather

than simply act on them, and to integrate algorithmic recommendations with broader business judgment.

**AI and digital literacy.** McKinsey (2021) explicitly identifies skills in AI, cloud engineering, and data engineering as priorities for banking talent acquisition. This does not require all professionals to become data scientists. It does, however, require a functional understanding of what AI systems can and cannot do, how to work effectively alongside them, and how to translate AI-generated insights into client-facing or decision-support value. McKinsey notes that retaining AI talent in banking requires more than competitive pay: clear career development pathways and meaningful work are equally critical (McKinsey, 2021).

**Psychological resilience and adaptive agility.** The WEF (2025) identifies resilience, flexibility, and agility as the second most critical skills cluster by 2030. As AI continuously shifts the boundaries of what human workers are asked to do in banking, the capacity to adapt, learn quickly, and remain effective under uncertainty is a core professional competency – not merely a personal attribute.

**Emotional intelligence and empathic communication.** As AI manages more of the analytical and administrative dimensions of banking, the relational premium intensifies. Client trust in complex financial decisions, leadership effectiveness during organisational change, and team cohesion in distributed environments all depend fundamentally on empathic competence. The WEF (2025) identifies social influence and leadership as among the fastest-growing skill requirements by 2030.

**Ethical reasoning and responsible AI use.** Banking industry operates in one of the most heavily regulated environments globally. The deployment of AI in credit decisioning, client profiling, fraud detection, and investment recommendation creates significant ethical and regulatory obligations. Banking leaders must develop clear frameworks for responsible AI governance, including model interpretability, bias prevention, data privacy, and audit trail management. This is not only a compliance requirement – it is increasingly a source of customer trust and competitive differentiation.

**Mentoring and Knowledge Transfer.** Generational succession in senior banking roles, combined with AI-driven disruption of traditional career pathways, makes structured mentoring and knowledge transfer more important than ever. Banks that develop strong internal mentoring cultures are better positioned to retain institutional knowledge, accelerate the development of next-generation leaders, and maintain client relationship continuity through leadership transitions.

## 6. 6. Towards a people-centred AI strategy in banking

The convergence of all these dimensions – strategic value, workforce dynamics, leadership competencies, and professional skills – points to a single overarching conclusion: AI transformation in banking is, at its core, a people-transformation challenge.

Banks that are winning with AI are not winning because they have the best algorithms or the most sophisticated technology platforms. They are winning because they have leadership teams that understand how to align people with strategic intent, build cultures of continuous learning, and manage the emotional dynamics of large-scale change. They invest in their leaders' coaching skills, their employees' psychological resilience, and their organisations' capacity for authentic dialogue about what AI means for everyone's future.

Practically, this requires banking leaders to act on five priorities:

**Integrate people strategy into AI governance.** Every AI implementation plan should have a corresponding organisational change management component, addressing communication, skills development, role redesign, and psychological safety. AI transformation without a people strategy is technology without a future.

**Invest in leadership development as a strategic priority.** Resilience training, emotional intelligence development, and coaching skills are not soft add-ons to leadership programmes—they are the core competencies that determine whether AI transformation succeeds or stalls. Boards and CEOs who treat leadership development as a budget line to be optimised, rather than a strategic investment, are underestimating the human foundations of competitive advantage.

**Build cultures of continuous learning.** The WEF (2025) finds that 85% of firms have upskilling plans in place, but the gap between intent and execution is wide. Banks that create embedded, ongoing learning cultures – where skill development is part of daily work, not a periodic training event – outperform their peers on both AI adoption and talent retention.

**Sustain continuous dialogue.** The most effective change leaders create and sustain ongoing, honest conversation about what AI means for the organisation and for individuals. PwC (2025) confirms that when organisations build this kind of trust, employee motivation, engagement, and adaptability all improve significantly.

**Make leadership succession an AI-era priority.** Succession planning in banking must evolve beyond identifying high performers in current roles to identifying individuals

with adaptive competencies, digital literacy, and people leadership skills to lead through continuous AI-driven transformation.

### 7. Conclusion: AI thinks — Leaders must listen

The title of this article poses a challenge that every bank CEO and board member should take personally: winning in the AI era is not primarily a matter of technology capability — it is a matter of human capability. AI will continue to improve at an extraordinary pace. The competitive advantage that AI creates will be increasingly available to all institutions willing to invest. The enduring differentiator — the one that cannot be replicated by algorithms, automated, or acquired from a technology vendor — is the quality of an organisation's leadership and its people.

AI knows how to process — leaders must know how to listen. AI can optimise — leaders must know how to inspire. AI can predict — leaders must know how to build trust. The banks that understand this will not merely survive the AI transition; they will use it to become stronger, more agile, and more deeply connected to the clients and communities they serve.

*The best leaders of the coming decade in banking will not be those who simply implement AI. They will be those who, in the language of executive coaching, know both what they want and why it matters — to themselves, to their teams, and to the clients and society they serve.*

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# Artificial intelligence in banking: Competitiveness through continuous transformation

*Franc Bračun\**

This comment examines Artificial Intelligence (AI) in banking not as a stand-alone technology but as part of the bank's operating model. It argues that AI creates strategic value when banks repeatedly redesign three interdependent layers: workflow, workforce, and reusable internal building blocks. Loan origination is used as a simple end-to-end example to show how AI can prepare, check, summarise and route work within bounded rules, while people remain accountable for judgment, exceptions, and approval. The central claim is that banks benefit most when they redesign these three layers so that AI improves service, speed, and control together, while reuse is created both through redesign of the end-to-end process and through repeated case execution that leaves behind reusable patterns, assets, and learning. The article concludes with practical implications for management and for smaller banking markets seeking to scale AI in a controlled and value-creating way.

JEL G21, O33

## Introduction

Artificial intelligence (AI) should be treated in banking as an operating-model matter, not only as a technology matter. For management, what matters in practice is whether AI shortens turnaround time, reduces rework and cost to serve, improves control quality, and makes future process improvement easier without weakening accountability. What makes the current AI wave more consequential is that change is no longer moving in a slow, linear way. AI capability is improving on an exponential curve: tools are becoming stronger, cheaper, and easier to apply in ever shorter cycles. That compresses the time available for banks to adapt their workflows, controls, and workforce. The management implication is clear: banks have less time to adapt their workflows, controls, and workforce to a faster-moving AI curve.

This adaptation is difficult not only because of complexity, but also because banks must respond under conditions of uncertainty and speed. Evidence from other industries points in the same direction: McKinsey's December 2025 survey of senior telecom executives

found operating model and talent to be the most cited roadblock to scaling AI, identified by 86% of respondents, underlining that AI scaling is not only a technology challenge.

What has changed is not that banks suddenly discovered AI. Banks have long used machine learning, AI, and advanced analytics in fraud detection, scoring, risk modelling, anomaly detection, and personalization. The change is that newer generative and more agent-like tools are easier to access, more flexible in the tasks they support, and better able to change how work moves through a process instead of improving only isolated tasks. In parallel, customer expectations are rising, fraud patterns are moving faster, and heavily manual operating models are under growing cost and execution pressure. More information-heavy work can now be prepared, checked, summarized, routed, and supported digitally.

The strategic issue is therefore no longer only whether AI can automate selected tasks. It is whether banks can redesign core workflows quickly enough to stay competitive in a fast-changing environment. AI can increasingly support that redesign not only as a tool, but as bounded digital work performed inside the process.

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### Three interdependent layers of change

The most useful way to understand that redesign is through three interdependent layers. The first is workflow: end-to-end processes, control points, handoffs, and customer journeys. The second is the AI-augmented workforce: bankers spend less time reconstructing files and moving work between queues, and more time reviewing outputs, handling exceptions, and taking responsibility for decisions, while AI agents increasingly take on defined preparation, coordination, and control-support tasks inside the workflow. The third is reusable internal building blocks: the assets the bank creates while improving one process and can reuse in the next improvement of that process or in similar processes. These assets include document extraction workflows, case-summary templates, decision rules, escalation logic, prompts, and cleaner system handoffs, including improved API-based connections where needed. This third layer is often the least understood, but it can be the most powerful, because reuse is created in two ways: by redesigning the end-to-end process itself and by learning from repeated case execution, where each case leaves behind patterns that can improve the next one.

This is why the strategic response should be continuous transformation rather than a scattered portfolio of use cases. In a fast-changing environment, workflow, workforce, and reusable internal building blocks all need to adapt together. A bank that adds AI to fragmented processes may move faster without becoming better. A bank that redesigns workflow, human role, and reusable building blocks together can simplify handoffs, sharpen escalation, strengthen control, and improve the next workflow from a better starting point (McKinsey & Company, 2025b). That compounding logic is increasingly visible beyond banking as well. In software and other knowledge work, AI is shifting from a helpful tool to a serious performer of high-value tasks, with AI agents emerging as a new digital workforce inside governed processes (Edwards, 2026; McKinsey & Company, 2025c; Relyea and Harrysson, 2026). Banking will not copy that pattern without modification, but it is likely to follow the same direction under stricter operational and regulatory discipline, reinforcing the broader management logic that codified improvements can accumulate over time. In software and IT work, this shift toward AI agents as a new digital workforce has already moved beyond early experimentation. At Cloud Next '26, Google's CEO said that 75% of all new code at Google is now AI-generated and approved by engineers, up from 50% the previous fall. That is a useful warning about how quickly operating

models can begin to change. This matters for banking because, from the perspective of large language models, much coding work and much banking knowledge work share the same basic pattern: understanding context, generating structured text, and moving work through multistep workflows.

### What AI agents do

An AI agent is a digital worker that people give a goal or task to carry out, not just a question to answer. Unlike a normal chatbot that mainly answers, an AI agent can "understand" the task, use tools and data, take a series of steps, and move the work forward. In managerial terms, it is best understood as a supervised digital teammate that can handle defined parts of a workflow, such as collecting information, checking rules, preparing a draft, or routing a case. People still set the objective, define the boundaries, review important outputs, and remain accountable for the final decision. In practice, these systems may prepare, check, extract, retrieve, summarize, recommend, and route work within predefined limits while human review, permissions, thresholds, audit trails, and escalation paths remain in place.

Their work typically falls into four practical categories. First, preparation work: checking whether the case file and supporting documentation are complete, extracting data from documents, retrieving relevant policies, or drafting a case summary. Second, coordination work: requesting missing documents, routing a case to the next step, or moving exceptions to the right queue. Third, control-support work: checking whether rules were applied, identifying missing evidence, flagging unusual cases or escalating cases above thresholds. Fourth, human-support work: drafting a first memo, comparing options, highlighting inconsistencies, or suggesting next actions. These categories are a practical way to organize how AI agents contribute inside banking workflows. Human judgment, however, remains central in ambiguous or high-risk cases, because current AI still faces important limits in reasoning and judgment (Bank for International Settlements, 2024).

### Loan origination as the clearest example

Loan origination is a useful illustration because it shows, in one governed workflow, how AI agents can contribute through all four practical categories of work and across all three layers of change. Lending is also one of the banking areas where gen AI and agentic AI is already being assessed for concrete value creation (McKinsey & Company, 2025a). It combines document collection, policy checks, handoffs, exception handling, and clear approval points.

Today, staff often spend time collecting documents, checking completeness, moving files between queues, repeating policy checks, and rewriting the same case facts in multiple places. A redesigned AI-enabled workflow does not make the credit decision on its own. It restructures how the case is prepared, moved, reviewed, and reused before human judgment is applied, making the process faster, simpler, more consistent, and less costly.

At the workflow layer, the process is redesigned as a sequence of bounded tasks. AI agents can perform preparation work by checking file completeness, validating document quality, extracting relevant data, and drafting a decision-ready case summary. They can perform coordination work by requesting missing documents, routing the file to the next step, and directing exceptions to the right queue. They can perform control-support work by testing policy requirements, identifying missing evidence, flagging unusual cases, and escalating files above thresholds. They can perform human-support work by presenting a structured first view of the case and highlighting issues for review. At the workforce layer, staff spend less time reconstructing the file and more time reviewing prepared outputs, challenging whether the recommendation fits policy, handling exceptions, and taking responsibility for final judgment while cooperating with AI agents inside the workflow. At the third layer, the process leaves behind reusable internal building blocks: document-check patterns, summary templates, escalation rules, prompts, decision logic, and cleaner data connections between channels, document tools, credit systems, and case-management tools. These building blocks can be reused in two ways: in redesigning the end-to-end process itself and in improving how future loan-origination cases are handled through learned patterns from repeated execution. This means the bank improves both the overall process and each new case it handles, so value compounds over time.

This example matters because it shows what agentic AI means in banking in practical terms: supervised delegation across a controlled process rather than autonomous decision-making. Banks are already beginning to introduce AI agents into parts of end-to-end processes, which makes this shift more practical than hypothetical. It also shows how human roles start to change when AI takes over more of the intermediate work. A similar pattern is already visible

in software development, where AI agents increasingly handle more coding work and human roles move more toward architecture, review, and orchestration. The same logic applies to other document-heavy and control-sensi-

tive workflows, such as know-your-customer checks, account opening, customer onboarding, employee onboarding, fraud-alert handling, service-centre queues, and payments exceptions, where information must be collected, verified, routed, reviewed, and approved under clear controls.

Work, control, and the real constraints

AI therefore changes not only tasks but also roles and management work. Staff move away from gathering documents, rewriting the same facts across systems, and moving work from queue to queue. They spend more time setting goals for the work, instructing AI agents, reviewing prepared outputs, challenging recommendations, handling exceptions, and taking responsibility for judgments where the cost of error is high. Management must correspondingly define review thresholds, evidence requirements, escalation paths, training expectations, and ownership of the reusable building blocks created through redesign. Management must also decide who delegates what to whom, how work is divided between people and AI agents, who supervises which outputs, and how performance is monitored and improved across both the human and digital workforce. Accepting that reality changes the nature of leadership, from overseeing projects to continuously shaping the bank for speed, scale, and reinvention. Accountability remains human, even when intermediate work is increasingly performed with AI agents (Bank of England and Financial Conduct Authority, 2024; European Banking Federation, 2024).

The stronger the case for AI becomes, however, the higher the cost of weak execution. Four constraints matter most. The first is process quality: poor processes do not become good processes simply because AI makes them faster. The second is governance: if AI influences customer treatment, credit work, compliance support, or internal decision-making, the bank needs validation, documentation, oversight, explainability, escalation, and clear accountability (European Commission, 2026). The third is resilience: the more AI is embedded into core workflows, the more the bank depends on data pipelines, integration layers, vendors, and cloud infrastructure, making operational resilience part of the AI equation rather than a separate topic (European Central Bank, 2025). The fourth is workforce adaptation: scaling AI requires not only tools and platforms, but also investment in workforce development, reskilling, role redesign, and active management of transition. JPMorgan Chase's own disclosures illustrate that pattern through continued investment in technology and data modernization and broad employee deployment of GenAI capabilities in a controlled environment (JPMorgan Chase, 2025; Piepszak, 2025).

### What banks should do

Management should redesign the bank's operating model to combine human judgment with machine intelligence. The first management step is to choose one impactful end-to-end process and redesign it across all three layers so it becomes AI-ready. Strong candidates include lending, onboarding, fraud-alert overload, payments exceptions, customer-service handling, and compliance queues; these are better starting points than generic AI agendas or scattered experimentation. The practical sequence is to redesign the process end to end, redefine how human judgment and AI agents work together, and convert the improvement into reusable internal building blocks. The goal is not more isolated use cases, but an operating model that improves service, speed, and control together (Shao et al., 2025; McKinsey & Company, 2025b; McKinsey & Company, 2025c).

### Why continuous transformation matters in Slovenia

For Slovenia, the issue is practical rather than abstract. In a smaller market, there is less room for fragmented initiatives, duplicated effort, or repeated rebuilding of the same capability. That makes structured reuse and proportionate governance more important than in larger markets.

Slovenian banks have started to disclose concrete forms of AI adoption. NLB Group's 2025 Annual Report states that an LLM (large language model)-based customer-facing virtual assistant went live on the bank's website, that an internal Personal Loans AI Assistant was deployed, and that employee adoption was supported through a systematic programme of AI enablement, literacy training, reskilling, community-building, and AI tools, alongside a pipeline of AI use cases of varying complexity. The report also states that NLB has established a formally designated organizational unit responsible for AI and AI governance (NLB Group, 2026). OTP bank reports that AI had already begun to support internal processes, with wider use planned in support of a virtual bank adviser, while UniCredit Banka Slovenija reports a special-purpose team for practical AI implementation and pilot projects in document processing and process automation (OTP banka, 2026; UniCredit Banka Slovenija, 2026). Taken together, these disclosures show that Slovenian banks are already moving beyond discussion and into practical AI adoption. That is exactly why continuous transformation matters: once adoption has begun, the real challenge is no longer whether to use AI, but how to redesign processes, roles, and reusable building blocks in a way that can be repeated and scaled. The important next step is to design operating models that are ready for AI agents.

### Conclusion

AI matters in banking when it helps the bank improve service, speed, and control together by redesigning workflows, reshaping the AI-augmented workforce, and carrying reusable internal building blocks into the next process improvement. The central issue is not whether isolated use cases can produce local gains, but whether banks can redesign important processes, reorganize how people and AI agents work together, and reuse what they build and learn from one improvement to the next. Continuous transformation therefore means repeated redesign of workflow, workforce, and reusable internal building blocks rather than a loose innovation agenda. Banks that benefit most will not be those with the loudest AI narrative or the largest number of scattered use cases. They will be those that turn AI into stronger workflow design, better-prepared decisions, clearer accountability, and repeated reuse of proven templates, rules, prompts, escalation patterns, and cleaner handoffs over time.

For management, the first step is to choose one impactful end-to-end process, assign one accountable business owner, and redesign it across workflow, workforce, and reusable internal building blocks before scaling further.

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# Adoption of artificial intelligence in banking: Implications and issues

*Gonzalo Capriolo\**

Slovenia's economic activity and business opportunities are being increasingly constrained by population ageing. The adoption of artificial intelligence (AI) can boost productivity and help mitigate these effects. To fully realise its benefits, however, AI must be widely adopted across the economy and supported by clear, coherent strategies. At the government level, this requires aligning economic and digital strategies to create an enabling environment for AI adoption, alongside sustained investment in skills development. At the sectoral level, leadership in AI adoption is particularly important in service industries such as banking. In the banking sector, AI adoption entails the implementation of robust governance frameworks, transformation of work processes, and continuous upskilling of the workforce to maintain competitiveness. Given the specific characteristics of the banking industry and the rising pressure from new competitors, AI adoption is no longer optional. However, it remains a significant challenge due to the industry regulatory constraints.

