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Dissatisfaction without Displacement

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Retention: Rethinking EU Cohesion Policy

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Dollar Dominance in the Global Financial System: Dissatisfaction without Displacement*

Massimiliano Castelli 

This paper examines the evolving role of the US dollar in the international monetary system through the lens of reserve manager behaviour. Combining survey evidence from the UBS Reserve Manager Survey with IMF COFER and BIS data, it identifies a growing divergence between declining confidence in the institutional foundations of dollar dominance and the persistence of dollar-centric reserve portfolios. Structural constraints, such as market depth, liquidity, safe asset supply, and financial infrastructure, continue to anchor the system despite rising geopolitical concerns. The findings characterise the system as one of “dissatisfaction without displacement”: beliefs are shifting, but portfolio adjustments remain gradual. Scenario analysis suggests that meaningful change is more likely to be crisis-driven than incremental.

Journal of Economic Literature (JEL) codes: E58, F33, C83, G11

Keywords: international monetary system, reserve currencies, US dollar, central banks, geopolitics, safe assets, diversification

1. Introduction

The role of the US dollar (USD) at the centre of the international monetary system has long been considered one of the defining features of the global financial

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architecture.¹ Despite repeated predictions of its decline, the dollar continues to dominate foreign exchange reserves, international trade invoicing, financial contracting, and global liquidity provision.

Recent developments, however, have introduced growing tension into this system. Rising geopolitical fragmentation, increased use of financial sanctions, concerns over US fiscal sustainability, and questions surrounding institutional credibility have prompted renewed debates about the durability of dollar dominance. At the same time, the emergence of alternative currencies, the expansion of gold holdings, and technological innovations such as digital currencies have intensified discussions around potential transitions toward a more multipolar monetary system.

This study combines survey-based evidence with aggregate reserve data and qualitative insights to distinguish between three analytical layers: beliefs, intentions, and outcomes.

One key contribution of the paper is to show that these layers evolve at different speeds. While beliefs may adjust rapidly, outcomes are shaped by institutional inertia, market structure, and operational constraints. The findings suggest that the international monetary system is best characterised not by transition or stability alone, but by a combination of both: a system in which dissatisfaction is rising, yet displacement remains limited.

The paper proceeds as follows. *Section 2* outlines the analytical framework and data sources. *Section 3* reviews the relevant literature. *Section 4* examines the structural foundations of dollar dominance. *Section 5* analyses reserve manager behaviour and its evolution over time. *Section 6* evaluates alternative reserve assets. *Section 7* develops scenario-based perspectives on the future of the system. *Section 8* discusses broader implications, *Section 9* outlines policy considerations, and *Section 10* concludes.

2. Analytical framework and data

The objective of this paper is not to estimate structural parameters or forecast currency shares of foreign exchange (FX) reserves, but rather to understand how reserve managers perceive risks, constraints, and strategic trade-offs in the current international monetary system.

¹ The centrality of USD to the international monetary system has long been recognised in the literature on hegemonic stability, international monetary arrangements, and reserve currency competition. Early and subsequent contributions emphasised the role of international public goods, financial market depth, network effects, and institutional credibility in sustaining dollar dominance (Kindleberger 1973; Cohen 1998; Eichengreen 2011; Gopinath et al. 2020). More recent contributions have also highlighted the role of the dollar as the central node in a global liquidity and funding system, sustained through offshore dollar markets and private-sector credit creation (Mehrling 2010; Pozsar 2014). Please see Section 3 for a more in-depth discussion of these perspectives and their implications for the analysis developed in this paper.

The analysis distinguishes between three layers:

- *Beliefs*: how reserve managers assess the credibility, stability, and geopolitical risk of major currencies.
- *Intentions*: stated plans regarding diversification, hedging, or strategic rebalancing.
- *Outcomes*: realised reserve allocations as observed in COFER data.

In practice, beliefs may change rapidly, intentions more slowly, and outcomes only gradually. Institutional processes, internal risk committees, benchmark constraints, and political oversight introduce significant inertia between layers.

The primary empirical input is the UBS Reserve Manager Survey (RMS), an annual survey of central banks and public reserve-holding institutions conducted by UBS Asset Management. The survey typically covers around fifty institutions across advanced and emerging economies, including senior officials directly involved in reserve management and strategic asset allocation decisions. Participation is voluntary and responses are anonymised. The questionnaire combines quantitative elements (expected currency and asset-class shares, diversification horizons, ranking of decision criteria) with qualitative assessments (confidence in institutional frameworks, geopolitical concerns, and operational constraints).

A number of surveys of sovereign institutions are conducted regularly by private financial institutions, think tanks, and multilateral organisations. The choice of the RMS in this paper is motivated by the specific objective of the analysis. While official reserve statistics such as IMF COFER provide valuable information on realised portfolio outcomes, they offer limited insight into the beliefs, intentions, and institutional constraints that shape reserve decisions. The RMS is particularly useful because it captures forward-looking assessments by reserve managers themselves and does not only focus on investment and operational issues related to foreign exchange reserve management, but also on how reserve managers assess the evolving geopolitical, economic, and financial environment in which they operate. This makes it possible to examine how perceptions and strategic priorities evolve even when portfolio allocations remain stable, allowing a more systematic analysis of the divergence between changing beliefs and persistent reserve outcomes that lies at the centre of this paper.

The value of repeated surveys lies in their ability to capture changes in beliefs and priorities that are not observable in aggregate data. Official reserve statistics reflect realised portfolios, which adjust slowly and are heavily constrained by market structure, regulation, and institutional mandates. Surveys provide a forward-looking complement by revealing how reserve managers interpret the evolving environment. This makes it possible to identify shifts in emphasis even when portfolio allocations

remain stable. Rather than focusing exclusively on point estimates in a single year, this paper draws on successive survey rounds to trace changes in: i) perceived risks to dollar dominance; ii) relative attractiveness of alternative reserve currencies; iii) importance attached to geopolitical versus financial factors; and iv) the role of gold and the impact of digitisation. This longitudinal perspective is particularly valuable in a system characterised by high inertia. It allows one to distinguish between temporary reactions to shocks and more persistent changes in institutional thinking.²

Survey evidence is complemented by IMF COFER data on the currency composition of official foreign exchange reserves, BIS statistics on international banking, securities issuance and cross-border payment infrastructure (*BIS 2023*), as well as European Central Bank (ECB) and IMF reports on reserve currency use, financial fragmentation, and safe asset supply. These sources allow comparison between stated preferences and actual portfolio outcomes and help distinguish between structural constraints and shifts in sentiment.

The practitioner-oriented perspective adopted in this paper complements rather than substitutes for existing theoretical approaches to reserve currency dominance. While the literature reviewed in the following section highlights the importance of hegemonic leadership, network effects, market depth, trade invoicing, and global liquidity provision, the survey evidence used here helps illuminate how these structural features are interpreted by reserve managers themselves. In this sense, the UBS RMS provides an institutional lens through which the interaction between systemic forces and portfolio behaviour can be better understood.

3. Literature review

The academic literature on international reserve currencies spans international economics, political economy, monetary history, and financial market microstructure. While early contributions focused on the provision of international public goods by hegemonic powers, more recent work has emphasised network effects, institutional credibility, financial market depth, and the strategic interaction between states. This section reviews the main strands of this literature and highlights where a practitioner perspective – grounded in reserve management constraints and institutional realities – both complements and challenges prevailing theoretical frameworks.

² Some limitations should be acknowledged. The survey sample, while broad, is not universal. Responses may be influenced by strategic considerations or reluctance to disclose sensitive views. Aggregate reserve data are reported with lags and at a high level of aggregation, obscuring intra-currency heterogeneity. Nevertheless, when interpreted jointly, repeated survey evidence and official statistics provide a coherent picture of a system characterised by rising concerns and limited behavioural adjustment.

3.1. Hegemonic stability, public goods, and the origins of currency dominance

The classical point of departure is *Kindleberger (1973)*, who argued that an open, stable international monetary system requires a dominant power willing and able to supply public goods, including a reserve currency, lender-of-last-resort facilities, and market access. In this view, the post-war dollar system reflected not only the economic size of the United States, but also its political willingness to underwrite global liquidity and stability.

Triffin (1960) famously identified the internal contradiction of such systems: the issuer of the dominant reserve currency must supply liquidity to the world, typically via external deficits, but persistent deficits ultimately undermine confidence in the currency itself. Although the gold-dollar standard has long since disappeared, the “*Triffin dilemma*” continues to shape debates on US fiscal sustainability and safe-asset supply. Proposals for a multilateral reserve currency modelled on existing SDRs are often brought forward to address the Triffin dilemma (*Robert Triffin International 2026*).

From a practitioner perspective, these early contributions remain relevant in two respects. First, they correctly identify reserve currency status as inseparable from political and institutional capacity. Second, they anticipate the tension between global liquidity provision and domestic policy constraints that reserve managers still monitor closely, particularly in periods of fiscal stress and geopolitical instability.

3.2. Network effects, inertia, and path dependence

Subsequent research shifted emphasis from political leadership to self-reinforcing market structures. *Krugman (1984)* and *Cohen (1998)* highlighted how transaction costs, established invoicing practices, and liquidity externalities create powerful network effects. Once a currency becomes dominant, users prefer it precisely because others already use it, generating inertia and multiple equilibria. Once a currency is dominant, switching costs are enormous; this explains why the dollar survived the end of Bretton Woods, the 1970s inflation and the 2008 financial crisis.

Eichengreen (2011) extended this reasoning historically, showing that transitions between dominant currencies are slow, overlapping, and contingent on financial development rather than simple shifts in economic size. The replacement of sterling by the dollar was not abrupt but unfolded over decades. By 1910, the US had already become the largest economy in the world and New York was a rising financial centre. However, the dollar did not immediately replace sterling and for about three decades the two currencies coexisted. What Eichengreen shows is that reserve currency transitions are slow, overlapping, and often messy.

For reserve managers, these arguments resonate strongly. Portfolio reallocation is constrained not only by strategic preferences but also by operational systems, legal frameworks, benchmark structures, and the depth of eligible asset markets. In this sense, inertia is not merely behavioural; it is embedded in institutional practice.

3.3. Modern models of the international monetary system: liquidity, trade invoicing, and the Money View

Recent theoretical work has formalised these intuitions. *Farhi and Maggiori (2018)* model the international monetary system as an equilibrium in which reserve currencies provide safety and liquidity services. Dominant issuers benefit from “exorbitant privilege” but also bear the cost of stabilising global markets during crises. The paper also shows that a global monetary system dependent on a reserve-currency country supplying safe assets is inevitably unstable as growing global demand for that asset eventually undermines confidence in that currency.

Gopinath et al. (2020) propose the “dominant currency paradigm”, demonstrating that trade invoicing and financial contracting in a single currency can persist even when trade patterns diversify. This insight helps explain why the dollar remains central to global trade finance and commodity markets, despite the rise of China and other emerging economies.

One complementary strand of the literature, often referred to as the “Money View”, shifts attention from reserve holdings and sovereign balance sheets to the functioning of global liquidity and funding markets. Rather than viewing the international monetary system primarily through the lens of official reserves, this perspective emphasises the role of the dollar as the apex of a hierarchical monetary system sustained by private-sector credit creation, offshore dollar funding, and wholesale financial intermediation (*Mehrling 2010; Pozsar 2014*). In this framework, dollar dominance reflects not only institutional credibility and network effects, but also the centrality of USD in collateral markets, cross-border banking, and international settlement mechanisms. This perspective is particularly useful in understanding why structural demand for dollar liquidity may persist even when confidence in the institutional foundations of the system weakens.

These models capture important structural mechanisms, yet they abstract from institutional frictions that practitioners consider critical: regulatory constraints on eligible assets, internal risk management frameworks, political mandates, and reputational cost considerations.

As a result, theoretical predictions about diversification often overstate the speed with which portfolios can adjust. The dominance of the dollar has remained almost intact, despite mounting concerns about debt sustainability, downgrades of US Treasuries (UST) and, more recently, a weakening of the rule of law in the US, including concerns about the independence of the Federal Reserve (*Bahceli 2025*).

3.4. Political economy, sanctions, and weaponised interdependence

A more recent strand of the literature focuses on the geopolitical dimension of currency dominance. *Farrell and Newman (2019)* introduce the concept of “weaponised interdependence”, arguing that control over financial networks and infrastructures can be leveraged for coercive purposes. *Drezner et al. (2021)* and others analyse how sanctions and network dependence reshape incentives for reserve accumulation and currency choice.

Some authors, notably *McDowell (2023)*, contend that sanctions strengthen the dollar by weakening rivals and reinforcing demand for safe assets. Others warn that excessive reliance on financial coercion may gradually erode trust and encourage diversification into gold or alternative currencies. The recent rise in the share of gold held by reserve managers as a share of total reserves appears to validate the diversification option as a reaction to the use of sanctions targeting FX reserves. This has been particularly true following the freezing of international reserves held by the Russian central bank, an unprecedented measure when the size of its reserves and the country involved are considered.

Mounting concerns about the use of FX reserves as a geopolitical tool for non-economic or financial goals have also emerged more recently with the “no-deal” on the proposed de-facto confiscation of Russia frozen reserves to finance Ukraine. This was largely a result of the opposition of the ECB fearing the violation of central banks’ mandates and the potential negative impact on the international role of the euro (*Bonini 2025*).

3.5. Bridging the literature and reserve management practice

The above strands in the literature provide important insights into the persistence and vulnerabilities of dominant reserve currencies. However, from a practitioner perspective, an additional layer of analysis is required to understand how structural forces translate into actual reserve management decisions

Taken together, the literature convincingly explains well why dominant currencies persist: network effects, safe-asset provision, and institutional credibility interact to create formidable barriers to entry. It also explains well where the vulnerabilities of a monetary system dependent on a dominant reserve currency lie: rising debt levels, weakening rule of law and the weaponisation of reserves.

Where the literature is less complete is in its treatment of operational and governance constraints. From a practitioner perspective, reserve management is shaped by conservative mandates, reputational risk, liquidity constraints and political oversight (*Castelli and Gerlach 2020*). These factors generate a strong bias toward incrementalism. Diversification, when it occurs, is typically framed as risk management rather than strategic realignment. Changes in key strategic reserve

management guidelines – for instance the currency composition – are often the result of a prolonged internal decision-making progress. Reserve managers rarely take tactical or directional investment decisions, leaning heavily towards stability and predictability.

This observation does not contradict existing theory, but rather adds an institutional layer that helps to explain the persistent gap between the apparent declining confidence in the dollar and the limited scale of observed portfolio shifts. Understanding this gap is essential for interpreting both survey evidence and aggregate reserve data in the sections that follow.

4. Structural foundations of dollar dominance

The persistence of the US dollar at the centre of the international monetary system cannot be understood solely through the lens of macroeconomic size or historical precedent. It is anchored in a set of structural features that are deeply embedded in global financial practice and difficult to replicate. From the perspective of reserve managers, these features are not just abstract theoretical constructs: they are operational realities that shape day-to-day portfolio decisions, risk management frameworks, and crisis response planning.

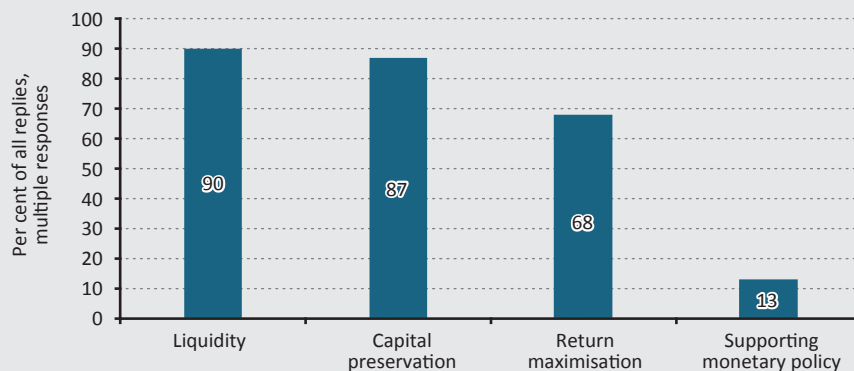
4.1. Market depth, liquidity, and scalability

The most frequently cited advantage of dollar assets is the depth and liquidity of US financial markets, in particular the market for US Treasury securities. With outstanding volumes exceeding USD 25 trillion and a highly developed dealer ecosystem, the Treasury market provides a level of scalability unmatched by any other sovereign bond market.

For reserve managers, scalability is not a secondary consideration. Portfolios often need to be adjusted in large sizes and under stressed conditions, whether to stabilise domestic currency markets, meet external obligations, or provide emergency liquidity to domestic financial institutions. Only US Treasuries offer the combination of size, continuous trading, and operational infrastructure required to execute such transactions without materially affecting market prices.

In practice, this means that diversification away from the dollar is constrained not only by preferences but also by market capacity. Even where alternative assets are attractive in principle, their limited depth imposes binding constraints at the portfolio level. The importance of liquidity is also highlighted by reserve managers' mounting concerns about the proper functioning of the UST market (*Figure 1*).

Figure 1
Primary investment objectives of reserve managers

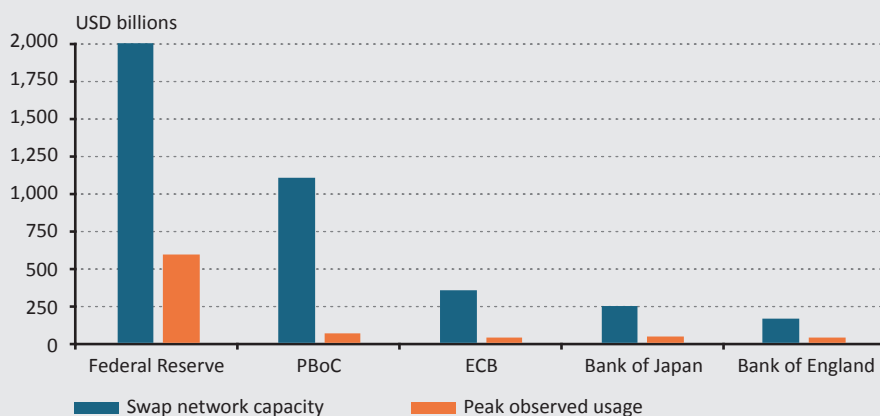


Source: UBS Reserve Manager Survey, 2025

4.2. Safe asset supply and crisis elasticity

A second structural pillar is the United States' ability to supply safe assets elastically during periods of stress. The experience of the global financial crisis, the euro area sovereign debt crisis, the pandemic, and recent geopolitical shocks has reinforced the perception that US fiscal and monetary institutions can expand the supply of risk-free assets when global demand surges. The Fed has swap agreements with other central banks totalling nearly USD 2 trillion, well above that of any other central bank such as the People's Bank of China (PBoC) or the European Central Bank (*Figure 2*).

Figure 2
Central banks swaps



Note: Values represent approximate capacity and observed peak usage.

Source: Federal Reserve Board (Central Bank Liquidity Swaps, peak usage 2008); PBoC bilateral RMB swap agreements; ECB liquidity line disclosures; Bank of Japan and Bank of England swap facilities; BIS and IMF reports on global central bank liquidity arrangements

This “elasticity of safety” is central to modern reserve management. Central banks value not only the current stock of safe assets but also the credibility of future supply. In this respect, the dollar benefits from the combination of monetary sovereignty, deep domestic capital markets, and a political system that – despite polarisation – has historically prioritised debt servicing.

From a practitioner standpoint, in the short to medium term this feature outweighs concerns about long-term debt sustainability. Reserve managers frequently distinguish between structural fiscal risk and immediate market functionality, with the latter carrying greater weight in operational decision-making. Until a few years ago, the potential supply of liquidity by the Federal Reserve was considered almost unlimited; in other words the elasticity of supply was almost infinite. More recently, concerns over the willingness of the US to be “the lender of last resort” have emerged as a result of the political use of tariff and sanctions for geopolitical goals. Will the US and the Fed provide liquidity to countries indiscriminately or only when they meet the US economic and financial interests?

4.3. Collateral centrality and financial plumbing

Dollar assets occupy a central position in the global collateral system. US Treasuries are the dominant form of high-quality collateral in repo markets, derivatives margining, and secured funding transactions.

This role creates powerful complementarities. Institutions that operate in dollar-based funding and settlement systems naturally hold dollar assets to manage liquidity risk. Central banks, in turn, structure their portfolios to remain compatible with these systems, reinforcing the dollar’s network advantages.

Recent contributions associated with the “Money View” further reinforce the structural logic of dollar persistence. Rather than focusing primarily on official reserves or sovereign balance sheets, this perspective emphasises the role of the dollar as the central settlement asset within a global hierarchy of money sustained by private-sector credit creation, offshore dollar markets, and wholesale funding mechanisms. From this perspective, the persistence of dollar dominance reflects not only confidence in US institutions or reserve preferences, but also the centrality of dollar liquidity in cross-border banking, repo markets, derivatives collateralisation, and trade finance.

This is particularly visible in the Eurodollar system and cross-currency funding markets, where global financial institutions continue to intermediate large volumes

of dollar liquidity outside the United States.³ Periodic disruptions in these markets – including during the Global Financial Crisis, the COVID shock, and episodes of market stress in recent years – have repeatedly required central bank swap lines and dollar liquidity facilities, reinforcing the dollar’s role as the global liquidity backstop. From a reserve management perspective, these dynamics create an additional structural floor under demand for dollar assets, largely independent of stated diversification preferences.

In practical terms, this means that reserve portfolios are designed not only as stores of value but as functional components of a broader financial infrastructure. Replacing dollar assets would therefore require not only alternative currencies, but alternative collateral ecosystems, settlement conventions, and legal frameworks as well.

4.4. Trade invoicing and financial contracting

The dominance of the dollar in trade invoicing and international financial contracts further entrenches its reserve role. Even countries with limited direct trade exposure to the United States frequently invoice commodities and intermediate goods in dollars. 40 per cent of global exports are invoiced in USD, well above the share the US share in global trade (*ECB 2025*). The dollar is not just a national currency – it is the global “vehicle currency” for trade, consistent with *Eichengreen’s (2011)* analysis of reserve currency persistence and international invoicing.

The dollar share in cross-border payments – according to SWIFT – is about 50 per cent. This is very important for sanctions as they operate through payment infrastructure control; if a transaction touches USD or US banks US jurisdiction applies. More importantly, more than 80 per cent of global trade finance (including letters of credit, financing and guarantees) is in USD. Commodities are largely invoiced in USD (*Bertaut et al. 2025*).

For reserve managers, this creates a natural alignment between reserve composition and balance-of-payments exposure. Holding dollar assets serves as a hedge against trade-related payment obligations and external financing needs. Although some diversification of invoicing currencies has occurred, particularly in regional trade, the dollar remains the reference currency for a large share of global commerce. This reinforces the incentive to maintain substantial dollar liquidity buffers.

³ A contemporary illustration is provided by recent episodes of yen carry trade unwinding. For decades, exceptionally low Japanese interest rates encouraged global investors to borrow in yen and invest in higher-yielding foreign assets, often USD-denominated securities. As Japanese yields have gradually normalised, periods of carry unwinding have highlighted the sensitivity of global liquidity conditions to funding costs, exchange-rate volatility, and access to dollar funding. While not directly linked to reserve management decisions, such episodes illustrate the continued centrality of USD in global liquidity provision and funding markets.

4.5. Rule of law and institutional credibility

Beyond market mechanics, the dollar benefits from a long-standing legal and institutional framework that underpins property rights, contract enforcement, and investor protection.

The rule of law rests on three key pillars: enforceability of contracts, independence of the courts, and the protection of property rights. No other jurisdiction can provide the same level of certainty as the US legal system. Reserve managers place considerable weight on legal certainty, particularly when managing public assets subject to political scrutiny. The perceived neutrality and robustness of US courts, settlement systems, and custodial arrangements remain important elements of dollar dominance.

US policy credibility rests on two key institutions: the Federal Reserve System and the US Treasury. The credibility of these two institutions has been built over time with predictable monetary policy and a commitment to low inflation (over the long term). Even when their policy is imperfect, it is understood and transparent.

While recent political developments have raised questions about institutional stability, the US legal system continues to be perceived as more predictable than the attractiveness of most alternatives. For instance, China still scores poorly in terms of capital controls, political influence over courts, and uncertain property rights

4.6. Stability today, fragility tomorrow

Taken together, these structural foundations explain why the dollar's dominance persists, despite growing unease about the geopolitical and institutional trajectory of the United States.

At the same time, they point to a paradox. The very inertia that stabilises the system in the short run may increase vulnerability over longer horizons. As portfolios remain concentrated and alternatives remain underdeveloped, the system becomes more sensitive to extreme shocks affecting the core. From a practitioner perspective, this tension is well understood, but is difficult to resolve. Reserve managers are tasked with preserving stability, not redesigning the international monetary system. As a result, structural dependence on the dollar is likely to persist even as confidence erodes at the margin.

5. Reserve manager beliefs, behaviour, and their evolution over time

Survey results point to a striking and consistent pattern: confidence in the long-term institutional foundations of dollar dominance has weakened, yet expectations of near-term displacement remain low. Looking across successive UBS RMS rounds, several systematic trends emerge.

5.1. Beliefs

First, the focus of risk assessment has shifted. Earlier surveys placed greater emphasis on macroeconomic and market risks, including inflation volatility and interest rate uncertainty. Since the early 2020s, geopolitical factors have moved decisively to the foreground. Sanctions, asset freezes, and payment-system access are now discussed routinely alongside credit and liquidity considerations.

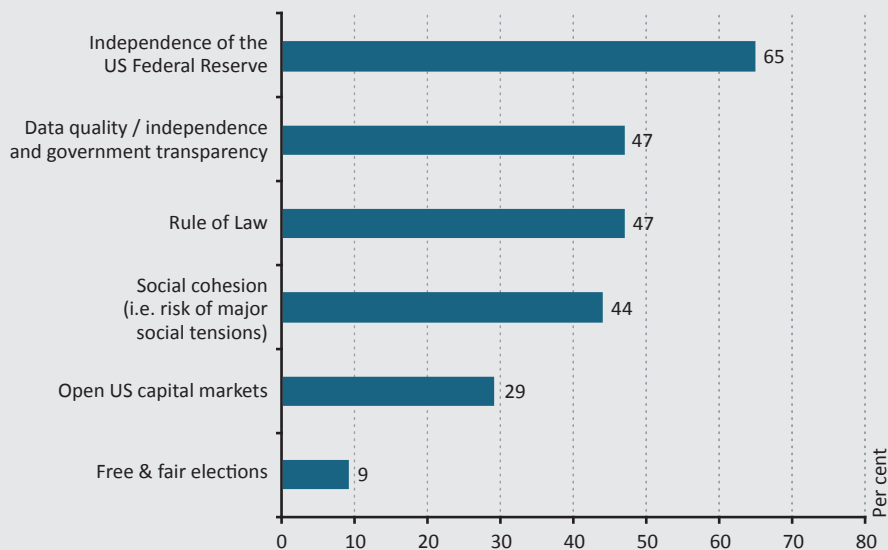
Second, concerns about the institutional environment in the United States have become more explicit. While earlier survey rounds rarely highlighted governance issues, recent responses increasingly reference central bank independence, political polarisation, and the stability of the legal framework as relevant for long-term reserve strategy.

Third, the perceived attractiveness of gold as a reserve asset has risen steadily. Initially viewed primarily as a diversification tool, gold is now frequently described as a hedge against extreme geopolitical scenarios and financial coercion. This shift is visible both in qualitative responses and in reported intentions to increase gold allocations.

Fourth, attitudes toward alternative currencies have evolved asymmetrically. Interest in the euro has increased modestly, often linked to expectations of deeper European financial integration. By contrast, views on the renminbi remain divided: some reserve managers see strategic value in limited exposure, while others remain constrained by concerns over capital controls and political risk.

From a practitioner perspective, this reflects realism rather than optimism. Dominance is defined operationally: by liquidity, market depth, collateral usability, and settlement infrastructure. In these dimensions, no alternative currently offers comparable scale. Respondents increasingly cite concerns related to:

- US fiscal sustainability and debt dynamics,
- political polarisation and governance risk,
- the weaponisation of financial infrastructure, and
- the long-term credibility of policy frameworks (*Figure 3*).

Figure 3**Expected deterioration of key economic and institutional factors in the US**

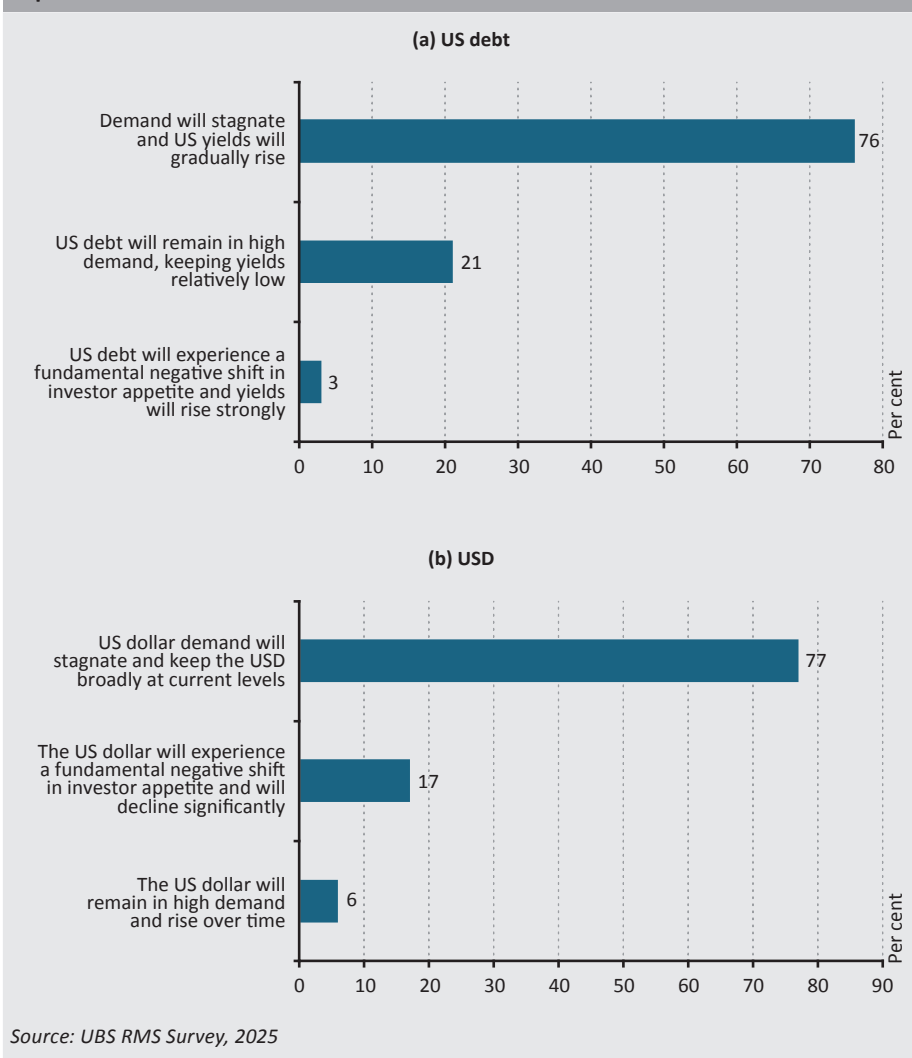
Source: UBS RMS Survey, 2025

These concerns are particularly pronounced among reserve managers in emerging economies, but are also present among advanced economies' institutions. They are evaluated in relative terms: the dollar is not compared to an ideal benchmark, but to the institutional limitations of available alternatives.

5.2. Why beliefs do not translate into reallocation

Despite these changes in perception, the pace of actual portfolio adjustment has remained slow: according to the 2025 UBS survey nearly 80 per cent of respondents believe that USD will not lose its status as a global reserve currency over the next years. Furthermore, despite the mounting concerns about US debt sustainability and the independence of the central bank, demand for US Treasuries and USD is expected to remain relatively stable according to the majority of reserve managers responding to the survey (*Figure 4*).

Figure 4
Expected evolution of demand for US debt and USD



The persistence of dollar dominance in realised allocations stands in sharp contrast to the growing prominence of institutional and geopolitical considerations in survey responses. The gap between declining confidence and stable portfolios can be explained by several operational constraints:

- *Liquidity requirements*: reserve portfolios must be deployable at scale during market stress. Only US Treasury markets consistently meet this criterion.

- *Benchmarking and peer effects*: many institutions follow conservative benchmarks or peer-relative frameworks, reinforcing convergence around established allocations.
- *Regulatory and legal mandates*: eligible assets are often narrowly defined, limiting the scope for experimentation.
- *Reputational risk*: significant deviations from established practice expose reserve managers to political scrutiny if outcomes disappoint.

As one respondent to the 2025 survey noted “diversification is easy to discuss, but difficult to execute at the scale and speed markets assume”. Across recent survey rounds, a large majority of respondents expect USD to remain the dominant reserve currency over the next decade. Only a small minority anticipate a rapid transition to a multipolar system. This expectation holds across both advanced and emerging market respondents.

Where diversification occurs, it is typically framed as incremental risk management:

- modest increases in gold holdings,
- selective use of smaller currencies,
- limited experimentation with renminbi assets,
- extension along the maturity spectrum of existing dollar portfolios.

This behaviour is consistent with a system adapting at the margin, rather than undergoing structural transition.

5.3. Dissatisfaction without displacement

The multi-year survey evidence reinforces the interpretation of “dissatisfaction without displacement”. The international monetary system is evolving primarily through changes in beliefs and risk assessments rather than through rapid portfolio reallocation. For analysts relying solely on aggregate data, this evolution is difficult to detect. Survey evidence therefore provides an essential complement, revealing pressures building beneath an apparently stable surface. For policy makers, the implication is that structural change, if it occurs, is likely to be crisis-driven rather than gradual, as beliefs and operational constraints continue to diverge.

6. Alternatives to the dollar

Discussions of de-dollarisation often assume the existence of viable substitutes. In practice, reserve managers evaluate alternatives against a demanding set of criteria: market depth, liquidity, safety, legal certainty, operational usability, and geopolitical risk. In these dimensions, no single asset currently matches the dollar (*Table 1*). Instead, alternatives offer partial substitutes, each constrained by specific limitations.

Table 1 Evolution of the currency composition of FX reserves (Per cent)															
Currencies	1995	2000	2005	2010	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025
USD	61.9	71.1	66.5	61.8	64.1	65.3	62.7	61.7	60.7	59.0	58.8	58.4	58.4	57.8	56.8
EUR*	28.4	18.3	23.9	26.0	19.9	19.1	20.1	20.7	20.6	21.2	20.6	20.5	20.0	19.8	20.2
GBP	2.2	2.8	3.7	3.9	4.9	4.3	4.5	4.4	4.6	4.7	4.8	4.9	4.8	4.7	4.4
JPY	7.1	6.1	4.0	3.7	4.1	3.9	4.9	5.2	5.9	6.0	5.6	5.5	5.7	5.8	5.8
CAD	NA	NA	NA	NA	1.9	1.9	2.0	1.8	1.9	2.1	2.4	2.4	2.6	2.8	2.5
AUD	NA	NA	NA	NA	1.9	1.7	1.8	1.6	1.7	1.8	1.8	2.0	2.1	2.1	2.0
REM	NA	NA	NA	NA	NA	1.1	1.2	1.9	1.9	2.3	2.8	2.7	2.3	2.2	2.0
REM**	NA	NA	NA	NA	NA	1.7	1.8	2.6	2.7	3.1	3.7	3.7	3.2	3.0	2.0
CHF	0.4	0.3	0.1	0.1	0.3	0.2	0.2	0.1	0.1	0.2	0.2	0.2	0.2	0.2	0.2
Other	1.5	1.7	4.4	3.0	2.4	2.5	2.5	2.5	2.7	3.0	3.5	3.9	4.6	6.1	NA

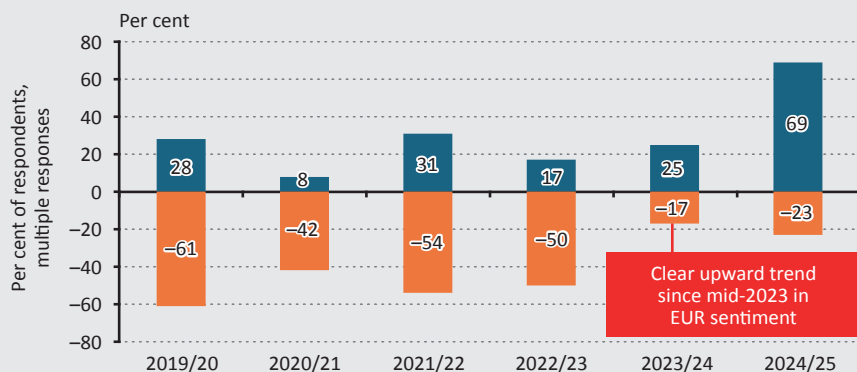
*Note: * ECU and other European currencies before the introduction of the euro, ** excl Chinese reserves.*
Source: IMF COFER as of October 2025

6.1. Euro: credible but incomplete

The euro is widely regarded as the most credible alternative reserve currency. It benefits from the economic scale of the euro area, a strong commitment to price stability by the ECB, and a sophisticated financial sector.

In the latest UBS Survey, the euro was in fact the most frequently mentioned currency when asked which currencies were added on a net basis to reserves during the past year. This represent the best result for the euro as a reserve currency after many years of stagnation; the fears of a break-up of the euro that emerged after the fiscal crisis in early 2010s are now a distant memory (*Castelli 2026*).

Figure 5
Changes in EUR allocations among reserve managers, 2019–2025



Note: Number of survey respondents that reported increases or decreases to EUR allocations since 2020.

Source: UBS Annual Reserve Manager Survey results from 2020–2025

However, the improved outlook for the euro has not translated into a significant increase in the share of the euro in global foreign exchange reserves. By the third quarter of 2025 – after “Liberation Day”, a weakening USD and rising concerns about the UST market – the share of the euro in global reserves stood at around 20.5 per cent. This is around 1.5 percentage points higher than at the end of 2024, but most of this increase is explained by the revaluation of EUR against USD. After netting out the currency effect, the share of the euro is basically unchanged. Whilst reserve managers indicate growing interest in the euro area currency, this has not yet translated into any significant additional flows of reserves.

From a reserve management perspective, three structural constraints dominate. First, the absence of a unified fiscal authority limits the supply of a single, homogeneous safe asset comparable to US Treasuries. EUR-denominated sovereign bond markets remain fragmented along national lines, complicating large-scale portfolio allocation and liquidity management. Recent joint issuance under the Next Generation EU programme and more recently to fund defence expenditure and support Ukraine has been welcomed by reserve managers as a positive development, increasing the stock of high-quality EUR-denominated assets. Nevertheless, most respondents view this as an incremental improvement rather than a structural transformation.

Second, financial market integration within the euro area remains incomplete. Progress toward the capital markets union – now rebranded as the Saving and Investment Union – has been uneven, and cross-border market depth remains

limited relative to the United States. The shift in approach with the Saving and Investment Union – from directives to regulations, the 28th regime and the phased approach – could be a catalyst for finally making progress. However, the key question is whether there is enough support across member states to give up sovereignty in very politically sensitive areas such as the banking sector and the pension sector.

Third, crisis management frameworks, while significantly strengthened since 2012, are still perceived as politically complex and slower to activate than their US counterparts. In the euro area, crisis response is institutionally fragmented across multiple bodies, including the ECB (monetary policy, lender of last resort to banks), the European Stability Mechanism (sovereign rescue facility), the European Commission (fiscal rules, coordination) and national governments (fiscal authority). In other words, crisis management is a multi-layered negotiation system in the euro area. This contrasts with the US system which is perceived as having fewer veto points, a clear hierarchy and faster execution.

The ECB's evolving stance toward the international role of the euro, increasingly framed in terms of strategic autonomy and financial resilience, is well noted by reserve managers. However, it is widely understood that institutional reforms, rather than policy communication, will ultimately determine the euro's reserve potential (*Castelli 2026*).

6.2. Renminbi: rising but constrained

China's economic size and role in global trade make the renminbi a natural candidate for greater international use. Over the past decade, the inclusion of renminbi in the IMF's SDR basket, expansion of offshore clearing centres, and development of Chinese bond markets have increased its visibility in reserve portfolios.

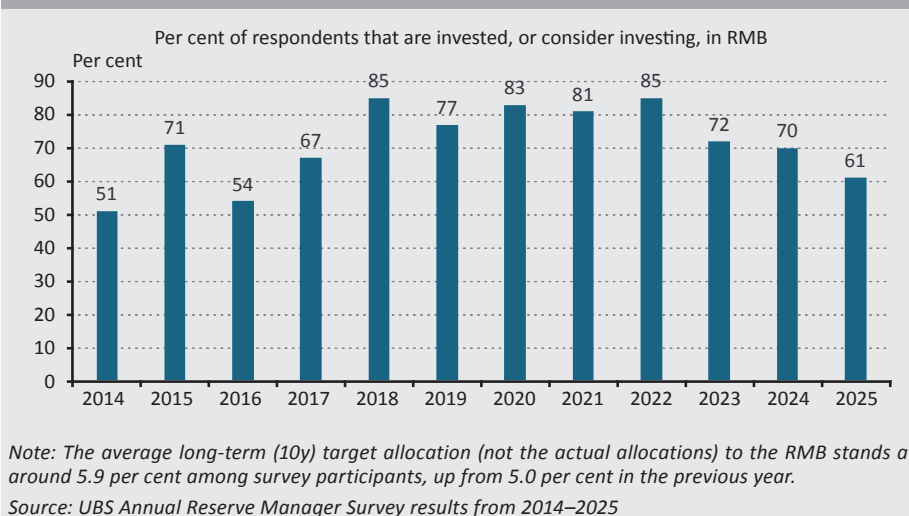
In practice, uptake has remained limited. According to the latest COFER data, RMB-denominated reserves represent about 2 per cent of global FX reserves (*IMF 2026*). Following the inclusion of RMB in the SDR basket, there has been growing interest in RMB bonds among reserve managers; however, this interest has been levelling off in the last few years and the share of RMB in global reserves has been stagnating at low levels.

The principal constraint continues to be capital account management. Restrictions on capital flows, combined with episodic regulatory intervention, reduce the attractiveness of RMB assets for institutions whose primary objective is liquidity and risk minimisation. The inclusion of RMB in the SDR basket was largely a "political decision" based on the assumption that China would continue to open up its financial sector and ultimately the capital account.

Legal transparency and governance are also recurring concerns. Reserve managers emphasise the difficulty of assessing political risk and the lack of independent judicial recourse in the event of disputes. Finally, it also appears that growing tensions between the US and China over trade, technology, and many other issues are perceived by many reserve managers as a risk, as they fear the potential impact of (direct or indirect) sanctions should the relationship between the two superpowers escalate further.

As a result, RMB holdings are typically small, strategic, and carefully ring-fenced. They are viewed as a diversification tool, rather than as a core reserve asset.

Figure 6
Current and prospective RMB exposure among reserve managers, 2014–2025

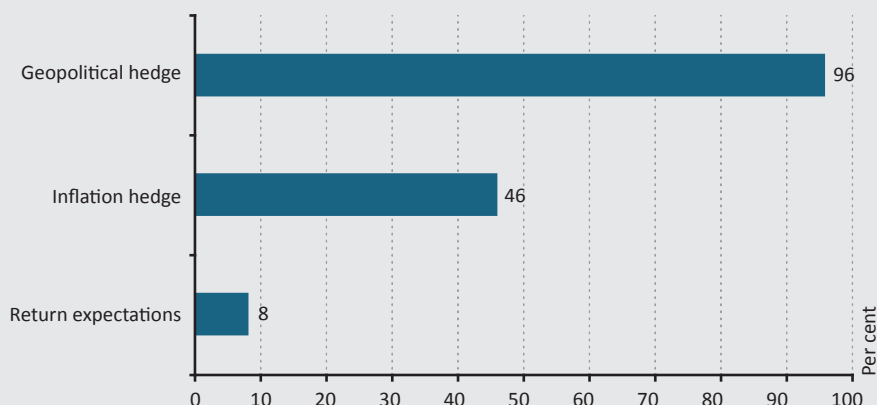


6.3. Gold: trusted but inert

Gold occupies a distinct position in reserve portfolios. It is not a currency, does not yield income, and is costly to store and insure. Nevertheless, its role has expanded in recent years.

Repeated survey evidence indicates that gold is increasingly viewed as a hedge against geopolitical risk, sanctions, and extreme financial scenarios. Unlike foreign currency assets, gold carries no issuer risk and is immune to legal seizure within domestic custody. From a practitioner perspective, gold's appeal lies precisely in these properties. However, its lack of liquidity in stressed market conditions and its price volatility limit the scale at which it can replace currency reserves.

Figure 7
Key drivers of increasing gold allocation at central banks



Source: UBS RMS Survey, 2025

It should also be noted that the net purchase of gold by central banks is a trend that has been going on for many years. It is largely driven by emerging markets, with China accounting for the lion's share. De-dollarisation and sanction risk appear to be the main motivations behind this trend. However, there is a limit in the share of FX reserves that central banks can allocate to gold. Gold therefore functions as a complement to, rather than a substitute for, dollar holdings.

6.4. Smaller currencies: stable but not systemic

Currencies such as the Japanese yen, Swiss franc, Canadian dollar, and Australian dollar play a role in diversification strategies. They offer political stability and well-regulated financial markets, but their limited market size constrains their systemic relevance. In most reserve portfolios, these currencies are used to finetune risk characteristics or enhance returns, rather than to alter strategic orientation.

6.5. Digital assets and central bank digital currencies

Technological innovation has prompted renewed discussion of whether digital assets or digital currencies could alter the structure of the international monetary system. In the 2025 survey, 44 per cent of reserve managers believe cryptocurrencies or stablecoins could benefit from macro shifts, putting them ahead of traditional currencies such as the yen or Swiss franc. However, the market remains fragmented, and regulatory clarity is still lacking in most jurisdictions.

Interestingly, there is also a geopolitical angle: some central banks see dollar-pegged stablecoins as a tool to enhance demand for short-dated Treasuries, while others view central bank digital currencies as a pathway to reduce reliance on the dollar altogether. The battle between decentralised and centralised digital monetary

systems will undoubtedly shape future reserve strategies – but for now, the impact remains peripheral (*Castelli 2025*).

At present, reserve managers remain cautious. Cryptocurrencies are institutionally immature and are unlikely to become eligible as a reserve asset (*Feyen et al. 2024*). Central bank digital currencies are seen primarily as instruments for domestic payments efficiency rather than as reserve assets. At the wholesale level, however, some reserve managers increasingly monitor the development of cross-border CBDC platforms as a potential longer-term source of change in international payments infrastructure. Projects such as mBridge – involving cooperation among several central banks to facilitate cross-border wholesale payments using distributed ledger technology – are often discussed as potential mechanisms to reduce reliance on traditional correspondent banking channels and, at the margin, on dollar-centric settlement systems. While still at an experimental stage and limited in scale, such initiatives illustrate how technological innovation could gradually alter the operational infrastructure underpinning international transactions, particularly if combined with greater regionalisation of trade and finance. However, from a reserve management perspective, these developments are generally viewed as complements to existing systems rather than as immediate substitutes for the liquidity, safety, and market depth associated with dollar-based financial markets.

While digital infrastructure may eventually reduce transaction costs and reshape settlement systems, it is unlikely to resolve the fundamental issues of market depth, legal certainty, and safe-asset supply that underpin reserve currency status. Crypto-assets are currently incompatible with the traditional central banks' objectives of safety, liquidity, and return. They are highly volatile and are not very reliable as a store of value.

6.6. A constrained choice set

The evaluation of alternatives reinforces a central conclusion: dissatisfaction with the dollar does not imply the existence of a superior substitute. Reserve managers face a constrained optimisation problem. They may wish to reduce exposure to US-specific risks, but doing so requires accepting other, often less transparent, risks elsewhere.

In this context, diversification proceeds at the margin, through modest adjustments and portfolio layering, rather than through wholesale reallocation. The dollar remains the anchor not because it is flawless, but because the opportunity cost of abandoning it remains high.

7. Scenarios for the international monetary system

Forecasting the evolution of the international monetary system is inherently uncertain. Structural inertia coexists with episodic shocks, and small institutional changes can produce disproportionate effects when confidence is disrupted. Rather than offering point forecasts, this section develops a set of stylised scenarios that capture plausible pathways over the coming decade.

The scenario analysis follows a qualitative, practitioner-oriented approach rather than a formal probabilistic forecasting exercise. The scenarios are constructed using three complementary inputs: historical experience with reserve currency transitions and episodes of monetary fragmentation, including the prolonged, overlapping transition from sterling to the US dollar (*Eichengreen and Flandreau 2009*); the structural features of reserve currency systems discussed in the literature, including market depth, safe-asset supply, and network externalities; and repeated survey evidence on reserve manager beliefs and constraints from the UBS Reserve Manager Survey. The objective is not to assign probabilities to specific outcomes, but to identify plausible pathways and the conditions under which shifts in the international monetary system may accelerate or remain constrained. This approach is consistent with the scenario-based analysis commonly used by reserve managers and policy institutions when assessing long-term strategic risks under conditions of high uncertainty.

The scenarios are not mutually exclusive, and elements of different scenarios may coexist or emerge sequentially over time depending on political, institutional, and market developments.

7.1. Baseline scenario: Persistent dollar dominance with gradual diversification

In the baseline scenario, USD remains the dominant reserve currency throughout the next decade. Its share in global reserves declines slowly, but without a discrete break or regime change. This scenario would be a continuation of the trend experienced over the last years, with a steady decline in the share of USD in global FX reserves. Over the last two decades the USD share has fallen from more than 70 per cent to less than 60 per cent.

Structural drivers supporting this outcome include:

- continued depth and liquidity of US financial markets;
- absence of a unified euro-area safe asset;
- capital account restrictions in China; and
- the lack of scalable alternatives for collateral and crisis liquidity.

In this scenario, the diversification of FX reserves continues primarily at the margin:

- modest increases in gold holdings;
- incremental allocation to smaller currencies;
- limited growth in renminbi reserves; and
- selective use of euro-denominated assets.

Survey evidence is consistent with this outcome. While institutional confidence in the US has weakened, most reserve managers expect the operational advantages of the dollar to dominate portfolio construction for the foreseeable future. The implication is a system characterised by rising political unease but stable financial architecture.

7.2. Multipolar transition scenario

A second scenario envisions a gradual move toward a more multipolar reserve system. In this case:

- the euro expands its role through sustained joint issuance, deeper capital markets, and stronger financial integration;
- the renminbi grows as capital controls are selectively relaxed; and
- gold continues to gain prominence as a geopolitical hedge.

The transition remains slow and incomplete. The dollar remains the single largest reserve currency, but its share declines more visibly as alternative pools of safe assets become operationally viable. This scenario requires credible progress on European fiscal and financial integration, durable institutional reforms in China and demonstrations of crisis management capacity outside the US. Absent these conditions, reserve managers are unlikely to materially rebalance portfolios.

7.3. Fragmentation scenario: financial blocs and regionalisation

A more disruptive scenario involves increasing geopolitical fragmentation and the emergence of partially segmented financial blocs. In a more fragmented geopolitical environment, efforts to reduce dependence on USD could also intensify through alternative payment arrangements linked to commodity trade and regional economic blocs. Discussions within BRICS and other groupings increasingly contemplate greater use of local currencies, gold-linked settlement mechanisms, or non-USD invoicing arrangements for strategic commodities such as energy, critical minerals, and agricultural goods. While these initiatives remain fragmented and operationally limited, a more systematic shift in the denomination of trade flows – particularly in energy and raw materials – could gradually weaken one of the structural foundations of dollar dominance: its central role in global trade

invoicing and settlement. From a reserve management perspective, however, such developments would only become systemically relevant if supported by deeper financial markets, scalable liquidity infrastructure, and greater confidence in alternative legal and institutional frameworks.

Key features include:

- expanded use of financial sanctions;
- regional payment systems replacing global platforms;
- preferential trade invoicing within political blocs; and
- regulatory barriers to cross-border capital flows.

In such an environment, reserve portfolios become more politically differentiated. Some countries increase exposure to USD to preserve access to US financial infrastructure, while others deliberately reduce exposure to limit vulnerability to sanctions.

Gold plays a larger role as a politically neutral asset, and regional currencies gain importance within specific trade networks. For reserve managers, this scenario raises complex trade-offs between financial efficiency and political risk management. Portfolio optimisation becomes inseparable from foreign policy considerations.

7.4. Shock-driven transition scenario

Historical experience suggests that reserve currency transitions often require crises. In this scenario, a severe shock undermines confidence in USD assets. Possible triggers include:

- a disorderly fiscal crisis in the US;
- prolonged impairment of US Treasury market functioning;
- a breakdown in central bank independence; or
- extreme geopolitical escalation involving asset freezes.

Such an event could accelerate diversification dramatically, but at the cost of substantial market disruption. The absence of ready substitutes would amplify volatility and potentially destabilise global liquidity provision. From a practitioner perspective, this is the least desirable outcome. Reserve managers prioritise stability and would prefer gradual adjustment even if confidence erodes.

The implications of the different scenarios for major reserve assets are summarised in *Table 2* below. The table highlights that while diversification increases across most scenarios, the absence of scalable and fully credible alternatives constrains the speed and extent of any transition away from USD.

Table 2
Role of major reserve assets across scenarios

Asset class	Baseline scenario: persistent USD dominance	Multipolar transition	Fragmentation / blocs	Shock-driven transition
US dollar (USD)	Remains dominant anchor; gradual decline in share, but retains central role in liquidity, collateral, and invoicing	Still the largest reserve currency, but with a reduced share; coexists with EUR and RMB	Core currency within a US-aligned bloc; reduced role elsewhere	Loss of confidence triggers disorderly adjustment; still widely used as substitutes remain limited
Euro (EUR)	Modest increase through diversification at the margin; constrained by the absence of a unified safe asset	Gains share if deeper integration, joint issuance, and capital markets union advance	Stronger regional role within a European and aligned bloc; limited global expansion	Potential safe-haven beneficiary, though inflows are constrained by market fragmentation and limited common safe-asset supply
Renminbi (RMB)	Limited increase; constrained by capital controls and governance concerns	Expands if liberalisation progresses; still remains below USD and EUR in scale	Core currency in a China-centred bloc; increased use in trade invoicing and regional reserves	Gains as an alternative to USD, but its role is capped by convertibility and trust constraints
Smaller currencies (JPY, CHF, CAD, AUD, etc.)	Continue to play a marginal diversification role	Slightly larger role as secondary diversifiers; still not systemic because of limited market size	Regional importance increases within aligned networks, but scale remains too small for a major system-wide role	Temporary safe-haven inflows are possible, but limited market depth prevents a structural shift
Gold	Gradual increase as a diversification tool and geopolitical hedge	Continued rise as a neutral reserve asset alongside multiple currencies	Strong increase due to sanctions risk and demand for politically neutral stores of value	Major beneficiary as a crisis hedge, though liquidity and storage constraints limit substitution for currency reserves

Note: The following scenarios are purely illustrative analytical constructs used for academic discussion. They do not represent forecasts, predictions or recommendations regarding the future performance or allocation of any currency or asset class.

7.5. Implications across scenarios

Across all scenarios, three common themes emerge.

First, structural features dominate short-term outcomes. Beliefs can change rapidly, but portfolio adjustment is constrained by infrastructure and market capacity.

Second, institutional reform matters more than policy rhetoric. Changes in reserve currency status follow from safe-asset supply, legal frameworks, and market integration, not declarations of intent.

Third, geopolitical risk is now an enduring component of reserve management. Even in the baseline scenario, political considerations increasingly shape strategic thinking.

From the standpoint of those managing reserves, the international monetary system is best understood as stable, but brittle. It is stable because operational constraints anchor portfolios to the dollar; it is brittle because confidence is concentrated in a narrow institutional core. This combination explains why dissatisfaction coexists with persistence, and why diversification is cautious even when political risk is rising.

Reserve managers therefore approach future scenarios defensively. The objective is not to engineer transformation, but rather to preserve optionality: to maintain liquidity, protect against extreme outcomes, and adapt incrementally as conditions evolve. In this sense, the international monetary system is drifting, rather than transitioning.

8. Discussion: Interpreting stability, risk, and change in the international monetary system

The preceding sections examined reserve manager behaviour, the structural foundations of dollar dominance, the limits of available alternatives, and plausible future scenarios. This section synthesises these strands and outlines their broader implications as to how the international monetary system should currently be interpreted.

Rather than framing the system in terms of imminent transition or immutable stability, the evidence points to a more complex configuration: a system that is operationally resilient, yet strategically fragile; adaptive at the margin, yet resistant to structural transformation.

8.1. Dominance without confidence

One central empirical finding of this paper is the growing divergence between confidence and dependence. Survey evidence documents declining trust in the institutional and political environment underpinning the dollar. Concerns about fiscal sustainability, governance, central bank independence, and the weaponisation of financial infrastructure are no longer confined to a small subset of respondents. They are now part of mainstream reserve management discourse.

At the same time, realised reserve allocations remain heavily concentrated in USD assets. This coexistence of scepticism and reliance would appear to be contradictory in a purely theoretical framework. In practice, it reflects the binding role of infrastructure, liquidity, and institutional constraints. Dollar dominance, in this sense, no longer rests primarily on positive preference. It rests on the absence of operational substitutes.

8.2. Inertia as a rational response

The persistence of USD-centric portfolios should not be interpreted as complacency or lack of awareness. For reserve managers, inertia is often the rational outcome of risk minimisation under uncertainty.

Reallocation away from the dollar entails accepting:

- lower liquidity,
- greater price volatility,
- legal and political opacity, or
- operational complexity.

Against this backdrop, maintaining USD exposure is not an endorsement of US policy or institutions, but rather a defensive choice in an imperfect environment. This distinction is important for policy interpretation. Observed stability does not imply underlying comfort with the system; it reflects constrained optimisation.

8.3. Limits of market-led adjustment

Much of the academic literature assumes that shifts in relative economic weight, financial development, or investor preferences will eventually translate into changes in reserve currency status (*Cohen 1998; Eichengreen 2011; Farhi and Maggiori 2018*).

The evidence presented here suggests that such mechanisms operate only weakly in the presence of:

- strong network externalities,
- regulatory and governance constraints, and
- the central role of collateral and settlement infrastructure.

Market-led adjustment is therefore slow, path-dependent, and highly sensitive to institutional reform. Without changes in safe-asset supply, legal frameworks, and financial integration, even large shifts in sentiment may produce only marginal portfolio rebalancing.

8.4. Geopolitics as a structural variable

Another implication concerns the role of geopolitics. Historically, geopolitical considerations were treated as episodic shocks to an otherwise economically driven system. The repeated survey evidence suggests that this is no longer the case. Political risk has become a structural parameter of reserve management (*Table 4*).

This does not mean that portfolios will be rapidly reshaped along geopolitical lines. It does mean that traditional metrics of reserve adequacy and portfolio optimisation are increasingly complemented by scenario analysis involving sanctions, asset freezes, and financial decoupling. In this respect, reserve management has become an exercise in strategic risk management, rather than purely financial optimisation.

Table 4 Top 3 risks for reserve managers (2016–2025)			
Year	#1 Risk	#2 Risk	#3 Risk
2025	Trade war escalation	Military conflicts (Ukraine, Middle East)	Economic volatility (inflation, cycles)
2024	Geopolitical conflicts (Russia, US–China, Middle East)	Persistent inflation / rising yields	Economic volatility
2023	Geopolitical conflicts (Russia, US–China)	Persistent inflation / rising yields	Global recession
2022	Inflation / rising yields	Geopolitical conflicts (Russia, US–China)	Commodity prices & energy security
2021	Failure to end the pandemic	Government debt levels	Inflation / rising yields
2020	Trade wars (protectionism)	Global slowdown / deflation	US political developments
2019	Trade wars	Global slowdown / deflation	China hard landing
2018	Trade wars	EU political developments	US political developments
2017	US political developments (protectionism)	EU political developments	China hard landing
2016	China hard landing	Deflation	Euro area crisis
Source: UBS RMS Survey, 2016–2025			

8.5. Fragility beneath stability

The combination of concentrated dependence and declining confidence creates a latent fragility. As long as markets function and crises are managed effectively, the system appears robust. However, confidence is increasingly contingent rather than unconditional. This configuration differs from earlier periods of dollar dominance, when institutional trust and operational dependence reinforced each other. Today, they increasingly diverge. Such divergence does not guarantee instability, but it increases the system's sensitivity to extreme events.

8.6. Implications for analysis and policy debate

These findings suggest that debates framed in terms of “de-dollarisation” versus “dollar supremacy” risk oversimplification. A more accurate characterisation is incremental adaptation within a structurally rigid system. For analysts, this implies that:

- survey-based evidence should be treated as an early indicator of structural pressure;
- aggregate reserve data should be interpreted with caution; and
- institutional reform should be viewed as a prerequisite for meaningful change.

For policymakers, it implies that credibility, legal predictability, and crisis management capacity remain more important than rhetorical ambition in shaping the future of international currencies.

9. Policy implications

The analysis in this paper has implications for three broad groups of actors: the US as issuer of the dominant reserve currency, the euro area and other jurisdictions seeking to expand the international role of their currencies, and reserve-holding central banks navigating an increasingly complex environment. These implications follow directly from the central finding that the international monetary system is characterised by operational dependence combined with declining institutional confidence.

9.1. Implications for the US

For the US, reserve currency status is often portrayed as a source of privilege: lower borrowing costs, external financing flexibility, and geopolitical leverage. While these benefits remain substantial, the evidence suggests that they are becoming more conditional.

First, institutional credibility has become a core asset. Survey responses indicate that reserve managers increasingly view central bank independence, fiscal governance, and legal predictability as integral to the value of dollar assets. Concerns in these areas do not translate immediately into portfolio shifts, but they shape long-term risk assessments and scenario planning.

From a policy perspective, this implies that:

- safeguarding the operational independence of the Federal Reserve;
- maintaining predictable debt management practices; and
- preserving the integrity of legal and settlement institutions;

are not merely domestic policy choices, but rather components of international monetary stability.

Second, the weaponisation of finance entails trade-offs. The use of sanctions and financial restrictions has reinforced the geopolitical relevance of the dollar, but it has also altered perceptions of neutrality. Reserve managers increasingly treat access to USD infrastructure as a political contingency rather than a given. This does not imply that sanctions should be abandoned. It does imply that their systemic consequences should be considered alongside their immediate objectives.

Third, market functioning matters as much as macroeconomic fundamentals. Episodes of stress in US Treasury markets have drawn close attention from reserve managers. Ensuring the resilience of market-making capacity, repo markets, and clearing infrastructure is central to preserving the dollar's operational advantages.

9.2. Implications for the euro area

For the euro area, the findings point to both opportunity and constraint. The euro is widely regarded as the only currency with the economic scale and institutional foundation to complement the dollar in a meaningful way. At the same time, repeated surveys suggest that its potential remains constrained by structural features rather than by policy communication. Three priorities stand out.

First, safe asset supply. Joint issuance under the Next Generation EU programme has materially improved the availability of high-quality EUR-denominated assets. Extending this framework, or developing a permanent common issuance mechanism, would address one of the most frequently cited obstacles to greater reserve use of the euro.

Second, financial integration. Progress toward a genuine capital markets union remains essential. Fragmented market structures limit liquidity, reduce collateral usability, and complicate large-scale portfolio management by official investors.

Third, institutional clarity in crisis management. While the euro area's crisis toolkit has expanded, its political complexity remains a source of uncertainty for external investors. Clearer, faster, and more predictable mechanisms would strengthen confidence in the euro's ability to function as a systemic reserve currency during periods of stress.

The ECB's evolving stance, framing a stronger international role for the euro as a by-product of financial resilience and strategic autonomy, is broadly consistent with reserve manager preferences. However, credibility will depend on institutional delivery rather than rhetorical ambition.

9.3. Implications for China and other aspiring issuers

For China, the analysis highlights the tension between strategic ambitions and institutional constraint. Internationalising the renminbi would require:

- greater capital account openness,
- improved legal transparency, and
- more predictable regulatory practices.

Each of these steps carries domestic policy trade-offs. Absent such reforms, the renminbi is likely to remain a supplementary reserve asset rather than a systemic alternative.

For other jurisdictions, including Japan, Switzerland, Canada, and Australia, the implication is that their currencies will continue to play niche diversification roles. Structural limits to market size and safe-asset supply constrain their capacity to move beyond this function.

9.4. Implications for central banks

For reserve managers themselves, the findings suggest a redefinition of best practice.

Traditional reserve management frameworks have typically emphasised liquidity, safety, and return. These criteria remain central. However, they are increasingly complemented by geopolitical risk assessment, scenario analysis involving sanctions and market segmentation, and consideration of operational resilience across multiple infrastructures. In practical terms, this implies maintaining diversified liquidity buffers, developing operational capacity to manage assets across jurisdictions, and strengthening internal governance to handle politically sensitive portfolio choices. Importantly, diversification should be understood as risk layering rather than as an attempt to forecast systemic transition.

9.5. A restrained policy message

One final implication concerns the tone of policy debate.

Calls for rapid de-dollarisation, or for deliberate currency rivalry, are unlikely to align with the incentives or constraints faced by reserve managers. They risk underestimating the depth of structural dependence embedded in the system.

A more realistic objective is incremental strengthening of institutional foundations across major currency areas. In this sense, the future of the international monetary system will be shaped less by strategic declarations than by the credibility of legal systems, the resilience of financial markets, and the quality of macroeconomic governance.

10. Conclusions

This paper has examined the evolving position of the dollar in the international monetary system through the lens of reserve manager behaviour, structural market characteristics, and institutional credibility.

Contrary to narratives of rapid de-dollarisation, the evidence points to a system characterised by changes in perception and continuity in outcomes. Survey-based evidence from repeated UBS Reserve Manager Surveys reveals a clear shift in how official investors assess the foundations of dollar dominance. Concerns regarding fiscal sustainability, political polarisation, central bank independence, and the weaponisation of financial infrastructure have become increasingly salient. These concerns now form part of mainstream reserve management discourse.