JEL G21, O33, D23, D24

Beyond external shocks, Slovenia's economic activity is being constrained by low investment activity and ageing of population. Raising productivity is the key policy priority to sustained increase in living standards. This implies improving business environment and pursuance of targeted policies at microeconomic and firm-level towards fostering technology adoption and innovation across firms, improve management quality and organizational practices and enhance skills and human capital of workers. In this context adoption of artificial intelligence can play a role in boosting productivity. Contingent to sectoral specialisation and broad adoption it is estimated that AI could result in productivity growth between 0.4– 1.3 percentage points annually in countries with high AI exposure and between 0.2 to 0.8 percentage points in countries with less exposure (Filipuci et al., (2025)).

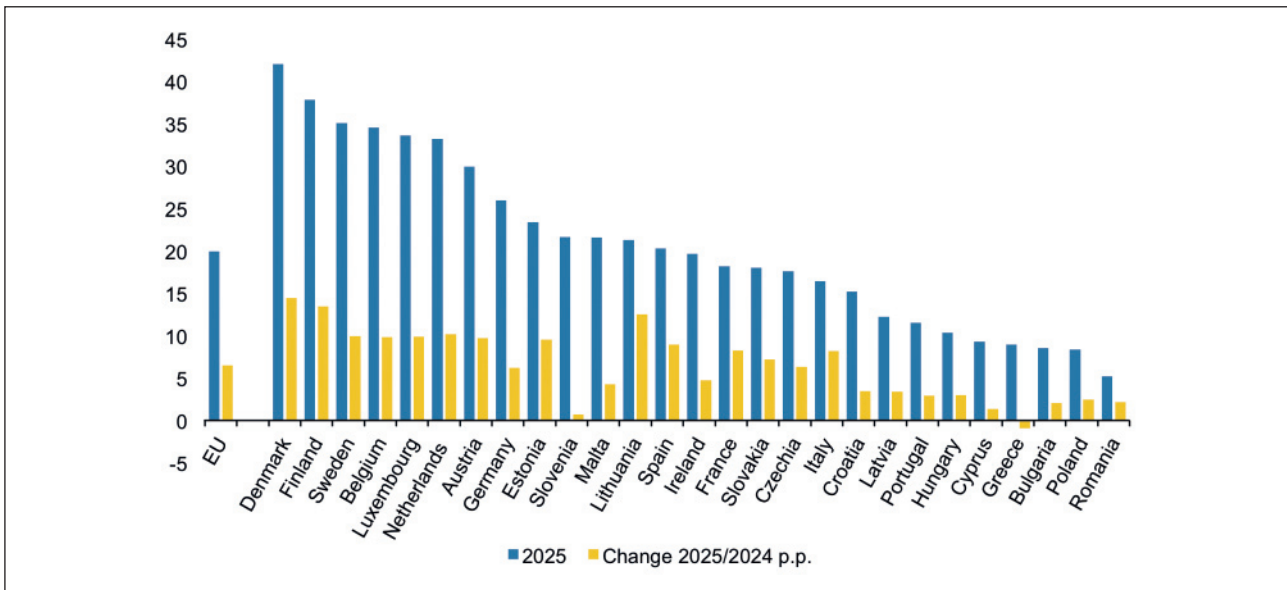
By exposure to AI it is understood a high share of tasks in economic activities' overlaps with capabilities where AI is improving the fastest (language, coding, data classification, document processing, prediction) (Felten et al., (2021)). Economic activities with high AI exposure include finance (banking, capital markets, insurance); information & communication (software/IT services, media, publishing, data services); professional services (legal, accounting, consulting,

marketing/advertising, HR/recruitment) and; administrative & support services / customer operations (call centers, shared services, back offices). Among all industries, banking is regarded as one of the industries with the biggest impact as a share of revenues from generative AI (McKinsey 2023). The extent of potential gains from AI seems to be related to the prevalent growth model in a given country (services-led vs industry-led model) and its adoption. Among more developed countries where AI gains are identified as being more pronounced are United States and the United Kingdom with strong specialization in finance, ICT and other knowledge-intensive services and where AI is being fast adopting. Canada, Germany and France are regarded as having less favourable conditions. They exhibit substantial industrial bases, meaningful but less dominant knowledge-intensive service exposure and experiencing intermediate AI adoption (Filipuci et al., (2025)).

The other key dimension underpinning productivity gains from AI adoption is the extent to which such technology is widely adopted and structural conditions that support its diffusion. For example, even if AI tools raise productivity in pilot projects, economy-wide gains may remain limited without complementary investment (e.g., IT infrastructure), workforce upskilling, and organisational changes that enable firms to scale their use across sectors and improving framework conditions such as data protection concerns, regulatory uncertainty and skill shortages.

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Figure 1: Enterprises using at least one of the AI technologies (% of enterprises), 2025 and change 2025/2024



Source: Eurostat (online data code: isoc\_eb\_ai), own calculation

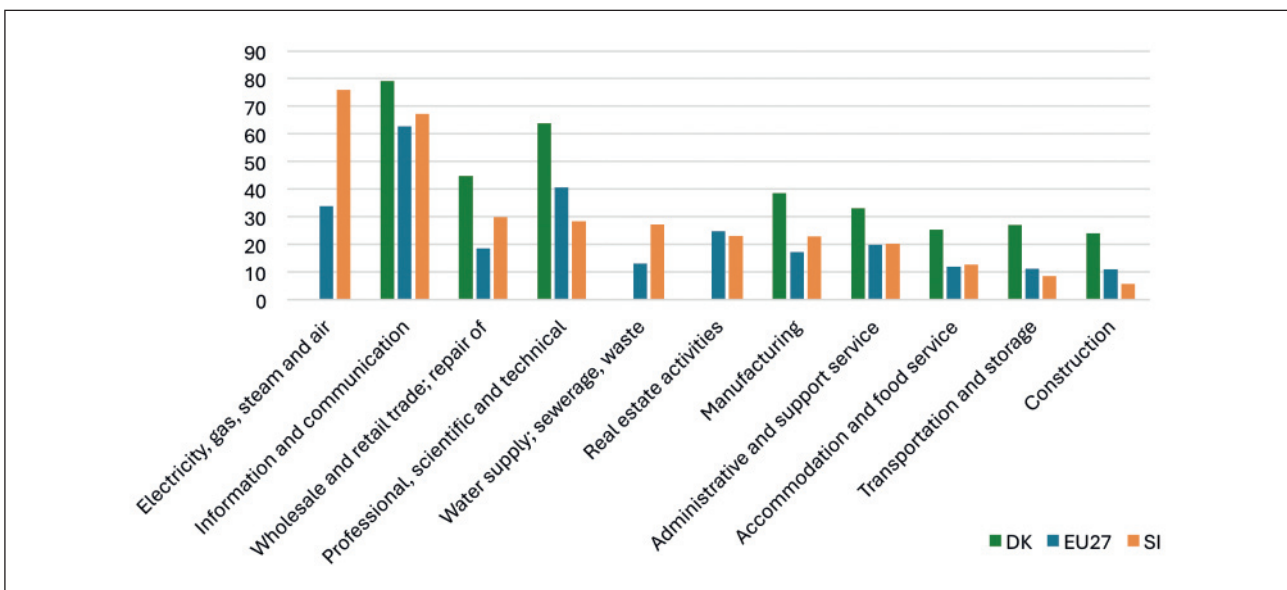
### AI adoption in Slovenia

Slovenia’s level of AI adoption by enterprises (excluding those in banking and financial services) was above EU average in 2025. While it exhibited one of the fastest growth rates in adoption in 2024, it seems that the pace of adoption slowed down in 2025 (Figure 1). Looking at AI diffusion and following Kergroach and Héritier (2025), Slovenia can be classified among EU countries with uneven AI diffusion across sectors where knowledge-intensive services and automotive industry lead AI adoption. However, manufacturing and SMEs lag behind and are faced with structural constraints such as skills shortages, limited access

to advanced data infrastructure, and scale effects. Thus Slovenia, while benefiting from the EU-level digital policies, is facing regional and firm-size divides.

Comparing AI adoption in economic activities in Slovenia with in the EU27 and Denmark, the leading country among those of EU in AI adoption, suggests that Slovenia performs relatively well in the utilities and ICT activities while it lags behind in terms of adoption in knowledge-intensive services. The lags are notorious in professional scientific and technical activities, real state, administrative support, transportation and construction activities (Figure 2).

Figure 2: Enterprises using AI technologies by economic activity, EU27, Denmark (DK) and Slovenia (SI), 2025



Source: Eurostat (online data code: isoc\_eb\_ai)

### AI adoption in banking

Banking is one of the most exposed economic activities to AI, where it is reshaping how banks generate value and manage risks. AI adoption in the banking is both transformative and constrained. This is because AI directly affects the industry's core profit engine in terms of making better decisions at scale (credit, fraud, anti money laundering, pricing, service). At the same time, the banking sector operates under high and strict regulatory constraints and supervision (regulation, model risk governance, cybersecurity, and trust). This combination makes AI's upside (growth, cost-to-income improvement, capital efficiency) and downside adoption (losses, compliance breaches, reputational damage) larger and more immediate than in most activities. Furthermore, it raises challenges in terms of increased execution difficulty and downside risk (model risk, compliance breaches) requiring suitable governance arrangements. The high exposure of banking to AI can be explained by various factors: Banking being "decision-heavy" where AI automates or improves decisions; Banking is "data-rich", which makes AI easier to apply to scale; Winner-takes-most dynamics are stronger than in many industries; AI influences both cost (e.g., automation in operations) and revenue (e.g., personalisation), thus balance sheet outcomes (e.g., better credit decisions and earlier risk detection); Dealing with regulation increases exposure as banks must prove explainability, fairness, auditability, governance, and third-party risk controls.

The adoption of AI in banking is motivated by efficiency gains, improved risk assessment, enhanced customer experience, and competitive pressure from fintech firms and digital-first banks. The use of AI in banking is systemic and no longer marginal (Machado 2026). Over 85% of large EU banks use AI, with adoption accelerating. Similarly, Grant Thornton 2026 *AI Impact Survey* indicates that AI adoption is widespread and 54% of banks are now scaling AI across multiple functions.

Four phases of AI adoption can be identified in banking with large banks in the more advanced phases. Deployment of pilot projects and experimentation. Broader deployment in core business activities. Use of generative AI (where the technology creates new and original content based on patterns and available data) and Agentic AI (where systems act as autonomous or semi-autonomous agents that can set or interpret goals, plan steps, take actions, use tools and adapt based on feedback (Standford (2026). A key 2025–2026 development is the emergence of agentic AI—systems that can execute multi-step financial actions autonomously within constraints (McKinsey's 2025).

With AI adoption in banking no longer marginal, governance capacity is now regarded as the binding constraint on performance (value creation), risk control, and scalability (Machado (2026; and BIS (2026). Data readiness, and accountability frameworks have lagged behind. As a result, banks are realising efficiency gains but limited revenue growth and strategic returns (Grand Thornton 2026). Supervisory authorities consistently identify governance as the critical enabler for scaling AI safely and effectively (Machado 2026).

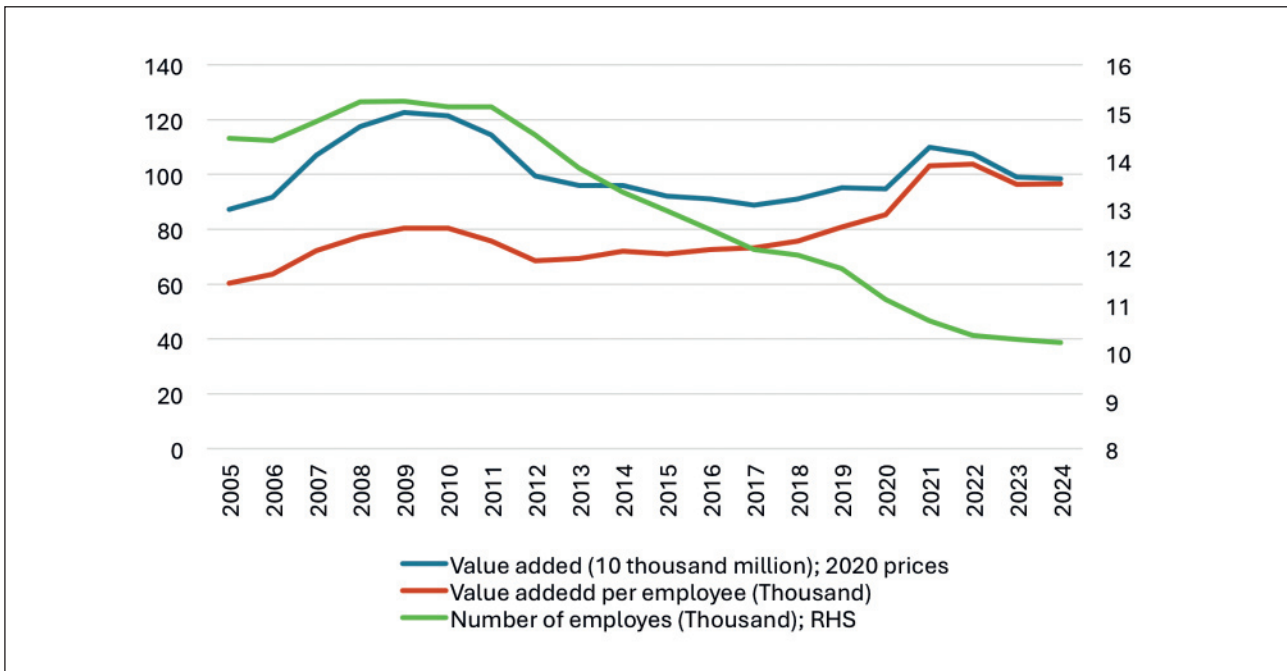
Concerning the stage of AI adoption in banking in Slovenia, there is no specific or official data to draw conclusions. The degree of AI adoption in banking can be inferred only indirectly through the broader assessment in the EU regulatory and supervisory context. According to the European Banking Authority (EBA 2024), AI has been widely adopted across the euro area banks over the past five years, with most institutions having moved beyond pilot projects and integrated AI systems into their core information-technology infrastructures. The EBA reports that approximately one-third of EU banks have already implemented general-purpose or generative AI (GPAI) in at least one operational use case, and around 40 % are actively using GPAI, most commonly in customer support, fraud detection, anti-money-laundering processes, and internal process optimisation. Slovenia-specific evidence from the Bank Association of Slovenia confirms that AI applications are actively discussed and presented within the domestic banking sector, particularly in the context of digital transformation and data-driven operations, although without consolidated quantitative reporting at sector level. Looking at productivity developments in banking in Slovenia can provide some insight on how AI might have contributed to them. From 2017 until 2023 productivity improved underpinned by a process of banking consolidation and reduction of employment. This development would not have taken place without automation and use of algorithms, Figure 3 shows how productivity (value added per employee) increased until 2022 resulting also from reduction in employment. In the last year productivity remained constant.

### Main areas of AI adoption

A review of the literatures indicates that AI is reshaping front-office customer interactions, middle-office risk management, and back-office operations in banks (Fares et al., 2023; Vuković et al., 2025)

According to the EBA (2024), the main areas of AI adoption in banking include: customer service and personalisation (AI-enabled chatbots, virtual assistants, and

Figure 3. Productivity, value added, and employment in the banking sector



Source: SORS. Own calculation

recommendation systems); credit scoring and risk assessment (one of the most mature AI use cases in banking including machine learning models, including gradient boosting, random forests, and neural networks); fraud detection and financial crime compliance (delivering significant benefits through real-time monitoring, anomaly detection, and adaptive learning capabilities) and operational efficiency and cost reduction (contributing to automating back-office processes such as document processing, transaction reconciliation, and compliance reporting).

Information on the use of AI from leading AI adopting banks, indicates a shift from cost efficiency to balance-sheet and revenue generation or from cost cutting to grow assets and revenues. PwC (2026) highlights that AI leaders focus on growth and business model reinvention, not just productivity gains. For banks, this means that the use of AI is moving beyond the areas identified above (chatbots, back-office automation and basic fraud detection) toward high-impact uses such as: AI-driven credit underwriting and dynamic pricing, personalised product bundling (loans, savings, insurance, investments), AI-assisted origination for SMEs and retail customers, predictive balance-sheet optimisation (liquidity, capital allocation).

Leading AI adopting banks are not just automating but redesigning credit, risk, and compliance. AI is being regarded as enterprise transformation technology and not as mere enhancement. According to PwC (2026), banks that keep AI as a “decision support tool” will be slower,

more expensive and less accurate than those embracing AI-assisted or AI-executed decision within regulatory limits.

### Governance challenges

AI can materially improve bank performance, but it also increases model, compliance, and cyber risk. Thus, governance capacity is now the binding constraint on performance, risk control and scalability. (Grant Thornton 2026; ECB 2026).

AI is currently delivering cost, productivity, and process improvements. However, revenue-generating and growth-oriented AI use cases remain harder to scale. Furthermore, AI without governance can deliver efficiency gains but not transformation. 50% of surveyed banks reported that governance and compliance barriers limit AI performance (Grant Thornton 2026). Governance gaps, model risk, data quality, and accountability are identified as key reasons why AI benefits may fail to materialise despite adoption. Thus, governance-ready organisations can safely scale AI into revenue-and strategy-critical functions.

Solid governance frameworks should exhibit clear accountability for AI-driven decisions, suitable senior management oversight and robust challenge mechanisms covering risk management, compliance and internal audit (Machado 2026). They should exhibit clear ownership, integration into existing risk management and ensure continuous monitoring and auditability.

Risk management and governance frameworks should be aligned alongside technology. This in terms of risk management involves: Explainability of outputs; model lifecycle management as AI models evolve over time and; data quality and avoidance of. The risk management framework should deal with dependency risks such as vendor lock-in, data confidentiality and security, operational resiliency and exit strategies bias (Machado 2026).