At the same time, aggregate reserve data continue to show a high degree of concentration in USD assets. This apparent contradiction reflects the structural features that anchor portfolio decisions: market depth, liquidity under stress, collateral usability, legal certainty, and the ability of the US to supply safe assets elastically during crises.

From a practitioner perspective, this combination of declining confidence and persistent dependence is not paradoxical. It is the natural outcome of constrained optimisation in an environment where operational requirements dominate strategic preferences.

From a broader academic perspective, the paper contributes to the literature in three ways. First, it introduces a practitioner-oriented framework for analysing the international monetary system through the interaction of beliefs, intentions, and outcomes, highlighting the different speeds at which perceptions and portfolio allocations evolve. Second, by combining repeated survey evidence with aggregate reserve data, it provides an institutional explanation for the persistent gap between declining confidence in USD and limited portfolio reallocation. Third, it complements existing theories of reserve currency dominance – centred on hegemonic stability, network effects, and global liquidity – by emphasising the operational and governance constraints faced by reserve managers, including liquidity requirements, benchmark effects, reputational considerations, and political oversight.

The evaluation of alternatives reinforces this conclusion. The euro, while institutionally credible, continues to be constrained by incomplete fiscal integration and fragmented capital markets. The renminbi is limited by capital controls and governance concerns. Gold and smaller currencies offer hedging benefits, but lack the scalability required for systemic substitution. Digital assets and central bank digital currencies, for now, address transaction efficiency, rather than the structural foundations of reserve currency status.

Scenario analysis suggests that the most plausible future is one of gradual diversification within a USD-centred system. More radical transitions are possible, but they are likely to be crisis-driven rather than policy-engineered.

The policy implications are correspondingly sober. For the US, reserve currency status increasingly depends on preserving institutional credibility and market functioning rather than on economic size alone. For the euro area and other aspiring issuers, structural reform matters more than strategic ambitions. For reserve-holding central banks, the task is to manage rising geopolitical risk without compromising liquidity and stability.

Taken together, these findings point to an international monetary system that is stable in form, but fragile in confidence. It is stable because the operational infrastructure of global finance remains overwhelmingly dollar-based. It is fragile because trust in the institutions underpinning that infrastructure is no longer unconditional.

In this sense, the system is not undergoing a transition so much as a re-pricing of political and institutional risk.

For practitioners, this implies a prolonged period of cautious adaptation: incremental diversification, greater emphasis on operational resilience, and continuous reassessment of scenarios previously considered remote.

For analysts and policymakers, it implies that meaningful change will emerge not from declarations of currency rivalry or strategic intent, but from the slow accumulation of institutional reforms, market development, and credibility.

Dollar dominance, therefore, is not about to disappear. But it is no longer taken for granted. As I argued in a recent article: *“As Mark Twain might have said, reports of the dollar’s demise are greatly exaggerated. But they’re no longer entirely unfounded either”* (Castelli 2025).

References

- Bahceli, Y. (2025): Fed independence, US rule of law risk, UBS Reserve Managers Survey says. Reuters, 3 July. <https://www.reuters.com/business/finance/fed-independence-us-rule-law-risk-ubs-reserve-managers-survey-says-2025-07-03/>
- Bertaut, C. – Von Beschwitz, B. – Curcuro, S. (2025): The International Role of the USD – 2025 edition. FEDS Notes. <https://doi.org/10.17016/2380-7172.3856>

- BIS (2023): *Annual Economic Report*. Bank for International Settlements. <https://www.bis.org/publ/arpdf/ar2023e.htm>
- Bonini, E. (2025): *Lagarde clarifies on Russian assets: "ECB will help Kyiv, but without violating treaties"*. EU news, 3 December. <https://www.eunews.it/en/2025/12/03/lagarde-clarifies-on-russian-assets-ecb-will-help-kyiv-but-without-violating-treaties/>
- Castelli, M. (2025): *The dollar endures but for how long?*. OMFIF, Commentaries. <https://www.omfif.org/2025/08/the-dollar-endures-but-for-how-long/>
- Castelli, M. (2026): *The Euro opportunity is now: will Europe take it?*. OMFIF, The Bulletin, February.
- Castelli, M. – Gerlach, S. (2020): *Are central banks too risk averse?*. Proceedings of the Seventh Public Investors Conference organized by BIS, Banca d'Italia and Bank of Canada, pp. 23–41. https://www.publicinvestorsconference.com/proceedings/conference_7/EPPIM7_Paper002.pdf
- Castelli, M – Scacciavillani, F. (2012): *The New Economics of Sovereign Wealth Funds*. Wiley Finance. <https://doi.org/10.1002/9781119973478>
- Cohen, B.J. (1998): *The Geography of Money*. Cornell University Press.
- Drezner, D.W. – Farrell, H. – Newman, A.L. (eds.) (2021): *The Uses and Abuses of Weaponized Interdependence*. Brookings Institution Press. <http://www.jstor.org/stable/10.7864/j.ctv11sn64z>
- Eichengreen, B. (2011): *Exorbitant Privilege: The Rise and Fall of the Dollar*. Oxford University Press.
- Eichengreen, B. – Flandreau, M. (2009): *The Rise and Fall of the Dollar (or When Did the Dollar Replace Sterling as the Leading Reserve Currency?)*. European Review of Economic History, 13(3): 377–411. <https://doi.org/10.1017/S1361491609990153>
- European Central Bank (2019–2025): *The international role of the euro*. ECB Annual Reports.
- Farhi, E. – Maggiori, M. (2018): *A model of the international monetary system*. Quarterly Journal of Economics, 133(1): 295–355. <https://doi.org/10.1093/qje/qjx031>
- Farrell, H. – Newman, A. (2019): *Weaponized Interdependence: How Global Economic Networks Shape State Coercion*. International Security, 44(1): 42–79. https://doi.org/10.1162/isec_a_00351

- Feyen, E. – Klingebiel, D. – Ruiz, M. (2024): *Can Crypto-Assets Play a Role in Foreign Reserve Portfolios? Not Today, and Likely Not in the Near Future*. Equitable Growth, Finance and Institutions Insight – Finance. World Bank. <https://doi.org/10.1596/41121>
- Gopinath, G. – Boz, E. – Casas, C. – Díez, F.J. – Gourinchas, P.-O. – Plagborg-Møller, M. (2020): *Dominant currency paradigm*. American Economic Review, 110(3): 677–719. <https://doi.org/10.1257/aer.20171201>
- IMF (2026): *Currency Composition of Official Foreign Exchange Reserves (COFER)*. International Monetary Fund. <https://data.imf.org/en/datasets/IMF.STA:COFER>
- Kindleberger, C. (1973): *The World in Depression*. University of California Press.
- Krugman, P. (1984): *The International Role of the Dollar: Theory and Prospect*. In: Bilson, J.F.O. – Marston, R.C. (eds.): *Exchange Rate Theory and Practice*. University of Chicago Press, Chapter 8. <https://www.nber.org/books-and-chapters/exchange-rate-theory-and-practice/international-role-dollar-theory-and-prospect>
- Mehrling, P. (2010): *The New Lombard Street: How the Fed Became the Dealer of Last Resort*. Princeton University Press. <https://doi.org/10.1515/9781400836260>
- McDowell, D. (2023): *Bucking the Buck: US Financial Sanctions and the International Backlash against the Dollar*. Oxford University Press. <https://doi.org/10.1093/oso/9780197679876.001.0001>
- OMFIF (2025): *Reserve managers see dollar dominance persist, UBS survey*.
- Pozsar, Z. (2014): *Shadow Banking: The Money View*. Office of Financial Research Working Paper No. 14-04. https://www.financialresearch.gov/working-papers/files/OFRwp2014-04_Pozsar_ShadowBankingTheMoneyView.pdf
- Robert Triffin International (2025): *RTI Manifesto: The Triffin Dilemma is at the root of the recurrent financial crises but there is a way to build a new, more efficient, and equitable international monetary system*. https://www.triffininternational.eu/images/2025/RTI-MANIFESTO_March2025.pdf
- Triffin, R. (1960): *Gold and the Dollar Crisis*. Yale University Press.
- UBS Asset Management (2021–2025): *UBS Reserve Manager Survey* (various editions).

Demographic Changes and Human Capital Retention: Rethinking EU Cohesion Policy*

Csaba Zalai 

The paper examines the macroeconomic and regional implications of the EU's demographic transition, with a particular focus on the role of the free movement of labour. It highlights that demographic disparities, exacerbated by population decline and emigration, will weaken the EU's competitiveness and fiscal sustainability in the medium term, while the sustained outflow of human capital will deepen regional inequalities and undermine prospects for economic convergence. The paper argues that the systemic integration of demographic considerations into cohesion policy is key to the EU's long-term economic stability and competitiveness. The 2028–2034 Multiannual Financial Framework provides an opportunity to strengthen policy instruments that support human capital retention and mitigate brain drain. In this regard, the concept of “freedom to stay”, proposed by Enrico Letta, could provide a new policy framework.

Journal of Economic Literature (JEL) codes: F15, J11, J18, J61, O52, R19

Keywords: demographic change, EU Multiannual Financial Framework (MFF), cohesion policy, workforce mobility, territorial effects of the Single Market

1. Introduction

Over the past two decades, demographic transition in the European Union has accelerated to such an extent that natural population decline, ageing and the sustained outflow of human capital have become one of the most critical structural challenges facing the Union's economic and social model. The decline in the working-age population, deepening regional disparities and asymmetric intra-EU mobility adjustment effects constitute a complex set of problems that justify rethinking cohesion policy comprehensively beyond 2027. Addressing this challenge requires an examination of the mechanisms of human capital outflow

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at the Member State and regional levels, including an analysis of intra-EU mobility patterns and their macroeconomic, institutional and social consequences. A deeper understanding of these processes can lay the groundwork for policy measures that help retain the workforce – particularly young people – and strengthen economic and social convergence as well as regional cohesion within the EU.

This paper aims to demonstrate how free movement of labour within the EU can be understood in the context of human capital allocation and fiscal sustainability, with particular regard to the brain drain phenomenon. While mobility within the Union is a fundamental freedom of the Single Market, the analysis argues that it generates asymmetric adjustment processes that contribute to the persistence and deepening of development disparities among Member States. Therefore, the sustained outflow of human capital is not merely a labour market phenomenon, but a systemic challenge that affects growth potential, fiscal stability and social cohesion.

The paper is structured into three main sections. First, it reviews the economic theoretical frameworks of intra-EU mobility and brain drain, paying particular attention to their macroeconomic consequences and structural drivers. Second, it presents the macroeconomic and territorial impacts of the EU's demographic transition, emphasising the demographic and economic vulnerabilities of Central and Eastern European regions and the long-term consequences for economic convergence. Finally, it formulates policy recommendations for the 2028–2034 Multiannual Financial Framework (MFF), with particular regard to the policy application of Enrico Letta's "freedom to stay"¹ concept and the integration of demographic considerations into cohesion policy.

This paper aims to contribute to the development of EU policy responses to demographic challenges, while also demonstrating how cohesion policy could simultaneously support economic convergence, territorial equity and the retention of human capital.

2. Theoretical perspectives on intra-EU labour mobility and brain drain

Free movement of labour is one of the fundamental freedoms of the Single Market and a key driver of EU integration. However, a growing body of research indicates that internal migration can result in uneven regional growth and fiscal impacts, posing a persistent structural challenge, particularly for less developed regions. The outflow of human capital, and particularly brain drain – the sustained outflow of highly skilled workers – is primarily driven by wage differentials, more favourable career opportunities and quality-of-life factors. In recent decades, this phenomenon

¹ In discussing this concept, Letta uses two expressions, "freedom to stay" and "right to stay", in relation to fundamental EU rights and EU law.

has become a systemic economic and demographic challenge, receiving significant attention in academic and policy discourse. The literature primarily focuses on labour flows from less developed countries to more developed ones, paying particular attention to the labour market, innovation, and demographic and competitive impacts on both sending and receiving countries (*Docquier – Rapoport 2011*).

According to classical human capital theory, the mobility of skilled labour is an individual investment decision aimed at maximising lifetime earnings, i.e. the total income earned over a working lifetime (*Sjaastad 1962; Borjas 1987*). At the macroeconomic level, labour mobility improves allocative efficiency by utilising the workforce where its marginal productivity is highest, in line with neoclassical convergence models (*Barro – Sala-i-Martin 1992*). At the same time, human capital is a key factor of production in endogenous growth models, supporting innovation and long-term growth through positive externalities (*Romer 1990; Lucas 1988*).

From the perspective of sending countries, however, the loss of human capital generates significant negative externalities. Emigration of the working-age population, particularly high-value-added workers, slows productivity growth and weakens innovation activity, especially given limited research and development capacities (*Docquier–Rapoport 2011*). The distortion of the demographic structure – the decline in the proportion of the working-age population – narrows the tax and contribution base while increasing age-related public expenditure. A sustained outflow of human capital undermines the social return on public services, particularly state-funded higher education, since the costs are borne by the sending country, while the added value and tax revenues are realised in the receiving countries. This process thus affects both economic growth and fiscal sustainability.

At the same time, however, the literature points out that brain drain can also generate positive feedback mechanisms under certain conditions. For example, remittances can increase consumption and foreign exchange reserves, while return migration and diaspora networks can facilitate the transfer of knowledge and technology, expand trade relations and encourage the inflow of working capital. The findings of *Faini (2007)* support this, as he demonstrated that highly skilled immigrants typically send larger remittances, thereby strengthening the income and investment positions of their countries of origin. According to the “brain gain” hypothesis, the prospect of mobility can stimulate the accumulation of human capital (*Beine et al. 2008*), while New Economic Geography approaches emphasise the networked nature of knowledge flows (*Krugman 1991*). However, the extent to which these positive effects are realised depends heavily on institutional quality and the predictability of the economic policy environment (*Chen et al. 2024*).

The structural drivers of brain drain stem from the interplay between factors that encourage emigration (push factors) and those that attract immigration (pull

factors). Push factors are primarily found in economically weaker countries and include high unemployment, underfunded education and research sectors, limited opportunities for advancement, uncompetitive wages and poor working conditions. These issues are often compounded by corruption, a lack of trust in institutions and political instability. This creates an environment in which young, educated workers in particular see no long-term professional prospects, leading them to leave the country (*Bodnár – Szabó 2014*). By contrast, pull factors are concentrated in more developed countries, where favourable labour market conditions, a higher standard of living, competitive wages, a predictable institutional environment and well-funded research infrastructure are available. Emigration thus appears as a rational life-course strategy if the benefits outweigh the cultural and emotional costs of leaving one's home country (*Beine et al. 2011*).

Despite the growing political significance of labour mobility, comprehensive analyses of its economic impacts remain limited, particularly at the EU level. A significant proportion of research has examined the budgetary impact of immigration, often yielding mixed empirical results. According to *OECD (2021)* estimates, the net fiscal contribution of foreign-born immigrants typically ranged from –1 to +1 per cent of GDP between 2006 and 2018, with variations mainly stemming from the age structure of immigrants.

One distinctive feature of the EU is that there are few institutional barriers to mobility, meaning that the flow of human capital primarily takes place between Member States. While this process may improve efficiency at the EU level, it can generate asymmetric costs and benefits at the Member State level, which may result in persistent regional inequalities. In peripheral, demographically declining regions, brain drain can lead to structural labour shortages and a growth trap. In the longer term, this weakens convergence processes and undermines the foundations of cohesion within the European integration (*Committee of the Regions 2020*).

Overall, brain drain within the EU is a multidimensional economic and social phenomenon affecting growth potential, fiscal sustainability and cohesion. Addressing this requires an integrated approach to growth and fiscal policy that also takes into account interactions with demographic trends.

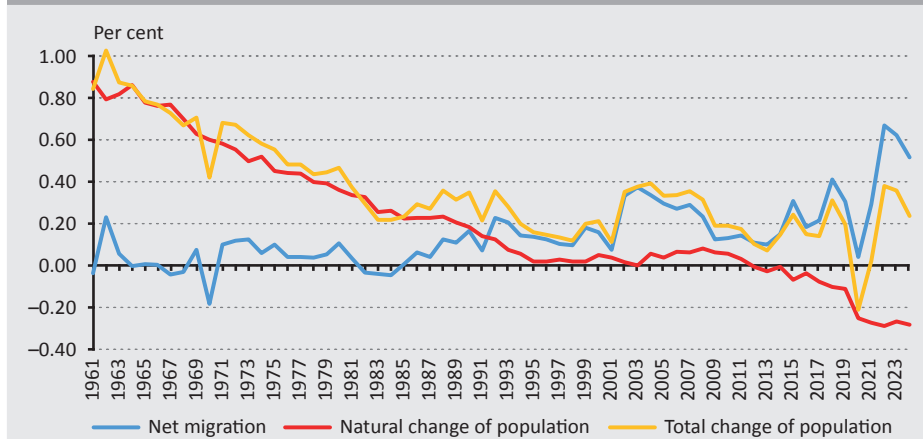
3. Main macroeconomic effects of demographic change in the EU

Developed countries, including EU Member States, have undergone profound demographic change in recent decades, characterised by a sustained decline in fertility rates and an increase in life expectancy. Consequently, many Member States have begun to experience a decline in their natural population, and the ageing of society has accelerated. In the EU, natural population growth has steadily declined since the 1960s, turning permanently negative in 2012 (*Figure 1*), which indicates

the structural nature of the population decline. At the same time, the importance of migration has grown: while its contribution was modest until the 1990s, it has become a key factor in population change since the 2000s. However, according to projections by the UN and Eurostat, immigration from outside the EU will not be sufficient to offset natural population decline in the long term. The EU's population is expected to decline by 3.8 per cent by 2070 (*Eurostat 2023*), while the global population could grow by around 29 per cent.² The temporary population decline observed in 2020–2021 – the first since World War II – could thus become a lasting demographic trend, unless comprehensive policy responses are implemented.

These trends will have a significant influence on the EU's global standing, given that its ability to assert its interests internationally continues to depend heavily on its demographic and economic clout. In the current geopolitical environment, which is characterised by great power competition, the need to secure critical raw materials and the growing importance of technological sovereignty, this factor has once again become more significant. Therefore, in the longer term, the EU's sustained population decline may diminish its global economic and political weight, as well as its influence in key international forums such as the G7 and the G20.

Figure 1
Change of population in the EU-27 and the main factors (1961–2024) (as percentage of total population)



Source: Authors' calculations based on Eurostat data (https://ec.europa.eu/eurostat/databrowser/view/demo_gind__custom_12724987/default/table. Downloaded: 10 March 2026.)

² <https://population.un.org/wpp/Download/Standard/MostUsed/>. Downloaded: 6 March 2026.

At the same time, the economic consequences of demographic change extend far beyond the reduction in geopolitical leeway. Population decline and ageing societies directly impact the labour market, productivity, the sustainability of public finances and the financial viability of welfare systems. This is why demographic trends have become one of the EU's economic model's key structural challenges (*Halmai 2014, 2018*). The greatest economic risk stems from the sustained decline in the working-age population (those aged 20–64).³ According to projections, this age group will shrink from 263 million to 223 million between 2022 and 2070, a decrease of over 15 per cent (*European Commission 2024a*). This process will fundamentally reshape the traditional sources of growth. Although an increase in the employment rate may mitigate the effects of a shrinking labour force to some extent, the trend indicates persistent labour shortages and rising costs, while changes in the age composition of the workforce may hinder productivity growth. For the first time in the EU's history, GDP growth will not be driven by an increase in the size of the labour force (*Draghi 2024*). According to current projections, the EU's annual GDP growth will average around 1.3 per cent between 2022 and 2070, while the direct contribution of the labour force will be negative (*European Commission 2024a*).

Therefore, future growth must be primarily based on innovation and technological progress, despite the EU gradually falling behind in these areas over the past few decades. Disparities in education, a key factor in productivity and competitiveness, clearly illustrate the scale of the challenge. In 2021, for example, EU spending on education accounted for just 4.4 per cent of GDP, lagging behind the figures for the United Kingdom (6.2%), the United States (5.8%), and South Korea (5.2%) (*OECD 2024*). A significant gap also exists in terms of research and development spending: the EU's R&D-to-GDP ratio was 2.1 per cent in 2024, compared to 2.7 per cent in the United Kingdom, 3.4 per cent in the United States, and 5.1 per cent in South Korea.⁴ Patent activity also lags behind that of global technology leaders, indicating a sustained weakening of knowledge-based competitiveness. This could all slow the accumulation of human capital and limit the effectiveness of economic policy responses to demographic challenges.

The effects of demographic changes extend beyond labour market and growth issues. Ageing societies also influence saving behaviour, investment patterns and entrepreneurial activity. The risk-averse portfolio choices and lower propensity to invest of older age groups dampen economic dynamism. The fiscal implications of ageing are significant as well: on average, the proportion of people aged 65 and over

³ While the working-age population is traditionally defined as individuals aged 15–64, the European Union usually uses the 20–64 age group as its primary benchmark. This approach improves the comparability of employment indicators between Member States, since a significant proportion of 15–19-year-olds are still in full-time education.

⁴ <https://www.oecd.org/en/data/datasets/main-science-and-technology-indicators.html>. Downloaded: 17 May 2026.

in the EU will rise from 21.2 per cent in 2022 to 30.5 per cent by 2070, while the old-age dependency ratio will increase from 36.1 per cent to 59.1 per cent. Ageing-related expenditure – pensions, healthcare and social benefits – as a percentage of GDP could rise from an average of 24.4 per cent in 2022 to 25.6 per cent by 2070 (*European Commission 2024a*),⁵ putting sustained pressure on national budgets. However, the trend in these costs varies significantly between Member States. The largest increases are expected in Luxembourg (10.7%), Malta (8.6%), and Slovakia (6.1%), while a decrease in spending is projected in Latvia (–1.9%), Italy (–2%), and Greece (–2.4%). Since pension and social security systems rely on taxes and contributions linked to earned income, a shrinking working-age population directly threatens government revenue sustainability. This is particularly critical in countries with high public debt, where fiscal manoeuvring space is limited. Demographic trends therefore pose a risk to macroeconomic stability and addressing them will be among the economic policy priorities of the coming decades.

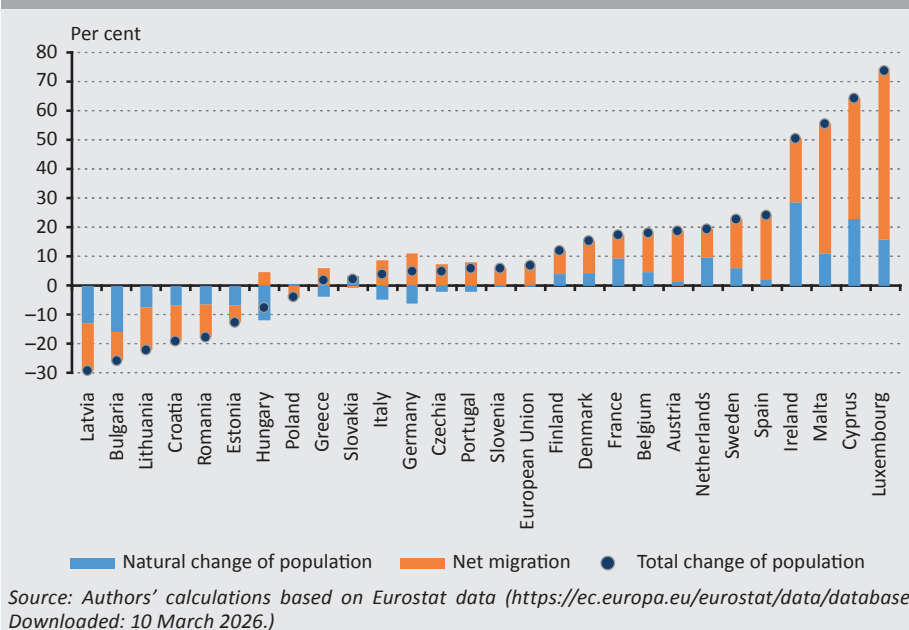
4. Economic and demographic implications of intra-EU mobility

While the EU as a whole is facing serious demographic challenges, disparities between and within Member States are further exacerbating structural risks. Low and declining fertility rates are common in developed economies, yet significant variations can be observed within the EU. According to data from 2024, Bulgaria (1.72) had the highest total fertility rate, while Malta (1.01) had the lowest; the EU average was just 1.34.⁶ This falls significantly short of the replacement level of 2.1, foreshadowing substantial labour market and fiscal adjustment pressures in the medium term. In this context, there are also marked differences in natural population change. Between 1990 and 2023, natural population growth was consistently negative in nearly half of EU Member States. Bulgaria, Latvia and Hungary experienced the largest declines (*Figure 2*), while Ireland, Cyprus, Luxembourg, and Malta showed the strongest natural population growth.

⁵ It should be noted, however, that the Commission's forecast is based on several overly optimistic assumptions. For example, it assumes that the EU's average fertility rate will rise from 1.53 in 2021 to 1.62 by 2070. However, this is not supported by current trends, given that the rate fell to 1.38 in 2023 and to 1.34 in 2024. Based on this, it is likely that the fiscal costs of ageing will increase more sharply than projected by the Commission in the future.

⁶ <https://ec.europa.eu/eurostat/databrowser/view/tps00199/default/table?lang=en>. Downloaded: 29 May 2026.

Figure 2
Natural change of population and net migration in Member States (1990–2023)
(as percentage of total population in 1990)



In Central and Eastern Europe, natural population decline and population ageing have been exacerbated by persistently negative net migration, primarily due to the emigration of young, highly skilled workers. Only Slovenia, the Czech Republic and Slovakia avoided significant population decline, while Latvia (−29.5%), Bulgaria (−26.1%), Lithuania (−22.3%), Croatia (−19.3%), Romania (−17.8%) and Estonia (−12.3%) recorded significant declines.⁷ Hungary and Poland showed more moderate declines at −7.5 per cent and −3.7 per cent, respectively. In Hungary's case, positive net migration – partly due to immigrants of Hungarian ethnicity arriving from neighbouring countries – partially offset the natural population decline. By contrast, favourable natural population change and a positive net migration balance resulted in population growth in several Western, Northern and Southern European Member States. In Germany, Greece, Italy and Portugal, immigration offset natural population decline, playing a decisive role in maintaining demographic balance.⁸

⁷ https://ec.europa.eu/eurostat/databrowser/view/demo_gind__custom_12724987/default/table. Downloaded: 10 March 2026.

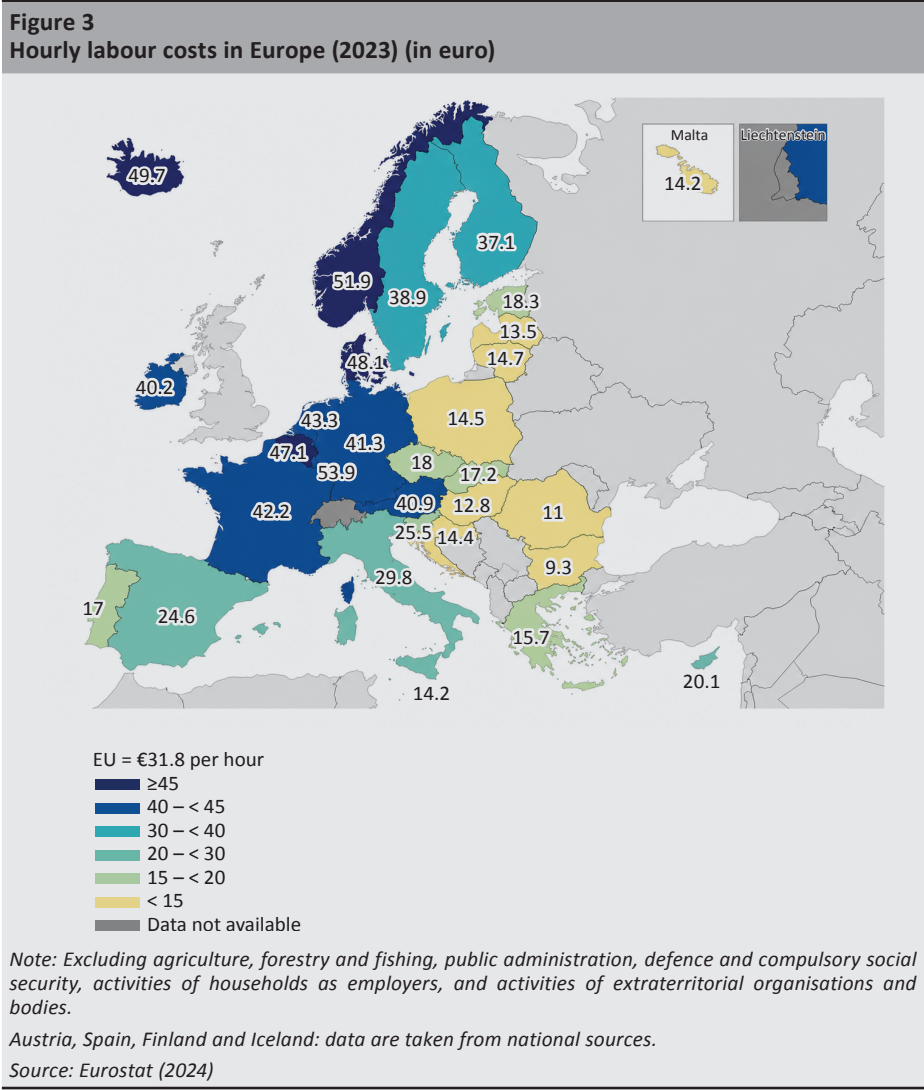
⁸ It should be noted that positive net migration in Western, Northern and Southern Europe was largely due to immigration from outside the EU. While this adds a layer of complexity to the overall picture, it does not change the fact that intra-EU mobility has led to uneven territorial outcomes. This is particularly evident in Central and Eastern Europe, where negative net migration is predominantly driven by emigration to other EU Member States.

Although free movement of people is one of the most significant achievements of European integration, intra-EU mobility has led to a substantial outflow of highly skilled workers from less developed Member States and regions. This has further widened disparities in development and labour markets, strengthening the economic position of host countries in the process. In 2024, 13.9 million EU citizens were living in another EU country, accounting for 3.1 per cent of the EU's total population (*Eurostat 2025*). Seven Member States accounted for 84 per cent of intra-EU mobility: Germany (4.4 million), Spain (1.8 million), France (1.6 million), Italy (1.4 million), Belgium (1 million), Austria (0.9 million) and the Netherlands (0.8 million). This clearly illustrates the concentration of countries to which people migrate. Among immigrants arriving from other EU Member States, the proportion of working-age individuals is particularly high in Germany and Italy (78% and 75%, respectively), while it is lower in Austria and Spain (both 70%) and significantly lower in Belgium and France (67% and 58%, respectively) (*European Commission 2025*). Accordingly, immigration to Germany and Italy may contribute more significantly to GDP growth, whereas in Belgium and France, the higher proportion of older adults is likely to stimulate consumption rather than production.

Mobility also reveals significant disparities in terms of population share. For example, 36.5 per cent of Luxembourg's population are citizens of other EU Member States, compared to 10 per cent in Cyprus and Austria, 8.4 per cent in Belgium, 7.8 per cent in Malta, 6.7 per cent in Ireland, 5.3 per cent in Germany, and 4.5 per cent in Denmark. By contrast, the inflow is negligible in Central and Eastern European Member States: Poland and Lithuania (both 0.1%), Latvia (0.2%), Romania (0.3%), Bulgaria (0.4%), Croatia (0.5%), Slovakia (0.7%), and Hungary (0.9%). Emigration, however, paints a different picture: Romania leads the EU in both absolute (3.1 million people) and relative (16.1%) terms, followed by Croatia (14.6%), Bulgaria (11.5%), Estonia and Lithuania (both 5.3%), Latvia and Slovakia (both 5.2%). Overall, the 11 Central and Eastern European Member States account for more than one-half of EU citizens living in other EU Member States, despite making up barely one-fifth of the EU population.

Intra-EU mobility is characterised primarily by east-to-west and, to a lesser extent, south-to-north labour migration, which results in significant reallocation of human capital across the Union. While this process is facilitated by the institutional framework underpinning the free movement of workers, it is primarily driven by economic disparities between Member States and migrants' social networks. Migration decisions are influenced by income differentials (*Figure 3*) and the concentration of employment opportunities in more developed Member States (*European Commission 2024b*). The demographic and educational profile of migrants further reinforces these trends. In 2024, for example, 57 per cent of working-age EU citizens residing in another Member State were aged 20–34, compared to just 43 per cent of the host country population. Furthermore, the employment rate of these mobile EU citizens (78%) was higher than that of the native population (76%) (*European Commission 2025*).

These developments suggest that, while the Single Market and the free movement of persons have created more opportunities for EU citizens, they have also exacerbated economic and demographic imbalances within the Union. The sustained outflow of young, highly skilled workers undermines the long-term growth potential of sending countries, reducing productivity and weakening the quality of public services while posing challenges to fiscal sustainability. Over time, this process may generate a negative spiral whereby human capital losses further deteriorate development prospects and trigger further waves of emigration. Consequently, the outflow of human capital directly exacerbates social and territorial disparities across the EU and undermines the Union’s cohesion objectives.



In peripheral, ageing regions, the outflow of young, skilled workers exacerbates demographic decline and can result in lasting structural deficits, threatening the long-term survival of local communities. If skilled workers continue to leave these regions permanently, a structural duality may emerge, whereby Western and Northern European regions primarily benefit from innovation and economic growth, while other regions – including several in Hungary – are permanently relegated to the periphery.

Addressing these issues requires a comprehensive European demographic and development policy that links cohesion policy with targeted development tools in Member States and regions particularly affected by emigration. A multi-level governance approach can help retain talent and mitigate the adverse effects of brain drain while enabling solutions to be developed that are based on local conditions. To achieve these goals, spatial, area-based policy instruments are required to ensure competitive career and life prospects, even in less developed regions. Mitigating brain drain is therefore not only an economic policy task, but also a key issue for the institutional and social resilience of European integration.

Ensuring equal opportunities for all European citizens, regardless of where they live, is of fundamental importance for the future of the Union. To achieve this, we must address the adverse regional consequences of the free movement of people. A shift in mindset is needed: one that does not restrict mobility, but makes it a genuine choice rather than a necessity. The concept of “freedom to stay” offers a new approach in this regard, as it could enable people living in less developed regions to find realistic life and career prospects locally.

5. Single market challenges and the recommendations of the Letta report

Since 1993, the Single Market has been a central pillar of European integration, ensuring the free movement of goods, services, people and capital. While this framework has significantly expanded cross-border opportunities for citizens and businesses, the crises of recent decades – from the global financial crisis of 2008 and the COVID-19 pandemic to the economic consequences of the war in Ukraine – have highlighted the Single Market’s structural limitations and the risks of fragmentation. In its communication marking the 30th anniversary of the Single Market, the European Commission identified several obstacles, including uneven enforcement of rules, persistence of national barriers, insufficient coordination in responses to the challenges of climate change, energy transition and digitalisation, and persistent

competitiveness difficulties faced by small and medium-sized enterprises (SMEs) (*European Commission 2023a*).

To address these issues, the European Commission asked Enrico Letta, a former Italian prime minister, to prepare a comprehensive expert report. Entitled “Much More Than a Market” (*Letta 2024*), the document begins by acknowledging that, although the Single Market is one of the EU’s most successful achievements, it is currently unable to effectively address the global and geopolitical challenges of the 21st century. According to Letta’s analysis, the Single Market suffers from profound structural deficiencies that limit business growth, undermine the effectiveness of strategic investments and hinder the EU’s global competitiveness. The report proposes a comprehensive reform package, including the introduction of a new “fifth freedom” to facilitate the cross-border mobility of knowledge and research, the creation of a Savings and Investment Union to mobilise private capital, and deeper integration in strategic sectors such as defence, energy and space policy.

This paper focuses on Letta’s concept of the “freedom to stay,” which can be interpreted as a complement to the approach centred on mobility. Although the free movement of people is one of the cornerstones of integration, Letta argues that this freedom does not constitute a genuine choice for all regions. In many disadvantaged regions, mobility is more of a necessity for young, skilled workers, as there are structural barriers to remain and prosper in their home regions. Mobility has increased unevenly across regions: certain areas of Southern Europe and in particular Central and Eastern Europe have become major sources of emigration. Consequently, several regions have fallen into the so-called “talent development trap,” where, despite investing in human capital development, they are unable to retain skilled workers.

According to Letta, the “freedom to stay” is not an alternative to mobility within the EU, but rather a complement to it. It is aimed at making remaining (in one’s home region) a realistic and attractive option for citizens. This requires targeted policy measures, particularly in the Union’s peripheral regions, where emigration stems from deep-rooted structural causes. From a scientific and policy perspective, the initiative aims to address the complex mechanisms of regional imbalances and demographic decline. It emphasises that mobility can only be considered a true freedom if staying is also an equivalent choice.

Letta’s proposal urges policymakers to view intra-EU mobility not as a positive development in and of itself, but rather as a right that forms part of the concept of freedom – a right that only achieves its full meaning when remaining and prospering

in one's home region is also a genuine alternative. The report sets out several policy recommendations:

- *Targeted cohesion funding for economically declining regions:* Regional disparities have persisted and many peripheral regions have fallen into a development trap characterised by low growth, deteriorating public services and demographic decline. Cohesion policy must provide these regions with more focused support, particularly in areas critical for retaining human capital, such as education, vocational training, research and development, innovation, public services, housing and infrastructure.
- *A system of indicators suitable for measuring “the freedom to stay”:* Letta proposes developing a comprehensive system of indicators to objectively measure the extent to which a region can offer a genuine alternative to emigration. This would take into account factors such as employment opportunities, the quality of public services, the development of digital and physical infrastructure, social cohesion and the cohesive power of local communities (i.e. their ability to foster a sense of belonging).
- *Decentralised development of local innovation and entrepreneurial ecosystems:* Research and development, as well as start-up ecosystems, are currently concentrated in major urban centres, exacerbating regional disparities. Letta argues that the EU should encourage the territorial diversification of these structures to integrate peripheral regions into the innovation chain.
- *Multi-level governance and capacity building:* Disadvantaged regions often have weak administrative capacities, hindering the effective use of EU funds. Letta therefore recommends building the capacity of local and regional actors, as well as strengthening cooperation at the EU and national levels. Policy measures must be tailored to the specific challenges faced by regions in order to avoid an ensuing downward spiral of development.
- *Encouraging circular migration and return:* If the possibility of return exists, emigration does not necessarily entail a permanent loss. Letta therefore proposes incentive programmes for returning professionals, including targeted scholarships, start-up grants and administrative reintegration support.
- *Rethinking the balance between mobility (moving) and staying:* The “freedom to stay” should be incorporated as a horizontal principle into regional development, education, digitalisation and migration policies. Digitalisation plays a key role in ensuring that social mobility is not dependent on physical mobility. However, the digital divide, particularly in rural areas, remains a significant barrier, therefore

targeted investments in infrastructure, energy supply and the development of digital skills are needed.

Letta's initiative represents a paradigm shift, offering not a restriction on mobility but realisation of the freedom of choice. The goal is to ensure that, alongside free movement, staying is also a real and sustainable option. This approach reinterprets the Single Market as an instrument of social and territorial cohesion, not merely as an economic tool. It prioritises the integrated development of resilience, local capacity building and demographic adaptability, going beyond traditional redistributive logic. Therefore, a strategic rethink of cohesion policy beyond 2027 is essential, as the "right to stay" is not only a social expectation, but also an economic and political necessity that could serve as one of the main pillars of the EU's long-term sustainability and legitimacy.

6. Growing demographic dimension of EU Cohesion Policy

Cohesion policy is one of the cornerstones of European integration, aimed at strengthening economic, social, and territorial cohesion, particularly by helping the most disadvantaged regions to develop. Over the past few decades, this policy has evolved from an initial focus on redistribution into a complex set of development policy tools, with an increasing focus on the strategic goals of the green and digital transitions, competitiveness and social inclusion. Although cohesion policy has become more performance-oriented during the programming periods, its original purpose of mitigating territorial inequalities arising from the Single Market remains central. As early as the 1980s, Jacques Delors, former Commission President, emphasised that market integration alone does not guarantee balanced development since economic activity is inevitably concentrated in a few strong urban regions while peripheral areas may be excluded from growth (*Jouen 2017*). Therefore, as Delors put it, the Single Market and cohesion policy are "two sides of the same coin": while the former is the engine of economic development, the latter ensures that its benefits are distributed fairly both geographically and socially.

Nevertheless, demographic challenges such as population decline, an ageing population and the emigration of young, skilled workers have long received limited attention in cohesion policy. This is particularly noteworthy given that Commission discussion papers and proposals for addressing demographic issues at the EU level emerged as early as the late 1980s (*Zalai 2024*). This is due to significant regional variation in demographic trends and the fact that related policy areas, such as family policy, education and social welfare, remained largely within the competence of

Member States. In recent years, however, demographic issues have featured more prominently in EU debates, creating new opportunities for the further development of cohesion policy.

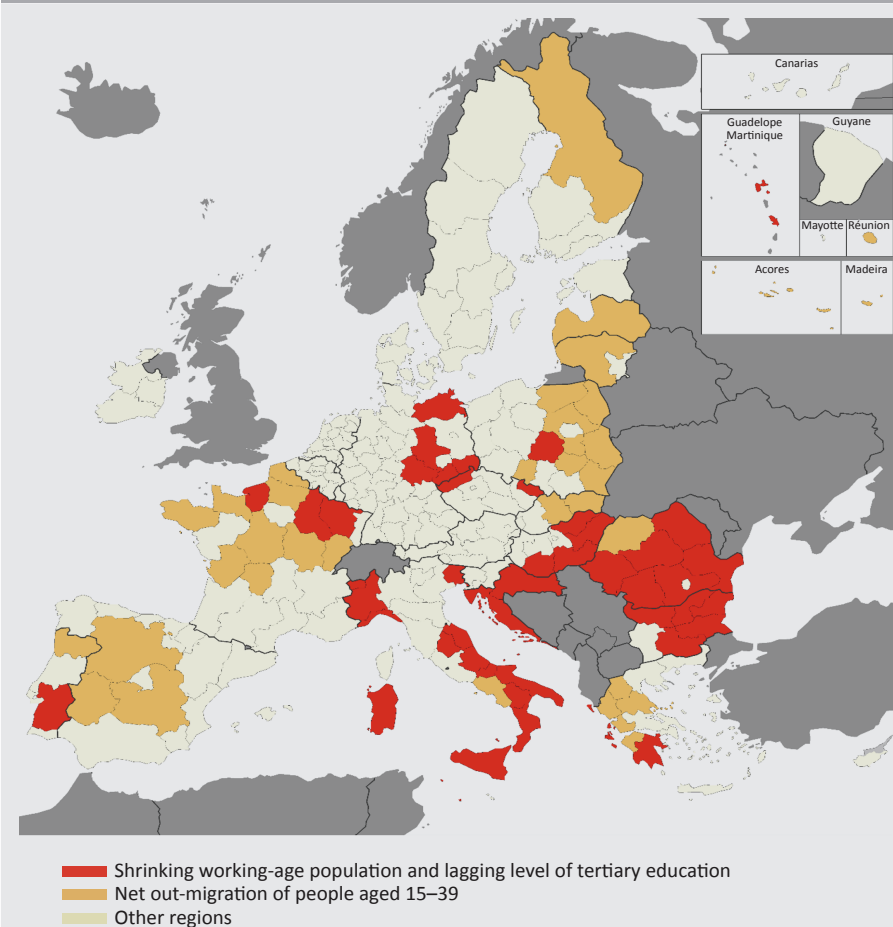
The first substantive attempt to integrate demographic considerations at a systemic level occurred during the 2021–2027 Multiannual Financial Framework.⁹ Following the 2015 migration crisis, the Commission proposed a special financial incentive for regions where a significant proportion of population growth was due to migration from outside the EU. These regions received EUR 405 per migrant annually to support their integration (*European Council 2020*). However, this approach primarily affected Western and Northern European Member States, and it failed to address the causes of demographic decline within the EU.

At the same time, primarily at the initiative of the Baltic States, a targeted support component was incorporated for those Member States where the population had declined by more than one per cent annually between 2007–2009 and 2016–2018. The amount of compensation was set at EUR 500 per person, based on the total population decline (*European Council 2020*). While this provided partial compensation for the structural disadvantages arising from the loss of human capital, its implementation was fragmented due to the absence of a unified strategic framework.

The most significant step forward was the Commission's January 2023 communication, entitled "Harnessing Talent in Europe's Regions" (*European Commission 2023b*). This document was the first at the EU level to recognise that demographic changes, particularly population decline, ageing and the outflow of skilled labour, directly exacerbate territorial inequalities and threaten EU cohesion. The Commission introduced the concept of the "talent development trap," referring to regions where a declining working-age population, low rates of higher education attainment and out-migration of young people persistently undermine development potential. While the analysis primarily focused on the urban-rural development gap, the Commission acknowledged that peripheral regions, particularly in Central, Eastern and Southern European Member States, were disproportionately affected.

⁹ In the 2014–2020 Multiannual Financial Framework, the category of sparsely populated areas was incorporated into the EU cohesion policy framework. These territories are characterised by low population density and persistent demographic decline. While this category could have been used to address the structural challenges associated with population loss, it was primarily introduced to improve the net budgetary positions of the initiating Member States, Sweden and Finland, rather than for demographic reasons.

Figure 4
Regions in a talent development trap (NUTS 2 level)



Note: The EU has developed a classification known as nomenclature of territorial units for statistics (NUTS), which divides each Member State into three levels. Under the latest classification, there were 92 major socio-economic regions (NUTS 1); 244 basic regions (NUTS 2); and 1,165 small regions (NUTS 3) in the EU in 2024. The NUTS framework plays a fundamental role in the allocation of EU funds and in the design and implementation of regional development policies.

Source: European Commission (2023b:5)

According to the EU's assessment, 46 regions – accounting for around 16 per cent of the EU's population – are currently in such a trap, while another 36 regions (representing around 13 per cent of the EU's population) are at risk of falling into one over the medium term (Figure 4). While more complex theoretical models for identifying regional development traps do exist (Diemer *et al.* 2022), the Commission's policy shift has created a new conceptual framework underpinning EU

interventions aimed at retaining human capital. In November 2023, the Commission launched the Talent Development Mechanism, building on existing EU funds and policy instruments to provide targeted support to regions affected by demographic decline and brain drain. The mechanism aims to retain, attract and develop human capital, as well as reduce territorial disparities.

However, the EU's demographic responses continue to be implemented within a fragmented policy framework. While the Talent Development Mechanism and the Demographic Toolbox¹⁰ (*European Commission 2023c*) are steps in the right direction, a comprehensive, long-term EU demographic strategy is still lacking. In light of all this, it is essential that the demographic dimension is integrated horizontally and at the systemic level into post-2027 cohesion policy, and not merely considered as a statistical factor, but as a priority in its own right. Population decline, ageing, the emigration of young people and the regional concentration of human capital are profound processes that directly threaten the Union's territorial cohesion. Therefore, addressing these issues requires region-specific policy responses.

In order to address these challenges, it is crucial to develop an integrated, proactive and region-specific EU demographic strategy that recognises demographic change as an opportunity for structural development, not just a problem. Numerous studies have shown that increasing the volume of subsidies is not the solution; instead, a qualitative rethinking of policy instruments is needed. Rather than taking a traditional, welfare-oriented, supply-driven approach, policies sensitive to the specific structural characteristics of regions are needed. The success of this approach hinges on skills development, promoting innovation and entrepreneurial activity, and consistently managing institutional distortions (*Rodríguez-Pose 2018; Iammarino et al. 2019*).

This shift in perspective could enable future cohesion policy to operate not just on a compensatory basis, but also according to a preventive and capacity-building logic. The focus of cohesion policy must be recalibrated, as current Commission initiatives lack independent financing mechanisms and institutional embeddedness. One of the key issues for the 2028–2034 programming period will therefore be to ensure that the “talent development trap” emerges as a distinct intervention axis with dedicated financial instruments and targeted programming. Only such a strategic shift can ensure that addressing demographic transition becomes one of the cornerstones of cohesion policy in the post-2027 period, guaranteeing the possibility of sustainable development and social cohesion for all EU regions.

¹⁰ The Demographic Toolbox aims to compile best practices from Member States and link them to existing EU programmes and resources. This facilitates flexible yet coordinated policy responses to diverse demographic challenges (*Pape – Széchy 2024*).

7. Embedding demographic objectives in post-2027 cohesion policy

In recent years, several comprehensive studies and policy proposals regarding how EU cohesion policy should be reformed to respond more effectively to the EU's structural challenges have emerged in both the international and domestic literature (Busse *et al.* 2025; Schwab 2024). However, the Commission's proposal for the 2028–2034 Multiannual Financial Framework, published in July 2025, fails to address demographic risks at a systemic level. In fact, it suggests the removal of cohesion funding as a distinct category. This approach would pit regions against other EU policies, such as those relating to agricultural, migration or climate, thereby weakening the original convergence function of the Structural Funds. As negotiations are not expected to conclude until late 2027, there is a real opportunity for demographic considerations to be permanently and institutionally integrated into the future cohesion policy framework. This is of particular importance for Hungary in terms of the practical implementation of the “freedom to stay” and the “talent development trap.” We therefore set out a few policy recommendations below:

- *Establishment of a compensation mechanism for the most affected regions:* The EU should develop a targeted compensation mechanism to support regions affected by population decline, emigration and the loss of human capital. In this context, it may be appropriate to create a separate instrument which, alongside the European Social Fund and the Cohesion Fund, would offset the negative effects of human capital loss and fund programmes that encourage people to remain in their local communities. Support could be distributed based on the concept of the “talent development trap”. At the same time, this approach must be fine-tuned in order to take into account demographic and developmental differences among Member States and regions. Waiving the co-financing requirement and adopting more flexible state aid rules could strengthen solidarity among Member States and distribute the socio-economic costs of mobility more equitably. This could substantially support the strengthening of long-term demographic resilience, particularly in peripheral, depopulating and ageing regions.
- *Incorporating demographic criteria into EU funding policy:* The allocation of structural funds should be reformed to better reflect the EU's demographic challenges. This should include incorporating demographic impact assessments into the allocation system of the European Structural and Investment Funds, as well as giving greater weight to demographic indicators such as natural population decline, emigration and the ageing index. Regions facing persistent population decline require long-term, targeted support, as demographic decline simultaneously threatens economic sustainability and social cohesion. Consideration of demographic factors must extend beyond cohesion policy.

Reducing the innovation gap is essential for mitigating development disparities between regions. Therefore, the Horizon Europe programme should provide targeted support for regions with weaker research capacities. This can complement the principle of excellence and help to build competitive research ecosystems, thereby mitigating brain drain. However, funding alone is insufficient; there is also a need for tailored technical support, capacity-building programmes and long-term institutional partnerships between leading research centres and emerging centres of excellence. Coordinating cohesion, research and development policies can create synergies that simultaneously strengthen the EU's competitiveness and territorial cohesion.

- *Targeted reintegration programmes to encourage professionals who have emigrated to return:* The return of skilled professionals who have left the country can have a significant impact on the economy and innovation. To capitalise on this potential, the EU should develop reintegration programmes offering financial, administrative and professional incentives to returnees, such as tax breaks, targeted start-up grants and preferential access to venture capital. Simplifying the recognition of qualifications could accelerate reintegration into the labour market, while involving returnees in regional innovation hubs could strengthen the local economy's diversification and resilience. Such programmes can therefore be a cost-effective means of mitigating demographic decline, particularly when integrated into cohesion and research and development policies, ensuring that every region can contribute to Europe's future.
- *Strengthening Smart Specialisation Strategies (S3):* To reduce disparities in regional innovation capacities, the EU should strengthen the implementation of Smart Specialisation Strategies. This area-based approach enables regions to develop dynamic innovation ecosystems that generate quality employment and sustainable growth by building on their own resources. Support should be provided for developing regional innovation hubs that build on existing industrial, scientific and cultural resources, particularly in sectors such as agricultural technology, renewable energy and digital services. Cooperation between universities, research institutes and businesses – particularly in green technology and digital health – can accelerate technology transfer and strengthen competitiveness. Research shows that regions which consistently implement the S3 strategy achieve higher innovation performance and more vibrant entrepreneurial activity (*Kelchtermans et al. 2021*), which helps to retain and attract talent, particularly in peripheral and structurally disadvantaged regions.

8. Summary and conclusions

Although the European Union as a whole is facing significant demographic challenges, these adverse trends are further exacerbated by the marked structural differences between Member States and regions. Population decline primarily affects Central, Eastern and Southern Member States, as well as rural areas, where the sustained emigration of young, skilled workers is accelerating demographic decline. Although the free movement of persons is a cornerstone of integration, it has resulted in asymmetric adjustment pressures, leading to persistent structural lag in several regions, including Hungary. This deepens territorial inequalities and threatens the EU's long-term competitiveness and social stability. Mitigating the brain drain and addressing the negative externalities arising from mobility are therefore key policy priorities. Enrico Letta's "freedom to stay" initiative offers a new approach to this issue by creating real opportunities for residents of less developed regions to thrive locally, while still allowing them to benefit from the free movement of persons. Implementing this will require a strategic rethink of cohesion policy beyond 2027, paying particular attention to the persistent structural problems of regions affected by emigration.

However, in order to be credible and sustainable, any reform of cohesion policy after 2027 must integrate demographic trends into the financing and policy frameworks at a systemic level, linking territorial cohesion, innovation capacity building and retaining human capital. This approach could help to mitigate the socio-economic consequences of population decline and ensure that one of the fundamental promises of European integration – balanced development and genuine territorial cohesion – remains sustainable in the coming decades.

The questions and recommendations raised in this paper aim to contribute to this policy discourse, particularly in light of the European Commission's publication in July 2025 of its proposal for the Multiannual Financial Framework for 2028–2034. The ensuing negotiation process between Member States, which is expected to last several years, provides an opportunity to incorporate demographic considerations into the future cohesion policy framework at a systemic level. This is particularly important for Hungary.

References

- Barro, R. – Sala-i-Martin, X. (1992): *Public Finance in Models of Economic Growth*. The Review of Economic Studies, 59(4): 645–661. <https://doi.org/10.2307/2297991>
- Beine, M. – Docquier, F. – Rapoport, H. (2008): *Brain Drain and Human Capital Formation in Developing Countries: Winners and Losers*. The Economic Journal, 118(528): 631–652. <https://doi.org/10.1111/j.1468-0297.2008.02135.x>
- Beine, M. – Docquier, F. – Özden, Ç. (2011): *Diasporas*. Journal of Development Economics, 95(1): 30–41. <https://doi.org/10.1016/j.jdeveco.2009.11.004>
- Bodnár, K. – Szabó, L.T. (2014): *The Effect of Emigration on the Hungarian Labour Market*. MNB Occasional Papers 114. <https://www.mnb.hu/letoltes/mnb-tanulmany-eng-114-1126.pdf>
- Borjas, G. (1987): *Self-Selection and the Earnings of Immigrants*. NBER Working Paper No. 2248. <https://doi.org/10.3386/w2248>
- Busse, M. – Lin, H.H. – Nabar, M.S. – Yoo, J. (2025): *Making the EU's Multiannual Financial Framework Fit for Purpose*. IMF Working Paper No. 2025/114. <https://doi.org/10.5089/9798229015042.001>
- Chen, F. – Wong, Z.W.V. – Law, S.H. (2024): *Brain drain: what is the role of institutions?*. Journal of Industrial and Business Economics, 51(3): 605–628. <https://doi.org/10.1007/s40812-023-00286-w>
- Draghi, M. (2024): *The Future of European Competitiveness – A Competitiveness Strategy for Europe*. <https://doi.org/10.2872/9356120>
- Diemer, A. – Iammarino, S. – Rodríguez-Pose, A. – Storper, M. (2022): *The regional development trap in Europe*. Economic Geography, 98(5): 487–509. <https://doi.org/10.1080/00130095.2022.2080655>
- Docquier, F. – Rapoport, H. (2011): *Globalization, Brain Drain, and Development*. Journal of Economic Literature, 50(3): 681–730. <https://doi.org/10.1257/jel.50.3.681>
- European Commission (2023a): *The Single Market at 30*. Communication from the Commission, COM(2023) 162 final. <https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:52023DC0162>
- European Commission (2023b): *Harnessing talent in Europe's regions*. Communication from the Commission, COM(2023) 32 final. https://ec.europa.eu/regional_policy/sources/communication/harnessing-talents/harnessing-talents-regions_en.pdf. Downloaded: 10 March 2026.

- European Commission (2023c): *Demographic change in Europe: a toolbox for action*. Communication from the Commission, COM(2023) 577 final. <https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=COM%3A2023%3A577%3AFIN>
- European Commission (2024a): *The 2024 Ageing Report: Economic and Budgetary Projections for the EU Member States (2022–2070)*. Institutional Paper 279, April. <https://doi.org/10.2765/022983>
- European Commission (2024b): *Annual Report on intra-EU Labour Mobility 2023*. Directorate-General for Employment, Social Affairs and Inclusion, Publications Office of the European Union. <https://doi.org/10.2767/59413>
- European Commission (2025): *Annual report on intra-EU labour mobility – 2024 edition*. Directorate-General for Employment, Social Affairs and Inclusion, European Commission. Publications Office of the European Union. <https://doi.org/10.2767/2077850>
- European Committee of the Regions (2020): *Opinion of the European Committee of the Regions – Brain Drain in the EU: addressing the challenge at all levels*. SEDEC-VI/052 (11–12 February). <https://cor.europa.eu/en/our-work/opinions/cdr-4645-2019#page-top>
- European Council (2020): *Special meeting of the European Council (17–21 July 2020) – Conclusions*. Note, EUCO 10/20. <https://www.consilium.europa.eu/media/45109/210720-euco-final-conclusions-en.pdf>
- Eurostat (2023): *EU’s population projected to drop by 6% by 2100*. <https://ec.europa.eu/eurostat/web/products-eurostat-news/w/ddn-20230330-1>. Letöltés ideje: 2026. március 10.
- Eurostat (2024): *Hourly labour costs ranged from €9 to €54 in the EU*. News Article. <https://ec.europa.eu/eurostat/web/products-eurostat-news/w/ddn-20240327-2>. Downloaded: 10 March 2026.
- Eurostat (2025): *Migration and asylum in Europe – 2025 edition*. <https://ec.europa.eu/eurostat/web/interactive-publications/migration-2025>. Downloaded: 10 March 2026.
- Faini, R. (2007): *Remittances and the Brain Drain: Do More Skilled Migrants Remit More?* The World Bank Economic Review, 21(2): 177–191. <https://doi.org/10.1093/wber/lhm006>
- Halmi, P. (2014): *Krízis és növekedés az Európai Unióban: Európai modell, strukturális reformok (Crisis and growth in the European Union: European model, structural reforms)*. Akadémiai Kiadó, Budapest. https://mersz.hu/dokumentum/dj166kenaeu__1/
- Halmi, P. (2018): *Az európai növekedési modell kifulladásá (Exhaustion of the European economic model)*. Közgazdasági Szemle (Economic Review), 65(2): 122–160. <https://doi.org/10.18414/KSZ.2018.2.122>

- Iammarino, S. – Rodríguez-Pose, A. – Storper, M. (2019): *Regional inequality in Europe: evidence, theory and policy implications*. Journal of Economic Geography, 19(2): 273–298. <https://doi.org/10.1093/jeg/lby021>
- Jouen, M. (2017): *The Future Cohesion Policy should represent EU solidarity in action*. Jacques Delors Institute, Paris. <https://institutdelors.eu/content/uploads/2025/04/Cohesionpolicy-WarsawConference-Jouen-1.pdf>
- Kelchtermans, S. – Kardas, M. – Klineciewicz, K. (2021): *Implementing Smart Specialisation Strategies – Analysis of the Role of Regional Strategies in National Innovation Strategies*. Publications Office of the European Union, Luxembourg. <https://doi.org/10.2760/711198>
- Krugman, P. (1991): *Increasing Returns and Economic Geography*. Journal of Political Economy, 99(3): 483–499. <https://doi.org/10.1086/261763>
- Letta, E. (2024): *Much more than a market – Speed, Security, Solidarity. Empowering the Single Market to deliver a sustainable future and prosperity for all EU Citizens*. European Commission, April. <https://www.consilium.europa.eu/media/ny3j24sm/much-more-than-a-market-report-by-enrico-letta.pdf>
- Lucas, R.E.Jr. (1988): *On the mechanics of economic development*. Journal of Monetary Economics, 22(1): 3–42. [https://doi.org/10.1016/0304-3932\(88\)90168-7](https://doi.org/10.1016/0304-3932(88)90168-7)
- OECD (2021): *International Migration Outlook 2021*. OECD Publishing, Paris. <https://doi.org/10.1787/29f23e9d-en>
- OECD (2024): *Education at a Glance 2024: OECD Indicators*. OECD Publishing, Paris. <https://doi.org/10.1787/c00cad36-en>
- Pape, M. – Széchy, B. (2024): *Demographic change in Europe: A toolbox for action*. Briefing, European Parliament Research Service. [https://www.europarl.europa.eu/RegData/etudes/BRIE/2024/762302/EPRS_BRI\(2024\)762302_EN.pdf](https://www.europarl.europa.eu/RegData/etudes/BRIE/2024/762302/EPRS_BRI(2024)762302_EN.pdf)
- Rodríguez-Pose, A. (2018): *The revenge of the places that don't matter (and what to do about it)*. Cambridge Journal of Regions, Economy and Society, 11(1): 189–209. <https://doi.org/10.1093/cjres/rsx024>
- Romer, P.M. (1990): *Human capital and growth: Theory and evidence*. Carnegie-Rochester Conference Series on Public Policy, 32(1): 251–286. [https://doi.org/10.1016/0167-2231\(90\)90028-J](https://doi.org/10.1016/0167-2231(90)90028-J)
- Schwab, T. (2024): *Quo Vadis, Cohesion Policy? European Regional Development at a Crossroads*. Intereconomics. 59(5): 284–292. <https://doi.org/10.2478/ie-2024-0056>

Sjaastad, L.A. (1962): *The Costs and Returns of Human Migration*. Journal of Political Economy, 70(5 Part2): 80–93. <https://doi.org/10.1086/258726>

Zalai, C. (2024): *Too Little Too Late? An Overview of the European Union's Approach to Address Demographic Change and Some Policy Implications for the Next (2028–2034) Multiannual Financial Framework*. European Mirror, 2024(1): 169–193. <https://doi.org/10.32559/et.2024.1.9>

A Three-Bloc Structure of the World Economy: Evidence of Geoeconomic Fragmentation in International Trade, Financial and Military Data

Eszter Boros  – Tamás Ginter 

Geoeconomic fragmentation has received much attention by scholars in recent years. The hypothesis that such fragmentation is taking place carries the assumption that distinct geopolitical blocs exist. Many studies include presumptions on the number and exact composition of these blocs, which vary largely in the literature. Taking stock of the different approaches reveals a considerable lack of effort to define blocs on an empirical basis. To narrow this gap, we aim to check the existence of different country groups in a data-driven manner. We apply hierarchical clustering to a broad set of geopolitically relevant data. Our results reveal a sensible three-bloc structure of the world economy, with these blocs centred around major geopolitical powers: the United States, the European Union, and a China-Russia conglomerate, respectively. While our results corroborate the commonly applied East-West divide, the finding that the two major Western geopolitical actors form separate blocs challenges the existing consensus.

Journal of Economic Literature (JEL) codes: F02, F12, F50

Keywords: geoeconomic fragmentation, geopolitical blocs, hierarchical clustering

1. Introduction

The global economy has been undergoing significant shifts throughout the past years. One of these reconfigurations can be described by the term geoeconomic fragmentation, which (although definitions vary) most commonly refers to a “policy-driven reversal of global economic integration often guided by strategic considerations” (IMF 2023a: p. 91). A body of research (see i.a. Norring 2024a; Kaarevirta et al. 2023) considers the formation of distinct geopolitical blocs to be a prerequisite for geoeconomic fragmentation. Nevertheless, the existence of such geopolitical blocs and the question of their composition are not empirically settled,

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and previous research correspondingly exhibits substantial variation. Both two-bloc and three-bloc models are commonly used. Poles are usually coined as East and West (alternatively, US- and China-leaning blocs), while three bloc models typically add a third, neutral grouping. Literature classifies respective countries into these blocs either arbitrarily or based on United Nations (UN) voting behaviour patterns (for a detailed comparison refer to *Section 2.3*). Thus, we have identified a significant niche in the literature addressing the phenomenon of geoeconomic fragmentation: to the best of our knowledge, the existence (as well as the number and the composition) of such economic blocs has not been researched in any systematic manner. In order to narrow this gap, our aim was to identify geoeconomic blocs (if any) empirically, i.e. based on linkages which might exist between different countries in terms of various geoeconomic data such as trade, investments, finance and military links. Applying a widely used clustering technique (hierarchical clustering) to a broad set of data, our results support the idea that certain country groupings exist and have a meaningful impact on the structure of the international economy. Nevertheless, our results offer a different bloc structure of the global economy than those in the existing literature. We identify three blocs centred around the United States, the European Union, and the China-Russia conglomerate, respectively. While the East-West divide remains, the finding that the United States and the EU belong to different blocs largely differs from what has been assumed in previous research.

This paper is structured as follows. *Section 2* provides an overview of the literature (including a definitional framework and a review of the effects of geoeconomic fragmentation, as well as an extensive discussion of how the various studies divide the world economy into geopolitical blocs). *Section 3* describes the methodology and empirical approach we used to identify blocs. In *Section 4*, we present the results, while *Section 5* elaborates on our conclusions.

2. Literature review

2.1. Geoeconomic fragmentation: a definitional framework

The recent shifts in the global economy cover a broad range of economic activities and cross-border flows, and are caused by a multitude of reasons, including the emerging systemic rivalry between the United States and China, the COVID-19 pandemic, supply chain and energy crises as well as the ever-intensifying military conflicts of the 2020s (see e.g. *Halmai 2023*; *Altman et al. 2024* and *Halmai 2025b*; for an in-depth historical review, see i.a. *Halmai 2025a*). Many concepts have emerged in the literature describing these reconfigurations (e.g. deglobalisation, decoupling, nearshoring, friendshoring, etc. with fragmentation being the most common of them). Due to the novel need to describe the shifts of the global economy, definitions often vary and overlap. In this section we provide a brief overview of concepts related to the current reshaping of the global economy in order to facilitate a deeper discussion of the analysis of geoeconomic fragmentation.