### AI impact on jobs, skills and workforce strategies

Short-term AI impacts in banking are more about tasks transformation and productivity than employment reduction or growth (Grant Thornton 2026). Between 2013/2019, routine roles contracted globally while technical and professional roles expanded. This trend has accelerated by AI adoption. AI is reshaping banking unevenly, not eliminating jobs across the board. Empirical evidence using vacancy data between 2024-2026 (Srinivasan 2026) suggests that banking is one of the most affected sectors, but with polarized outcomes resembling a “K-shaped” transformation. Whereby job posting declined for automation-exposed roles, while augmentation-prone roles saw rising demand. Job augmentation dominates displacement where human judgement matters. The ongoing process is regarded more as “rewiring the firm” than cost cutting alone whereby banks that redesign workflows, not just adopt tools, capture most value. The K-shaped pattern indicates that AI in banking is reallocating value within the workforce, rewarding complementary skills and penalizing static task definitions. The most exposed automatable roles in banking include routine compliance, reporting, and back-office processing while front-line decision roles (credit, risk, asset management) are enhanced, not eliminated.

The organizational mechanics producing the K-Shaped labour outcome can be explained by AI decoupling tasks from roles. Advances in AI are pushing banks to shift from static, role-based job architectures toward dynamic, skills- and task-based models, as AI breaks the traditional link between job titles and value creation (Oliver Wyman, 2026). In the emerging model, routine and data-heavy tasks are increasingly automated, while human workers focus on judgement, oversight, and outcome ownership, requiring new leadership roles, governance frameworks, and hybrid human-AI operating models (Oliver Wyman, 2026). AI is reshaping employment in banking and value generation through task level changes rather than rapid job displacement. Core competences needed across banking for AI-transformed roles include: digital and AI literacy consisting in understanding of AI capabilities, limitations, risks and

implications, critical thinking and analytical decision making, as AI assists with data processing but cannot replace human judgment, human-AI collaboration expressed as the ability to work alongside AI agents and automation tools, ethical AI and responsible governance awareness as banks must operate under strict accountability rules for AI decisions.

The implication of AI deployment is that skills and education policy must shift away from static occupations toward dynamic, judgment-intensive capabilities; prioritize lifelong reskilling; and treat workforce development as a distributional lever, as AI differentially rewards workers and firms able to redesign work, governance, and human-AI collaboration.

### One-sentence synthesis for Slovenia

AI adoption policy should focus on deploying solid governance framework promoting responsibility, mitigating risk and fostering skills. This implies for banks aligning AI strategies with internal capabilities, including human resources skill development, work organization and training systems. With AI demanding high skilled labour such a process is taking place under constrained of high tax on labour which might influence relative competitiveness of the Slovenian banks (Capriolo and Mičković 2025). More broadly, to reap productivity gains, Slovenia should foster AI uptake in knowledge-intensive services while easing the structural barriers that hold back AI adoption by manufacturing firms and SMEs.

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# From global risk signals to forward-looking betas - An AI-driven framework beyond CAPM

*Timotej Jagrič and Aljaž Herman\**

This paper develops an AI-driven hierarchical framework that links global risk signals to forward-looking estimates of systematic risk at both the industry and firm levels. The Global Risk Radar transforms unstructured news data into a structured, ISO- and COSO-aligned risk register using artificial intelligence. These signals serve as key inputs to the Industry Beta Monitor, which generates forward-looking industry betas for monthly and annual horizons, overcoming the backward-looking limitation of traditional beta estimates. The Beta Forecaster further adjusts industry betas using firm-specific financial and demographic characteristics. The framework provides direct empirical evidence that global risk indicators carry substantial predictive information about betas, challenging the static CAPM paradigm.

JEL G12, C53, G32, O32

## 1. Introduction

In the context of most securities today, systematic risk is no longer a stable, long-run characteristic of financial assets but rather a dynamic response to a fast-changing global risk environment. The traditional Capital Asset Pricing Model (CAPM) assumes that a beta coefficient can be robustly computed from historical returns and used as a representative measure of future risk (Sharpe, 1964; Lintner, 1965). This view was reasonable amid periods of relative macroeconomic stability, but it is becoming less practicable in today's context of constant geopolitical shocks, regulatory shifts, supply-chain upheavals, and technological advancements. For decades, the empirical literature has shown that betas are not static but time-dependent, and static estimates typically do not properly capture either cross-sectoral variation in returns or long-run changes in risk (Fama & French, 1992). The conditional CAPM codified this intuition in a set of information that influences expected returns, systematic risk, and, therefore, the risk/return (Jagannathan & Wang, 1996). However, one important open issue is which information is economically required to predict future beta

changes, and how to systematically and operationally incorporate this information into valuation and risk-management models.

This paper attempts to fill this gap by formulating and formalising the Global Risk Radar as a structured, AI-assisted information layer that augments the existing classical information model of financial environments. The Global Risk Radar is based on the systematic processing of global news flows and establishes a stable risk register aligned with the global risk management frameworks, especially ISO 31000 and COSO ERM. Its goal isn't to directly predict financial variables but rather to identify shifts in risk perception and dynamics, serving as early indicators of future structural transformations in the economy and financial markets (Jagrič et al., 2025).

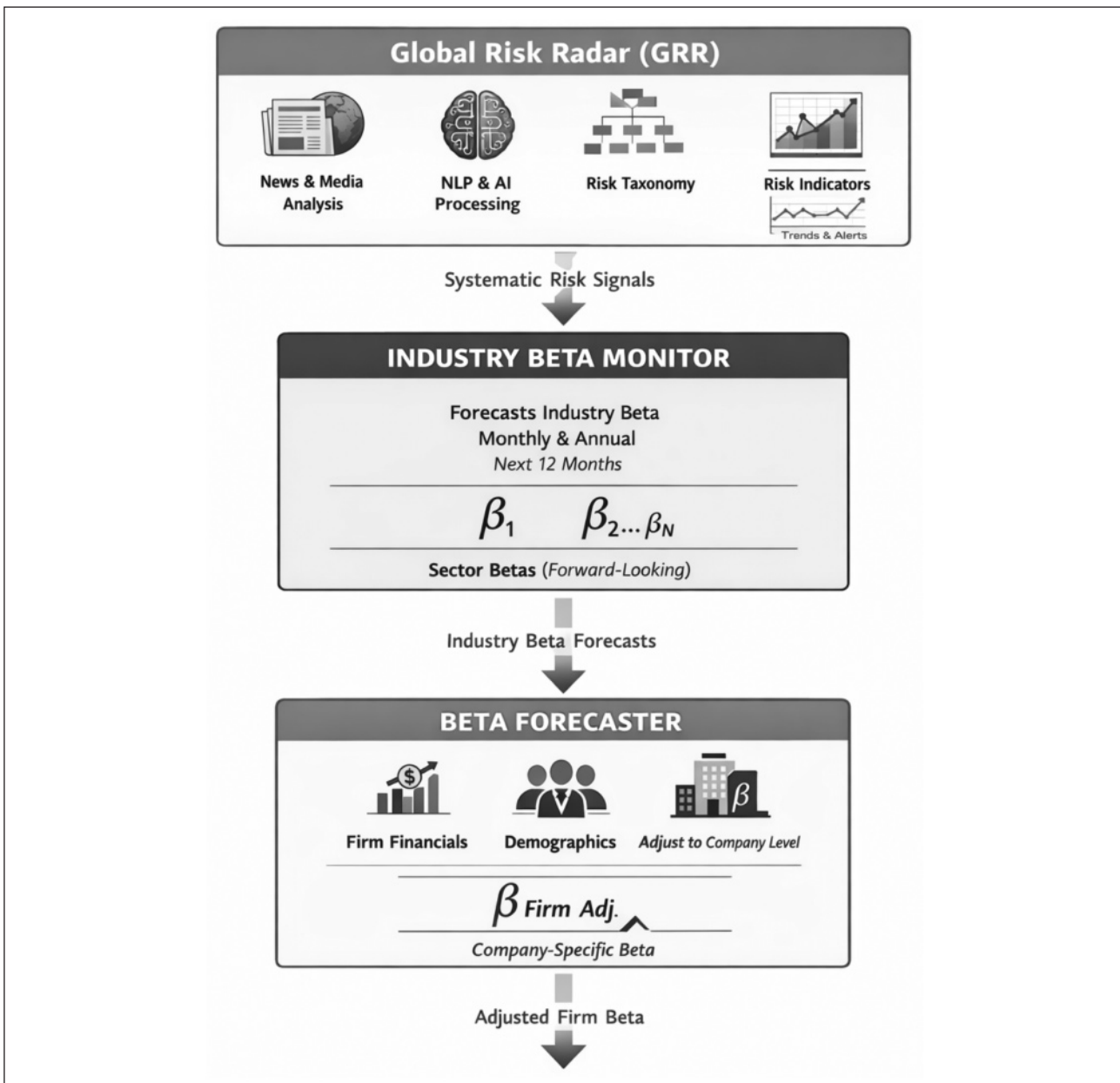
On this basis, the paper presents a hierarchical modelling framework in which the Global Risk Radar serves as an input layer for predicting industry betas. The Industry Beta Monitor generates forward-looking industry betas for the next 12 months on a monthly and annual basis using Global Risk Radar outputs. This strategy addresses a key methodological shortcoming of existing practice: industry betas are available only for historical years, so they do not reflect the current risk regime when the asset was valued.

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In this phase, industry beta forecasting will serve as an input parameter for the Beta Forecaster, enabling one-off beta estimates across individual firms. So too does Beta Forecaster further incorporate firm-specific characteristics and financial indicators for each company, as well as region- and demographic-specific factors, so its industry's beta can be adjusted accordingly based on how it actually experiences risk. Within this framework, the firm's beta is no longer estimated directly from historical returns, but instead from a forward-looking industry beta that already incorporates the company's information about international risk. The paper has three primary contributions. It first constructs and formalises the Global Risk Radar as an AI-equipped

risk register, conceptually congruent with traditional risk-management conventions. Second, it illustrates how these risk signals can serve as primary inputs to predict industry betas, thereby augmenting the conditional CAPM with rich information and non-financial factors. Thirdly, the paper illustrates that the hierarchical linkage of the Global Risk Radar, Industry Beta Monitor, and Beta Forecaster leads to consistent movement from global risks to the systematic risks for firm-specific, and has significant implications for firm sectoral risk and corporate valuation in the financial system, which has significant implications that should be studied in financial theory, corporate valuation, and risk management in the banking sector.

Figure 1: Hierarchical AI structure of the system for forecasting firm-level betas



Source: Author's own illustration

## 2. Beta, the conditional CAPM, and information sources

This fundamental role of beta in financial theory originates from the CAPM. It defines systematic risk as the only risk relevant to determining expected returns in equilibrium (Sharpe, 1964; Lintner, 1965). Beta in this framework measures the sensitivity of an asset's return to movements in the market portfolio and represents residual risk that cannot be eliminated through diversification. The operational appeal of this method lies in its simplicity. It can use historical market data very simply, which is advantageous both for company valuation and for investor decision-making.

However, there is ample empirical evidence that a static interpretation of beta does not give us a satisfactory explanation of realised returns. Fama and French (1992) found that the book-to-market ratio and firm size account for the major cross-sectional differences in returns, whereas the beta-to-returns relationship is inconsistent. This result encouraged the use of multifactor models but also raised the question of whether beta is a stable parameter or simply varies with the economic environment.

The conditional CAPM is a significant move in this debate, as it formally introduces expected returns and beta as functions of an information set that can change (Jagannathan & Wang, 1996). Beta is no longer a constant, in this scheme, but a conditional expectation, a factor that adapts to the economic state. Thus, the important question is the choice of the information set, as the predictive strength of the conditional CAPM is ultimately determined by which information the model takes up (or does not) and by its timeliness in incorporating changes in the risk environment.

Because most empirical applications of the conditional CAPM depend on macroeconomic variables such as interest rates, yield spreads, and the business cycle, the conditional CAPM is limited in this regard. These results are frequently brought to market with a lag time, and therefore only reflect sudden structural disruptions—consistent with modern world dynamics. The research interest has therefore leaned more and more towards alternative sources of information, particularly news-oriented and text-based sources, that have the potential to quickly capture shifts in risk perceptions.

The literature on news-based uncertainty and risk indices shows that systematic text processing can capture information pertinent to real economies and financial markets. The Economic Policy Uncertainty Index by Baker, Bloom, and Davis (2016) and a connection with investment activity and financial variables are presented. Caldara and Iacoviello (2022) construct a Geopolitical Risk Index that empirically demonstrates the significant impact of geopolitical shocks on macroeconomic and financial outcomes.

A shared trait of these approaches is that news flows are early indicators of environmental change, whereas classical data usually detect them very late.

Even so, most existing indices are either one-dimensional or limited to a single risk class. However, they are not directly associated with the risk-management frameworks utilised by firms and financial institutions, restricting their use in systematic valuation and risk management. The Global Risk Radar fits in this tradition of research but builds upon it by establishing a multidimensional risk register that is stable over time, consistent with international risk-management norms, and a direct input to systematic risk models.

In this sense, the Global Risk Radar is not an alternative to financial theory but merely a layer of information on top of it. By embedding structured, AI-assisted risk signals into beta-forecasting models, this approach enables the empirical implementation of the conditional CAPM, which escapes the constraints of classical macroeconomic perspectives. A conceptual link is established between the news-based risk index literature, the theory of conditional asset pricing, and valuation and risk management through the framework presented.

## 3. Global Risk Radar

The Global Risk Radar is designed as a systematic information layer whose primary purpose is to detect and quantify changes in the global risk environment that are not directly observable in traditional financial and macroeconomic data. In contrast to approaches that measure realised volatility or losses, the Global Risk Radar captures perceptions, intensities, and dynamics of risks as reflected in global news flows. These signals act as leading indicators of changes in risk regimes and thus as carriers of predictive information for models of systematic risk (Jagrič et al., 2025).

Let  $R = \{1, \dots, R\}$  denote the set of risks in the systematic risk register, conceptually aligned with the ISO 31000 and COSO ERM frameworks. Let  $D_t = \{d_{1t}, \dots, d_{N_t t}\}$  denote the set of news documents in period  $t$ . The artificial intelligence and NLP system defines a mapping that assigns to each document a vector of probabilities or weights of association with the risks in the register. Formally, let

$$\pi(d_{nt}) \in [0,1]^R$$

denote the model output for document  $d_{nt}$ , where the component  $\pi(d_{nt})$  represents a semantic assessment that the document contains content related to risk  $r$ . In its most general form,  $\pi(\cdot)$  can be understood as the output of a fine-tuned transformer model using contextual text

representations (Devlin et al., 2019); however, for the purposes of the formal framework, it suffices that this mapping is stable and reproducible.

Based on these document-level weights, a raw frequency/intensity indicator is constructed for each risk. Let

$$c_{r,t} = \sum_{n=1}^{N_t} \pi_r(d_{nt}),$$

where  $c_{r,t}$  measures the aggregated presence of risk  $r$  in the news flow during period  $t$ . Since the news volume varies over time, normalisation is required. Let  $s_t = \sum_{r=1}^R c_{r,t}$ , or alternatively  $N_t$  denote the size of the corpus; the relative share can then be defined as

$$p_{r,t} = \frac{c_{r,t}}{s_t}.$$

Because the purpose of the Global Risk Radar is to capture changes relative to each risk's own historical distribution, the central standardised indicator is defined as a z-score. Let  $\mu_{r,t}^{(L)}$  and  $\sigma_{r,t}^{(L)}$  denote the rolling mean and standard deviation of  $p_{r,t}$  over a window of length  $L$ , for example  $L = 12$  months. The 12-month relative risk indicator is then given by

$$z_{r,t} = \frac{p_{r,t} - \mu_{r,t}^{(L)}}{\sigma_{r,t}^{(L)}}$$

The vector

$$Z_{r,t} = (z_{1,t}, \dots, z_{r,t})$$

represents the state of the risk environment in period  $t$  in a standardised form. Since the dynamics of risk are also crucial for forecasting systematic risk, the Global Risk Radar defines short-term momentum and acceleration as discrete differences of the standardised process. Let us define

$$m_{r,t} = z_{r,t} - z_{r,t-1}, \quad a_{r,t} = m_{r,t} - m_{r,t-1}.$$

This yields an extended information set  $\tilde{Z}_t$ , which includes both levels and dynamics of risk:

$$\tilde{Z}_t = (Z_t, \text{MOM}_t, \text{ACC}_t)$$

where  $\text{MOM}_t = (m_{1,t}, \dots, m_{R,t})$  and  $\text{ACC}_t = (a_{1,t}, \dots, a_{R,t})$ . This construction is crucial because it allows for a distinction between risks that are persistently elevated and risks that are transitioning into an active regime phase. In the sense of the conditional CAPM,  $\tilde{Z}_t$  represents an expanded information set that complements classical macroeconomic and market variables (Jagannathan & Wang, 1996). The Global Risk Radar can therefore be interpreted as a

formalised infrastructure for transforming unstructured global information into quantitative time series that are simultaneously conceptually aligned with risk-management frameworks and operationally usable as inputs into models of systematic risk (Jagrič et al., 2025).

#### 4. Industry Beta Monitor

The Industry Beta Monitor is designed to forecast industry betas in a way that overcomes the fundamental limitation of classical practice, in which industry betas are estimated ex post and are therefore unsuitable as current parameters for valuation and decision-making Jagrič (2026a). Because the systematic risk of industries varies across risk regimes, the industry beta is treated as a latent, time-varying parameter that is conditioned on the economy's information structure and the global risk environment.