The most common term capturing this reconfiguration of the global economy is geoeconomic fragmentation. Its most widely accepted definition stems from the *IMF (2023a)*, which describe geoeconomic fragmentation as “a policy-driven reversal of global economic integration often guided by strategic considerations” (p. 91; this definition is also used by *Aiyar – Ilyina 2023; Bolhuis et al. 2023* as well as *Mohr – Trebesch 2025* amongst other). The IMF’s definition is complemented by that of *Gopinath et al. (2024)*, who emphasise that these policy-induced changes apply for “the sources and destinations of cross-border flows” (p. 1) and are “often guided by strategic considerations, such as national and economic security, sovereignty, autonomy” (*ibid.*; this definition is also referred to by i.a. *Altman et al. 2024* and *Ginter 2025*).

Separating the concepts of geoeconomic fragmentation is no easy task, not only due to their novelty but also due to several similar (or even overlapping) concepts having emerged in the past years. In her review, *Norring (2024a)* provides a conceptual framework by classifying the concepts of (de)globalisation and (geo)economic fragmentation. *Norring* defines globalisation as an “increasing of links of economic activity between countries” (*ibid.* p. 8) and conversely deglobalisation describes a dissolution of such linkages “driven by e.g. changes in technology, preferences, regulation, or economic conditions” (*ibid.*). *Norring* distinguishes fragmentation from deglobalisation by a special characteristic of the former, namely, the emergence of “concentration of economic activity within blocs” (*ibid.*).¹ Blocs (a term referring to a group of countries based on a certain kind of proximity) can be formed on a regional basis (i.e. between countries close to each other in a geographical sense) or based on policy proximity. Should fragmentation occur due to geopolitical motives and strategic rivalry, one speaks of geoeconomic fragmentation (see also *Norring 2024b* and *Airaudo et al. 2025*).

Other interlinked concepts include those of friendshoring (“a preference for sourcing inputs from economies that share similar values”; *Javorcik et al. 2023: p. 2*), nearshoring (the shortening and regionalisation of global value chains caused by the risks stemming from distance; *Plummer 2023*), reshoring (bringing back production to certain countries and thus protecting the domestic economy; *Altman et al. 2024* and *Plummer 2023*) as well as decoupling (“the process of weakening interdependence between two nations or blocs of nations”; *Witt et al. 2023: p. 1*). Other authors (e.g. *Kaaresvirta et al. 2023*) use the term decoupling for the “economic distancing of China and the United States” (p. 4) and use fragmentation as nations “either taking sides in US-China competition or forming alternative trading blocs” (*ibid.*).

As demonstrated above, concepts related to (geoeconomic) fragmentation are not only intertwined, but often used interchangeably. In this paper, we rely on

¹ In this paper, we use the term *blocs* in the broader sense outlined above, i.e. to denote groupings in which multiple dimensions of economic activity are concentrated. These dimensions include not only trade, but also other forms of cross-border economic flows.

the definition of the *IMF* (2023a) (i.e. we consider fragmentation as a policy-driven reversal of global economic integration, p. 91) as well as *Norring's* (2024a) prerequisite for the formation and concentration of economic activity within blocs. By such blocs (and in similar vein as e.g. *Aiyar et al.* 2023), we mean groups of countries that exhibit tighter economic integration within the group and reduced engagement with countries outside the group. In the following parts of the literature review, we consider studies that deal with geoeconomic fragmentation based on the above definitions, even if the respective authors use the term differently. In the following sections, we summarise certain characteristics and effects of geoeconomic fragmentation as well as the understanding of blocs serving as a prerequisite for geoeconomic fragmentation.

2.2. Geoeconomic fragmentation: channels and effects

In order to gain deeper understanding of the phenomenon, in this section we present the channels through which geoeconomic fragmentation is transmitted, as well as its effects on global welfare. *Aiyar – Ilyina* (2023) identify three main channels through which the effects of fragmentation are transmitted: (1) international trade, (2) cross-border migration, and (3) cross-border capital flows (and foreign direct investments, in particular). Earlier, these channels used to be the main contributors to global economic integration (supported by the diffusion of technology), and conversely the diminished use of these channels reinforces fragmentation trends. *Fernández-Villaverde et al.* (2024) identify a similar structure of variables along which they quantify geopolitical fragmentation. The authors identify 16 variables as proxies, grouped in a four-factor structure; the four factors include (1) trade fragmentation (comprising trade openness as well as different types of trade restrictions); (2) financial fragmentation (comprising FDI and financial flows as well as capital controls); (3) mobility fragmentation (including migration-related variables as well as patent flows); and (4) political fragmentation (including geopolitical risk, UN voting patterns, energy uncertainty as well as the number of armed conflicts and sanctions).

The estimated effects of geoeconomic fragmentation vary to a large degree (*Farkas et al.* 2023). Two different approaches persist in the literature when it comes to calculating these estimates. The first approach uses different modelling strategies to estimate the economic costs of fragmentation; these papers emphasise the costly nature of fragmentation-related policies. *Javorcik et al.* (2023) use a quantitative, two-bloc model incorporating inter-country inter-industry linkages and find that fragmentation² may result in losses of up to 4.7 per cent of GDP in certain economies. *Campos et al.* (2023) also model the welfare effects of trade fragmentation in a supposed three-bloc setup (West, East and Neutral). They estimate that in case

² While *Javorcik et al.* (2023) use the term “friendshoring”, their paper clearly focuses on fragmentation effects (as it analyses scenarios of trade between and within two distinct geopolitical blocs). This also reflects the need for a clear terminology on these interlinked concepts.

of three-bloc fragmentation, global trade flows would diminish by up to 57 per cent, resulting in welfare losses up to 3.7 per cent (these losses would be higher in the Eastern bloc). Similarly, *Felbermayr et al. (2023)* modelled the effects of decoupling by major economies and country groups (the EU, the US, Russia and China) from one another. The most severe scenario (with the US and the EU decoupling from the BRICS economies³) would result in welfare losses up to 3.9 per cent.

The second approach uses retrospective analyses of available data (on trade, FDI, etc.), trying to prove or disprove of the existence of geoeconomic fragmentation. In these studies, the results are more nuanced. *Altman et al. (2024)* challenge the deglobalisation narrative drawing on a multitude of variables proxying cross-border transactions. They find that “international flows have not decreased relative to domestic activity, there is not an ongoing shift from global to regional business, and geopolitically driven shifts in international flows still primarily involve countries at the centre of present conflicts” (p. 416). While certain signs of US-China decoupling persist (as well as Western countries successfully decoupling from Russia), the global economy does not seem to have rearranged itself into geopolitical blocs distinct from each other. *Kaarevirta et al. (2023)* come to a similar conclusion when comparing trade and investment trends before and after the start of the US-China trade war (using this need for decoupling as a demarcation). They find that while US-Chinese linkages contracted after the start of the trade war, no other signs of the formation of distinct blocs had emerged by their cut-off point in 2021. *Aiyar – Ohnsorge (2024)* contradict the above findings, stating that between 2016 and 2023 fragmentation increased in trade, bank and FDI liabilities. Similarly, *IMF (2023a)* find that FDI flows have become increasingly common between geopolitically aligned countries, and especially in strategic sectors.

2.3. Geoeconomic fragmentation and blocs

As referred to by *Norring (2024a)*, one prerequisite for (geoeconomic) fragmentation is the formation of distinct blocs. Specifically considering geoeconomic fragmentation, these blocs are formed on the basis of particular geopolitical strategic alliances. While a thorough definition of such blocs is necessary to capture geoeconomic fragmentation, the literature is divided on what categorisations should be used to describe the respective blocs. In the following, we review fourteen different studies focusing on fragmentation-related topics, all of which include geoeconomic blocs. The body of literature reviewed is not only divided on the number of blocs, but also their composition and what this composition is based upon. We summarise these variations below; the results of the review are also presented in a structured way in *Table 1*.

First, the number of blocs is not uniform across the literature: studies either use two- or three-bloc models (examples for the former include *Alvarez et al. 2023*; *IMF*

³ Brazil, Russia, India, China and South Africa.

2023b; Bekkers – Góes 2023; Maskus 2023; while for the latter Campos et al. 2023; Gopinath et al. 2024; Aiyar – Ohnsorge 2024; Bolhuis et al. 2023; Fernández-Villaverde et al. 2024; Conteduca et al. 2025; Baur et al. 2023; Baur et al. 2025; Kirsamer – Riha 2025 as well as Gopinath 2023) or both (Javorcik et al. 2023; Abeliansky et al. 2024).

Second, categorisations also vary, however, to a lesser extent. Most categorisations include an East-West divide, often framed as a US-centred bloc and a China-centred bloc (Aiyar – Ohnsorge 2024; Gopinath et al. 2024; Bekkers – Góes 2023; Abeliansky et al. 2024; Conteduca et al. 2025; Baur et al. 2023), respectively. Others (IMF 2023b; Bolhuis et al. 2023; Fernández-Villaverde et al. 2024 and Kirsamer – Riha 2025) specify the Western bloc as the conglomerate of the US and the European Union, while the Eastern counterpart is Russia and China. There are also some other regional specifications (Javorcik et al. 2023; Abeliansky et al. 2024; Gopinath 2023), which are presented in detail in Table 1. Three-bloc models (see above) also include a neutral or non-aligned bloc, the members of which are neither Western nor Eastern allies. In certain cases, the latter bloc is used as the set of “connector countries” (see Baur et al. 2025, as well as Aiyar – Ohnsorge 2024), characterised by “their unique position in maintaining substantial economic ties with both Western and Eastern blocs” (Baur et al. 2025: Section 1., para. 2). However, non-aligned countries are often treated as members of a third bloc (aligned to neither of the two world powers).⁴ Nevertheless, the available body of research on connector countries is limited so far and which countries behave as connectors varies across the literature. Thus, in our paper we do not address this issue explicitly; however, we encourage future research in doing so. Third, it varies to a high extent upon what the respective authors base the composition of the respective geopolitical blocs. The majority of the studies reviewed uses countries’ voting behaviour at the United Nations General Assembly (UNGA). Certain authors either compose their blocs based on the voting behaviour for one specific resolution: the resolution on the aggression against Ukraine (Javorcik et al. 2023; Alvarez et al. 2023; IMF 2023b) or the resolution concerning the suspension of the rights of membership of the Russian Federation in the Human Rights Council (Campos et al. 2023). A more sophisticated approach to countries’ categorisations into geopolitical blocs based on voting behaviour at the UNGA includes the usage of aggregate voting behaviour (ideal points and clustering: Javorcik et al. 2023 and Kirsamer – Riha 2025;⁵ the Foreign Policy Similarity Database based on UNGA voting: Bekkers – Góes 2023; or affinity of voting with China or the US: Maskus 2023; Gopinath et al. 2024; Abeliansky et al. 2024; Aiyar – Ohnsorge 2024). Several other authors (Bolhuis et al. 2023; Fernández-Villaverde et al. 2024; Conteduca et al. 2025) use an arbitrary East-West (or alternatively EU-US and Russia-China) categorisation of blocs instead. In addition, Gopinath (2023) uses a historical categorisation from the Cold War era.

⁴ The paper of Baur et al. (2025) includes three simulations, in two of which connector countries are assigned to either of the two blocs concentrated around the US and China.

⁵ The latter includes further diplomatic and political variables: the Level of Representation index and the Voice and Accountability index.

Table 1**Number and the composition of geopolitical blocs in the literature reviewed**

Author(s)	Number of blocs	Name and composition of blocs	Methodological basis of the composition of blocs
<i>Javorcik et al. (2023)</i>	2	Bloc 1: countries voting in favour of the UN General Assembly resolution on “Aggression against Ukraine” Bloc 2: countries voting against or abstaining	Voting behaviour at the UN General Assembly (on the resolution on “Aggression against Ukraine”)
		Bloc 1: North America and Europe Bloc 2: Southeast Asia, Russia, Latin America	Voting behaviour at the UN General Assembly (ideal points based on voting between 2014 and 2021)
	3	Friends, non-friends and non-aligned	Voting behaviour at the UN General Assembly (clustering based on heat maps of bilateral vote similarity)
<i>Alvarez et al. (2023)</i>	2	Bloc 1: countries voting in favour of the UN General Assembly resolution on “Aggression against Ukraine” Bloc 2: countries voting against or abstaining	Voting behaviour on the UN General Assembly resolution on “Aggression against Ukraine”
<i>IMF (2023b)</i>	2	Bloc 1: US-Europe+ Bloc 2: China-Russia+	Voting behaviour on the UN General Assembly resolution on “Aggression against Ukraine”
<i>Campos et al. (2023)</i>	3	Bloc 1: West Bloc 2: East Bloc 3: Neutral	Countries allocated to a bloc according to UN vote “on the resolution concerning the suspension of the rights of membership of the Russian Federation in the Human Rights Council. Countries are part of a Western, Eastern, or a Neutral bloc, depending on whether they voted with Russia, against Russia, or abstained” (p. 2)
<i>Gopinath et al. (2024)</i>	3	Bloc 1: US leaning bloc Bloc 2: China leaning bloc Bloc 3: Non-aligned	Political proximity based on voting patterns at the UN General Assembly; top quartile of voting with the US or China results in being classified into Bloc 1 or 2, otherwise a country is considered non-aligned
<i>Bekkers – Góes (2023)</i>	2	Bloc 1: West (US-centred bloc) Bloc 2: East (China-centred bloc)	Foreign Policy Similarity Database based on UN General Assembly voting
<i>Maskus (2023)</i>	2	Bloc 1: higher-productivity West (EU and US centred) Bloc 2: lower-productivity East (China-centred bloc)	Affinity of voting with China and the US at the United Nations

Table 1 Number and the composition of geopolitical blocs in the literature reviewed			
Author(s)	Number of blocs	Name and composition of blocs	Methodological basis of the composition of blocs
Abeliansky et al. (2024)	2	Bloc 1: US bloc (North America, Europe, Japan, South Korea, Australia, New Zealand) Bloc 2: China bloc (Asia, Africa, Latin America, Caribbean)	Geopolitical distance to China and the US based on voting behaviour at the UN General Assembly
	3	Bloc 1: US bloc (North America, Europe, Japan, South Korea, Australia, New Zealand) Bloc 2: China bloc (most of Central Asia and North Africa, parts of Southeast Asia) Bloc 3: Non-aligned (Russia, India, Middle East, Latin America, Caribbean)	Geopolitical distance to China and the US based on voting behaviour at the UN General Assembly; countries that are not in the closest quartile of the US or China are considered nonaligned
Aiyar – Ohnsorge (2024)	2	Bloc 1: US bloc Bloc 2: China bloc	Geopolitical distance to China and the US based on voting behaviour at the UN General Assembly
Bolhuis et al. (2023)	2	Bloc 1: EU and US Bloc 2: Russia and China	Arbitrary
Fernández-Villaverde et al. (2024)	3	Bloc 1: EU and US Bloc 2: Russia and China Bloc 3: others	Arbitrary
Conteduca et al. (2025)	3	Bloc 1: West (US-centric bloc) Bloc 2: East (China-centric) Bloc 3: non-aligned	Arbitrary
Baur et al. (2023)	3	Bloc 1: West (led by the US) Bloc 2: East (led by China) Bloc 3: non-aligned (i.a. India, Brazil, South-Africa)	Arbitrary; alternative scenarios include non-aligned joining either Bloc 1 or Bloc 2
Baur et al. (2025)	3	Bloc 1: West (led by the US) Bloc 2: East (led by China) Bloc 3: nonaligned (i.a. India, Brazil, South-Africa)	Voting behaviour in the UN vote on the suspension of Russia's membership in the Human Rights Council
Kirsamer – Riha (2025)	3	Bloc 1: EU and US Bloc 2: Russia and China Bloc 3: New bloc	The new bloc (which could not be identified with 2002 data) includes i.a. Latin American, South African countries as well as India.
Gopinath (2023)	3	Bloc 1: West (US, Europe, Canada, Australia and New Zealand) Bloc 2: East (Belarus, China, Mali, Nicaragua, Russia, and Syria) Bloc 3: Non-Aligned (rest of the world)	Based on Gokmen's (2017) categorisation referring to the Cold War period
Source: based on the body of literature listed			

2.4. Research questions

Our literature review clearly shows that the phenomenon of geoeconomic fragmentation has gained much importance in the past decade. Nevertheless, one conceptual question remains unanswered: what exactly are the blocs between which economic activity is diminishing and causing geoeconomic fragmentation by doing so? As shown in *Section 2.3*, there is no consensus on the number and composition of these blocs. Furthermore, so far the literature lacks any solid methodology for dividing the global economy into different blocs. A number of authors did so in an arbitrary fashion, while others used voting behaviour at the UNGA for doing so. As noted in *Section 2.1*, geoeconomic fragmentation is a complex phenomenon, comprising economic, security and foreign policy factors. Thus, the usage of voting behaviour only allows for a partial understanding of fragmentation and excludes a number of economic and geopolitical variables. (Some, but not all of relevant variables were collected by *Fernández-Villaverde et al. (2024)*; however, they also constructed the bloc structure in an arbitrary manner.) Thus, we have identified a niche in the literature focusing on geoeconomic fragmentation: to the best of our knowledge, no attempt has been made to empirically identify the blocs upon which geoeconomic fragmentation is based. We thus design our research to address the following questions:

1. Is there an identifiable structure of blocs in the global economy?
2. If such a structure exists, is it one consisting of two, three or more blocs?
3. If such a structure exists, does it align with the supposed East-West divide described in the literature?
4. If such a structure is available, which countries of the world economy can be categorised in the respective blocs?

3. Methodology

As described, we found a significant gap in the literature, i.e. a lack of empirical approaches to identify groups of countries (“clusters”) based on relevant data, which reveal basic splits (if any) on the global level in terms of trade, investment and other kinds of relations. To fill this gap, we apply a widely used clustering technique (hierarchical clustering) to a broad set of data which we deem relevant based on the literature of geoeconomic fragmentation, as well as practical considerations (data availability, quality, etc.).⁶ As usual in econometrics, the method of clustering

⁶ Clustering is a widely used methodological approach in international economic research. Some of the studies cited in *Section 2.3* use different clustering approaches (*Javorcik et al. 2023* and *Kirsamer – Riha 2025*) for researching certain (narrower or specific) aspects of geoeconomic fragmentation. Nonetheless, clustering is more typical for researching other aspects of international economics. Notable examples include the clustering of countries based on their Human Development Index (see e.g. *Altas – Arikan 2017*) or international (e.g. trade) flows (see e.g. *Jiménez-Almazán et al. 2020*).

is sensitive to different choices regarding (inter alia) the sample, the variables and certain features of the technique itself. Our choices are explained in more detail in *Sections 3.1* and *3.2*, respectively. The final results are based on several rounds of iterations where we applied clustering to various sets of countries and variables. In the following, we present our data and considerations which resulted in the final “sample” underlying the main output of this paper.

3.1. Variables and data

The starting point of our empirical work is the identification of variables which could be decisive in determining the “geoeconomic proximity” of different countries. For the purposes of this paper, the concept of “geoeconomic proximity” is operationalised to capture the strength of the relationship of country *i* with a small set of “great powers” of our age. Countries are then compared based on these relationships and included in clusters characterised by the presence or lack of these “great powers”. It is undoubted that the United States (US) and the People’s Republic of China (PRC, hereinafter “China” or CN) need to be regarded as such powers, as they are at the heart of the fragmentation issue nowadays. Besides them, the European Union (EU) and Russia (RU) are among the major players mastering a web of geoeconomic relations spanning beyond their closest neighbours. Thus, we select these four actors as “points of reference” when creating measures of economic and geopolitical links.

With regard to these links, we identify five broad topics relevant for fragmentation, based on our literature review:

- (1) Trade,
- (2) Foreign direct investments,
- (3) International financial support (development finance),
- (4) Military links (arms sales),
- (5) Public opinion (about “great powers”).

These broad categories cover the most important aspects of geoeconomic fragmentation discussed in a broad set of papers focusing on the topic (*Section 2*). Furthermore, this list already reflects practical considerations such as data availability. Variables and metrics related to these topics can be best interpreted as proxies signalling the overall stance or orientation of different countries vis-à-vis the four “great powers” mentioned above.

This approach yields the variables included in *Table 2*.

Table 2
Full set of variables considered in the empirical analysis

Topic	Variable	Description and notes	Unit of measure	Source	Variable names
(1)	Trade share of “great power” j in total foreign trade of goods of country i in 2022	$j = \text{US; CN; EU; RU}$ Total foreign trade (goods): exports + imports	%	IMF	TRADE_SHARE_US TRADE_SHARE_CN TRADE_SHARE_EU TRADE_SHARE_RU
(2)	Net FDI stock of “great power” j in country i in 2023	Liabilities less assets	Million USD	IMF	FDI_US FDI_CN FDI_EU FDI_RU
(3a)	Approved financing amounts by AIIB to country i between 2016 and July 2025 (Asian Infrastructure Investment Bank)	Proxy of closer links to China Sum of nominal values (sovereign and non-sovereign finance extended to/in country i)	Million USD	AIIB	FIN_AIIB
(3b)	IBRD loans, total disbursed amount to country i as of 30 June 2025 (International Bank for Reconstruction and Development, World Bank)	Possible proxy of closer links to the West Data provided by IBRD as sum of nominal values	Million USD	IBRD	LOAN_IBRD
(4)	Ratio of arms purchases by country i from source k , for items purchased between 2016–2024	$k = \text{NATO and APAC allies; CN; RU}$ Ratio calculated from sum of purchase volumes (number of items)	%	SIPRI	ARMS_NATO ARMS_CN ARMS_RU
(5)	Net favourability of China in country i , 2024 or latest data available since 2020	Aggregated worldwide polling data, share of positive minus negative responses No wide-scale data available for US, EU, RU	ppt	ASPI	FAV_CN
<i>Note: Topic (2) was omitted in final output due to data availability issues (several cases of missing data).</i> <i>Unit of measure: Standardised variables are used for clustering.</i> <i>APAC allies: Closest US allies in the Asia-Pacific region, i.e. South Korea, Japan, Australia, Philippines, Taiwan (Republic of China, ROC). The distinction between the ROC and the PRC is merely practical and does not represent any statement on the related territorial issues.</i> <i>For details of data sources, see Appendix Table 4.</i>					

3.2. List of countries and clustering method

Initially, we considered the full list of countries; however, due to missing data, countries with a population of less than one million were removed. In a narrower list of 156 countries, lack of data and potential distortions still posed a challenge, especially when FDI data was included as initially planned. To handle this issue, FDI variables had to be removed, just as Latin American and Sub-Saharan countries. Our final (standardised) data set thus contains 89 countries ($N = 89$) and 10 variables (those described in the last column of *Table 2*, except for Topic (2)). Clusters were identified by hierarchical clustering using the Ward criterion.^{7, 8}

4. Results

Based on the dendrogram (*Appendix Figure 2*), three clusters can be identified. *Figure 1* and *Table 3* provide an overview of them. For the list of members in each cluster, see *Appendix Table 5*. Significance tests show that all of the 10 variables included in the analysis have a significant relationship with cluster membership ($\alpha = 10\%$). (Except for `TRADE_SHARE_CN` and `FAV_CN`, all the other variables have an empirical significance level less than 5%.)

⁷ Our basic distance metric was the Euclidean distance which is a conventional and very common interpretation of distance in a multidimensional space of data points. The Ward approach starts with unique data points (i.e. their Euclidean distance) and creates groups based on the objective to minimise the increase in total within-cluster variance (within-cluster sum of squares, WSS). This process can be best illustrated with dendrograms. Instead of this agglomerative approach, it is possible to randomly set a certain number (k) of cluster centres and assign the closest data points to them (usually using their Euclidean distance). This is called k-means clustering, where the subsequent iterations change the cluster centres step by step to minimise the WSS (until no further improvement is possible). As a counterfactual to our main output, we also resorted to k-means clustering. (Missing data were handled by MICE imputation, i.e. multiple imputations by chained equations.) In the cases of $k = 3$ and $k = 4$, the result was disproportionate in terms of the size of the resulting clusters. (Most of the countries, i.e. 72 and 67 of them, respectively, formed one single cluster, while the remaining clusters were very small.) This highlights the fact that our results are sensitive to different clustering techniques as it was only the Ward criterion which resulted in meaningful outcomes. However, we believe that our case study adds to the empirical analysis of geoeconomic fragmentation, considering the significant barriers in data availability and quality, as well as the high complexity of the global geoeconomic landscape.

⁸ As FDI was excluded from our final cluster analysis, we deem that the remaining variables grasp conceptionally different dimensions of international linkages (i.e. trade; military links; financial links; public opinion). Any relationships among these variables can eventually be traced back to a latent variable, namely a general orientation of a country towards one of the great powers/geopolitical blocs, which is the major topic of our paper. Therefore, excluding any of our variables due to its potential relationship to the others could result in limiting our interpretation of “geopolitical proximity”, and would be rather arbitrary.

Figure 1
Our clusters on the world map

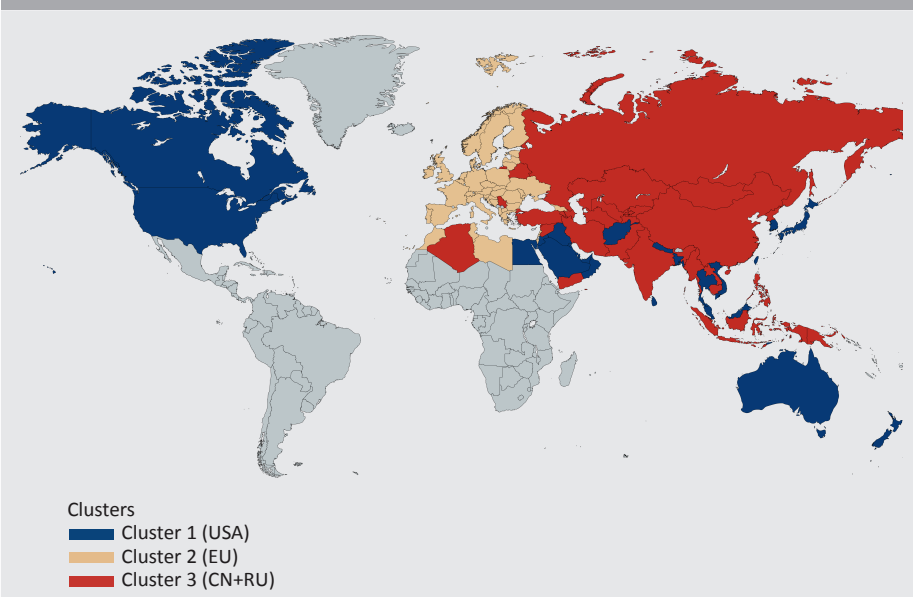


Table 3
Overview of the clusters

Cluster	“Great power” in the cluster	Examples of other countries	n	Cluster averages										FAV CN
				Trade share (%)				Finance (Million USD)		Arms purchases (%)				
				US	CN	EU	RU	AIIB	IBRD	NAT	CN	RU		
(1)	US	Australia, Canada, Gulf States, Japan, South Korea, Taiwan	25	10	19	10	1	420	2,598	85	4	4	7	
(2)	EU	Georgia, Israel, Ukraine, United Kingdom	38	5	6	60	3	28	2,974	90	1	0	−19	
(3)	CN, RU	Armenia, Azerbaijan, India, Iran, Kazakhstan, Serbia, Türkiye	26	4	26	17	11	1,565	10,787	20	16	42	31	

Note: Higher values (percentage points) of FAV_CN mean a more positive image of China. Averages are unweighted.

Based on this cluster structure, the between-cluster sum of squares (BSS) was calculated and compared to the total sum of squares (TSS). Calculating BSS/TSS, i.e. eta-squared yielded 0.102. This can be interpreted as meaning that 10 per cent of the variance in the dataset is explained by our cluster structure. This effect size is a major limitation of our paper. However, considering the difficulties in capturing the underlying phenomenon (i.e. fragmentation), as well as data availability issues, it can be concluded that our classification still carries a considerable amount of relevant information. This is supported by the fact that each variable proved to be significant in the respective ANOVA tests as explained above.

Boxplot is an easy-to-use tool to illustrate the distributions of the variables in each cluster. Our boxplots are included in *Appendix Figure 3*. We rely on them and the cluster averages (*Table 3*) to characterise the three country groups.

Cluster 1 includes the United States and many of its closest allies. It is remarkable that this group of countries stretches from North America to the Persian (Arabian) Gulf and the Asia-Pacific region (APAC) where it “encircles” China. Anglo-Saxon countries (Australia, Canada, New Zealand) are part of this cluster, except for the United Kingdom which proved to be “closer” to the European Union in this setting. All of the seven Arab states bordering the Persian Gulf (Bahrain, Iraq, Kuwait, Oman, Qatar, Saudi Arabia and the United Arab Emirates) belong to this cluster. From APAC, the cluster includes close US allies such as Japan, South Korea and Taiwan, as well as some countries with historical links to the West (Singapore, Malaysia, Thailand).⁹ The boxplots on trade share in *Figure 3* show that Cluster 1 countries tend to have the highest shares of trade with the US and the lowest with Russia. In addition, half of them purchased more than 87 per cent of their arms from the NATO and NATO allies.

Cluster 2 includes the members of the European Union and several of their neighbours. The boxplots tell a great deal about why these countries form a separate cluster (i.e. why they are not linked to the US). First of all, they trade far more with (other) EU members than anyone else. (The average share of trade with the EU is 60 per cent in this cluster.) Consequently, they trade less with the US and China than Cluster 1 countries on average. In addition, they have the lowest amounts of AIIB loans (if any at all) and the most unfavourable views of China. (Average FAV_CN indicates a relatively strong negative perception in this group, while the other clusters tend to be more positive about the East Asian giant.) In terms of arms purchases, NATO and NATO allies dominate this cluster.

⁹ Regarding the South China Sea disputes with China, three of the major claimants happen to be in this cluster, notably Vietnam, Malaysia and Taiwan. Interestingly, another major claimant, the Philippines was classified into the “China + Russia” cluster, which must be due to its relatively lower share of trade with the US and its higher amount of AIIB loans.

Note that Cluster 2 includes Israel and some other countries located in the Mediterranean (e.g. Lebanon, Morocco, Tunisia), as well as Ukraine and the United Kingdom. This reflects the impact of geographical proximity on trade, but it can also be indicative in terms of geopolitical orientation, especially in the case of Ukraine. The high share of trade with the EU and NATO arms supplies were decisive in classifying Ukraine into Cluster 2.

Having a separate “EU” cluster is one of the most remarkable results of our study; nevertheless, the composition of Cluster 3 is equally interesting. China and Russia belong in the same group, together with India, Iran, Türkiye, North Korea, Pakistan and a large part of the post-Soviet region. Southeast Asia is split between Cluster 1 and 3, reflecting its role as a “buffer zone”. It is worth mentioning that Serbia, a candidate country for EU membership, was classified into this group which is in line with its traditional relationship with Russia, as well as its more recent orientation towards China.

The boxplots show that higher shares of trade with China and Russia are typical for Cluster 3 countries, and they are also the main recipients of finance from the AIIB and IBRD. Let us note here that although IBRD loans proved to be significant in terms of the cluster structure, the reason for this is likely different from our original assumption. LOAN_IBRD was included as a possible proxy of Western influence (closer links to the West). Nonetheless, *Figure 3* (Boxplot on loans from IBRD) suggests that it may only indicate a “developing country” status and tells little about geopolitical orientation. By contrast, finance from the AIIB is a much clearer sign of closer links to China (see boxplot on AIIB financing in *Figure 3*).

As for arms purchases, Cluster 3 countries do not really buy weapons from NATO and its allies. Instead, Russia has a clear edge in this group. China also seems to be a relatively important arms supplier, and the image of China is apparently the most favourable in this cluster.

5. Discussion

The results of the hierarchical clustering thus show that the world economy is arranged into three blocs. These three blocs are centred around the United States, the European Union as well as the conglomerate of the two major non-Western powers (i.e. China and Russia), respectively. Our results are in line with previous research suggesting a three-bloc structure in the global economy (*Campos et al. 2023; Gopinath et al. 2024; Aiyar – Ohnsorge 2024; Bolhuis et al. 2023; Fernández-Villaverde et al. 2024; Conteduca et al. 2025; Baur et al. 2023* as well as *Gopinath 2023*), and similarly to previous papers, our results also reveal blocs centred around major global geopolitical powers.

However, the composition of the respective blocs differs from any of those reviewed in *Section 2*. Previous research on geoeconomic fragmentation emphasised the divide between East and West as well as the dichotomic systemic rivalry between the United States (often accompanied by i.a. the European Union, Japan, South Korea and Australia) and China (often accompanied by i.a. Russia, Central Asia and North Africa); others complement this structure with a neutral bloc. Our results, however, show a different structure. According to our findings, the United States and the European Union belong to separate blocs, while China, Russia and certain aligned states form the third one. (The latter, i.e. Russia and China jointly forming the cornerstone of a predominantly Eastern bloc however corroborates a vast array of literature reviewed in *Section 2.3*.) The fact that the United States and the European Union belong to different geoeconomic blocs challenges previous consensus in the fragmentation literature and suggests that the *a priori* linking of the US and the EU (as seen in many pieces of literature) may need reconsideration.

This result of ours has also implications on a broader scale: the public discourse on fragmentation also tends to classify the United States and the European Union into one geoeconomic bloc, which, however, is not justified by our data. The finding that these two Western actors belong to distinct clusters obviously does not weaken existing diplomatic and economic ties between them. Nevertheless, this measured geopolitical distance between the United States and the European Union should be taken into account in the overall fragmentation discourse. With our findings, we hope to have contributed to the literature on geoeconomic fragmentation. By answering the research questions and presenting a three-bloc structure of the world economy, we offer a new narrative for the fragmentation discourse where – despite all presuppositions – the Western bloc turns out to be two blocs instead of one.

While supplementing the fragmentation literature with novel findings, our paper also has certain limitations. First, our results represent a snapshot of the global economy – while geoeconomic fragmentation (along with deglobalisation, decoupling, etc.) is rather of a processual nature. Thus, longitudinal analysis may prove valuable if one aims to capture changes in how the global economy is structured (and thus add to our description of its present characteristics). Such a longitudinal analysis would also allow for a deeper understanding of the respective state actors' motives for pursuing fragmentation-enhancing policies. While relevant from our perspective, the cross-sectional nature of our research did not allow for the examination of such motives – future research delving deeper into this question would be of great value.

Second, due to the unavailability and inaccuracy of data in the case of certain variables, in our analysis, we had to exclude certain countries (Latin America and the majority of Africa, in particular). The exclusion of these countries from our analysis necessarily leads to an incompleteness of the results: the countries excluded are

typically considered as part of the neutral bloc. In addition, we were not able to use FDI data due to many missing values in the breakdown of FDI stocks. The need to omit certain variables and regions may have distorted the results to a certain extent. Furthermore, an analysis comprising all countries of the globe would also allow for identifying connector countries in the sample, as well as a deeper understanding of their function. (Pertinent studies listed in *Section 2.3* indicate that i.a. Latin American countries may fall under this definition – these were, however, excluded from our analysis due to data gaps.) Moreover, examining connector countries separately – by analytically distinguishing them from the main sample comprising the respective blocs – would make it possible to map their roles in mediating between-bloc interactions. However, conducting such an analysis (and especially the exploratory identification of connector countries) would have exceeded the scope of the present study. We encourage future research to pursue investigations in this direction as well.

Third, it is a general challenge to identify a broad set of variables capturing geoeconomic fragmentation while also avoiding excessive multicollinearity. Clustering does not involve estimating coefficients or predicting dependent variables, so in this sense, correlation between our variables does not violate any assumptions. Nevertheless, as the Ward criterion relies on calculating Euclidean distances, similar variables might carry the risk of overemphasising certain features. In our analysis, data on trade and arms purchases could thus play a more pronounced role in driving the classification of countries into clusters. If higher data quality and availability could be reached (especially in the case of FDI or attitude surveys), the set of variables could be further developed and refined, for example by using principal component analysis. It would be desirable for future quantitative research to address the above-mentioned matters.

References

- Abeliansky, A. – Belabed, C.A. – Mayrhuber, J. (2023): *Enjoy the silence? (De)globalization and cross-border investment – a gravity approach*. OeNB Bulletin, 2024/Q2: 60–81. [https://www.oenb.at/dam/jcr:6d105403-3807-45fa-87c3-4a584a0f5c1a/bulletin-july-2024-\(de\)globalization-and-cross-border-investment.pdf](https://www.oenb.at/dam/jcr:6d105403-3807-45fa-87c3-4a584a0f5c1a/bulletin-july-2024-(de)globalization-and-cross-border-investment.pdf)
- Airaud, F. – de Soyres, F. – Fisgin, E. – Gaillard, A. – Santacreu, A.M. – Richards, K. et al. (2025): *Understanding Trade Fragmentation*. Federal Reserve Board, FEDS Notes, December 12. <https://www.federalreserve.gov/econres/notes/feds-notes/understanding-trade-fragmentation-20251212.html>. Downloaded: 27 January 2026.
- Aiyar, S. – Chen, J. – Ebeke, C.H. – Garcia-Saltos, R. – Gudmundsson, T. – Ilyina, A. et al. (2023): *Geoeconomic fragmentation and the future of multilateralism*. IMF Staff Discussion Note SDN/2023/001. International Monetary Fund. <https://doi.org/10.5089/9798400229046.006>

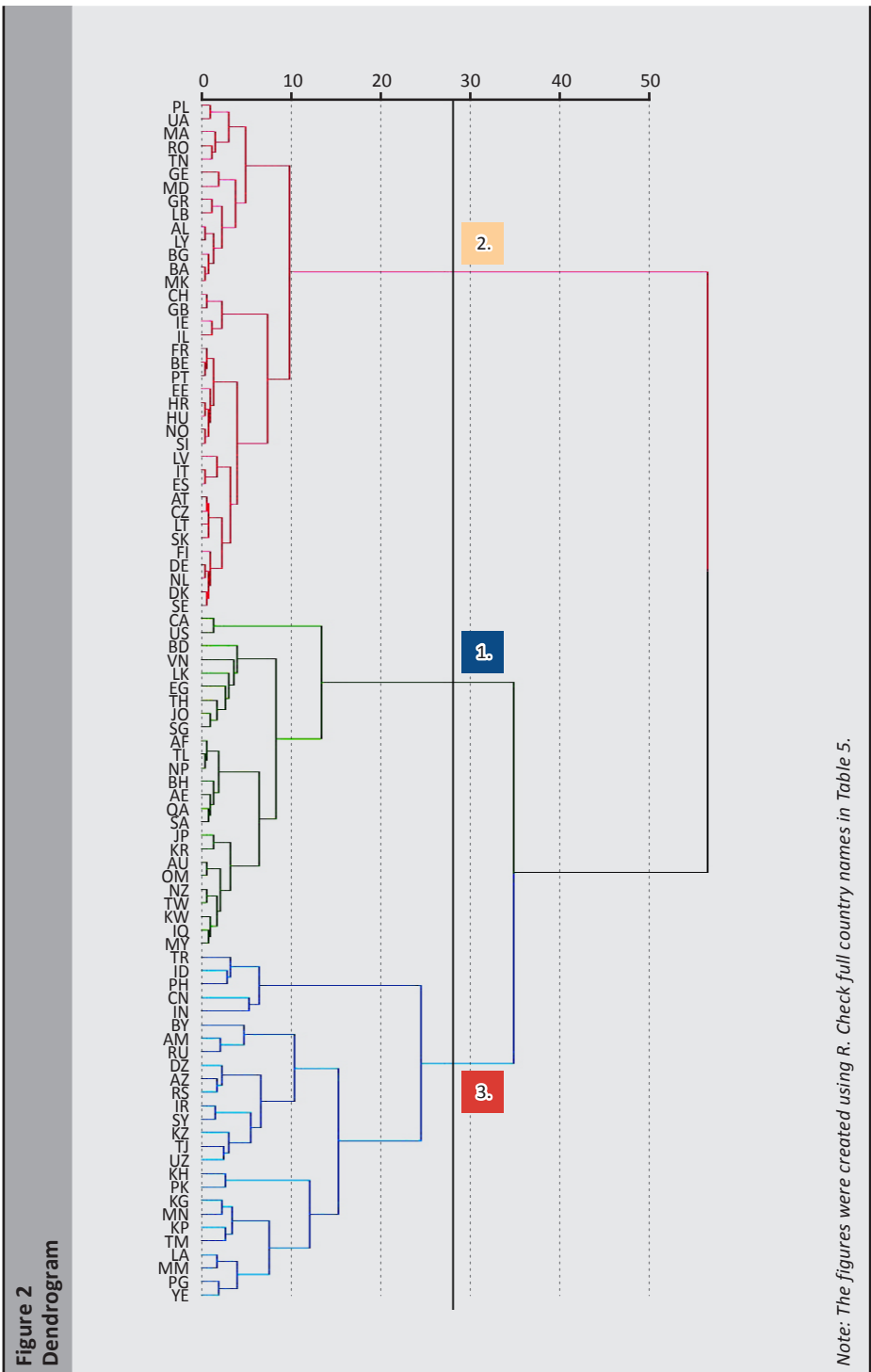
- Aiyar, S. – Ilyina, A. (2023): *Goeconomic fragmentation: An overview*. In: Aiyar, S. – Presbitero, A.F. – Ruta, M. (eds.): *Goeconomic Fragmentation – The Economic Risks from a Fractured World Economy*. CEPR Press, pp. 9–18.
- Aiyar, S. – Ohnsorge, F. (2024): *Goeconomic Fragmentation and “Connector” Countries*. MPRA Paper No. 121726. <https://mpra.ub.uni-muenchen.de/121726/>
- Altas, D. – Arian, G. (2017): *The analysis of Human Development Index with cluster analysis techniques*. Social Sciences Research Journal, 6(3): 126–138. <https://socialsciencesresearchjournal.com/index.php/ssrj/article/view/732>
- Altman, S.A. – Bastian, C.R. – Fattedad, D. (2024): *Challenging the deglobalization narrative: Global flows have remained resilient through successive shocks*. Journal of International Business Policy, 7(4): 416–439. <https://doi.org/10.1057/s42214-024-00197-0>
- Alvarez, J.A. – Andaloussi, M.B. – Maggi, C. – Sollaci, A. – Stuermer, M. – Topalova, P. (2023): *Goeconomic fragmentation and commodity markets*. IMF Working Paper No. 2023/201. <https://doi.org/10.5089/9798400252426.001>
- Baur, A. – Dorn, F. – Flach, L. – Fuest, C. (2023): *Rethinking goeconomics: Trade policy scenarios for Europe’s economy*. EconPol Policy Report No. 44, CESifo GmbH, Munich. https://www.ifo.de/DocDL/EconPol_Policy_Report_44-Rethinking_Goeconomics.pdf
- Baur, A. – Dorn, F. – Flach, L. – Fuest, C. (2025): *Goeconomic fragmentation and the role of non-aligned countries*. Economics Letters, 255, 112533. <https://doi.org/10.1016/j.econlet.2025.112533>
- Bekkers, E. – Góes, C. (2023): *The potential impact of global decoupling accounting for innovation spillovers from trade*. In: Aiyar, S. – Presbitero, A. – Ruta, M. (eds.): *Goeconomic Fragmentation – The Economic Risks from a Fractured World Economy*. CEPR Press, pp. 55–61.
- Bolhuis, M.A. – Chen, J. – Kett, B. (2023): *Goeconomic fragmentation: Accounting for commodities*. In: Aiyar, S. – Presbitero, A. – Ruta, M. (eds.): *Goeconomic Fragmentation – The Economic Risks from a Fractured World Economy*. CEPR Press, pp. 39–44.
- Campos, R.G. – Estefanía-Flores, J. – Furceri, D. – Timini, J. (2023): *Geopolitical fragmentation and trade*. Journal of Comparative Economics, 51(4): 1289–1315. <https://doi.org/10.1016/j.jce.2023.06.008>
- Conteduca, F.P. – Mancini, M. – Romanini, G. – Giglioli, S. – Borin, A. – Attinasi, M.G. et al. (2025): *Fragmentation and the future of GVCs*. Bank of Italy Occasional Paper No. 932. <https://doi.org/10.32057/0.QEF.2025.932>

- Farkas, B. – Pelle, A. – Somosi, S. (2023): *Az Európai Unió és a geoökonómiai kihívások – ipar- és versenypolitikai válaszok (The European Union and geoeconomic challenges: industrial and competition policy responses)*. Közgazdasági Szemle (Economic Review), 70(11): 1193–1212. <https://doi.org/10.18414/KSZ.2023.11.1193>
- Felbermayr, G. – Mahlkow, H. – Sandkamp, A. (2023): *Cutting through the value chain: The long-run effects of decoupling the East from the West*. *Empirica*, 50: 75–108. <https://doi.org/10.1007/s10663-022-09561-w>
- Fernández-Villaverde, J. – Mineyama, T. – Song, D. (2024): *Are we fragmented yet? Measuring geopolitical fragmentation and its causal effect*. NBER Working Paper No. 32638. <https://doi.org/10.3386/w32638>
- Ginter, T. (2025): *Geoeconomic Fragmentation in the Western Balkans*. *Financial and Economic Review*, 24(2): 27–46. <https://doi.org/10.33893/FER.24.2.27>
- Gokmen, G. (2017): *Clash of Civilizations and the Impact of Cultural Differences on Trade*. *Journal of Development Economics*, 127: 449–458. <https://doi.org/10.1016/j.jdevco.2016.12.008>
- Gopinath, G. (2023): *Cold War II? Preserving Economic Cooperation Amid Geoeconomic Fragmentation*. Presented at the 20th World Congress of the International Economic Association on 11 December. <https://www.imf.org/en/news/articles/2023/12/11/sp121123-cold-war-ii-preserving-economic-cooperation-amid-geoeconomic-fragmentation>
- Gopinath, M.G. – Gourinchas, P.O. – Presbitero, A.F. – Topalova, P. (2024): *Changing global linkages: a new cold war?*. IMF Working Paper No. 2024/76. <https://doi.org/10.5089/9798400272745.001>
- Halmi, P. (2023): *Globalisation versus Deglobalisation*. *Financial and Economic Review*, 22(2): 5–24. <https://doi.org/10.33893/FER.22.2.5>
- Halmi, P. (2025a): *Globális dezintegráció? A globális szabadkereskedelem víziójától a geoökonómiai fragmentációig (Global disintegration? From the vision of global free trade to geoeconomic fragmentation)*. *Külgazdaság (External Economic Bulletin)*, 69(1–2): 51–65. <https://doi.org/10.47630/KULG.2025.69.1-2.51>
- Halmi, P. (2025b): *Globalizáció vagy deglobalizáció? (Globalization or Deglobalization?)*. *Magyar Tudomány*, 186(10): 1898–1910. <https://doi.org/10.1556/2065.186.2025.10.4>
- IMF (2023a): *Geoeconomic fragmentation and foreign direct investment*. In: *World Economic Outlook, April 2023: A Rocky Recovery*, Chapter 4. USA: International Monetary Fund. <https://www.elibrary.imf.org/display/book/9798400224119/CH004.xml>

- IMF (2023b): *Fragmentation and Commodity Markets: Vulnerabilities and Risks*. World Economic Outlook, October 2023, Chapter 3. Washington, International Monetary Fund. <https://www.elibrary.imf.org/display/book/9798400235801/CH003.xml>
- Javorcik, B.S. – Kitmueller, L. – Schweiger, H. – Yildirim, M.A. (2023): *Economic Costs of Friend-Shoring*. CID Faculty Working Paper Series 422, Harvard University, Cambridge, MA. <https://growthlab.hks.harvard.edu/publications/economic-costs-friend-shoring>
- Jiménez-Almazán, M. – Uribe-Toril, J. – Ruiz-Real, J.L. (2020): *International trade and sustainability: Bibliometric and cluster analysis*. Sustainability, 12(17), 6816. <https://doi.org/10.3390/su12176816>
- Kaarevirta, J. – Kerola, E. – Nuutilainen, R. (2023): *Do international investment and trade flows show any signs of fragmentation?*. BOFIT Policy Brief 2023 No. 12. <https://publications.bof.fi/bitstream/handle/10024/53083/bpb1223.pdf?sequence=1>
- Kirsamer, N. – Riha, K. (2025): *Mapping geopolitical fragmentation: a bilateral index for economic analysis*. OeNB Bulletin, 2025/Q4: 1–35. <https://www.oenb.at/Publikationen/Volkswirtschaft/bulletin.html>
- Maskus, K.E. (2023): *The impacts of technological geoeconomic fragmentation: Comments and observations*. In: Aiyar, S. – Presbitero, A. – Ruta, M. (eds.): *Geoeconomic Fragmentation – The Economic Risks from a Fractured World Economy*. CEPR Press, pp. 75–80.
- Mohr, C. – Trebesch, C. (2025): *Geoeconomics*. CESifo Working Paper No. 11564, CESifo GmbH, Munich. https://www.ifo.de/DocDL/cesifo1_wp11564.pdf
- Norring, A. (2024a): *Geoeconomic fragmentation, globalization, and multilateralism*. BoF Economics Review No. 2. Bank of Finland, Helsinki. <https://nbn-resolving.de/urn:nbn:fi-fe2024031811700>
- Norring, A. (2024b): *The economic effects of geoeconomic fragmentation*. BOFIT Policy Brief No. 8. Bank of Finland, Helsinki. <https://www.econstor.eu/bitstream/10419/304310/1/1905432968.pdf>
- Plummer, M.G. (2023): *Estimating the costs of geoeconomic fragmentation to the global economy*. In: Aiyar, S. – Presbitero, A. F. – Ruta, M. (eds.): *Geoeconomic Fragmentation – The Economic Risks from a Fractured World Economy*. CEPR Press, pp. 45–51.
- Witt, M.A. – Lewin, A.Y. – Li, P.P. – Gaur, A. (2023): *Decoupling in international business: Evidence, drivers, impact, and implications for IB research*. Journal of World Business, 58(1), 101399. <https://doi.org/10.1016/j.jwb.2022.101399>

Appendix

Table 4 Data sources		
Variable	Variable names	Source
Trade share of “great power” j in total foreign trade of goods of country i in 2022	TRADE_SHARE_US TRADE_SHARE_CN TRADE_SHARE_EU TRADE_SHARE_RU	IMF International Trade in Goods (by partner country): https://data360.worldbank.org/en/dataset/IMF_DOT
Net FDI stock of “great power” j in country i in 2023	FDI_US FDI_CN FDI_EU FDI_RU	IMF Direct Investment Positions by Counterpart Economy: https://data360.worldbank.org/en/dataset/IMF_CDIS
Approved financing amounts by AIIB to country i between 2016 and July 2025	FIN_AIIB	AIIB Approved Financing Amounts: https://www.aiib.org/en/projects/list/year/2025/member/All/sector/All/financing_type/All/status/All
IBRD loans, total disbursed amount to country i as of 30 June 2025	LOAN_IBRD	IBRD Loans Disbursed Amount: https://financesone.worldbank.org/ibrd-country-economy-wise-loan-summary/DS01538
Ratio of arms purchases by country i from source k , for items purchased between 2016-2024	ARMS_NATO ARMS_CN ARMS_RU	SIPRI Arms Transfers Database, Transfers of Major Conventional Arms: https://armstransfers.sipri.org/ArmsTransfer/TransferData
Net favourability of China in country i , 2024 or latest data available since 2020	FAV_CN	Asia Society Policy Institute’s Global Public Opinion on China: https://asiasociety.org/policy-institute/global-public-opinion-china
<i>Note: FDI was omitted in final output due to data availability issues (several cases of missing data).</i>		



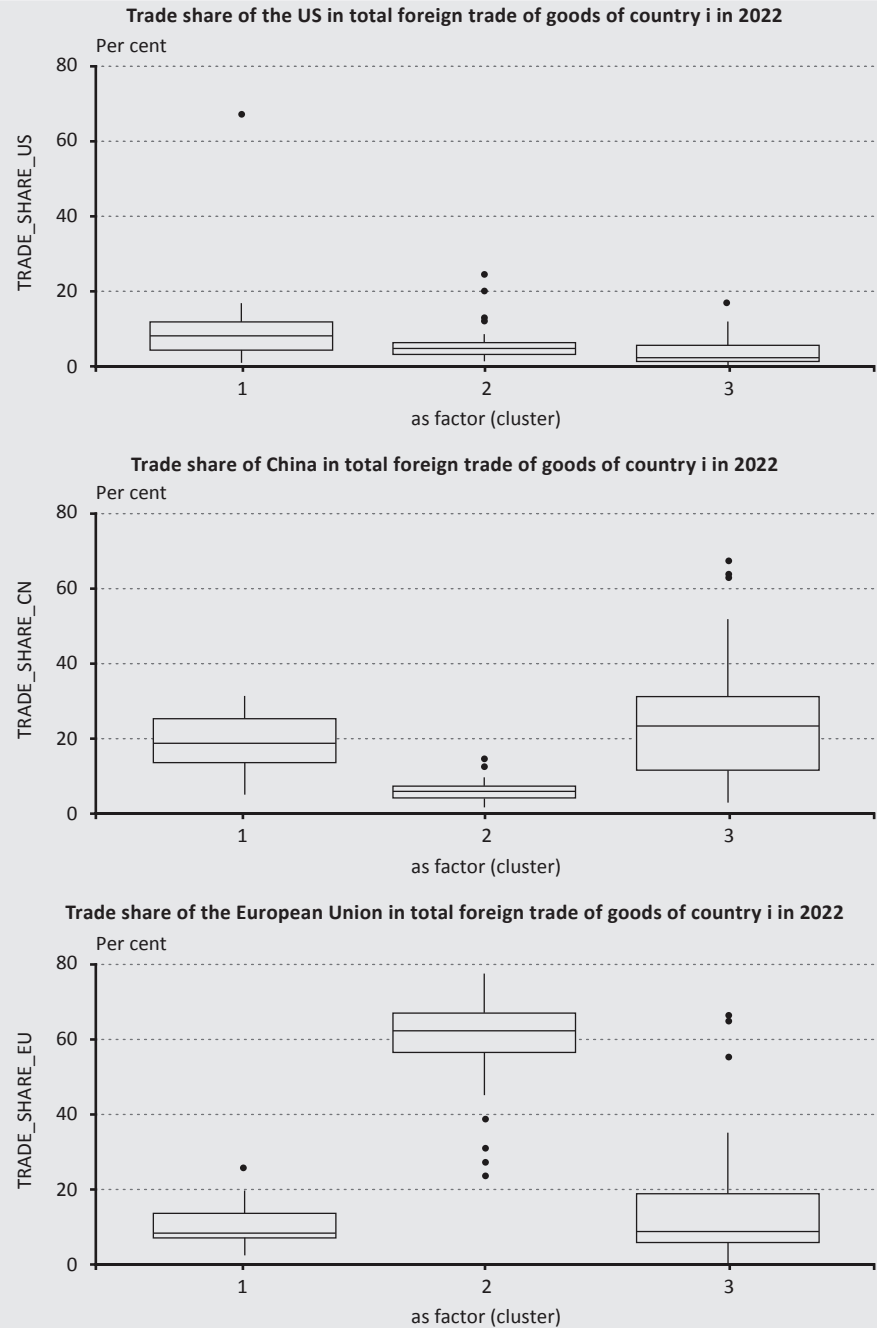
Note: The figures were created using R. Check full country names in Table 5.

Table 5
List of countries in each cluster (in alphabetical order)

Cluster 1 "US" 25 countries	Cluster 2 "EU" 38 countries	Cluster 3 "CN + RU" 26 countries
Afghanistan (AF)	Albania (AL)	Algeria (DZ)
Australia (AU)	Austria (AT)	Armenia (AM)
Bahrain (BH)	Belgium (BE)	Azerbaijan (AZ)
Bangladesh (BD)	Bosnia and Herzegovina (BA)	Belarus (BY)
Canada (CA)	Bulgaria (BG)	Cambodia (KH)
East Timor (Timor-Leste, TL)	Croatia (HR)	China (CN)
Egypt (EG)	Czech Republic (CZ)	India (IN)
Iraq (IQ)	Denmark (DK)	Indonesia (ID)
Japan (JP)	Estonia (EE)	Iran (IR)
Jordan (JO)	Finland (FI)	Kazakhstan (KZ)
Kuwait (KW)	France (FR)	Kyrgyzstan (KG)
Malaysia (MY)	Georgia (GE)	Laos (LA)
Nepal (NP)	Germany (DE)	Mongolia (MN)
New Zealand (NZ)	Greece (GR)	Myanmar (MM)
Oman (OM)	Hungary (HU)	North Korea (KP)
Qatar (QA)	Ireland (IE)	Pakistan (PK)
Saudi Arabia (SA)	Israel (IL)	Papua New Guinea (PG)
Singapore (SG)	Italy (IT)	Philippines (PH)
South Korea (KR)	Latvia (LV)	Russia (RU)
Sri Lanka (LK)	Lebanon (LB)	Serbia (RS)
Taiwan (TW)	Libya (LY)	Syria (SY)
Thailand (TH)	Lithuania (LT)	Tajikistan (TJ)
United Arab Emirates (AE)	Moldova (MD)	Türkiye (TR)
United States (US)	Morocco (MA)	Turkmenistan (TM)
Vietnam (VN)	Netherlands (NL)	Uzbekistan (UZ)
	North Macedonia (MK)	Yemen (YE)
	Norway (NO)	
	Poland (PL)	
	Portugal (PT)	
	Romania (RO)	
	Slovakia (SK)	
	Slovenia (SI)	
	Spain (ES)	
	Sweden (SE)	
	Switzerland (CH)	
	Tunisia (TN)	
	Ukraine (UA)	
	United Kingdom (GB)	

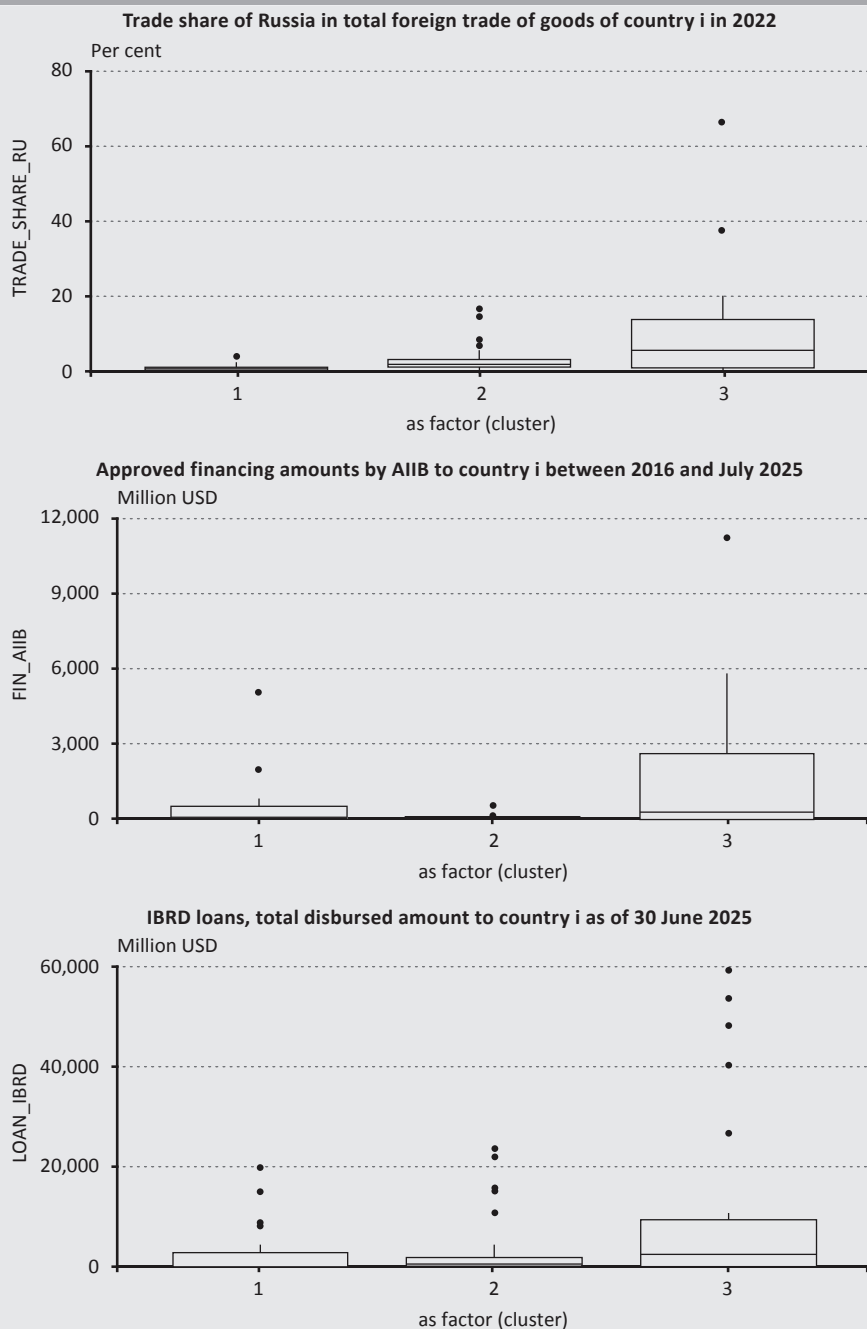
Note: N = 89

Figure 3
Boxplots



Note: Cluster 1: "US", Cluster 2: "EU", Cluster 3: "CN + RU". The figures were created using R.

Figure 3
Boxplots



Note: Cluster 1: "US", Cluster 2: "EU", Cluster 3: "CN + RU". The figures were created using R.

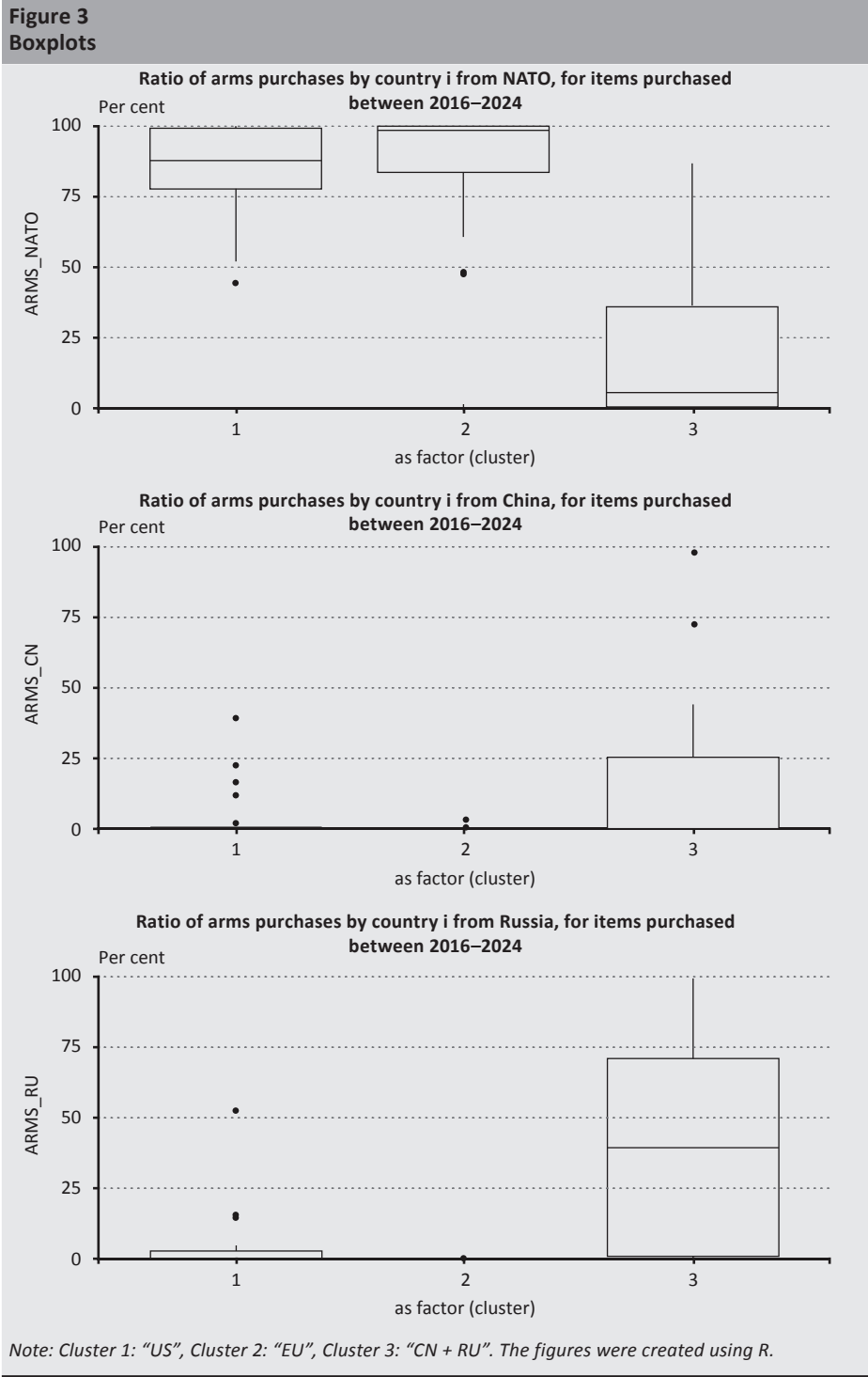
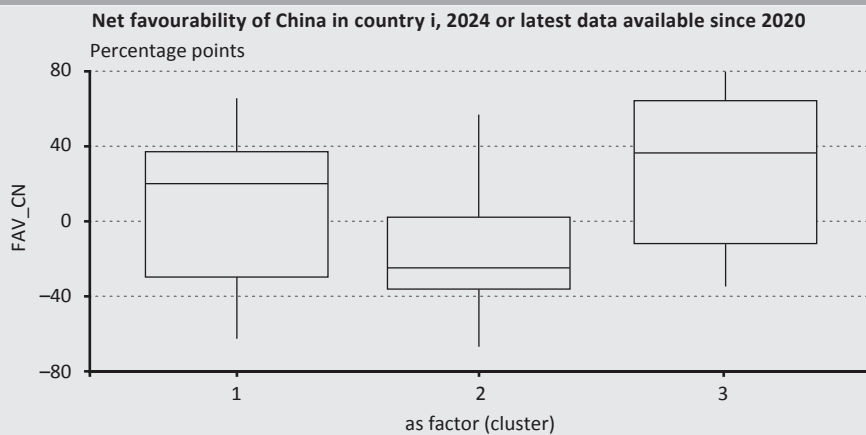


Figure 3
Boxplots

Note: Cluster 1: "US", Cluster 2: "EU", Cluster 3: "CN + RU". The figures were created using R.