Let  $i \in \{1, \dots, I\}$  denote the industry index,  $\beta_{i,t}$  the industry beta at time  $t$ , and  $M_t$  the vector of macro-financial control variables. The baseline forecasting specification defines the future industry beta as a function of its past value, macroeconomic information, and the Global Risk Radar. For a one-step-ahead forecast,

$$\beta_{i,t+1} = f_i(\beta_{i,t}, M_t, \tilde{Z}_t) + \varepsilon_{i,t+1},$$

where  $\tilde{Z}_t$  includes risk levels, momentum, and acceleration, and  $\varepsilon_{i,t+1}$  denotes the forecast error. The function  $f_i(\cdot)$  may be linear or nonlinear, with the key requirement that it allows for interactions between the macroeconomic state and risk regimes. In a linear approximation, this takes the form

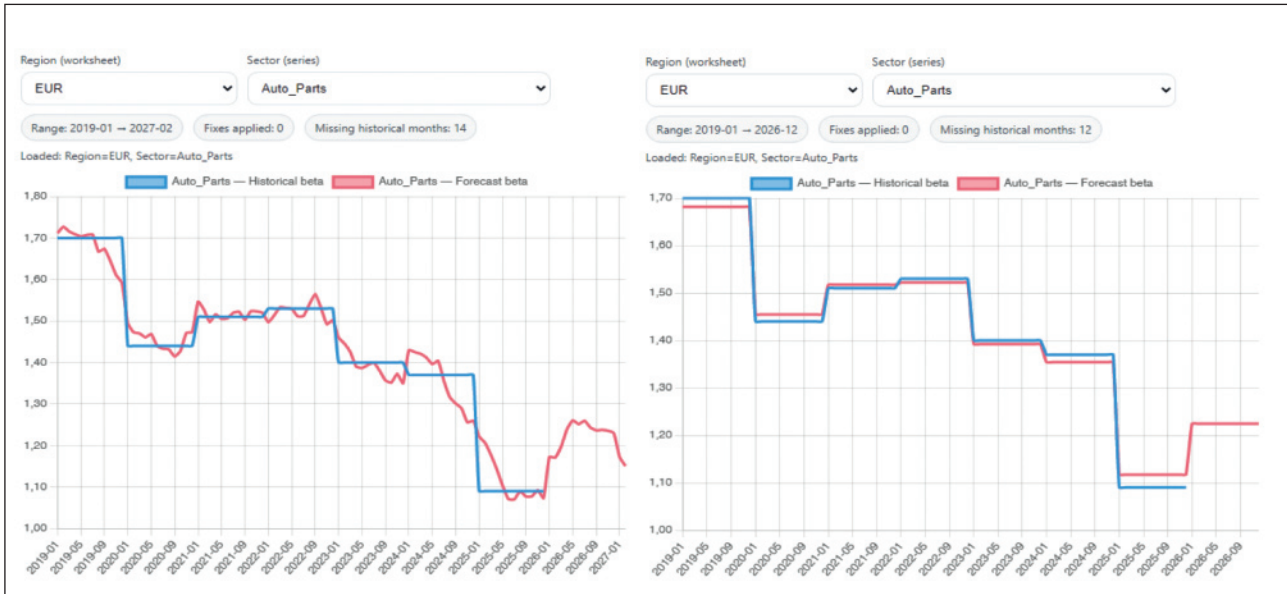
$$\beta_{i,t+1} = \alpha_i + \phi_i \beta_{i,t} + \gamma_i^T M_t + \delta_i^T \tilde{Z}_t + \varepsilon_{i,t+1}.$$

The coefficient vector  $\delta_i$  quantifies the informational contribution of the GRR indicators to the forecast of the industry beta and thus directly operationalises the concept of conditional systematic risk. Since the practical objective of the tool is to provide current industry betas for valuation purposes, the model is applied to multi-step forecasting horizons of up to 12 months. Let  $h \in \{1, \dots, 12\}$ . The general form is then

$$\beta_{i,t+h} = f_{i,h}(\beta_{i,t}, M_t, \tilde{Z}_t) + \varepsilon_{i,t+h}$$

where  $f_{i,h}$  may represent either a direct forecast for each horizon or a recursive iteration of the one-step-ahead model. The result is a forecast vector of industry betas  $\hat{\beta}_{i,t+1:t+12}$ , which provides users with forward-looking industry betas rather than historical ones.

Figure 2: Example of Industry Beta Monitor forecast for selected industry on a monthly and yearly basis



Source: Jagrič (2026a).

The monthly version of the Industry Beta Monitor is based on monthly indexing of and allows forecasts to be updated at high frequency, which is crucial for monitoring transitions between regimes. The annual version is derived from aggregation or re-estimation at an annual time step, which reduces short-term noise and emphasises the structural component of systematic risk. In both cases, it is essential that the forecasted industry beta  $\hat{\beta}_{i,t+h}$  is a direct function of GRR information, meaning that information about the global risk environment is already embedded at the industry level.

This constitutes a key element of the hierarchy, as the Beta Forecaster in the subsequent step does not start from a historical firm or industry beta, but rather from a forward-looking industry beta already adjusted to the prevailing risk regime. In this way, the CAPM interpretation shifts from static to conditional, with beta treated as a parameter conditioned on an expanded information set (Jagannathan & Wang, 1996), with the GRR serving as the formalised source of this information.

### 5. Firm-Specific Beta as a function of Forward-Looking Industry Beta

The Beta Forecaster represents the final and critical stage of the hierarchical modelling framework, in which systematic risk is progressively mapped from the global risk environment to the level of the individual firm. The fundamental difference relative to classical approaches is that the Beta Forecaster does not estimate a firm's beta directly from the firm's historical returns but instead starts from a forward-looking industry beta that already incorporates

information about the prevailing risk regime Jagrič (2026b).

Let  $\hat{\beta}_{i,t+h}$  denote the forecasted industry beta for industry  $i$  at horizon  $h$ , obtained from the Industry Beta Monitor. Let  $j$  denote a firm operating in industry  $i$ . The objective of the Beta Forecaster is to determine the firm-specific beta  $\beta_{j,t+h}$ , which reflects both the systematic risk of the industry and the firm's specific characteristics.

Within this framework, the firm beta is defined as a conditional transformation of the industry beta. Formally,

$$\beta_{j,t+h} = \hat{\beta}_{i,t+h} \cdot \psi(X_{j,t}),$$

where  $X_{j,t}$  denotes a vector of firm-specific variables and  $\psi(\cdot)$  is an adjustment function capturing the firm's relative exposure compared to average industry risk. The vector  $X_{j,t}$  includes financial indicators such as leverage, cash flow stability, profitability, and capital structure, as well as demographic and structural characteristics of the firm that affect its sensitivity to systematic shocks.

To ensure economic interpretability and stability of the estimates, the function  $\psi(\cdot)$  is constructed such that its expected value equals one, implying that a firm with average characteristics retains the industry beta. In logarithmic form, this can be expressed as

$$\log \beta_{j,t+h} = \log \hat{\beta}_{i,t+h} + w^T X_{j,t} + u_{j,t+h},$$

where the coefficient vector measures the relative impact of individual firm characteristics on systematic risk, and  $u_{j,t+h}$  represents a residual capturing unobserved heterogeneity.

Figure 3: Example of IFAI Beta Forecaster for a hypothetical company

The screenshot shows a web-based interface for the IFAI Beta Forecaster. At the top left, there is a dropdown menu set to 'Auto - Parts' and a text input field containing '1,230'. Below this, a note states: 'Selecting an industry applies the relevant internal industry classification and loads the default industry beta for 2024.' To the right of the input field, it says 'You may override this value.' Below the industry selection, it indicates 'Active inputs for this industry: 12' and 'Sector: d\_Auto\_Parts'.

The interface is divided into several sections for data entry:

- Company size:** A text input field for 'revenue' containing '9340030301,121' with a note 'Format: \$'.
- Financial indicators:** A grid of text input fields for various metrics:
  - debt to capital ratio: 0,374 (Format: decimal)
  - ebit margin: 0,101 (Format: decimal)
  - ebitda margin: 0,137 (Format: decimal)
  - financial leverage ratio: 2,534 (Format: decimal)
  - operating profit margin: 0,100 (Format: decimal)
  - return on capital employed: 0,117 (Format: decimal)
  - return on equity: 0,154 (Format: decimal)
  - return on tangible assets: 0,096 (Format: decimal)
- Macroeconomic indicators:**
  - inflation: 4,908 (Format: %)
  - unemployment rate: 4,950 (Format: %)
  - VIX: 8,238 (Format: decimal)

At the bottom left, there are two buttons: 'Compute beta' (highlighted in blue) and 'Reset to defaults'. On the right side of the interface, an 'Output' section displays the 'Predicted beta ( $\beta$ )' as **1.2083**. Below this, it shows the 'Risk regime' as  $\hat{\beta} > 1$  (more cyclical profile). A green callout box contains the text: 'Inputs look consistent. Predicted beta is within the suggested range (0 to 3). ( $\hat{\beta} = 1.2083$ )'. At the bottom of the output section, a disclaimer states: 'The estimate is intended for analytical support and scenario testing, not as a substitute for professional judgment. All calculations are performed locally, ensuring that no user-provided data is transmitted, processed, or stored on any server.'

Source: Jagrič (2026b).

This formulation allows the firm beta to be a multiplicative adjustment of the industry beta, consistent with the intuition that firms with higher leverage or more volatile cash flows bear above-average systematic risk.

One key element in the Beta Forecaster is that the beta of the firm is calculated using a currently known forward-looking industry beta rather than a historic association between the firm's return and the market. Indeed, the Beta Forecaster overcomes the double time inconsistency that traditionally characterises the classical methods. First, the industry beta is no longer an *ex post* estimate but rather a forecast value depending on the prevailing risk environment. Second, the company beta is no longer based on the firm's historical returns, which may be very contingent on idiosyncratic events or short-term deviations.

In the conditional CAPM framework, a Beta Forecaster can be seen as a device that adds internal firm-specific

information to the information set. While the Global Risk Radar and the Industry Beta Monitor capture external and aggregated risk factors, the Beta Forecaster can adapt systematic risk to the microeconomic determinants of each firm. The resultant beta is consistent with the global risk environment, industry structure, and firm-specific financial profile.

Such a hierarchical design is useful both regarding the firm's valuation behaviour and CAPM use. The cost of equity capital based on the firm-specific beta is no longer an outcome of a static regression, but a variable influenced by the general risk environment and the structure of the firm's financial system. In this sense, the Beta Forecaster offers us a functional application of conditional risk pricing that enables overcoming the drawbacks of traditional models by integrating macroeconomic, industry-level, and firm-level risk within a single analytical framework.

## 6. Implications for the CAPM and financial theory and practice

The primary question this paper attempts to answer is no longer whether beta is a time-varying variable, but rather what information can be used to forecast it. In that regard, Global Risk Radar is a formalised answer to this question, as it adds AI-processed global indicators that capture structural and non-financial characteristics that are usually not apparent in existing macroeconomic data.

The financial theory implications are manifold. First, the CAPM itself remains relevant as a theoretical framework, but it matters only if it is conceptualised as a special case of a broader conditional model of beta, where beta is an endogenous function of the prevailing risk regime. Second, the paper shows the importance of artificial intelligence in building the information set needed to empirically operationalise the conditional CAPM. The Global Risk Radar thus serves as an infrastructural enhancement, not a competing financial theory model, allowing for the integration of unstructured information with formal risk pricing models.

This study has more importantly practical implications than its theoretical contributions. The global risk register of the Global Risk Radar is conceptually aligned with the internationally recognised ISO 31000 and COSO ERM frameworks, hence it makes a direct link between the external risk environment and internal risk management within firms and financial institutions. These changes are demonstrated not only as qualitative estimates or stress scenarios, but also can be quantified by metrics, such as industry or firm-level betas that reflect shifts in the global risk environment, which have a direct impact on valuation, capital needs, and strategic decisions.

## 7. Conclusion and implications for banks

The conceptual foundation of this framework has a direct and practical impact on banks because it offers a consistent methodological approach for integrating global risks into the core processes of financial risk management. In the banking sector, where forward-looking risk assessments are becoming increasingly important for capital requirements, internal models, and credit decisions, relying only on static and historically based measures of systematic risk can create significant limitations.

By using the Global Risk Radar as an additional layer of external information, banks can detect shifts in risk conditions at an earlier stage before these changes are fully reflected in market prices or credit ratings. This allows them to respond more quickly and gain a better understanding of emerging risks.

The forward-looking industry betas generated by the Industry Beta Monitor help banks assess the systematic risk of portfolios across different economic sectors in a more realistic way. This is especially important in industries that are highly exposed to geopolitical developments, regulatory changes, or disruptions in supply chains. Historical betas often fail to capture the actual level of current risk. As a result, stress testing becomes more effective because internal models are no longer based solely on past volatility but also incorporate information about likely future risks.

The Beta Forecaster provides additional value in estimating credit risk and evaluating corporate exposures on bank balance sheets. It treats firm-level beta as an adjustment of the forward-looking industry beta while also considering company-specific financial characteristics. This enables banks to produce more consistent estimates of the cost of equity and risk-adjusted discount rates. Such estimates are particularly important for long-term investments, project finance, and collateral valuation, where assumptions about systematic risk strongly influence decision-making.

Another important aspect relates to regulation and internal risk governance. The Global Risk Radar should include a risk register that is conceptually aligned with ISO 31000 and COSO ERM frameworks. This allows banks to integrate new quantitative indicators into their existing risk-management systems instead of creating separate or incompatible approaches. In this way, global risk signals can become part of discussions at both management and supervisory board levels, supporting decisions related to risk appetite, capital allocation, and the long-term strategic direction of the bank.

More generally, the proposed framework facilitates banks to move from reactive to proactive management of systematic risk. Rather than making decisions based on simple historical data, decision-makers weigh data on the current and expected risk environment. It makes internal models more robust, the credit and investment decision-making more robust, and the resilience of the banking system to sudden structural shocks is improved.

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# How risk management in Europe has quietly replaced economic imagination

*dr. Slaven Mičković\**

This paper examines how risk management has become a dominant organising principle of European economic governance after the global financial crisis. It introduces the concepts of risk inflation and the Risk Management Intensity Index (RMII) to explain the growing intensity of supervisory and regulatory frameworks which constrain innovative and uncertainty-intensive investments. The paper further introduces the concept of policy sustainability risk, suggesting that the cumulative effects of well-intentioned policies may weaken Europe's long-term competitiveness and economic dynamism.

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## 1. INTRODUCTION

Over the past two decades, particularly following the 2008 global financial crisis, risk management has become a central organizing principle of economic policy and financial regulation in Europe. Through the expansion of supervisory practices, stress-testing methodologies, and regulatory frameworks - including macroprudential instruments and ESG requirements - Europe has developed a highly sophisticated architecture for identifying and controlling systemic risks. While this has strengthened financial stability, it also raises a fundamental question: whether the cumulative success of risk management has come at the expense of economic imagination.

This paper argues that Europe has undergone a subtle but profound transformation in its policy paradigm. Risk management, originally conceived as a supporting function, has evolved into a dominant logic shaping institutional priorities, resource allocation, and credit dynamics. Evidence from the banking sector points to a structural reallocation of organisational capacity toward risk, compliance, and control functions, alongside increasing procedural complexity in decision-making.

To capture this shift, the paper introduces two analytical concepts: the Risk Management Intensity Index (RMII), reflecting the cumulative growth of supervisory expectations and methodological complexity, and the concept of risk inflation, defined as the expansion and intensification of the

risk universe (Power, 2004; Hubbard, 2009). Together, these concepts provide a framework for understanding how risk governance reshapes financial intermediation. Building on recent policy debates, including concerns raised in the competitiveness analysis led by Mario Draghi, the paper introduces the notion of policy sustainability risk - the possibility that the cumulative effects of well-intentioned policies may constrain economic dynamism and innovation (Draghi, 2024). It further proposes a conceptual EU policy stress test as a tool for identifying structural imbalances within the governance model.

The central argument is not that Europe manages risk too much, but that it may manage it too exclusively. Without restoring the capacity to finance uncertainty and transformation, the success of risk-based governance may itself become a constraint on long-term economic performance.

## 2. From the Expansion of the Risk Universe to Risk Inflation

Over the past two decades, European economic governance has undergone a profound transformation in the way risk is conceptualised, categorised, and operationalised. What began as a response to growing economic, technological, and environmental complexity has evolved into a dense architecture of risk identification and control. To understand this transformation, it is useful to distinguish between two related but conceptually distinct processes: the expansion of the risk universe and risk inflation.

The expansion of the risk universe refers to the progressive

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broadening of phenomena formally recognised as economically and financially relevant risks. Traditionally, risk management focused on a relatively narrow set of financial risks - primarily credit, market, and liquidity risks. Over time, this scope expanded to include operational, legal and conduct, reputational, cyber, model, climate-related, ESG, and, more recently, geopolitical and digital transformation risks. This expansion reflects structural changes in the economic environment. Financial systems have become more interconnected, technologies more complex, and societies more sensitive to externalities and long-term sustainability. It can therefore be interpreted as a largely rational adaptation of governance frameworks to a more uncertain world, resulting in a broader and more differentiated “map” of risk (Beck, 1992; Basel Committee, 2010–2019). Importantly, this process is primarily driven by external factors - technological change, climate dynamics, and geopolitical fragmentation - and is supported by strong normative arguments. The inclusion of cyber, climate, or conduct risk within governance frameworks is rarely contested.

Risk inflation represents a second-order phenomenon. It concerns not which risks are recognised, but how intensively they are governed once incorporated into the regulatory and supervisory domain.

It refers to the progressive intensification and proceduralisation of risk-related requirements within an already expanded risk universe (Power, 2004). This includes increasing granularity of metrics, proliferation of scenarios and stress tests, layering of governance structures, and growing demands for documentation and validation. Risks are decomposed, assessed through parallel methodologies, and subjected to increasingly frequent supervisory scrutiny.

Unlike the expansion of the risk universe, risk inflation is not necessarily driven by new external shocks or materially higher underlying risk. Rather, it emerges endogenously from institutional dynamics - precautionary regulation, supervisory risk aversion, legal defensiveness, and the cumulative logic of post-crisis learning (Haldane, 2012). As a result, the marginal cost of additional risk governance may rise faster than its contribution to systemic resilience. Distinguishing between these processes is essential. The expansion of the risk universe concerns scope, while risk inflation concerns intensity. The former enlarges the set of relevant risks; the latter deepens the governance apparatus surrounding them.

This distinction enables a more balanced assessment of European economic governance. Critically examining risk inflation does not imply questioning the legitimacy of new

risk categories, but raises issues of proportionality and opportunity cost (Hubbard, 2009). As governance intensity increases, it may absorb organisational capacity and managerial attention that could otherwise support innovation and long-term investment.

The analytical importance of risk inflation lies in its institutional consequences. As governance intensifies, organisations respond by reallocating resources toward risk, compliance, and control functions, prioritizing validation and documentation, and internalizing supervisory expectations as operational constraints.

While this strengthens financial stability, it may also reduce the capacity of financial institutions to support investment, innovation, and structural transformation.

This tension is reflected in recent policy debates, including the competitiveness analysis led by Mario Draghi, which highlights persistent gaps in productivity, innovation, and private investment (Draghi, 2024). Although not explicitly framed in terms of risk governance, the underlying logic is consistent: cumulative regulatory and procedural complexity may constrain capital allocation toward growth-oriented activities.

### **Box 1: Conceptual Definitions Expansion of the Risk Universe**

The process through which an increasing number of economic, financial, technological, environmental, and social phenomena are formally recognised as relevant risks within regulatory and institutional frameworks.

#### **Risk Inflation**

A second-order process characterised by the increasing intensity, granularity, and proceduralisation of risk governance within an already expanded risk universe, leading to disproportionate growth in controls, metrics, and organisational effort relative to changes in underlying risk.