The Role of Cash in Household Savings*

Ildikó Ritzl^{ID} – Anikó Száraz^{ID} – Anikó Bódi-Schubert^{ID}

According to both domestic and international analyses, the stable behaviour of household cash holdings in developed countries is primarily attributable to cash holdings for accumulation purposes. In our study, we review the factors that characterised the holding of forint cash for accumulation purposes between 2022 and 2025 and examine the motives behind individual cash-holding decisions, based on the results of a survey conducted among the adult Hungarian population. Our findings suggest that households' savings practices can be organised into a savings needs pyramid, in which cash plays a significant role in the safety reserve category, and individuals make what they perceive to be a rational decision regarding its holding in light of the foregone return. The mobilisation of funds held in liquid form as a safety reserve towards investment can be achieved by increasing institutional trust and reducing economic and social uncertainty.

Journal of Economic Literature (JEL) codes: G41, G51, E21

Keywords: savings, cash, savings needs pyramid

1. Introduction

With the spread of electronic payments, the role of cash has changed significantly in recent decades. At the start of the millennium, in conjunction with a decline in transactional cash demand, many predicted that cash would soon disappear from everyday life (Rogoff 2016). By contrast, nominal demand for cash – aside from the Scandinavian countries – has increased on the whole over the past decade and a half (Ashworth – Goodhart 2020). Several studies confirm that this phenomenon is driven by cash holding for accumulation purposes, which is also evident in the case of demand for the euro (Zamora-Pérez 2021).

* The papers in this issue contain the views of the authors which are not necessarily the same as the official views of the Magyar Nemzeti Bank.

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During periods of high inflation, it is even more economically justified for households to significantly reduce their cash holdings and invest accumulated cash in interest-bearing instruments to preserve stability of value. In Hungary, however, during the period of rising inflation in 2022–2023, the amount of cash held by households fell only to a relatively moderate extent, even as inflation reached 25.7 per cent in early 2023, and the nominal value of cash in circulation remained stable even in the volatile economic environment that followed. Examining the relationship between inflation and households' cash holdings is also justified because, according to economic logic, it is not rational to hold cash even in a low-inflation environment; the losses are simply smaller in such circumstances.

Our research was motivated by a desire to understand how households structure the composition of their savings and asset accumulation, with particular regard to the role of cash. What might explain why such a seemingly irrational trend has been observed in Hungary in recent years, despite the progress in financial education (*Educational Authority 2024*)?

Bódi-Schubert – Ritzlné Kazimir (2023) conducted a macro-focused analysis covering the period 2004–2022. According to their findings, over the long-term cash holdings are shaped by households' net wealth, long-term and short-term yields, uncertainty, the real effective exchange rate, the cost of financial services and the institutional environment. Over the short term, only uncertainty and short-term yields were found to be explanatory factors. Building on this earlier analysis, the present study complements the investigation by mapping the factors influencing individual decision-making, demonstrating how cash holdings are shaped by various factors at the individual level, and how uncertainty and trust in the institutional system are reflected in individual savings decisions.

The first part of the study presents the macroeconomic trends observed since 2022, thereby complementing the analysis by *Bódi-Schubert – Ritzlné Kazimir (2023)*; this is followed by an examination of individual attitudes on savings decisions based on the results of focus group discussions and a representative sample survey of households.

2. Trends in cash demand and accumulation

In the period 2022–2025, nominal cash demand was on the rise, apart from the period of rising inflation in 2022–2023. Cash demand can be for transactional or accumulation purposes. In line with previous trends, transactional cash demand showed a downward trend, whereas non-transactional cash holdings continued

to expand in nominal terms during this period. The increase in households' cash holdings for accumulation purposes was driven by the persistently high uncertainty characteristic of this period, which was mitigated by relatively high yields. Finally, *Subsection 2.3* confirms that activity in the hidden economy still does not represent the main driver of growth in cash demand.

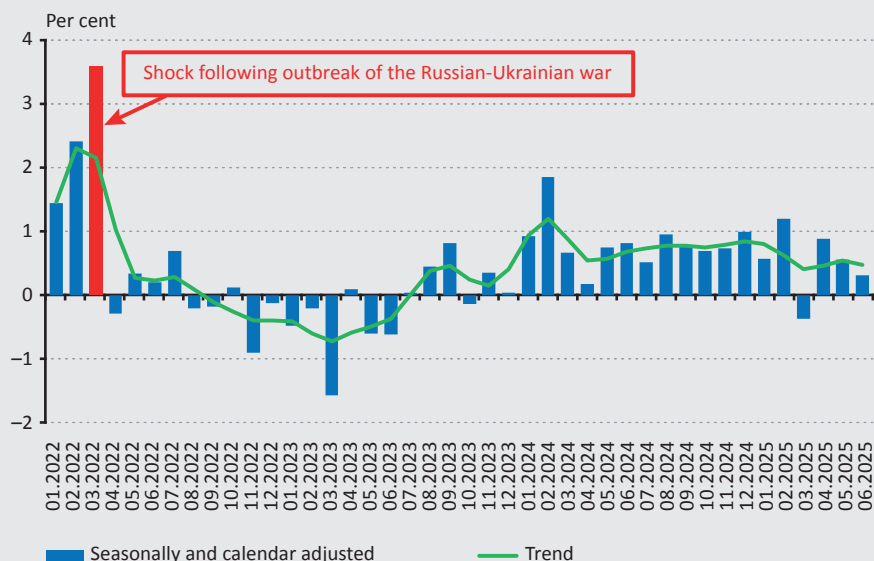
2.1. Changes in cash demand

This study examines the development of cash demand between January 2022 and 2025 Q1. In March 2022, the panic caused by the outbreak of the Russia–Ukraine war led to a surge in demand for cash. In the two weeks following the start of the war, the amount of cash in circulation increased by nearly HUF 500 billion, representing a rise of more than 6 per cent in three weeks. The cash demand shock following the outbreak of the Russia–Ukraine war also occurred in countries across the region and in the euro area, although its magnitude decreased with increasing geographical distance from the conflict (*Faella – Zamora-Pérez 2025*).

Following the cash demand shock, the adjustment process lasted until October 2022, during which time households gradually reduced the cash holdings accumulated in March. This was reflected in the fact that, although a monthly increase in nominal cash holdings was observed at the start of the process, the rate of this increase fell short of previous levels. At the same time, weakening of the correction process coincided with a drop in cash demand caused by inflation, which had been rising dynamically since 2022 Q2. As a result, a decline occurred on a monthly basis from August 2022 to July 2023: during this period, the amount of cash in circulation fell by 4.2 per cent, or HUF 353.4 billion. Despite this decline, at the end of July 2023, the amount of cash in circulation was 2.6 per cent higher than at the end of 2021. Starting from August 2023, in line with the moderation of inflation, cash holdings have once again moved on an upward trend, although the monthly growth rate has lagged behind the rate seen between 2013 and 2020. Nominal cash in circulation increased by 18.4 per cent from HUF 7,788.3 billion at the end of 2021 to HUF 9,218.6 billion by the end of June 2025 (*Figure 1*).

Examining the amount of cash in circulation in terms of its real value or in relation to household wealth or GDP, it is clear that the period between 2022 and 2025 differed significantly from the economic boom period between 2013 and 2019 (*Table 1*).

Figure 1
Changes in cash demand based on seasonally and calendar-adjusted data



Note: Previous month = 100; the value marked in red in the figure indicates an outlier detected by the JDemetra+ seasonal adjustment software.

Source: Calculations based on Magyar Nemzeti Bank (MNB) data

Table 1
Key data for periods relevant to cash demand

	2013–2019	2022 – June 2025
Annual average change in households' real net financial wealth (%)	+10.1	+4.3
Average 3-month government bond market reference interest rates (%)	+1.1	+7.9
Average annual change in real GDP (%)	+4.2	+1.0
Annual average inflation (%)	+1.4	+9.1
Monthly relative standard deviation of changes in cash demand during the period in question (%)	1.1	2.7
Annual average change in the nominal value of cash holdings (%)	+13.4	+3.9
Annual average change in the real value of cash holdings (%)	+10.9	–5.9

Source: Based on MNB Preliminary financial accounts of the general government and households: <https://statiztika.mnb.hu/statistical-topics/financial-accounts/statistical-releases/preliminary-financial-accounts-of-general-government-and-households>, Government securities market reference interest rates: https://statiztika.mnb.hu/statistical-topics/interest-rates_-money-and-capital-market-data/benchmark-yields-on-government-debt-securities/benchmark-yields-on-government-debt-securities and Hungarian Central Statistical Office (HCSO) data (1.2.1.1. Key price indices, by month [same period of the previous year = 100.0 per cent], https://www.ksh.hu/stadat_files/ara/en/ara0039.html and 21.2.1.8. Gross domestic product (GDP) output at 2021 average prices, by economic sector, seasonally and calendar-adjusted and balanced quarterly data [HUF million], https://www.ksh.hu/stadat_files/gdp/en/gdp0092.html), calculation by authors, preliminary estimate for 2025

Following the 2008–2011 economic crisis, the amount of cash in circulation grew dynamically in both real and nominal terms starting from January 2013 to the end of 2019, with this expansion characterised by moderate volatility. The cash-to-GDP ratio rose from 10.6 per cent in 2013 to 13.8 per cent in 2019. This steady growth was attributable to low inflation, a moderating interest rate environment, dynamic economic growth and rising household wealth.

By contrast, from 2022 onwards, growth in household financial wealth moderated, with yields significantly exceeding the levels seen between 2013 and 2019. Cash holdings as a percentage of GDP declined from 2020 and stabilised at around 10.8 per cent from 2023. Overall, the macroeconomic environment was unfavourable during this period, with GDP growth averaging 1 per cent annually and average annual inflation at 9.1 per cent. The turbulent economic environment was also reflected in the high relative standard deviation of cash demand. As a result, the real value of cash in circulation declined by an average of 5.9 per cent annually (*Table 1*). The trends for both nominal and real values of the amount of cash proved to be inelastic relative to the rise in the price level.

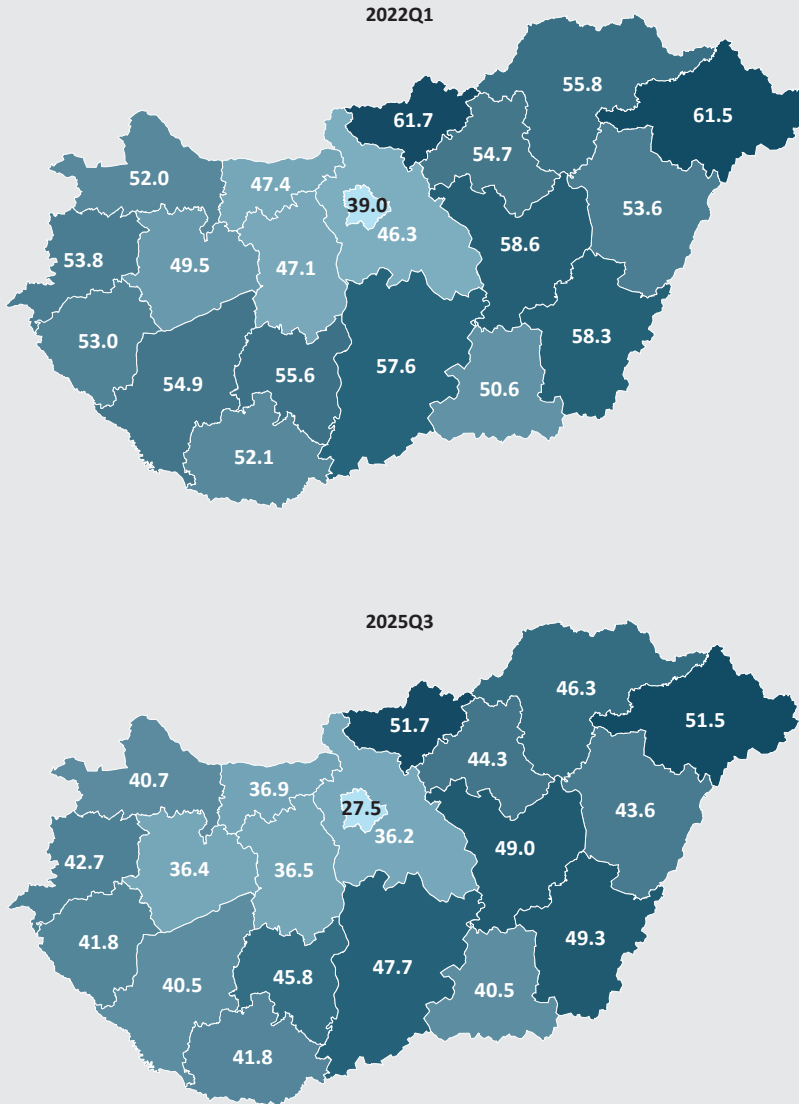
These trends suggest that, following the decline in previous years, cash holdings as a proportion of GDP have stabilised since 2023, meaning that cash holdings for accumulation purposes have stabilised at a lower level in real terms.

2.2. Cash demand of Hungarian households

Electronic payment methods expanded strongly between 2022 and 2025, according to data from online cash registers (OPG). A year-on-year decline in the number of cash transactions became characteristic from June 2022, and from November 2023, the value of cash transactions has also been falling continuously compared to the same prior-year period, leading us to conclude that demand for cash for transactional purposes is dropping. In January 2022, cash transactions accounted for 50.7 per cent of the value of transactions recorded in the OPG system; by the end of June 2025, this proportion had fallen to 39.4 per cent.

At the same time, cash use exhibits significantly different patterns across regions, which can be explained by regional differences in both income and preferences for cash use. It is characteristic of the country as a whole that as gross real average earnings rise, the proportion of cash transactions falls; however, the rate of change in this indicator affects the change in the proportion of cash transactions to varying degrees across the counties in Hungary (*Figure 2*).

Figure 2
Total value of cash transactions to total transactions (%)



Source: MNB, National Tax and Customs Administration of Hungary online cash register database

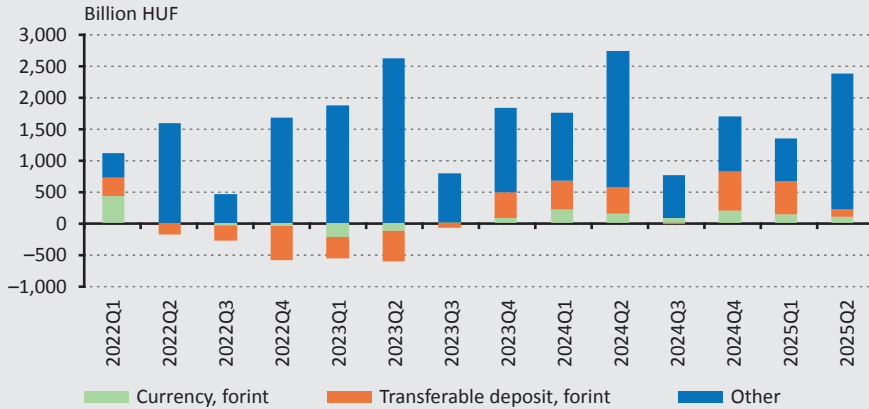
Based on OPG data, alongside a clear decline in demand for cash for transactional purposes, the accumulation of cash for savings purposes has become the dominant driver of household demand for cash.

Examining savings behaviour as a proportion of GDP, the Hungarian household sector has seen net financial savings (also known as net lending, calculated as the difference between gross financial asset growth and liability growth) of around 6 per cent of GDP, which is higher than the figures recorded in other countries in the region or across the EU as a whole, according to data from the MNB's 2025 Savings Report (*MNB 2025*). In general, although household net financial savings show an upward trend relative to GDP, the proportion of cash within gross savings has been steadily declining since 2011. The proportion of savings held in cash fell from 9.3 per cent in 2022 to 7.7 per cent in 2025 H1.

Given the rise in inflation in the summer of 2022, it may have seemed a rational decision to tie up cash that was losing value and thus preserve its value. However, data from detailed quarterly household financial accounts show that, although the amount of cash held by households fell during the period of high inflation between 2022 Q2 and 2023 Q2, the decline in current account deposits was several times larger (*Figure 3*). Compared to the holdings data at end-2022 Q1, cash held by households had fallen by 6.8 per cent by end-2023 Q2, while deposits held with credit institutions had dropped 16.1 per cent. During the same period, holdings of other financial assets (households' financial assets excluding forint cash and deposits held with credit institutions, such as government securities, bonds and shares) expanded by 17.8 per cent. From this, we conclude that deposits held with credit institutions reacted more flexibly to changes in inflation, while cash holdings can be regarded as rather inelastic in response to rising price levels. In other words, even under unfavourable conditions, households only moderately reallocate their available cash into yield-generating assets, whereas they are much more likely to do so with deposits.

As inflation fell from the end of 2023, the nominal stock of cash holdings and current account deposits held with credit institutions rose again, as households "replenished" funds in these forms of saving. From the end of 2023 Q2 to the same period in 2025, cash holdings increased by 16.5 per cent, deposit holdings by 25.8 per cent and holdings of other financial assets by 26.6 per cent. Thus, even during a period of falling inflation, the trend in nominal cash holdings by households proved to be more inelastic compared to deposit holdings. The inelasticity of cash relative to deposit holdings implies that substitutability between cash and other financial assets, such as government securities, bonds and shares, is considerably lower than between amounts held in current accounts and other financial assets.

Figure 3
Changes in household financial assets compared to the previous quarter



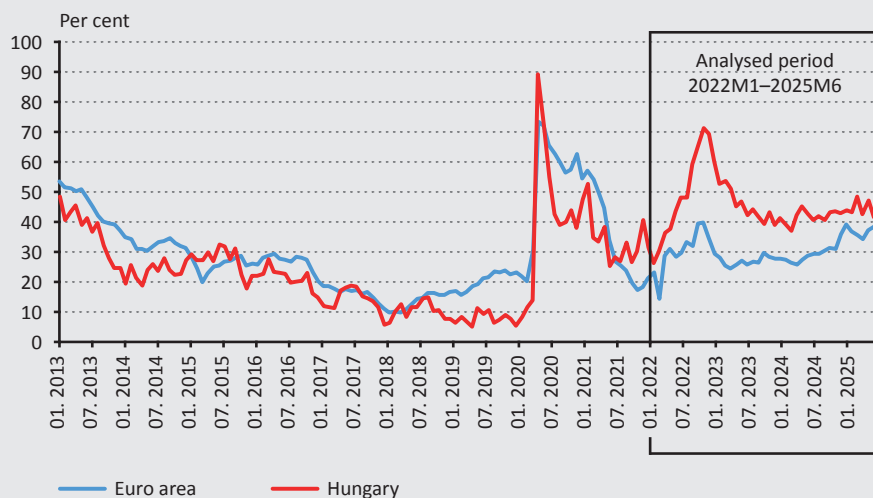
Source: MNB (preliminary financial accounts of the general government and households: <https://statistika.mnb.hu/statistical-topics/financial-accounts/statistical-releases/preliminary-financial-accounts-of-general-government-and-households>)

Bódi-Schubert – Ritzlné Kazimir (2023) demonstrated that rising uncertainty increases demand for cash both in the short term and long term. Uncertainty was approximated using the ESI index, which measures perceptions of unemployment prospects, as the fear of job loss poses a serious existential threat. A higher index value indicates that a larger proportion of the population expects to lose their job in the next twelve months (Figure 4). The Russian–Ukrainian war that broke out in March 2022 significantly increased this uncertainty in Hungary, but the peak reached at that time did not match the levels recorded at the onset of the 2008 crisis or at the start of the COVID-19 pandemic. The difference compared to these local peaks is that the index level has not fallen permanently. The indicator ranges at values between 30 and 40, despite the fact that the unemployment rate has not risen significantly since then, reaching 4.3 per cent in June 2025, which is 0.7 percentage point higher than the figure for June 2022. By way of comparison, the ESI index, which measures unemployment prospects, ranged between 0 and 20 in the period between 2013 and 2019. The persistently high level of uncertainty has been fuelled by the rapid, unexpected economic, political, social and other changes that have characterised the turbulent period continuing to the present day, which (may) directly or indirectly impact individuals' lives significantly and (could) thus lead to growing uncertainty.

Uncertainty regarding unemployment prospects in Hungary has consistently exceeded the euro area average since the COVID-19 pandemic. This pattern was previously observed only during periods of economic crisis. Between 2013 and 2016, the Hungarian and euro area indicators were at similar levels, while between 2016 and 2019, domestic uncertainty lagged significantly behind that of the euro area. The data suggest that uncertainty may continue to contribute to the high level of household cash holdings in Hungary.

Figure 4

Assessment of unemployment prospects for the next twelve months

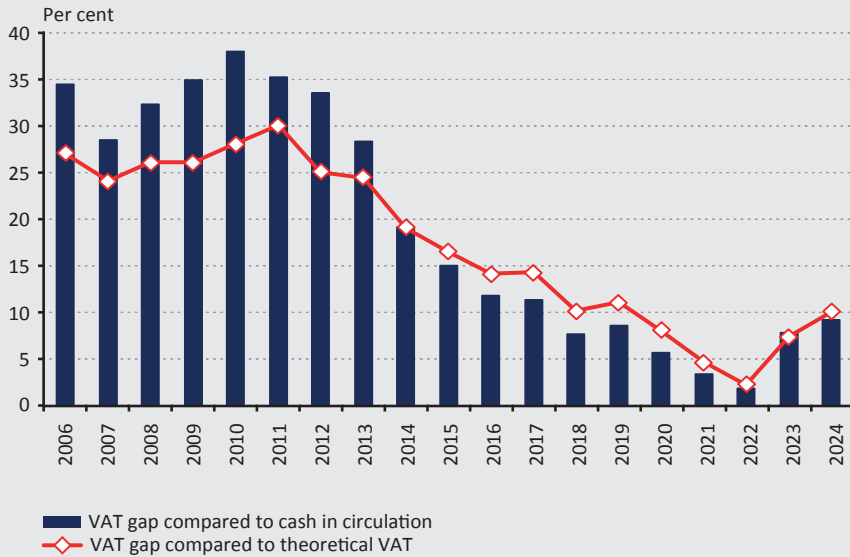


Source: European Commission (Economic Sentiment Indicators: https://ec.europa.eu/economy_finance/db_indicators/surveys/documents/series/nace2_ecfin_2510/consumer_total_sa_nace2.zip, downloaded: 7 November 2025)

2.3. Impact of the hidden economy on cash demand

In public discourse regarding the expansion of the cash in circulation, it is often suggested that the growth of the hidden economy explains the increase in demand for cash. It is clear that, in addition to transaction and savings factors, the cash requirements of the hidden economy also have an impact on cash demand to a certain extent. The most significant measurable factor in the hidden economy is VAT evasion, which declined steadily between 2011 and 2022 based on VAT gap estimates (Ritzlné Kazimir – Máténé Bella 2020); however, a trend reversal occurred from 2023 onwards, with the VAT gap returning to a growth trajectory. The long-term trend in cash demand is explained not only by the usual variables but also by the hidden economy; it is therefore likely that the rising rate of VAT fraud over the past three years has also contributed to the expansion of cash demand (Figure 5).

Figure 5
Hungarian VAT gap as a ratio of theoretical VAT and of cash in circulation



Note: The VAT gap shows the proportion of unpaid VAT relative to theoretical VAT.

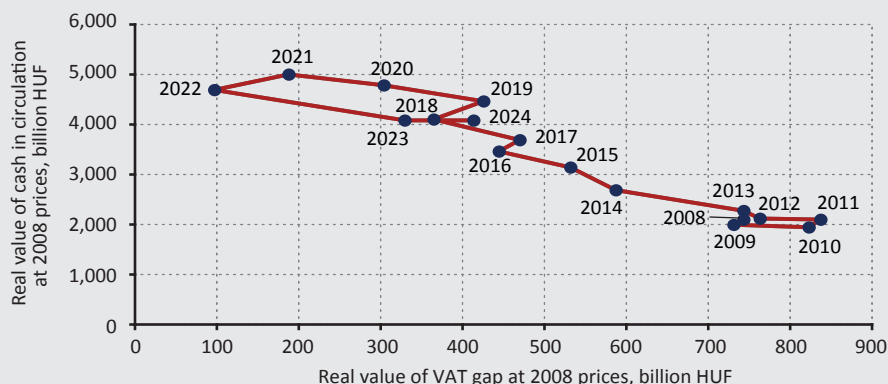
Source: European Commission (VAT Gap in the EU: <https://op.europa.eu/en/publication-detail/-/publication/298d43e2-bd28-11ef-91ed-01aa75ed71a1/language-en>, downloaded: 6 June 2025, as well as VAT Gap in the EU Report 2025: <https://op.europa.eu/en/publication-detail/-/publication/b5c7403b-d67f-11f0-8da2-01aa75ed71a1/language-en>, the 2024 data were calculated from the table containing the underlying data: https://taxation-customs.ec.europa.eu/document/download/c4ce2e13-0a9b-4a26-8f49-7238a8b4dc7a_en, downloaded: 7 January 2026)

Figure 5 shows that the hidden economy may have played a more significant role in the development of cash in circulation between 2006 and 2013 than in the period from 2014 to 2022. The trend reversal that occurred after 2022 may have increased the share of the hidden economy in cash demand once again, but this role cannot be compared to that of the period prior to 2014. This supports the view that, while the significance of the hidden economy cannot be overlooked in terms of cash demand, it was not the main driving force behind the nominal growth in cash demand during the period of intense expansion between 2014 and 2022.

If, instead of the nominal value of cash in circulation and the VAT gap, we focus on their real values, it is clear that there is a strong negative relationship between the two variables, with a correlation coefficient of -0.959 ; i.e. a decrease in the real value of the VAT gap is accompanied by an increase in the real value of cash in circulation. An examination of this phenomenon, as well as an analysis of cash demand in the hidden economy, goes beyond the scope of this study for reasons of

length, but based on *Figure 6*, it can be stated that, *ceteris paribus*, an increase in the VAT gap is not accompanied by an increase in the amount of cash in circulation.

Figure 6
Real value of cash in circulation and real value of VAT gap at 2008 prices



Source: European Commission (VAT Gap in the EU: <https://op.europa.eu/en/publication-detail/-/publication/298d43e2-bd28-11ef-91ed-01aa75ed71a1/language-en>, downloaded: 6 June 2025, as well as VAT Gap in the EU Report 2025: <https://op.europa.eu/en/publication-detail/-/publication/b5c7403b-d67f-11f0-8da2-01aa75ed71a1/language-en>, the 2024 data were calculated from the table containing the underlying data: https://taxation-customs.ec.europa.eu/document/download/c4ce2e13-0a9b-4a26-8f49-7238a8b4dc7a_en, downloaded: 7 January 2026) and Hungarian State Treasury (Budget balance of the central sub-sector, Archive: https://www.allamkincstar.gov.hu/Koltsegetes/Kozponti_alrendszer_-_Merlegek/a-kozponti-alrendszer-koltsegetesi-merlege/Archivum, downloaded: 6 June 2025)

3. Individual incentives for accumulation in cash – research findings

The aim of the research was to explore the motivations behind the prevalence of cash accumulation among the adult Hungarian population. To this end, in 2025 Q1, the Magyar Nemzeti Bank conducted a comprehensive survey of households' cash use habits, mapping household cash use habits and attitudes through a questionnaire survey and focus group interviews.¹ The questionnaire data was collected from a representative sample of 1,500 adults using a hybrid method, comprising 1,000 online respondents and 500 telephone respondents. The survey data was grossed up to the entire adult population based on variables such as gender, educational attainment, type of residence and age, using data from the 2022 census.

A total of six focus group interviews were held, two in Budapest and one each in Debrecen, Győr, Keszthely and Tiszaöldvár. Each focus group consisted of ten participants; in selecting the participants, the composition of the adult population was taken into account in terms of gender, age and educational attainment.

¹ The public opinion survey was conducted by Századvég Konjunktúrakutató Zrt.

The focus group interviews were recorded, and the transcripts were produced using Alrite software. In the analysis of the text (Nyumba *et al.* 2018; Rabiee 2004), passages relating to accumulation were subjected to multi-round categorisation (Lochmiller 2021), which identified forms of accumulation, perspectives, emotions, life situations and cognitive distortions. The detailed methodology for analysing the focus group interviews and the results of this analysis are described in Ritzl *et al.* (2026).

By exploring the role of cash in accumulation through the focus group interviews, it becomes clear why households hold a proportion of their accumulation – which is decreasing in relative terms, but remains significant at the macroeconomic level – in cash, a decision that appears irrational. A key element in explaining cash holdings is the categorisation of savings according to the savings needs pyramid. This aspect, along with the findings on savings from the representative household survey, is covered in *Subsection 3.1*. In *Subsection 3.2*, we analyse the factors determining individual-level decisions that shape cash holdings and the categories of the savings needs pyramid.

3.1. Savings needs pyramid

Although in economic terminology “savings” is a clear-cut category identified as the unspent portion of income, in everyday language the term “savings” cannot be regarded as a comprehensive concept for the same thing from a semantic perspective. Additionally, our household survey confirms that the term “savings” may denote both stock and flow values. Another important finding is that the research revealed that synonyms for “savings”, such as money set aside, investment, safety reserve, emergency fund, reserve and wealth, have different layers of meaning in the individual’s cognitive assessment: they have different purposes and functions, and different emotional attitudes are associated with them. Due to these differing emotional associations and purposes, these categories are in a hierarchical relationship with one another. The formation of these different categories has two main implications for our research.

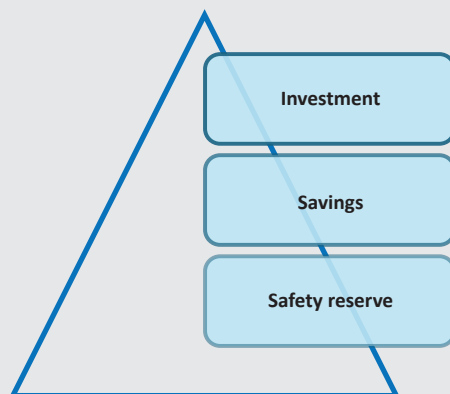
Consequently, in the case of the household survey, we had to take into account that, due to the non-comprehensive and semantically ambiguous meaning of the term “savings”, responses to questions containing this word would cover only part of the information set and could even lead to misleading results. For this reason, it was necessary to treat the stock of accumulated funds and the process of accumulation separately, a point we kept in mind when formulating both the questionnaire and the focus group discussion guidelines. Cash plays a role both in the stock of savings available to the individual and in the accumulation process, but these two are distinct.

Furthermore, due to the hierarchical relationship between the categories “safety reserve”, “savings” and “investment”, which are all used to describe accumulation, it was necessary to map out the discernible hierarchical structure between them in detail. Given the nature of the problem, we were mainly able to carry this out during the focus group interviews, where we examined the attitudes associated with each term, the decision-making mechanisms, the factors influencing the relative weight of the different layers and the process of change in such.

The hierarchical structure of accumulation needs explains why sums of money not intended for spending in a given month, and the various components of financial wealth, are distinct, serve different functions and are generally associated with different attitudes. This hierarchical relationship also contributes to the fact that households hold part of their savings in cash or other liquid forms. This hierarchical structure is similar to *Maslow’s (1954)* hierarchy of needs. The delineation of categories related to accumulation was already formulated by *Fisher (1930)* and *Keynes (1936)*, but the hierarchical structure of the categories was later confirmed (*Lindqvist 1981; Xiao – Noring 1994; DeVaney et al. 2007*), with assets of varying liquidity and risk (*Xiao and Anderson 1997*) and different planning time horizons being assigned to the levels (*DeVaney et al. 2007*).

Generally speaking, in the focus group interviews, the concept of accumulation was broken down into the well-defined categories of safety reserves, savings and investment for the majority of participants (*Figure 7*). This categorisation is considerably simpler than that defined in the literature, containing fewer levels. At the same time, it should be noted that those multi-level classifications are based on questionnaire-based data surveys, where the levels were determined as a function of income.

Figure 7
Levels of the savings needs pyramid



Based on the results of the focus group interviews, the three categories are arranged in a hierarchical relationship: the most important is the creation of a safety reserve, followed by savings for a specific long-term purpose, while investment comes on top of this, with the sole aim of generating income.