Taken together, the expansion of the risk universe and risk inflation point to structural dynamics in which organisational adaptation to governance requirements may unintentionally crowd out economic initiative. This provides the conceptual bridge to the subsequent sections, which formalise RMI and examine its implications for organisational structure and credit dynamics.

Table 1 provides a stylised representation of successive waves in the expansion of the risk universe in European banking since 2008, highlighting the cumulative broadening of risk categories embedded in supervisory and regulatory frameworks.

**Table 1: Waves of Risk universe expansion in European banking (Post-2008)**

Period	Dominant Risk Focus	Newly Internalized Risk Categories	Key Regulatory / Policy Triggers
2008-2010	Financial stability	Credit risk (advanced models), liquidity risk, counterparty risk	Global Financial Crisis Basel III framework ECB liquidity measures
2011-2013	Sovereign and systemic risk	Sovereign risk, contagion risk, macroprudential risk	Euro area sovereign debt crisis creation of ESRB
2014-2016	Governance and operational resilience	Operational risk, conduct risk, legal risk	Banking Union SSM establishment stress testing institutionalization
2017-2019	Non-financial, model and emerging ESG risk	Reputational risk, model risk, IT risk, early climate-related risk	Post-crisis regulatory deepening Paris Agreement TCFD recommendations increasing digitalization
2020-2021	Shock resilience and ESG mainstreaming	Pandemic risk, extreme scenario risk, climate risk (early supervisory integration)	COVID-19 crisis supervisory flexibility combined with stress testing growing role of NGFS
2022-2023	Geopolitical, energy and ESG transition risk	Geopolitical risk, energy price risk, supply-chain risk, transition risk	War in Ukraine energy shock inflation surge expansion of EU climate policy agenda
2024-present	Sustainability and transition risk (full institutionalization)	Climate risk, ESG risk, biodiversity risk, transition risk	EU Green Deal ECB climate stress tests CSRD implementation

Source: Author's own elaboration, drawing on ECB supervisory practices, Basel III framework developments, and EU financial regulation (2008–2024).

While this expansion captures which risks entered the governance framework, it does not capture how intensively they are governed – an issue addressed in the following section through RMII.

The evolution of the risk universe does not follow discrete shifts but overlapping waves, with sustainability-related risks emerging in the mid-2010s, becoming mainstream during the pandemic period, and reaching full institutionalisation only in the most recent phase.

### 3. Risk Management Intensity Index (RMII)

The expansion of the risk universe, as discussed in the previous section, captures the growing breadth of risks incorporated into the European banking regulation and supervision. However, this descriptive mapping remains incomplete without an analytical framework that accounts for the intensity with which these risks are governed. The institutional impact of successive regulatory waves depends not only on the recognition of risks, but on the depth, frequency, and organisational embedding of risk management practices.

To address this gap, this paper introduces the Risk Management Intensity Index (RMII) as a conceptual instrument designed to capture the cumulative institutional weight of risk governance (Haldane, 2012; IMF, 2023). RMII does not measure risk levels or the effectiveness of individual controls. Rather, it reflects the extent to which economic activity is mediated through risk management processes, procedures, and organisational structures.

The motivation for RMII rests on a central hypothesis: beyond a certain threshold, increasing risk management intensity may yield diminishing returns in terms of financial stability while generating unintended consequences for economic dynamism, credit intermediation, and strategic decision-making.

Risk management intensity can be understood as the density of risk-related requirements, practices, and institutional arrangements imposed on economic actors, particularly financial institutions. It encompasses regulatory mandates, supervisory expectations, internal governance standards, and self-reinforcing compliance practices. RMII is thus defined as a composite, multidimensional construct capturing the extent to which risk considerations structure organisational behaviour (Stulz, 2014). Its purpose is not precise quantification, but comparative and temporal assessment – tracing how the role of risk management within institutions evolves over time.

Importantly, RMII is conceptually distinct from both risk exposure and risk materiality. An increase in RMII does not necessarily reflect higher underlying risk, but rather a more intensive governance response to perceived or anticipated uncertainty.

The RMII framework is structured around four interrelated dimensions that capture the institutional manifestation of risk inflation: regulatory and supervisory scope; procedural and methodological depth; the frequency and permanence of risk exercises; and organisational embedding. Together, these dimensions describe how risk management shifts from

a supporting function to a central organising principle within financial institutions.

RMII is not intended as a critique of risk management, but as an indicator of institutional transformation. Rising RMII signals that an increasing share of organisational resources – human, financial, and cognitive – is devoted to managing, documenting, and justifying risk-related decisions. As RMII increases, organisations adapt by reallocating staff, restructuring decision processes, and internalising supervisory expectations as operational constraints. While these adaptations are individually rational, they may collectively alter the balance between control and initiative.

This perspective complements broader policy concerns regarding Europe's competitiveness and investment capacity (EIB, 2024). RMII provides a lens through which such challenges can be interpreted not as isolated shortcomings, but as potential outcomes of cumulative governance dynamics.

The RMII framework is deliberately conceptual and exploratory. Its purpose is to structure analysis and enable comparative reasoning rather than to produce a single definitive metric. Any empirical implementation would require subjective weighting choices and detailed institutional data that are not uniformly available. Moreover, RMII does not imply an optimal level of risk governance; the appropriate intensity remains context dependent. Nevertheless, it offers a useful heuristic for identifying potential saturation points where additional layers of governance may yield diminishing marginal benefits.

By conceptualising risk management intensity as an object of analysis in its own right, RMII opens the discussion of policy sustainability risk – the possibility that cumulative governance frameworks may constrain the system they are designed to stabilise. The following sections build on this foundation by examining how rising RMII translates into organisational reallocation and affects credit dynamics within the European model.

#### **4. Organisational reallocation: From business to control functions**

The expansion of the risk universe and the associated increase in regulatory and supervisory requirements do not remain external constraints imposed on financial institutions. Over time, they are internalised through changes in organisational structure, resource allocation, and governance priorities. As risk management frameworks become more comprehensive and granular, banks devote increasing shares of internal capacity to identifying, measuring, documenting, and monitoring risks across a widening spectrum. This process can be understood as an organisational trans-

lation of risk inflation. Regulatory expectations – embodied in stress tests, supervisory reviews, model validation standards, and ESG-related assessments – require not only formal compliance but sustained operational capacity. As a result, risk inflation manifests in the expansion of control functions, including risk management, compliance, internal audit, model validation, and IT governance, which increasingly shape decision-making processes and priorities (ECB SSM, 2023).

Importantly, this reallocation is driven less by strategic choice than by necessity. In a highly supervised environment, insufficient control capacity constitutes a risk in itself. Banks therefore strengthen internal control structures even when such investments do not directly contribute to revenue generation or credit expansion.

The cumulative effect is a gradual shift in organisational focus – from revenue-generating activities toward compliance and control capacity. While core banking functions such as credit origination, relationship management, and project financing remain central, their relative weight declines as control functions expand.

This shift is reflected not only on headcount allocation but also on internal processes. Credit decisions increasingly involve multiple layers of risk assessment, documentation, and approval, extending timelines and raising transaction costs. The objective is not to restrict lending, but to ensure that decisions are defensible within regulatory and supervisory frameworks.

Over time, this transformation alters internal power structures (Acharya et al., 2013). Control functions gain influence over strategic and operational decisions, while business units operate within tighter procedural boundaries. In this environment, the binding constraint on credit activity is no longer capital alone, but organisational attention, procedural capacity, and regulatory risk tolerance.

A key mechanism reinforcing this shift is the asymmetry of accountability embedded in modern supervisory regimes. Errors in risk management – such as model deficiencies, insufficient documentation, or governance weaknesses – are clearly attributable and subject to supervisory scrutiny, sanctions, and reputational consequences. By contrast, missed opportunities or overly conservative lending decisions rarely trigger comparable accountability mechanisms. This asymmetry creates a powerful incentive structure: managers are rewarded for minimising regulatory risk, while the opportunity cost of excessive caution remains largely invisible. Rational behaviour under such conditions favours risk avoidance over risk-taking, even when the latter is economically justified (Stulz, 2014). As a result, decision-making frameworks prioritise procedural robustness and

compliance over economic judgment and entrepreneurial initiative - not due to individual failure, but as an outcome of institutional design.

### **Box 2: The asymmetry of accountability in risk-based governance**

Modern risk-based governance frameworks are characterised by a fundamental asymmetry of accountability. Errors in risk management - such as insufficient controls, model weaknesses, data gaps, or governance deficiencies - are clearly identifiable and subject to supervisory scrutiny, sanctions, and reputational costs. By contrast, missed opportunities or overly conservative decisions rarely generate comparable accountability.

When the costs of being wrong are visible and sanctionable, while the costs of not acting remain diffuse, rational agents prioritise error avoidance over value creation. Compliance and procedural robustness become dominant criteria of success, while economic judgment and initiative are subordinated.

This dynamic does not arise from individual risk aversion, but from the incentive structure embedded in supervisory regimes. Over time, organisations internalise these incentives, redesigning processes and reallocating resources to minimise exposure to identifiable regulatory risks.

As a result, risk management evolves from a supporting function into a governing principle. Stability is preserved, but potentially at the cost of diminished economic imagination.

*When risk management becomes the safest strategy, economic imagination becomes the riskiest one.*

#### **4.1 Organisational reallocation as a transmission channel of RMII**

Within the conceptual framework of this paper, organisational reallocation represents a key transmission channel through which RMII affects real economic outcomes. RMII captures the cumulative intensity of risk-related requirements, but its economic relevance materialises through internal organisational responses.

As RMII increases, banks allocate more resources to control functions, reducing the relative capacity devoted to business development, credit origination, and innovative financing. The effect is not a mechanical contraction of credit supply, but a gradual deceleration relative to economic potential, particularly in segments characterised by higher uncertainty or longer investment horizons.

Conceptually, this relationship can be summarised as:

Risk Inflation → RMII ↑ → Organisational Reallocation →  
Credit Dynamics

This chain highlights that the impact of risk management intensity on credit is indirect, mediated by institutional adaptation rather than explicit regulatory constraints.

This chain highlights that the impact of risk management intensity on credit is indirect, mediated by institutional adaptation rather than explicit regulatory constraints.

Empirical analysis of organisational reallocation remains constrained by data limitations. While harmonised statistics are not available, consistent evidence from supervisory assessments, regulatory analyses, and industry surveys indicates a sustained expansion of risk and compliance functions since the global financial crisis.

Supervisory practices – such as SREP, stress testing, and thematic reviews – place increasing emphasis on governance, internal controls, and data capabilities, shaping internal investment decisions and reinforcing control-oriented organisational models (EBA, 2023).

While precise quantification is limited, the consistency of these observations supports the central argument: organisational reallocation is a structural and persistent response to risk inflation, with material implications for financial intermediation.

#### **5. Risk governance and credit dynamics**

Credit dynamics are often analysed through macroeconomic variables such as interest rates, capital adequacy, or aggregate demand. While relevant, these factors provide only a partial explanation. Credit supply is not a mechanical outcome of balance-sheet capacity, but an institutional product shaped by governance structures, decision-making processes, and prevailing risk frameworks (Thakor, 2016).

In modern banking systems, credit represents a managed form of uncertainty. Its provision depends not only on the willingness to assume risk, but on the institutional capacity to assess, document, approve, and defend lending decisions within regulatory and supervisory environments. Changes in risk governance therefore alter the conditions under which credit is allocated, influencing both its volume and structure.

The increasing intensity of risk governance introduces frictions that affect credit dynamics in subtle but persistent ways. These frictions do not typically appear as explicit constraints, but as cumulative procedural and organisational burdens embedded in credit processes – longer approval timelines, expanded documentation, multi-layered validation, and heightened sensitivity to supervisory interpretation.

While individually justified, their aggregation raises the cognitive and operational cost of credit provision (BIS,

2022). As a result, credit supply becomes more selective and process-driven, increasingly shaped by procedural feasibility and compliance considerations rather than economic judgment alone. This does not eliminate credit but slows its transmission and reorients it toward activities that are easier to process within existing governance frameworks.

Risk governance affects not only the volume of credit, but also its composition. In this respect, the green and digital transition presents a structural challenge. Conventional risk management systems operate in environments where outcomes are identifiable, probabilities can be estimated, and historical data provide a basis for modelling - favouring mature sectors and stable cash flows.

By contrast, transition-related investments are characterised by fundamental uncertainty. Their viability depends on evolving regulation, uncertain technological trajectories, and long-term policy commitments, with limited historical data and outcomes that cannot be reduced to stable probability distributions. Such projects require judgment under uncertainty rather than optimisation under risk (Taleb, 2007). This distinction has direct implications for credit allocation. Institutions operating under dense risk governance regimes tend to favour projects linked to existing models and supervisory expectations. Investments that can be documented and stress-tested are more easily processed, even if their transformative potential is limited. By contrast, projects aligned with long-term transition objectives but characterised by uncertainty face higher internal hurdles.

The integration of ESG considerations further reinforces this dynamic (EBA, 2023). While normatively supportive of transition goals, ESG frameworks introduce additional layers of assessment, documentation, and model risk. As a result, projects most aligned with long-term policy priorities may become more difficult to finance precisely because they combine multiple, hard-to-model uncertainties.

In this environment, credit allocation reflects compatibility with governance structures rather than strategic relevance alone. Credit flows toward what can be measured and defended *ex ante*, rather than toward what must be judged under uncertainty. This does not imply a deliberate bias against transformation, but an endogenous outcome of systems optimised for procedural robustness.

The Risk Management Intensity Index (RMII) provides a lens through which these dynamics can be understood. As RMII increases, banks allocate more resources to risk identification, validation, and governance, translating into higher procedural density and greater emphasis on control functions. The impact on credit is indirect but systematic.

Rather than causing abrupt contractions, higher RMII is

associated with gradual deceleration in lending relative to economic potential, particularly in segments characterised by uncertainty, long maturities, or innovation. SMEs, project finance, and transition-related investments are especially affected, as they rely on forward-looking judgment. The relationship is likely nonlinear: beyond certain thresholds, additional risk governance yields diminishing returns in terms of stability while increasingly constraining credit throughput.

These dynamics help explain Europe's growth puzzle. Despite financial stability and well-capitalised banks, investment and productivity growth have remained subdued relative to other major economies. This divergence cannot be fully explained by macroeconomic conditions alone. From an institutional perspective, Europe's credit dynamics reflect a governance model that prioritises controllability, predictability, and procedural legitimacy. While this has strengthened resilience, it may also contribute to an under-provision of credit to activities central to long-term transformation. As highlighted in policy debates, including concerns raised by Mario Draghi, this imbalance may constrain Europe's ability to finance innovation and scale emerging technologies (Draghi, 2024).

This chapter has shown that credit dynamics in Europe cannot be understood independently of the prevailing risk governance framework. Risk management intensity, organisational reallocation, and the asymmetry of accountability collectively shape how credit is allocated and under what conditions.

The central implication is not a lack of financial stability, but its transformation into a dominant organizing principle with unintended consequences. Credit has become safer and more defensible - yet potentially less transformative. In this sense, credit serves as a mirror of risk governance, reflecting a system optimised for managing measurable risks but challenged by the demands of long-term transformation under uncertainty.

## 6. Europe's Competitiveness and the Policy Sustainability Risk

The preceding analysis has shown that the increasing intensity of risk governance in Europe - captured through the expansion of the risk universe, the rise of RMII, and associated organisational reallocation - has important implications for credit dynamics and capital allocation. These dynamics gain additional significance in the context of Europe's evolving position in the global economy. Recent policy assessments, most notably the competitiveness analysis led by Mario Draghi, highlight persistent structural challenges, including weak productivity growth,

fragmented capital markets, underinvestment in innovation, and a widening technological gap relative to the United States and China (OECD, 2023). While often framed in terms of scale and integration, these challenges also point to deeper institutional conditions under which economic transformation is financed.

In this context, Europe's strength – a highly developed framework for risk governance – may also entail trade-offs. A system optimised for identifying and controlling risk may face limitations in environments where uncertainty, rather than measurable risk, dominates, particularly in the green and digital transition.

These dynamics become clearer when contrasted with other major economies. In the United States, risk is treated as an inherent component of economic dynamism: capital markets absorb uncertainty, and institutional frameworks support rapid reallocation toward innovation, with failure accepted as part of the process. In China, risk is managed through state coordination, with strategic sectors supported via directed credit and long-term planning.

Europe, by contrast, internalises risk within regulatory and supervisory processes, emphasising precaution, procedural legitimacy, and ex ante control. While consistent with European values, this approach may favour activities that are more easily governed within existing frameworks. These differences reflect distinct paradigms in balancing stability, risk-taking, and transformation. Europe's challenge is to ensure that its strength in risk governance does not become a structural disadvantage in environments that reward speed and action under uncertainty.

To capture this tension, the paper introduces the concept of policy sustainability risk – the risk that the cumulative effects of well-intentioned policies aimed at stability, resilience, and sustainability may, over time, constrain economic dynamism, capital allocation, and political legitimacy (Rodrik, 2011).

Unlike traditional policy failure, this risk arises from the success and accumulation of individually rational policies. When layered over time, such policies may generate unintended systemic effects, including increased complexity, reduced flexibility, and rising opportunity costs. In the European context, it manifests through the saturation of institutional capacity with risk-related requirements, the reallocation of resources toward control functions, the increasing difficulty of financing uncertainty-intensive projects, and the divergence between policy ambition and operational capacity.

This raises a fundamental question: can a system become too effective at managing risk? The analysis suggests that this is increasingly plausible. Governance frameworks that

prioritise control, documentation, and ex ante validation may inadvertently constrain long-term, uncertain, and transformative investments.

This reflects a deeper trade-off: stability and predictability enhance resilience, but may reduce adaptability and innovation. When this balance shifts too far, risks are meticulously managed while opportunities are systematically underexploited. Europe's challenge is therefore not insufficient governance, but imbalance.

Recognizing policy sustainability risk does not imply deregulation or rejection of ESG objectives. Rather, it calls for recalibration: strengthening institutional capacity to govern uncertainty alongside risk, allowing for greater use of judgment, flexibility, and forward-looking decision-making, and acknowledging that not all economically relevant risks can be fully quantified ex ante.

Ultimately, Europe's challenge is not whether it can remain a global leader in risk governance, but whether it can complement this strength with a renewed capacity to imagine, finance, and realise economic futures. This balance is central to both competitiveness and the long-term sustainability of the European policy model.

## 7. A Conceptual EU Policy Stress Test

Over the past decade, stress testing has become a central tool of financial supervision in Europe, evolving from a resilience check into a structured methodology for identifying vulnerabilities and systemic interdependencies (EBA, 2023; IMF FSAP, 2022). This paper argues that a similar logic can be applied to economic governance itself. If financial institutions are subject to stress testing, it is conceptually consistent to assess the resilience and coherence of the policy framework within which they operate.

The proposed EU policy stress test serves as a heuristic tool for evaluating the balance and long-term sustainability of Europe's governance model. Its purpose is not precise quantification, but the identification of structural tensions, saturation points, and unintended consequences that remain invisible within standard evaluation frameworks.

The framework focuses on three core tensions:

First, the relationship between normative ambition and operational capacity. European governance is characterised by high ambitions – particularly in climate, digital transformation, and financial stability – articulated through comprehensive regulatory frameworks. Their realisation, however, depends on the capacity of institutions to translate these objectives into economic action. A stress perspective therefore asks whether cumulative regulatory complexity exceeds institutional capacity, creating a gap between ambition and execution.

Second, the balance between risk control and risk-taking. While Europe has developed advanced systems of risk control, economic transformation requires the ability to assume risk under uncertainty (Taleb, 2007). A stress perspective examines whether increasing governance intensity constrains the financing of uncertain, long-term, and innovative projects, favouring instead activities that are more easily governed and modelled. The key issue is whether the balance between control and initiative remains conducive to economic dynamism.

Third, the relationship between legitimacy and effectiveness. European policymaking emphasises transparency, accountability, and rule-based processes, enhancing legitimacy but potentially reducing responsiveness. A stress perspective considers whether the pursuit of procedural correctness constrains the system's ability to act effectively in fast-moving technological and geopolitical environments. The proposed framework is conceptual and diagnostic rather than predictive. It can identify structural tensions, reveal cumulative effects of overlapping regulatory initiatives, and make implicit trade-offs explicit. However, it cannot determine optimal levels of regulation, resolve normative policy choices, or substitute for empirical analysis and political decision-making. It should therefore be understood as a tool for structured reflection rather than a prescriptive instrument.

Its primary value lies in shifting the focus from individual policies to the policy paradigm as a whole. Rather than assessing isolated measures, it examines whether the cumulative logic of governance remains aligned with Europe's long-term objectives. In this sense, the policy stress test operationalises the central argument of this paper: if risk management has become the dominant organising principle of economic governance, its systemic implications must be evaluated alongside its benefits.

### **8. Conclusion: Beyond risk management – Toward a new European policy equilibrium**

This paper has argued that Europe's economic governance has undergone a subtle but consequential transformation over the past two decades. Risk management, initially conceived as a supporting function enabling economic activity under uncertainty, has evolved into a dominant organising principle shaping institutional priorities, resource allocation, and the boundaries of legitimate economic action.

Through the concepts of risk inflation and the Risk Management Intensity Index (RMII), the analysis has shown how the expansion and intensification of risk governance have restructured the internal functioning of financial institutions. Reinforced by organisational reallocation toward control

functions and by the asymmetry of accountability embedded in supervisory regimes, these dynamics have altered the conditions under which credit is allocated – favouring activities that are measurable and procedurally defensible over those that are uncertain, long-term, and transformative.

Importantly, this paper does not interpret these developments as policy failure. Europe has built one of the most advanced systems of risk governance globally, strengthening financial stability and resilience. Yet it is precisely this success that gives rise to policy sustainability risk – the possibility that the cumulative effects of well-intentioned and individually rational policies may constrain economic dynamism, innovation, and competitiveness. A comparative perspective suggests that Europe's challenge is not the absence of governance, but its imbalance. While the United States and China operate within paradigms that more readily accommodate risk-taking and uncertainty, the European model emphasises controllability, procedural legitimacy, and ex ante validation. In contexts of structural transformation, this orientation may limit the capacity to mobilise capital and organisational resources toward future-oriented activities.

The conceptual EU policy stress test proposed in this paper provides a framework for assessing these dynamics. By examining tensions between ambition and capacity, risk control and risk-taking, and legitimacy and effectiveness, it shifts attention from individual policies to the coherence of the policy paradigm as a whole.

Ultimately, the question is not whether risk should be managed, but how it should be balanced with the capacity to act under uncertainty (Knight, 1921). This does not require deregulation, but recalibration: preserving stability while restoring economic imagination.

Europe's future competitiveness may depend not only on its ability to manage risks, but on its willingness to accept that some of the most important economic opportunities cannot be fully modelled or controlled ex ante. The central challenge is therefore not technical, but conceptual: to move from a system that governs risk to one that can also govern transformation.

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# From ratings to reality: ESG rating disagreement

Barbara Kurbus\*

Rating providers often disagree on a company's "true" environmental, social and governance (ESG) performance. So-called ESG rating disagreement has become an important topic of debate in both academic research and practice, as it reduces comparability across providers and can confuse stakeholders about what an ESG score actually captures. This paper is designed to illustrate ESG rating disagreement for market participants by (1) outlining the prominence of ESG research, (2) portraying ESG rating disagreement across five ESG rating providers, and (3) discussing how legal environments and country-level policies may act as channels that affect ESG rating disagreement in the banking sector. Importantly, the paper does not assume that national institutional environments dominate the ratings of internationally visible banks. Instead, it treats country-level institutions as one contextual channel that may shape the information environment from which rating providers draw when assessing banks.

JEL G21, G24, G28

## 1. Introduction

The ESG framework, encompassing environmental, social, and governance dimensions, has become the dominant approach for translating sustainability into measurable criteria. The three ESG pillars were formally consolidated and brought to wider prominence in 2004 through the United Nations Global Compact's influential report *Who Cares Wins* (United Nations Global Compact, 2004), which demonstrated how ESG issues could be incorporated into financial analysis and investment decision-making. The report called on financial markets to embed the ESG framework into their practices and strategic thinking, stressing that attention to these issues not only advances sustainability goals but may also improve long term financial performance by helping identify and manage risks linked to ESG challenges. Since then, ESG has gained substantial traction across developed financial markets.

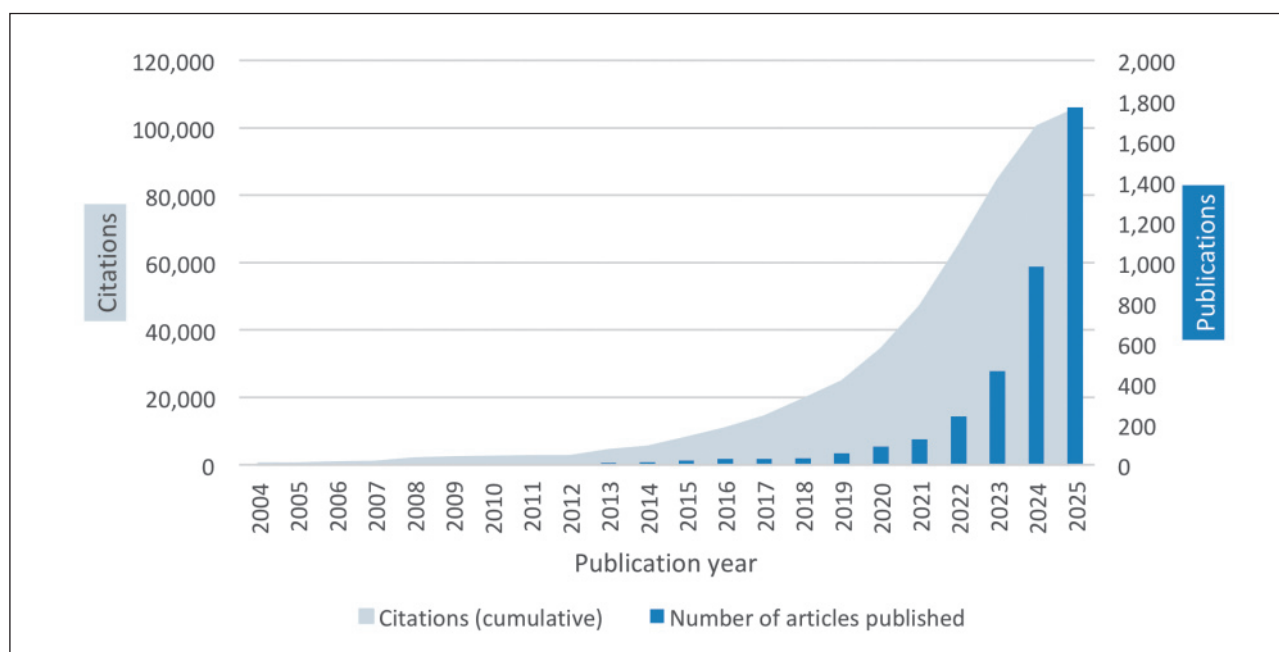
Over the last two decades, ESG issues have moved from the periphery of academic debate to the centre of research in finance, accounting, and corporate governance. Figure 1 illustrates the substantial growth of academic research on ESG-related issues as reflected in the increasing number of publications and citations between 2004 and 2025. In the early period (2004–2012) ESG research is represented by only a handful of

publications (0–4) per year. From 2013 onwards, the number of publications starts to rise steadily, exceeding 50 per year by 2019 and then accelerating sharply: 90 publications in 2020, 126 in 2021, 240 in 2022, 462 in 2023, 980 in 2024 and 1,769 in 2025, for a total of 3,877 publications over the full period (2004–2025)<sup>1</sup>. Cumulative citations of sampled articles increase accordingly, surpassing 100,000 by 2024 and reaching 105,580 by 2025 (Figure 1).

Early academic research was primarily concerned with whether socially responsible or sustainability oriented corporate behaviour affects firm reputation, stakeholder relations, and financial performance (see Dorfleitner et al., 2015; Eccles & Viviers, 2011; Friede et al., 2015; Halbritter & Dorfleitner, 2015). Hence, earlier research is rooted in the Corporate Social Responsibility (CSR) and Socially Responsible Investing (SRI) terminology. As non-financial disclosure became more institutionalised, literature gradually shifted toward the ESG terminology (see Kumar et al., 2022). Regardless of the terminology employed, ESG scores have long functioned as key empirical inputs in academic analyses. Recently, however, a notable strand of ESG research has shifted toward the critical examination of ESG measurement.

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<sup>1</sup> The publications are limited to English-language academic journal articles published in journals indexed in SSCI or SCI-Expanded and included in the AJG 2024 ranking list.

**Figure 1: Evolution of ESG-related publications and cumulative citations in business and economics (2004–2025)**

Note: Figure 1 illustrates the growth in ESG-focused research in business and economics over time. The data presented are limited to English-language academic journal articles published in journals indexed in SSCI or SCI-Expanded and included in the AJG 2024 ranking list. The publication search was conducted on 19 November 2025 using the Web of Science Core Collection.

The presence of multiple ESG rating providers in the market, each using its own methodology to assess companies' ESG performance, has led to significant variation in ESG assessments. This phenomenon is commonly referred to in the literature as **ESG rating disagreement**, meaning that different providers often assign divergent ESG scores to the same company. These differences typically reflect variation in methodologies, data inputs, indicator weights, and the interpretation of the ESG materiality construct (Berg et al., 2022; Billio et al., 2021; Christensen et al., 2022). Consequently, ESG rating disagreement has become an important concern in the literature, as it affects the comparability and credibility of ESG assessments.

To illustrate ESG rating disagreement, Figure 2 presents an example of ESG scores assigned to OTP banka d.d. in 2024 by five rating providers (horizontal axis), where 100 represents the best possible ESG performance (vertical axis). The figure reveals substantial variation across providers, with scores ranging from 40.1 (Bloomberg) to 85.3 (Sustainalytics), thereby highlighting the extent to which OTP banka d.d. received markedly different ESG scores in 2024 depending on the provider.

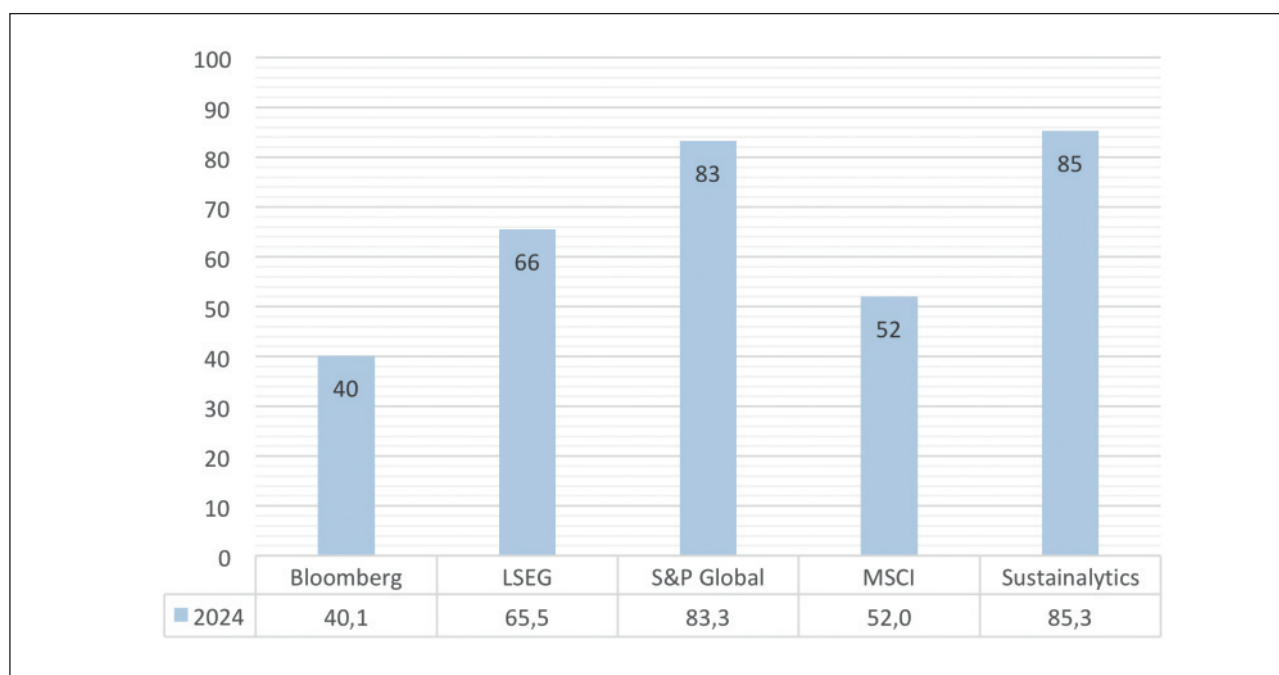
The ESG rating disagreement is problematic because it reduces the comparability and reliability of ESG assessments, making it more difficult for investors, regulators, and other market participants to form consistent judgments about a company's sustainability performance. At the same time, a

growing body of literature suggests that ESG rating disagreement can affect portfolio choice, asset pricing, and perceived risk, although the evidence remains more fragmented with respect to benchmarking practices and the broader credibility of ESG-based financial decisions (Avramov et al., 2022). This points to the need for research that moves beyond documenting the existence of ESG rating disagreement or explaining it solely in methodological terms.

In particular, if disagreement weakens the comparability and practical usefulness of ESG assessments, it becomes important to understand the broader conditions under which such disagreement emerges and persists. Against this background, the present paper shifts the focus from the level of ESG scores to the variation across them and examines whether institutional settings help explain ESG rating disagreement.

This paper differs from prior research in that it does not use the level of ESG scores as the primary variable of interest. Rather, it draws on ESG scores from multiple providers to construct a measure of ESG rating disagreement, which is then used as the key input (dependent variable) in the analysis. Accordingly, it does not focus on the methodological sources of ESG rating disagreement. Rather, it investigates whether broader institutional factors are associated with ESG rating disagreement. This perspective is important because ESG assessments are produced and used within institutional settings that differ across countries in terms of

Figure 2: Comparison of ESG scores assigned to OTP banka d.d. in 2024 across five rating providers



Note: ESG scores are adjusted to a common 0–100 scale, where 100 represents the best possible ESG performance. The data were retrieved in April 2026 from Bloomberg Terminal and LSEG Workspace.

regulation, legal quality, disclosure requirements, and policy support for sustainability. Such cross-country differences may influence both the availability of ESG-related information and the way in which that information is interpreted by rating providers.

The theoretical expectation underlying the empirical analysis is that ESG rating disagreement reflects not only provider-specific methodologies, but also the clarity, availability, and interpretability of ESG-relevant information. Institutional environments may reduce disagreement when they generate more comparable disclosure, clearer regulatory signals, and more credible climate-policy commitments. At the same time, more developed institutional and policy environments may also increase the amount and complexity of available information, thereby leaving greater room for rating providers to apply different materiality judgements. For this reason, the analysis is framed as a test of conditional institutional associations rather than as a claim that country-level institutions mechanically determine ESG rating disagreement.

Based on this reasoning, the paper addresses the following research questions:

- RQ1: Are country-level climate transition and climate-policy conditions associated with bank-level ESG rating disagreement?
- RQ2: Does this association differ across legal origin systems, in particular between common law and civil law jurisdictions?

RQ1 focuses on whether stronger government climate-transition conditions are associated with lower ESG rating disagreement. The underlying reasoning is that clearer and more credible climate-policy signals may reduce the scope for divergent interpretations by ESG rating providers. RQ2 extends this reasoning by asking whether legal origin conditions this association. Common law and civil law jurisdictions may differ in market orientation, investor protection, disclosure practices, enforcement, and the role of formal regulation, all of which may affect how climate-related information is produced, standardized, and incorporated into ESG assessments. The paper does not assume that country-level institutional factors are the dominant determinant of ESG rating disagreement. This is particularly important because the sample consists of banks that are rated by all five ESG providers and are therefore likely to be relatively large, publicly visible, and embedded in international financial markets. Rather than testing whether national institutional environments fully explain ESG rating disagreement, the paper examines whether country-level climate and legal-institutional conditions remain relevant in explaining rating dispersion among internationally visible banks. The remainder of the paper is structured as follows. Section 2 describes the data, sample construction, ESG score adjustments, and empirical methodology used to measure ESG rating disagreement. Section 3 presents and discusses the empirical results, focusing on the relationship between ESG rating disagreement, government climate scores and

legal origin. Section 4 concludes by summarising the main findings, discussing their implications for market participants and ESG data users, and outlining limitations and avenues for future research.

## 2. Data and methodology

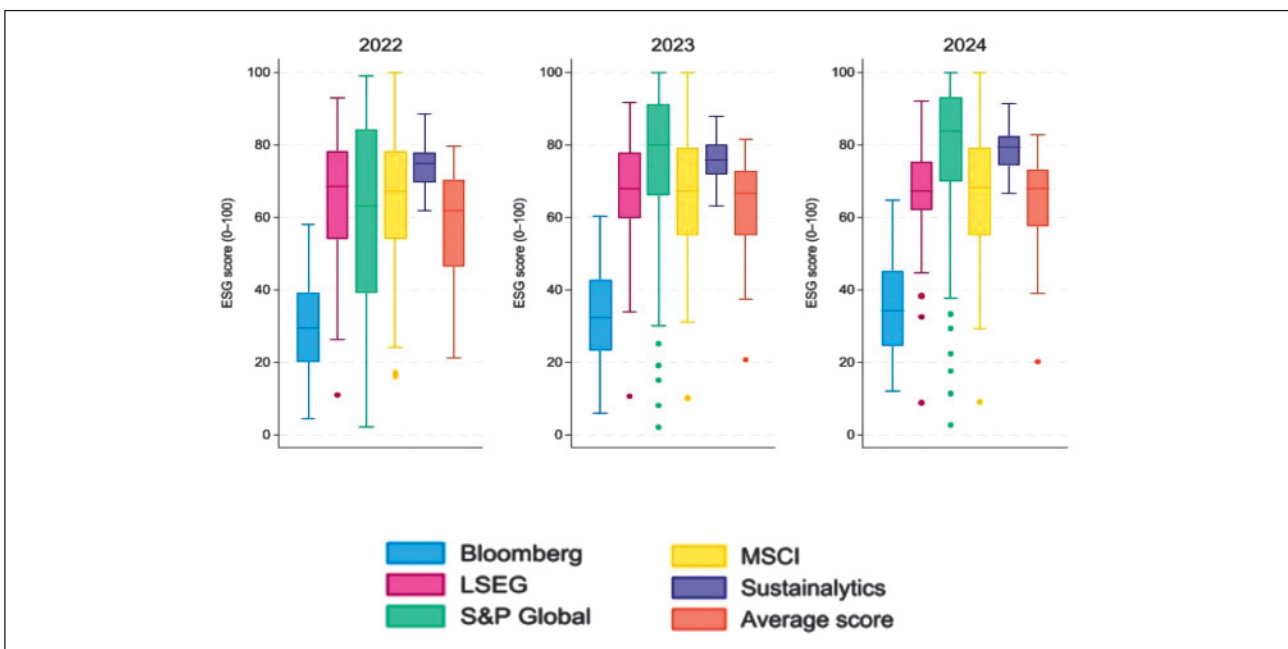
This study focuses on the banking sector and constructs a measure of ESG rating disagreement using ESG scores from five rating providers: Bloomberg, LSEG, S&P Global, MSCI, and Sustainalytics. To ensure comparability across providers, the sample is limited to banks that received ESG ratings from all five providers in each year of the three-year period. The final sample comprises 93 banks over the 2022–2024 period. The final sample is biased toward publicly listed, internationally visible banks for which ESG information is sufficiently available to be assessed by multiple providers. Such banks are more likely to be exposed to international investors, cross-border capital-market expectations, and global ESG disclosure practices than smaller domestically oriented banks. Consequently, the country of incorporation should be interpreted as the institutional environment in which public disclosure and regulatory signals are generated, not as a complete description of the bank's ownership structure, funding model, or degree of internationalisation. Summary statistics describing the sample, the ESG rating variables, the country- and bank-level control variables are reported in the Appendix. A key issue in comparing ESG

scores across providers is the use of different rating scales and, in some cases, different rating concepts. Bloomberg and the numeric MSCI score used in this study were converted to a 0–100 scale by multiplying the original 0–10 values by 10. LSEG and S&P Global scores were already expressed on a 0–100 scale and were therefore left unchanged. Sustainalytics differs conceptually from the other providers because it reports an ESG Risk Rating, where lower values indicate lower unmanaged ESG risk. To align the direction of the score with the other providers, Sustainalytics scores were transformed as 100 minus the original risk score. This transformation harmonizes the direction of the scale but does not eliminate the conceptual difference between a risk-based rating and performance-based ESG scores. Figure 3 illustrates the distribution of adjusted ESG scores for the five providers, together with the distribution of the average ESG score, shown in orange.

Figure 3 indicates substantial ESG rating disagreement by illustrating the differences in the distribution of ESG scores across providers in each year of the sample period. Mean scores generally increased from 2022 to 2024, most notably for S&P Global and Bloomberg, while LSEG remains comparatively stable. S&P Global displays the widest spread in all three years, whereas Sustainalytics shows the most compressed distribution.

The Pearson correlation matrix in Table 1 provides evidence on the extent of sample-level correlation-based

**Figure 3: Distribution of ESG scores across five rating providers and the average score over the 2022–2024 period.**



Note: The figure presents the distributions of ESG scores from five rating providers (Bloomberg, LSEG, S&P Global, MSCI, and Sustainalytics), together with the average ESG score, for a sample of 93 publicly listed banks over the 2022–2024 period. All ESG scores are expressed on a common 0–100 scale (horizontal axis), where 100 denotes the best ESG performance.

**Table 1: Pairwise Pearson correlation matrix of ESG ratings for the sample of 93 banks over the 2022–2024 period**

	Bloomberg	LSEG	S&P Global	MSCI	Sustainalytics
Bloomberg	1				
LSEG	0.5684	1			
S&P Global	0.7186	0.6627	1		
MSCI	0.5857	0.548	0.6718	1	
Sustainalytics	0.5118	0.492	0.6515	0.4719	1

Note: The table reports the pairwise Pearson correlation matrix of ESG scores across five rating providers (Bloomberg, LSEG, S&P Global, MSCI, and Sustainalytics) for a sample of 93 publicly listed banks from 31 countries observed over the 2022–2024 period. All reported correlation coefficients are statistically significant at the 0.0001 level.

ESG rating disagreement among the five providers. The reported coefficients are all positive and range from 0.4719 to 0.7186, indicating that the providers capture a common underlying ESG signal, but that their assessments are far from fully aligned. The average pairwise correlation is approximately 0.59, which, in the sense emphasized by Kurbus & Rant (2025), the matrix does not suggest complete divergence, because all coefficients are positive and statistically significant. However, the correlations are far below one, indicating ESG rating disagreement and only moderate cross-provider alignment. This implies that the ESG evaluation of banks depends to a considerable extent on which rating agency is used.

The highest correlation is observed between Bloomberg and S&P Global (0.7186), followed by S&P Global and MSCI (0.6718) and LSEG and S&P Global (0.6627). This suggests that these providers evaluate banks in a relatively similar way. By contrast, the lowest correlations are found between MSCI and Sustainalytics (0.4719), LSEG and Sustainalytics (0.4920), and Bloomberg and Sustainalytics (0.5118), indicating stronger sample-level disagreement in the ESG ratings produced by these pairs of providers. Overall, S&P Global appears to be the provider most closely aligned with the others, whereas Sustainalytics appears to be the least aligned, as it exhibits the weakest correlations with most of the remaining agencies. This pattern is in line with prior research showing that ESG rating disagreement is primarily driven by methodological divergences across providers, especially with respect to the scope of attributes considered, the measurement of the same attributes, and the weights assigned to individual components (Berg et al., 2022; Billio et al., 2021; Christensen et al., 2022).

This research does not investigate methodological differences beyond the data presented above. Instead, ESG rating disagreement is captured by a dispersion measure proposed by Kurbus and Rant (2025) (see Equation (2)) and is used as the dependent variable in the following regression model (Equation (1)):

$$ESGDisp_{ijt} = \beta_0 + \beta_1 LegOr_j + \beta_2 BLScr_{s,j,t-1} + \beta_3 (LegOr_j \times BLScr_{s,j,t-1}) + \delta' CC_{j,t-1} + \theta' BC_{i,t-1} + \gamma_t + \varepsilon_{i,j,t} \quad \text{Eq. (1)}$$

Where  $ESGdisp_{ijt}$  denotes the bank-specific ESG rating disagreement for bank  $i$ , incorporated in country  $j$ , in year  $t$ , measured using the standard deviation (SD) and the coefficient of variation (CV):

$$ESGDisp_{it} = \begin{cases} SD_{it} = \sqrt{\frac{1}{5-1} \sum_1^5 (ESG_{it} - \overline{ESG}_{it})^2} \\ CV_{it} = \frac{SD_{it}}{\overline{ESG}_{it}} \end{cases} \quad \text{Eq. (1)}$$

The standard deviation measures the absolute spread of the five adjusted provider scores and is expressed in score points on the common 0–100 scale. The coefficient of variation divides this spread by the average ESG score and therefore captures relative disagreement. The two measures are complementary: the standard deviation is sensitive to the absolute distance between provider assessments, whereas the coefficient of variation controls for the fact that the same absolute spread may be more substantial when the average ESG score is low than when it is high. This distinction is particularly relevant in the present sample because the providers have visibly different score distributions. The distributional evidence in Figure 3 and the correlation matrix in Table 1 indicate that the providers share a common ESG signal but do not rank or scale banks identically. The regression analysis therefore does not ask whether a bank has a high or low ESG score, it asks whether the dispersion among the five assessments is systematically related to the institutional setting in which the bank is incorporated.

The main variables of interest are the interaction terms between legal origin ( $LegOr_j$ ) and the Bloomberg's country-level government climate scores ( $BLScr_{s,jt}$ ), covering both the overall Government Climate Risk score and its three underlying pillars: the Carbon Transition,

Power Sector Transition, and Climate Policy. The Carbon Transition captures historical, current, and forward-looking emissions performance, Power Sector Transition measures progress and expected effort toward decarbonizing the power mix, and Climate Policy reflects net-zero pledges, green debt issuance, and renewable energy policy frameworks. The structure of Bloomberg's Government Climate Risk score is reported in Table 2. The model is estimated for each government climate score separately.

Estimating country-level interactions for each dispersion measure (Equation 2) allows us to test whether the association between government climate transition conditions and bank-level ESG rating disagreement is conditional on the institutional setting in which banks operate:  $LegOr_{j,t}$  is a country-level indicator assigned to each bank based on its country of incorporation, with common law banks coded as 1 and civil law banks as 0.

All country-level ( $CC_{j,t-1}$ ) and bank-level ( $BC_{i,t-1}$ ) control variables included in the regression are reported in Table 3. Country-level and bank-level controls are included to account for alternative determinants of ESG rating disagreement. At the country level, the model controls for the regulatory quality and control of corruption, and GDP per capita, as these variables capture the institutional quality, and level of economic development in the bank's country of incorporation. Better institutions and greater economic development are expected to be associated with lower ESG disagreement. At the bank-level, the model controls for ESG controversies ( $ESGovScr$ ), size ( $logTA$ ), profitability ( $ROA$ ), board size ( $BrdSize$ ), and board meeting frequency ( $BrdMeet$ ).

Since ESG rating disagreement may contemporaneously affect bank characteristics and investor perceptions, all explanatory variables are included with a one-year lag, except for legal origin, which is time invariant. This approach ensures that the explanatory variables are ob-

served before the dependent variable and helps reduce potential endogeneity arising from reverse causality or simultaneity. The model is estimated using pooled OLS with year fixed effects  $\gamma_t$  to control for common time-specific shocks affecting all observations in a given year. Standard errors are clustered at the country level to account for within-country correlation in the error term  $\epsilon_{i,j,t}$  over time. The model is therefore intentionally conservative in its interpretation. The inclusion of lagged controls, year fixed effects, and country-clustered standard errors helps align the timing of explanatory variables and the dependent variable, but it does not eliminate all endogeneity concerns. In particular, internationally embedded banks may respond simultaneously to domestic regulation, supranational disclosure standards, investor pressure, and rating-agency expectations. The estimated coefficients should therefore be interpreted as evidence of associations between institutional environments and ESG rating disagreement, not as causal effects of national institutions on rating outcomes.

### 3. Results and discussion

The first point to clarify is the role of the interaction terms. Because legal origin ( $LegOr$ ) is coded as 1 for common law banks and 0 for civil law banks, the coefficient on each lagged government score variable ( $ClIRScr$ ,  $CrbTScr$ ,  $PwrTScr$  and  $ClIPScr$ ) captures the association for civil law banks, which form the reference category. The interaction term indicates how this association differs for common law banks. Accordingly, the relevant marginal effect for common law banks is obtained by summing the main coefficient on the government score (e.g.,  $ClIRScr$ ) and the corresponding interaction coefficient (e.g.,  $LegOr \times ClIRScr$ )<sup>2</sup>. Finally, the coefficient on  $LegOr$  captures the difference in ESG rating disagreement between common law and civil law banks when the lagged government climate score equals zero. Because

**Table 2: Bloomberg's Government Climate Risk score framework**

Government Climate Risk (Bloomberg)	Carbon Transition	Current performance	<ul style="list-style-type: none"> <li>Intensity</li> <li>Trend</li> </ul>
		Carbon outlook	<ul style="list-style-type: none"> <li>NDC ambition vs 1.5 °C budget</li> <li>Emissions gap vs 1.5 °C budget</li> </ul>
	Power Sector Transition	Current performance	<ul style="list-style-type: none"> <li>Fossil fuel generation</li> <li>Renewable generation</li> </ul>
		Power outlook	<ul style="list-style-type: none"> <li>Renewable shortfall 1.5 °C scenario</li> <li>Wind and solar forecast</li> <li>Coal forecast</li> <li>Clean energy investment</li> </ul>
	Climate Policy		<ul style="list-style-type: none"> <li>Climate scope power policy</li> <li>Green bonds issuance</li> <li>Net zero legislation status</li> </ul>

Source: Own work based on Bloomberg Terminal.

**Table 3: Overview of county-specific and firm-specific variables, their data sources and adjustments**

Variable	Variable name	Description	Data source	Date of collection	Year and frequency	Adjustment
<b>LegOr</b>	Legal origin	A dummy variable distinguishing civil law (0) from common law (1).	La Porta et al., (2008)	Apr-24	2008 <i>Static</i>	No adjustments
<b>ClirScr</b>	Government Climate Risk score	Score on a scale of 0 to 10, where 10 represents the best.	Bloomberg Terminal	Jul-25	2021–2024 Quarterly	Annualized average based on quarterly data.
<b>CrbTScr</b>	Carbon Transition score	Score on a scale of 0 to 10, where 10 represents the best.	Bloomberg Terminal	Jul-25	2021–2024 Quarterly	Annualized average based on quarterly data.
<b>PwrTScr</b>	Power Sector Transition score	Score on a scale of 0 to 10, where 10 represents the best.	Bloomberg Terminal	Jul-25	2021–2024 Quarterly	Annualized average based on quarterly data.
<b>ClipScr</b>	Climate Policy score	Score on a scale of 0 to 10, where 10 represents the best.	Bloomberg Terminal	Jul-25	2021–2024 Quarterly	Annualized average based on quarterly data.
<b>RQInd</b>	Regulatory quality index	Index on a scale from -2.5 to 2.5, where higher is better.	World bank open data	Apr-26	2021–2024 Annual	Both indices (RQInd and CCInd) are combined into a single
<b>CCInd</b>	Control of corruption index	Index on a scale from -2.5 to 2.5, where higher is better.	World bank open data	Apr-26	2021–2024 Annual	averaged variable (RQCCInd).
<b>logGDPpc</b>	Gross domestic product per capita	GDP per capita, PPP, constant 2021 USD.	World bank open data	Apr-26	2021–2024 Annual	Logarithm, measured in thousands of USD.
<b>ESGCovScr</b>	ESG controversies score	Score on a scale of 0 to 100, where 100 represents the best.	LSEG Workspace	Apr-26	2021–2024 Annual*	No adjustments
<b>logTA</b>	Total assets	Denominated in USD, current prices.	LSEG Workspace	Apr-26	2021–2024 Annual	Logarithm of total assets.
<b>ROA</b>	Return on assets	Ratio as a percentage.	LSEG Workspace	Apr-26	2021–2024 Annual	No adjustments
<b>BrdSize</b>	Number of board members at the end of the fiscal year	The number of directors on the board ranges from 5 to 28.	LSEG Workspace	Apr-26	2021–2024 Annual	No adjustments
<b>BrdMeet</b>	Number of board meetings during the year	The annual number of board meetings ranges from 5 to 45.	LSEG Workspace	Apr-26	2021–2024 Annual	No adjustments

\*Updates in case of a scandal reported in global media.

Source: Own work.

a value of zero is not the empirically central point of these climate scores, the legal origin dummy should not be over-interpreted on its own as an unconditional average difference between legal origin groups. Instead, the difference between common law and civil law banks depends on the level of the government climate score. Table 4 presents the results of the eight model specifications.

RQ1 asked whether country-level climate transition and climate-policy conditions are associated with bank-level ESG rating disagreement. The answer is mixed and more informative patterns emerge when the Government Climate Risk score is decomposed into its underlying pillars. RQ2 asked whether the relationship between country-level climate conditions and ESG rating disagreement differs across legal origin systems. The results provide partial support for this interpretation.

The results in Table 4 indicate that the overall Government Climate Risk Score (*ClirScr*) may be too coarse. Models (1) and (2) use the lagged overall Government Climate Risk Score and neither the main effect nor its interaction with legal origin is statistically significant for either SD or CV dispersion measure. This suggests that the overall Government Climate Risk score does not have a clear relationship with bank-level ESG disagreement in this sample.

The lack of significance is informative in itself: it implies that the overall climate transition environment may be too broad a measure, and that important heterogeneity is likely hidden inside the separate pillars.

Once the score is decomposed, institutional heterogeneity appears. Models (3) and (4) show the results for the Carbon Transition pillar. For SD (Model (3)), the main effect of Carbon Transition is not significant for civil law banks (0.204), but the interaction with common law is negative and highly significant ( $-1.323$ ,  $p < 0.01$ ). This means that the relationship between Carbon Transition conditions and ESG disagreement is significantly more negative in common law banks than in civil law banks. Put differently, an improvement in the country's Carbon Transition score is associated with a stronger reduction in the absolute dispersion of ESG scores among common law banks. For CV (Model (4)), the Carbon Transition coefficient is negative and significant for civil law banks ( $-0.0204$ ,  $p < 0.05$ ), while the interaction is not statistically significant. This suggests that better Carbon Transition performance is associated with lower relative ESG rating disagreement in civil law banks, but there is no statistically reliable evidence that this relationship differs between common law and civil law banks when disagreement is measured using the

**Table 4: Pooled OLS estimates of the relationship between legal origin–government climate score interactions and ESG rating disagreement measured by SD and CV**

Model	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
ESGdisp	SD	CV	SD	CV	SD	CV	SD	CV
<b>LegOr</b>	7.422 (-4.737)	0.135 (0.157)	6.202*** (-2.089)	0.0587 (0.0924)	-0.131 (-3.141)	0.00154 (0.102)	5.731* (-2.875)	0.132* (0.0738)
<b>ClIRScr</b>	0.658 (0.459)	-0.0175 (0.0122)						
<b>LegOr × ClIRScr</b>	-1.738 (-1.200)	-0.0355 (0.0346)						
<b>CrbTScr</b>			0.204 (0.263)	-0.0204** (0.00780)				
<b>LegOr × CrbTScr</b>			-1.323*** (0.373)	-0.0128 (0.0152)				
<b>PwrTScr</b>					0.800* (0.465)	0.00477 (0.0149)		
<b>LegOr × PwrTScr</b>					0.167 (0.595)	-0.000821 (0.0180)		
<b>ClIPScr</b>							0.206 (0.547)	0.00662 (0.0157)
<b>LegOr × ClIPScr</b>							-1.729* (0.860)	-0.0422** (0.0192)
<b>logGDPpc</b>	-0.662 (-1.366)	0.0192 (0.0344)	-0.310 (-1.379)	0.0220 (0.0390)	-0.967 (-1.439)	0.0214 (0.0413)	-1.205 (-1.412)	0.0109 (0.0330)
<b>RQCCInnd</b>	-0.318 (-1.360)	-0.0495 (0.0338)	-0.435 (-1.195)	-0.0406 (0.0404)	-0.435 (-1.410)	-0.0802** (0.0383)	0.762 (-1.208)	-0.0624* (0.0348)
<b>ESGCovScr</b>	0.0254** (0.0109)	0.0009*** (0.00024)	0.0284** (0.0109)	0.0008*** (0.00026)	0.0194 (0.0137)	0.00071** (0.00031)	0.0187 (0.0116)	0.000601* (0.0003)
<b>logTA</b>	-0.0528 (0.456)	0.000782 (0.0117)	-0.0630 (0.429)	-0.00787 (0.0130)	-0.225 (0.489)	0.000710 (0.0112)	-0.222 (0.401)	0.00143 (0.0113)
<b>ROA</b>	0.450 (0.358)	-0.0103 (0.0106)	0.287 (0.391)	-0.0109 (0.00945)	0.483 (0.284)	-0.00787 (0.0119)	0.566 (0.349)	-0.00481 (0.0102)
<b>BrdSize</b>	-0.0897 (0.159)	-0.00186 (0.00433)	-0.0504 (0.153)	-0.00141 (0.00406)	-0.108 (0.141)	-0.00409 (0.00351)	-0.0273 (0.164)	-0.00411 (0.00437)
<b>BrdMeet</b>	-0.0951* (0.0467)	-0.00297* (0.00162)	-0.0499 (0.0457)	-0.00144 (0.00125)	-0.112** (0.0441)	-0.0042*** (0.00134)	-0.111*** (0.0380)	-0.0043*** (0.00116)
<b>Constant</b>	25.44 (23.11)	0.238 (0.599)	22.85 (22.35)	0.413 (0.644)	32.88 (25.14)	0.193 (0.625)	36.79* (21.55)	0.280 (0.492)
<b>Observat.</b>	223	223	229	229	223	223	223	223
<b>R-squared</b>	0.171	0.356	0.194	0.399	0.174	0.327	0.186	0.356

Note: The regressions are estimated using the pooled OLS model with year fixed effects. The year fixed effects are included to control for common time-specific shocks affecting all banks in a given year, while standard errors are clustered at the country level to account for within-country correlation over time. The number of observations is lower than the maximum possible balanced panel of 279 bank-year observations, based on 93 banks observed over three years, because some observations are lost due to missing values in the lagged explanatory and control variables. The number of observations differs across specifications because data availability varies.

coefficient of variation. Taken together, the Carbon Transition results are meaningful, although not fully consistent across the two disagreement measures. The SD results point to a stronger role of Carbon Transition conditions in explaining ESG disagreement among common law banks, whereas the CV results are mainly driven by the negative baseline relationship observed for civil law banks.

Models (5) and (6) focus on the Power Sector Transition pillar. Here, the main effect on SD (Model (5)) is positive and weakly significant (0.800,  $p < 0.10$ ), while the interaction with legal origin is not significant. Thus, in civil law banks, stronger Power Sector Transition conditions are associated with higher absolute ESG disagreement, and there is no evidence that this relationship differs systemati-

cally between civil law and common law banks. For CV (Model (6)), neither the main effect nor the interaction is significant. Since significance appears only for the standard deviation and only at the 10% level, the evidence is weak. Still, the positive sign is interesting. It may suggest that improvements in Power Sector Transition create more room for heterogeneous judgments among rating providers rather than less.

Models (7) and (8) examine the Climate Policy pillar, and this is where the legal origin interaction is most clearly visible across both disagreement measures. The main effect of Climate Policy is not significant in either specification, implying no clear association for civil law banks. However, the interaction with common law is negative and significant for both SD ( $-1.729$ ,  $p < 0.10$ ) and CV ( $-0.0422$ ,  $p < 0.05$ ). This means that the slope of Climate Policy is significantly more negative in common law countries than in civil law jurisdictions. In substantive terms, stronger Climate Policy conditions appear to be associated with lower ESG disagreement among common law banks, whereas such a pattern is not evident in civil law banks. This is an important result because Climate Policy is the pillar that most directly captures the institutional commitment of the Government environment through net-zero legislation, green debt issuance, and policy support.

Common law jurisdiction is often more market-oriented, which may make climate-related signals more comparable and more directly incorporated into ESG assessments. By contrast, civil law jurisdictions tend to rely more heavily on formal regulation and stakeholder-oriented disclosure requirements. While this may increase the amount of available ESG information, greater disclosure does not necessarily lead to greater rating agreement. Instead, richer or more complex information may allow rating providers to apply different interpretations, thereby sustaining or even increasing disagreement (see Christensen et al., 2022). Among the lagged controls, several patterns deserve attention. The coefficient on *logGDP* per capita is consistently insignificant. This suggests that, once climate scores, legal origin, and other institutional and bank-level controls are taken into account, general economic development does not have an independent association with ESG disagreement in this sample. The coefficient on *RQCC* is negative in all CV models and becomes significant in Models (6) and (8). This indicates that better regulatory quality and control of corruption are associated with lower relative ESG disagreement, especially in the models using the Power Sector Transition and Climate Policy pillars. This is intuitive: stronger institutions should improve the reliability and comparability of underlying information, making it easier for rat-

ing providers to converge in their ESG assessments. The fact that significance appears more clearly for CV than for SD suggests that institutional quality may matter more for the relative than the absolute dispersion of ratings.

The coefficient on ESG Controversies score is one of the most robust findings in the Table 4. It is positive and significant in all CV models and in the first two SD models. Since higher values of the controversies score indicate fewer controversies or a better controversies profile, this positive sign implies that banks with better controversy records tend to exhibit higher ESG disagreement, not lower. Although this result may appear counterintuitive, one possible interpretation is that major controversies create salient and widely observable signals that rating providers incorporate in a more similar way, thereby reducing disagreement.

The coefficients on *logTA* and *ROA* are uniformly insignificant. Thus, neither bank size nor profitability seems to explain ESG disagreement once the broader institutional and governance factors are controlled. Board size is also insignificant throughout. This indicates that the number of directors alone is not systematically related to lower or higher ESG disagreement. By contrast, board meetings is a strong and consistent control. The coefficient is negative in all models and statistically significant in six of the eight specifications, including both SD and CV measures in several cases. Because this variable is lagged, the interpretation is that more active boards in the previous period are associated with lower current ESG disagreement. This is an important result. It suggests that board diligence, rather than board structure in the narrow sense, may improve the consistency and quality of ESG-related reporting or oversight, thereby reducing the scope for divergent assessments by rating providers. Taken together, the regression results suggest that bank-level ESG rating disagreement is shaped by specific dimensions of the climate transition environment, and that these effects are conditioned by legal origin of the county of incorporation, particularly in the case of Carbon Transition and Climate Policy. ESG rating disagreement across providers appears to be less about the scale or short run profitability of the bank and more about the institutional environment and certain aspects of governance. The study is subject to several limitations. The sample is limited to banks with ratings from all five providers and covers only the 2022–2024 period. For the banks in this sample, international capital-market exposure may also reduce the marginal influence of domestic institutional differences. Large listed banks are likely to face similar reporting expectations from global investors and ESG data providers. This common international layer can make the country-level effect harder to detect and can contribute to results that are statis-

tically significant in some specifications but not in others. The findings should consequently be read as partial evidence that institutional context conditions ESG rating disagreement, rather than as evidence that national institutions are the primary driver of disagreement. The analysis also focuses on association rather than causality. Future research could extend the time period, increase sample size, examine individual ESG pillars separately, and include direct measures of internationalization, such as foreign ownership, cross-listing, international bond issuance, or the share of wholesale market funding, to test whether domestic institutional effects are weaker for more internationally integrated banks. Further robustness tests using alternative disagreement measures, marginal effect plots, and post estimation tests of interaction effects would also strengthen the interpretation of the results.

#### 4. Conclusion

This paper examined ESG rating disagreement in the banking sector by shifting attention from the level of ESG scores to the dispersion of ESG scores across providers. Using ESG scores from Bloomberg, LSEG, S&P Global, MSCI, and Sustainalytics for a sample of 93 publicly listed banks over the 2022–2024 period, the paper documents substantial cross-provider variation in ESG scores. Although the pairwise correlations among providers are positive, they remain far from perfect, indicating that ESG ratings capture a common underlying signal but also reflect meaningful methodological and interpretive differences across rating providers.

The empirical analysis suggest that broader institutional and country-level conditions are also relevant in explaining bank-level ESG rating disagreement. The overall Bloomberg Government Climate Risk score does not show a clear relationship with ESG rating disagreement, suggesting that the aggregate score may be too broad to capture the mechanisms affecting rating dispersion. Once the score is decomposed, however, more informative patterns emerge. Carbon Transition and Climate Policy are the most relevant components, particularly through their interaction with legal origin. The results indicate that stronger Carbon Transition and Climate Policy conditions are associated with lower ESG rating disagreement among common law banks, while the same pattern is weaker or not evident among civil law banks. These findings suggest that certain country-level climate-policy and legal conditions appear to be associated with how consistently ESG providers evaluate banks. This reinforces the need to interpret ESG ratings jointly through provider methodology, bank characteristics, and institutional context.

The control variables provide additional insights. General economic development, bank size, profitability, and board size do not appear to explain ESG rating disagreement in a consistent way. By contrast, stronger institutional quality is associated with lower relative disagreement in some specifications, and more frequent board meetings are consistently associated with lower disagreement. The positive coefficient on ESG controversies scores suggests that banks with fewer controversies may display greater rating dispersion, possibly because major controversies create more visible and comparable signals for rating agencies. This interpretation should be treated cautiously, but it highlights the importance of information salience in ESG assessment. Overall, the findings imply that ESG rating disagreement is shaped not only by differences between rating providers, but also by the institutional and policy environments in which banks operate. For market participants, this means that ESG scores should not be treated as neutral or fully interchangeable measures of sustainability performance. Instead, users of ESG ratings should consider the provider, the underlying methodology, and the country-level context in which the rated firm operates. For regulators and standard setters, the results suggest that improving ESG comparability may require not only more disclosure, but also clearer and more consistent frameworks for interpreting climate-related and governance-related information.

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## Appendix

**Table A1: Distribution of sampled banks by country of incorporation and legal origin**

Country of incorporation	Legal origin	Number of banks
China	Civil law	19
Taiwan	Civil law	9
Japan	Civil law	7
South Africa	Common law	4
Malaysia	Common law	4
Poland	Civil law	3
Saudi Arabia	Common law	3
Indonesia	Civil law	3
Israel	Common law	3
Spain	Civil law	3
Chile	Civil law	3
Australia	Common law	3
Philippines	Civil law	3
Singapore	Common law	3
Turkey	Civil law	2
Korea, Rep.	Civil law	2
Hong Kong	Common law	2
Canada	Common law	2
United Arab Emirates	Common law	2
Brazil	Civil law	2
Kuwait	Civil law	1
Denmark	Civil law	1
Hungary	Civil law	1
Thailand	Common law	1
Sweden	Civil law	1
France	Civil law	1
Italy	Civil law	1
Germany	Civil law	1
Belgium	Civil law	1
Qatar	Civil law	1
Mexico	Civil law	1

Note: The table reports the number of unique banks in the final sample by country of incorporation and legal origin. Common law corresponds to LegOr = 1, while civil law corresponds to LegOr = 0. The sample contains 93 banks from 31 countries. Because the panel is fully balanced over 2022-2024, each bank contributes three bank-year observations. The country distribution provides context for interpreting the legal-origin interaction terms in the empirical analysis.

**Table A2: Descriptive statistics for ESG scores across rating providers**

Variable	Obs.	Mean	Std. dev.	Min	Max
Bloomberg ESG score	279	33.27	12.76	4.40	64.70
LSEG ESG score	279	66.65	14.84	8.71	92.78
S&P Global ESG score	279	69.79	25.58	2	100
MSCI ESG score	279	64.91	17.17	9	100
Sustainalytics ESG score, adjusted	279	76.18	5.80	61.80	91.17
Average ESG score across providers	279	62.16	12.80	20.10	82.71

Note: The table reports descriptive statistics for ESG scores assigned by Bloomberg, LSEG, S&P Global, MSCI, and Sustainalytics, together with the average ESG score across providers. All ESG scores are expressed on a common 0-100 scale, where 100 denotes better ESG performance. The 279 observations correspond to 93 banks observed over the 2022-2024 period.

**Table A3: Descriptive statistics for country-level government climate scores**

Variable	Obs.	Mean	Std. dev.	Min	Max
Government climate risk score	364	4.01	1.07	1.76	6.92
Carbon transition score	372	3.89	1.93	0.95	8.66
Power sector transition score	366	4.84	1.16	2.43	8.35
Climate policy score	364	3.59	1.22	0.39	6.22

Note: The table reports descriptive statistics for Bloomberg Government Climate risk score and their underlying pillars: Carbon Transition, Power Sector Transition, and Climate Policy. Scores are measured on a 0-10 scale, where higher values indicate better climate-transition or climate-policy conditions. The number of observations differs across variables because data availability varies by country and year. These variables are used as country-level explanatory variables in the empirical analysis.

**Table A4: Descriptive statistics for institutional and bank-level control variables**

Variable	Obs.	Mean	Std. dev.	Min	Max
Regulatory quality and control of corruption index	372	0.69	0.72	-0.57	2.16
GDP per capita, PPP (log)	336	10.45	0.61	9.09	11.80
ESG controversies score	371	88.69	23.74	8.15	100
Total assets (log)	372	26.25	1.27	23.06	29.41
Return on assets	372	1.50	1.79	-0.31	16.70
Board size	371	12.20	3.38	5	28
Board meetings	342	13.71	7.25	5	45

Note: The table reports descriptive statistics for the country-level and bank-level control variables. The regulatory quality and control of corruption index summarizes institutional quality, with higher values indicating stronger institutions. GDP per capita, PPP is reported in logarithmic form. The ESG controversies score is measured on a 0-100 scale, where higher values indicate fewer or less severe controversies. Total assets are reported in logarithmic form. Return on assets measures bank profitability, while board size and board meetings capture board structure and board activity.



ZBS<sup>1</sup> Združenje bank Slovenije  
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BANKING CONFERENCE  
**FRAGMENTATION:**  
GEOPOLITICS, DIGITALIZATION, AND 'NEW' SOVEREIGNTY

Wednesday, June 3<sup>rd</sup> 2026  
Brdo pri Kranju, dvorana Splendens

- 08.30 – 09.00 Registration
- 09.00 – 09.05 Welcome Address  
**Stanislava Zadavec Capriolo, M. I. A.**, Conference Moderator, Director, The Bank Association of Slovenia
- 09.05 – 09.20 Address by the Chairman of the Supervisory Board of the Bank Association of Slovenia  
**Blaž Brodnjak, MBA**, President of the Management Board, Nova Ljubljanska banka d.d.
- 09.20 – 09.40 Address by the Governor of the Bank of Slovenia  
**dr. Primož Dolenc**
- KEYNOTE SPEAKERS
- 09.40 – 10.05 European Digital Sovereignty – Implications for the financial sector  
**Kolja Gabriel**, Managing Director, Bundesverband Deutscher Banken
- 10.05 – 10.30 EU payment infrastructure within the Framework of the »New« Sovereignty  
**Piotr Jan Pietrzak**, European Payments Initiative
- 10.30 – 10.55 New Opportunities in a Changing World Order - online  
**Alex Krijger**, Krijger & Partners
- 10.55 – 11.20 Towards Cybersecurity  
**dr. Uroš Svete**, Director, Government Information Security Office of the Republic of Slovenia
- 11.20 – 11.30 Discussion
- 11.30 – 12.00 Break
- 12.00 – 12.45 Roundtable: Strengthening Defense Sovereignty – Investment Opportunities and Instruments  
Moderated by **Stanislava Zadavec Capriolo, M. I. A.**, Director, The Bank Association of Slovenia  
Participants:  
**Matej Miklavčič**, Director General, Company for Defense, Security and Resilience  
**dr. Simon Savšek**, European Investment Bank, Ljubljana Office  
**Boštjan Skalar**, Director, Slovenian Defence Industry Cluster (GOIS), e.i.g.
- 12.45 – 13.15 Innovation of the Financial System/Financial Markets (stablecoins)  
**Prof. Dr. Vasja Rant**, Professor at School of Economics and Business, University of Ljubljana
- 13.15 – 14.00 Roundtable: Digitalization and Financial Sovereignty  
Moderated by **Stanislava Zadavec Capriolo, M. I. A.**, Director, The Bank Association of Slovenia  
Participants:  
**dr. Marko Pahor**, Vicegovernor, Bank of Slovenia  
**Andrej Ciglič**, Deputy Director, Agency for Communication Networks and Services of the Republic of Slovenia  
**Rok Šketa**, Deputy Chairman of the Board, KDD – Central Clearing and Depository Company d.d.
- 14.00 – Lunch

We will be happy to provide you with any further information regarding the organisation of the conference at [ic@zbs-giz.si](mailto:ic@zbs-giz.si).  
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