The stratification of accumulation levels also clearly emerged in the analysis of the focus group interview transcripts. However, for some participants, a safety reserve and savings were one and the same concept, because “they are used to it, they treat them as one”, or in many cases, their low disposable income does not make it possible for them to distinguish between the two. These are the persons who distinguish, at most, between current expenditure and money set aside. In the following, we briefly outline the characteristics of the three savings categories as identified through focus group interviews.

3.1.1. Safety reserves

Participants defined the safety reserve as the amount needed for unexpected expenses, which they must have available at all times. Liquidity is a key feature of safety reserves: when accumulating them, yields and, in parallel, stability of value play absolutely no role, which is why it is typical for participants to hold at least part of their safety reserve in cash.

Of the attitudes associated with the safety reserve, the pursuit of security is the most significant. In this case, this refers to the individual’s security: should they need money due to some sudden event, it should be immediately available to them. In other words, liquidity itself contributes to the individual’s security. Of all the forms of saving, the safety reserve is associated with the most intense emotions. The safety reserve alleviates anxiety caused by uncertainty and fear arising from perceived reality; its existence brings peace of mind and stability. The safety reserve is to be used in the event of “disasters”; participants spoke of it with much greater intensity and significant emotional charge.

Its accumulation depends less on the individual’s circumstances, knowledge or expertise, as the main motivation is that “it is necessary” and “it must be available”. The safety reserve is of a size determined by the individual; its absence causes tension and negative feelings, which are alleviated once the specified amount level is reached, while use of the reserve rekindles these feelings. This may be linked to the fact that regularity was not mentioned in relation to the accumulation of the safety reserve; it “must be available”.

Regarding the safety reserve, participants also specified amounts ranging from a few hundred thousand forints to HUF 2–3 million or defined it as an amount sufficient to cover three to twelve months of living expenses. Nearly one-half of the participants emphasised that they keep the safety reserves they have accumulated

at home in cash. Taking the above into account, and based on the HCSO's earnings statistics, the initial amount of safety reserves is around HUF 1 million for those with a median income (Table 2).

Table 2	
Hypothetical development of the value of safety reserves held by households in 2024	
Time horizon	Safety reserve calculated from net median earnings (HUF)
Three months	1,067,203
Six months	2,134,406
Twelve months	4,268,812

Note: Gross median earnings = HUF 516,994/month/person; calculated using the net/gross average earnings ratio (68.8 per cent) to derive the net median earnings (HUF 355,734/month/person).

Source: HCSO (20.2.1.41. Main earnings data – for all employers, monthly and monthly/quarterly cumulative. STADAT table: https://www.ksh.hu/stadat_files/mun/en/mun0143.html, downloaded: 30 September 2025)

Another characteristic theme was that focus group participants were aware of the loss of value of cash holdings due to inflation; in other words, holding cash in this context represents a consciously accepted loss, and thus cannot be attributed to a lack of financial education. As economic or livelihood uncertainty increases, the value of safety reserves rises. Therefore, there is little chance that, in the event of inflation, these sums will be channelled into less liquid forms.

Accumulation in foreign currency is a specific form of safety reserve, as it alleviates internal anxiety linked to inflation and the devaluation of the forint; consequently, participants value the security it provides and regard the currency as a store of value. They primarily mentioned the euro, and also the US dollar, which some keep at home.

3.1.2. Savings

Unlike safety reserves, savings generally serve to achieve a specific goal. In this context, participants frequently mentioned savings for retirement or buying property as well as increasing their standard of living. These goals are not linked to day-to-day, everyday needs, and savings for anticipated healthcare costs also feature. When it comes to savings, regularity is valued highly, and factors such as stability of value, yields and costs are also important. Generally, people set aside a specific amount or a certain proportion of their income on a regular basis or with the aim of doing so regularly.

From an emotional perspective, accumulating savings is seen as beneficial, and many mentioned it as a means of achieving happiness.

In the case of savings, cost, yields and security were mentioned most frequently, but here, security relates less to the individual themselves and more to the

individual's desire to know that their money is safe; security and stability of value were identified as the primary decision-making criteria. When discussing savings, participants frequently mentioned government bonds as a safe form of saving.

As yields and costs are important considerations when saving, and participants generally do not trust banks to have their best interests at heart, distrust of banks and a general lack of confidence are strongest here, resulting in a shorter planning time horizon.

The role of cash in savings is far less dominant compared to safety reserves, but it is also a common practice for many to accumulate their savings in cash up to a certain threshold before turning to a financial institution.

Furthermore, saving in cash was mentioned in the interviews as a way of avoiding bank charges, and even in this case, liquidity and accessibility play a significant role. In relation to savings, cash was mentioned alongside attitudes of fear, trust and uncertainty; many also identified cash as a means of alleviating general uncertainty and distrust of banks.

3.1.3. Investment

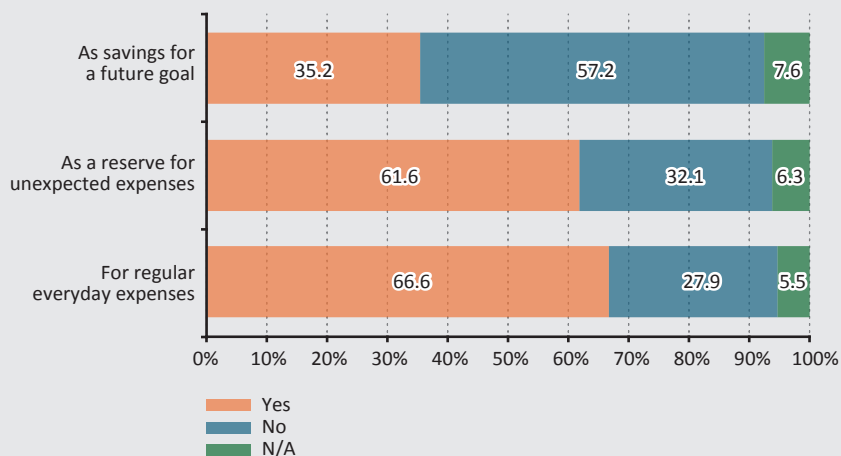
According to the reasoning of the majority of respondents, investment can take place when a larger sum of money is available to the individual and they do not plan to use it in the near future. In this category, the available yields and costs become the key considerations. In several cases, it was suggested that rather than financial products, property is considered the safest and most stable form of investment. Investment is clearly long-term and is less associated with deep, personal emotions. This is the "extra money" that people wish to use to generate income and is therefore seen as more distant than the sums used to meet immediate day-to-day needs. In the case of investments, cash plays no role at all.

3.1.4. Results of the questionnaire survey

The results of the focus group interviews are exploratory in nature and do not provide representative information on the frequency of specific behaviours. However, based on the survey data, we can get a sense of the role cash plays in the savings behaviour of the adult population at each level of the savings needs pyramid. However, as focus group findings indicated that cash played no role whatsoever in investment, we asked specifically about holding cash for transactional purposes, as a safety reserve and for savings purposes. 66.7 per cent of respondents keep cash at home for regular day-to-day expenses, and 61.6 per cent also keep it as a safety reserve for unexpected, sudden expenses. Cash categorised as savings was identified by only 35.2 per cent of respondents (*Figure 8*).

Figure 8

Does your household keep cash in forints for the following reasons?



Note: N=1,500

When examining the driving forces behind keeping cash at home, the most important motivation proved to be building a safety reserve, with 82 per cent of respondents stating that “it is good to have cash at home in case of any unexpected events”. This held true for respondents regardless of educational attainment, income or place of residence (*Figure 9*).

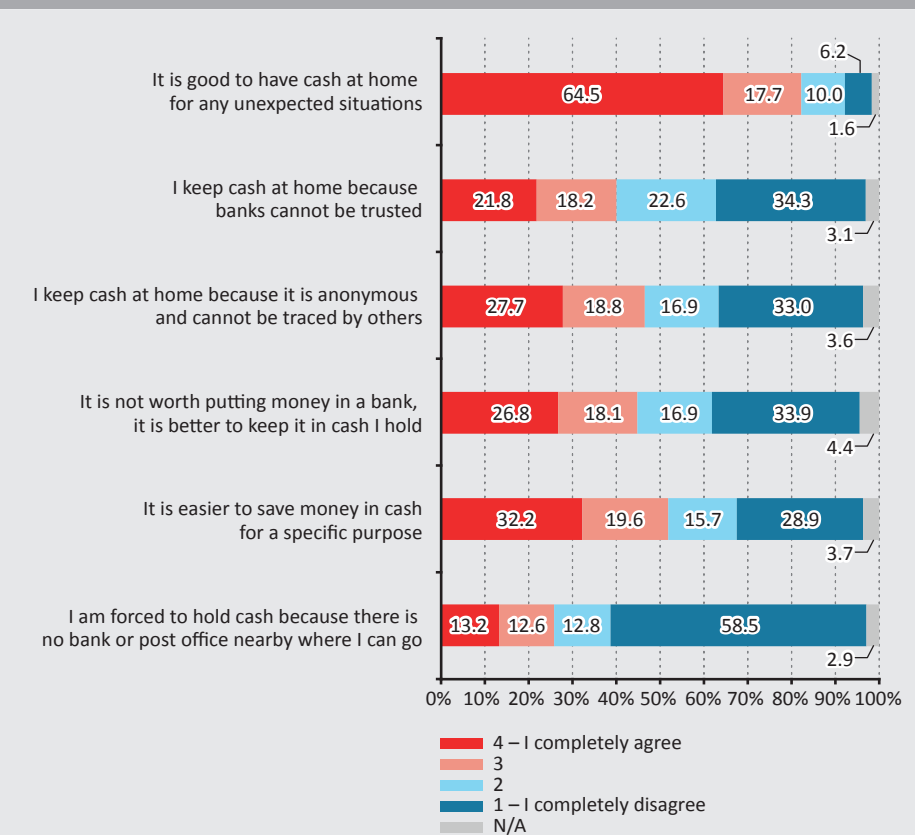
More than half of the respondents (52 per cent) believed that it is easier to set aside cash for a specific purpose; this response points to the prevalence of mental accounting. This simple technique is aimed at maintaining self-control, with the goal of fostering consistent behaviour towards long-term goals (*Thaler – Shefrin 1981*). Cash can be a good tool for this because, as it is physically tangible, spending it feels like a greater loss compared to electronic payments, particularly when large banknote denominations are involved (*Raghubir – Srivastava 2008, 2009*).

In the focus group interviews, several layers of distrust towards credit institutions emerged. The argument that banks’ pricing practices are unfair or excessive, and that it is therefore not worth putting money in the bank, seemed fairly widespread. More serious, yet still quite common, was the view that it is not worth putting money in the bank because ultimately the individual does not get back what was promised to them. Fear of bank failure also emerged during the interviews, but extremely rarely. Finally, the highest level of distrust is distrust of the entire institutional system, which may encourage individuals to seek anonymity. Based on this, distrust of financial institutions may stem from the following sources:

(i) a lack of knowledge or competence, i.e. the individual does not possess the financial knowledge required to realistically assess the costs and yields of alternatives to holding cash; (ii) reputation, i.e. social attitudes regarding the assessment of financial institutions; (iii) the unequal balance of power and ability to assert interests between the individual and the financial institution. A lack of trust in banks and the financial system motivates 40–50 per cent of respondents to hold cash.

Finally, it is worth noting that a quarter of respondents (25.8 per cent) keep cash at home because there is no bank or post office branch nearby.

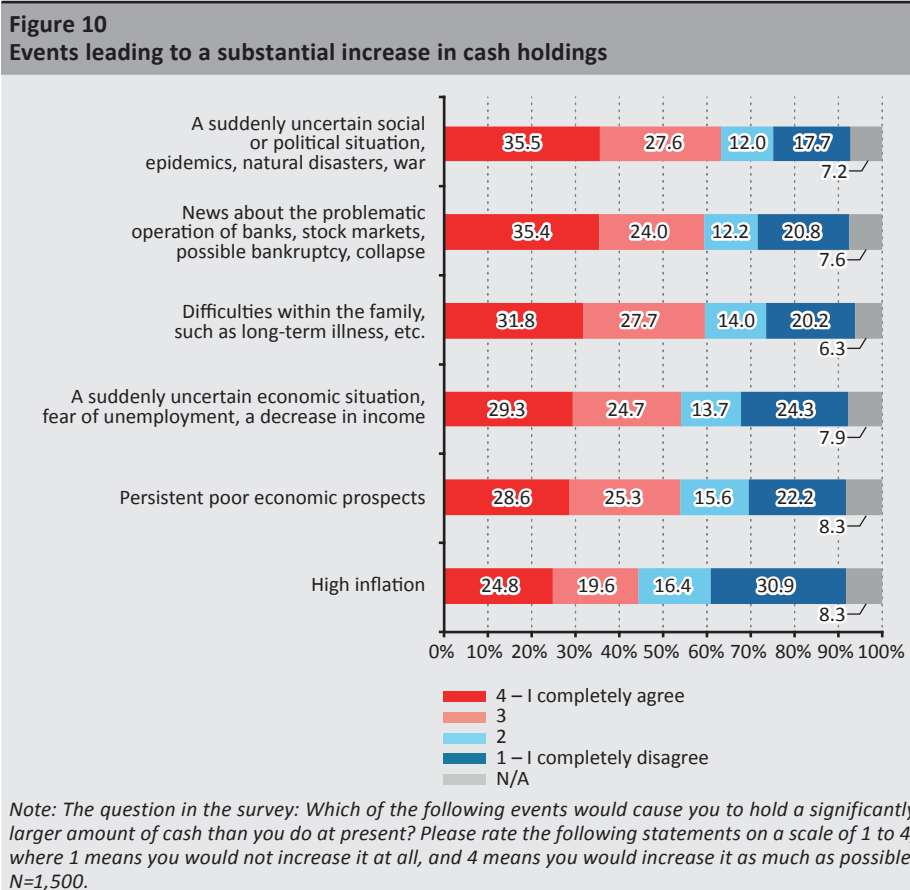
Figure 9
Reasons for keeping cash



Note: The question in the survey: Please rate the following statements on a scale of 1 to 4, where 1 means you completely disagree and 4 means you completely agree. N=1,500.

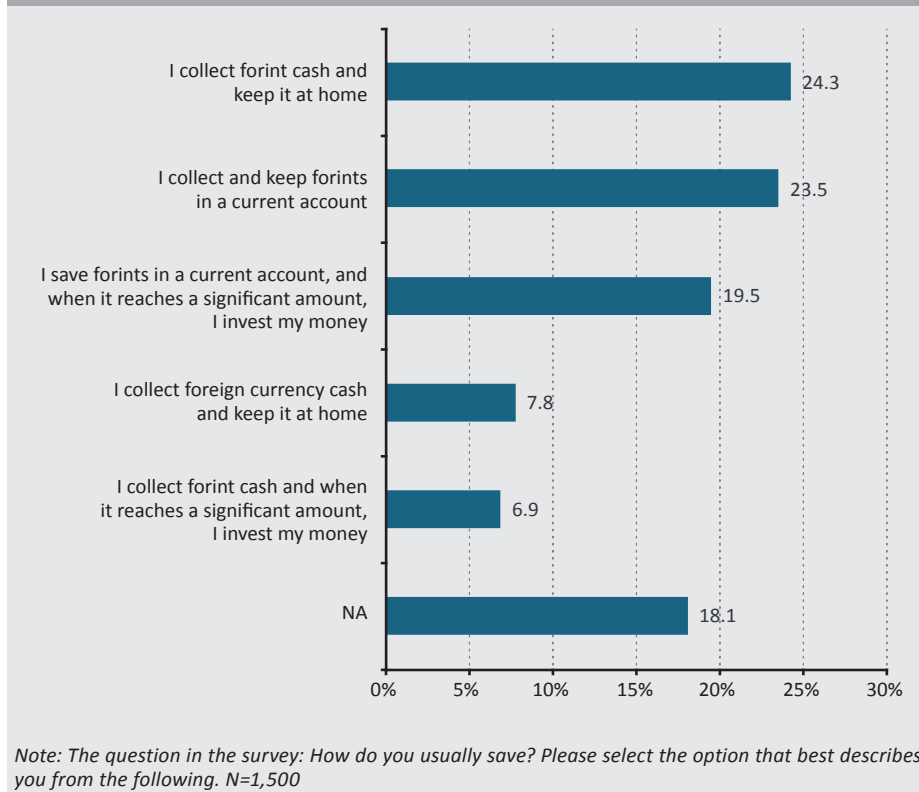
In the focus group interviews, it also became clear that when determining the levels of the savings needs pyramid, the lowest level – the safety reserve – expands in the event of increased uncertainty, either by topping up from income or by reallocating from other levels. Increased uncertainty can arise in the event of any economic, financial or health-related problems. Our questionnaire survey confirmed that, in the event of increased uncertainty, the majority of households would opt to increase their cash holdings (Figure 10). The adult population would be most likely to increase their cash holdings in the event of a sudden deterioration in the social or political situation, epidemics, natural disasters or armed conflicts; in such cases, 63.1 per cent of the adult population would increase their cash holdings to some extent.

Surprisingly, 44.4 per cent of the adult population stated that they would increase their cash reserves even in the event of high inflation. This seemingly profoundly irrational decision is presumably due to the fact that high inflation also increases uncertainty, owing to the greater standard deviation caused by a high inflation trajectory, the volatility of relative prices and the increasing unpredictability of economic policy (Ball – Cecchetti 1990).



The questionnaire survey also included an examination of the accumulation process. The most common forms of saving are keeping cash and accumulating funds in a current account without a fixed-term deposit. These are used by 24.3 per cent and 23.5 per cent of households, respectively. 19.5 per cent of households save for investment purposes in a current account, 6.9 per cent in cash, and 7.8 per cent keep foreign currency at home (Figure 11).

Figure 11
Savings techniques



3.2. Evaluation of results

3.2.1. Forms of accumulation and their allocation

The focus group discussions confirmed that the primary goal in the accumulation process is to build up a safety reserve, with any amounts exceeding this being referred to as savings. Investment takes place when a larger sum has been accumulated from savings and consumption goals have already been met. Attitudes also vary across these categories: while the aim of a safety reserve is to enhance personal security and reduce anxiety and fear regarding potential unexpected events, with savings, goals and feelings aimed at increasing welfare take precedence.

The aim of investment is clearly to secure supplementary income over the longer term.

Within the categories of accumulation, cash clearly plays the most important role in building up a safety reserve, and the focus group participants agreed that a certain portion of the safety reserve should be kept at home in cash. Keeping cash at home can also play a role in saving through mental accounting.

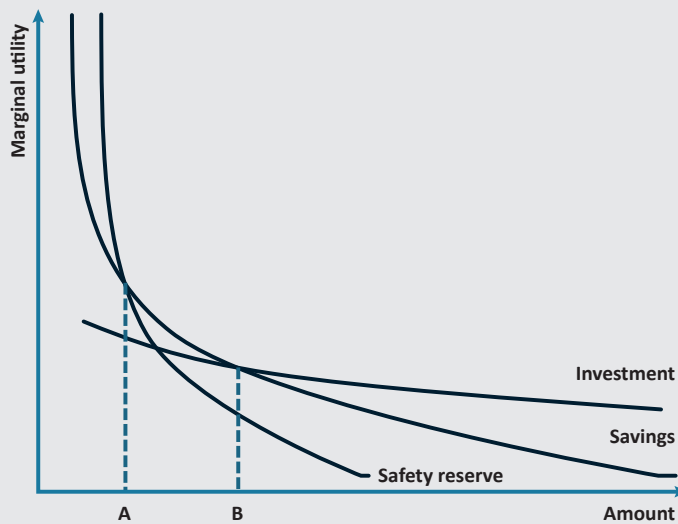
Focus group participants mentioned on several occasions that the safety reserve is a clearly definable, specific amount for them, which they must have at their disposal; however, this also represents the upper limit of the safety reserve, which is only adjusted in the event of changes in internal and external circumstances. Savings, on the other hand, are characterised by regular accumulation and the continuous growth of money set aside; thus, there is no upper limit, and the larger the amount, the greater the individual's satisfaction. Based on the focus groups, emotional attitudes also vary across the accumulation categories; people feel the strongest emotional attachment to the safety reserve, and as they move up the hierarchy of needs, the intensity of their emotions decreases, and they become emotionally more detached from the higher categories. Risk tolerance is lowest in the case of the safety reserve. The need for liquidity and immediate, unhindered access overrides any potentially attractive yield offers that would involve the funds being tied up. When it comes to savings, the majority of participants expect a combination of low risk and stability of value. In the case of savings, the concept of security is re-evaluated and focuses on the individual's desire to know that their money is safe.

The questionnaire survey also confirms that respondents follow different savings strategies. 48 per cent of those with savings accumulate funds in liquid form and did not mention wanting to tie them up, while 38 per cent plan to tie up the funds after accumulating them in liquid form. This is linked to the time horizon over which the savings are planned.

According to common stereotypes, a lack of financial education prevents the majority of people from making more informed use of their savings, which is likely to be true in many cases. However, the research also reveals a more nuanced situation, in which, thanks to its quick and easy accessibility, money held in liquid form offers individuals such utility that they are willing to forego any potential extra income. The importance of this was particularly emphasised in the focus group interviews by respondents who, by their own admission, do not distinguish between savings and a safety reserve, as their savings opportunities are limited due to their low income. Based on the transcripts of the focus group interviews, participants treat the amounts corresponding to the levels of the savings needs pyramid as distinct goods, with an additional unit of accumulation in each category

increasing their utility to different extents. *Figure 12* illustrates how the amounts of money belonging to the accumulation categories treated as distinct goods may evolve based on an individual's preferences. At low levels of accumulation, the marginal utility of the safety reserve is highest; up to amount *A*, topping up the safety reserve yields the greatest increase in utility for the individual; at amount *A*, the individual already feels existentially secure and increasing their welfare comes to the forefront of their thinking. Between amounts *A* and *B*, the marginal utility of savings is highest; at this point, savings are topped up until immediate welfare goals are met. Once amount *B* is exceeded, they identify sums that can be considered "currently unnecessary", which can be invested and from which financial gain is expected.

Figure 12
Formation of accumulation category levels

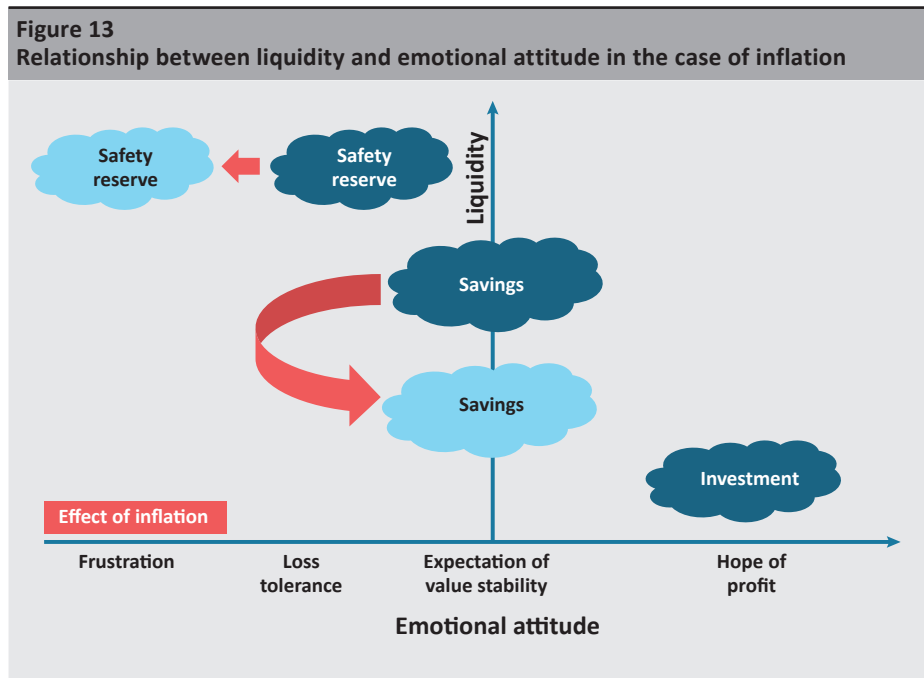


3.2.2. Recategorisation of accumulation

Examining the relationship between liquidity and emotional attitudes, individuals are willing to tolerate the loss associated with keeping their money in a current account or as cash without any restrictions, in exchange for high liquidity in the case of a safety reserve. In the case of savings, they seek the optimal combination of stability of value and liquidity, while in the case of investment, the expectation of high yields compensates for low liquidity.

If inflation rises, individuals are willing to sacrifice a further portion of liquidity in their savings in order to gain stability of value. By contrast, when it comes to

their safety reserve, they do not compromise on their high liquidity requirements. Indeed, in an uncertain environment, they even increase its nominal amount, which causes them frustration as their money is worth less and less (Figure 13).

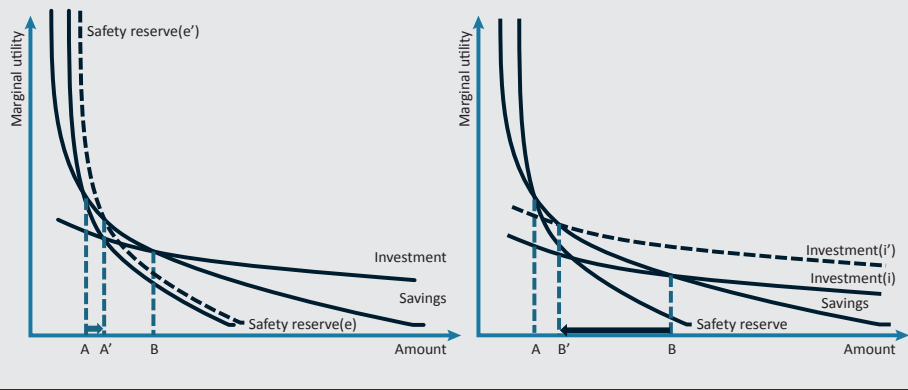


Uncertainty, distrust, rising stress and the perception that the pool of information is becoming more limited lead to simplified, and in some cases sub-optimal, decisions. Tension is alleviated and decisions are made through the use of appropriate narratives (“we have always done it this way”, “what I have is what I can be sure of”, etc.) and, alongside this, the pursuit of liquidity. The mechanism of mental accounting differs somewhat from this, as this technique is primarily used to enhance self-control; apart from family traditions, low income can be a strong incentive for its use. Due to these mechanisms of action, it is possible that situations of limited choice or scarcity – whether of time, income or information – tend to drive an increase in control and the accumulation of liquidity, thereby increasing an individual’s cash holdings, generally through the expansion of the safety reserve.

The process of re-categorising forms of accumulation can also be understood using the theory of marginal utility (Figure 14, left-hand panel). An increase in uncertainty ($e < e'$) makes the safety reserve more valuable. The marginal utility function shifts upwards, causing its optimal level to rise to A' ($A' - A$) by reallocating savings to the safety reserve, and in parallel with this, savings decrease to $(B - A')$, while the level

of investment remains unchanged. However, in the event of extreme uncertainty, some of the investment may even be reallocated.

Figure 14
Changes in the marginal utility of the safety reserve in the event of increased uncertainty (left) and rising yields (right)



Similarly, a reallocation occurs at the expense of savings when yields rise ($i < i'$) (Figure 14, right-hand panel). As the yield rises, investment becomes more valuable, its marginal utility shifts upwards, the optimal level of savings falls to B' , and the amount of investment increases by the value $(B - B')$. The level of the safety reserve does not change.

4. Conclusion

Between 2022 and 2025, cash holdings in Hungary increased despite the unfavourable macroeconomic environment and declining transaction-related demand for cash. Between 2022 and 2023, during a period of rising inflation, the value of cash in circulation fell, but the extent of the decline was less than the drop in cash holdings in current accounts. However, as inflation moderated, a correction, or “replenishment”, of cash holdings became apparent. Thus, at the end of June 2025, the amount of cash in circulation was 18.4 per cent higher than the figure recorded on 31 December 2021. All of this suggests that cash holdings for accumulation purposes dominated the trend in cash holdings during the period.

Based on the focus group interviews, we concluded that households organise their savings into a hierarchical structure based on their future needs. In this context, a savings needs pyramid emerged, similar to Maslow’s hierarchy of needs, with the safety reserve at its lowest level. The main purpose of this reserve is to ensure the individual’s existential security and alleviate their anxiety. At least part of the

safety reserve is held in cash, as its liquidity is of paramount importance. Based on the results of the questionnaire survey, this accumulation category is present in the case of over 80 per cent of households.

The next level of the savings needs pyramid is savings, which serve to achieve some form of future well-being or goal. Compared to the safety reserve, the stability of value of savings is more pronounced. Cash plays a role in this category because of perceived banking costs and as a means of reducing distrust. Moreover, cash simplifies the accumulation process, as mental accounting is one of the most straightforward tools for strengthening self-control. At the top of the pyramid are investments, where cash is of no significance.

The amounts allocated to each level depend on external circumstances and the individual's life situation and personality, but it can generally be stated that increasing uncertainty and declining trust in the institutional system lead to an increase in the amount of the safety reserve, even through the "reclassification" of savings. Due to the pursuit of stability of value, rising yields lead to the conversion of savings into investments, but this has no effect on the level of the safety reserve. Another research question arises: given that the liquidity of current accounts is as high as that of cash, to what extent is the development of their stock influenced by the consumer attitude of seeking to accumulate a safety margin, which is an attitude also identified in relation to cash. Namely, whether it can be demonstrated that households specifically set aside a certain amount in their current account as a safety reserve for precautionary purposes, even though they are aware of the loss of interest incurred as a result. A further question that may arise is whether a difference in perception and attitude between the liquidity of cash and current account deposits can be verified.

The results of our survey confirm that individuals are aware that inflation causes their safety reserves to lose value, but an internal compulsion for liquidity prevents them from tying up these sums, while the loss of value causes some frustration. The inelasticity of safety reserves was confirmed by the questionnaire survey, as the vast majority of households believe it is wise to keep cash at home in case of unexpected events. Therefore, Hungarian households' accumulation of cash is not simply a "lack of financial knowledge" but a response perceived as rational to uncertainty, distrust and a heightened need for liquidity.

The mobilisation of funds held as a safety reserve towards investment can be achieved by strengthening institutional trust and reducing economic and social uncertainty.

References

- Ashworth, J. – Goodhart, C.A. (2020): *The surprising recovery of currency usage*. International Journal of Central Banking, 16(3): 239–277.
- Ball, L. – Cecchetti, S.G. (1990): *Inflation and uncertainty at short and long horizons*. Brookings Papers on Economic Activity, 1990(1): 215–254. <https://doi.org/10.2307/2534528>
- Bódi-Schubert, A. – Ritzlné Kazimir, I. (2023): *Factors Shaping Euro and Forint Cash Holding Ratios – The Rise of Cash Demand for Savings Purposes from the Turn of the Millennium*. Financial and Economic Review, 22(3): 67–96. <https://doi.org/10.33893/FER.22.3.67>
- DeVaney, S.A. – Anong, S.T. – Whirl, S.E. (2007): *Household savings motives*. Journal of Consumer Affairs, 41(1): 174–186. <https://doi.org/10.1111/j.1745-6606.2006.00073.x>
- Faella, F. – Zamora-Pérez, A. (2025): *Keep calm and carry cash: Lessons on the unique role of physical currency across four crises*. ECB Economic Bulletin, 2025/6: Article 6. https://www.ecb.europa.eu/press/economic-bulletin/articles/2025/html/ecb.ebart202506_02~1a-773e2ca3.en.html. Downloaded: 20 November 2025.
- Fisher, I. (1930): *The theory of interest*. Macmillan, London.
- Keynes, J.M. (1936): *The general theory of employment, interest and money*. Harcourt Brace.
- Lindqvist, A. (1981): *A note on determinants of household saving behavior*. Journal of Economic Psychology, 1(1): 39–57. [https://doi.org/10.1016/0167-4870\(81\)90004-0](https://doi.org/10.1016/0167-4870(81)90004-0)
- Lochmiller, C.R. (2021): *Conducting thematic analysis with qualitative data*. The Qualitative Report, 26(6): 2029–2044. <https://doi.org/10.46743/2160-3715/2021.5008>
- Maslow, A.H. (1954): *Motivation and Personality*. Harper & Row Publishers, New York.
- MNB (2025): *Savings report – October 2025*. Magyar Nemzeti Bank. <https://www.mnb.hu/letoltes/savings-report-2025.pdf>
- Nyumba, T.O. – Wilson, K. – Derrick, C.J. – Mukherjee, N. (2018): *The use of focus group discussion methodology: Insights from two decades of application in conservation*. Methods in Ecology and Evolution, 9(1): 20–32. <https://doi.org/10.1111/2041-210X.12860>
- Educational Authority (2024): *PISA 2022 – Pénzügyi műveltség, összefoglaló jelentés (PISA 2022 – Financial Literacy, Summary Report)*. https://www.oktatas.hu/pub_bin/dload/kozoktatasi/nemzetkozi_meresekek/pisa/PISA2022PM.pdf. Downloaded: 20 November 2025.
- Rabiee, F. (2004): *Focus-group interview and data analysis*. Proceedings of the Nutrition Society, 63(4): 655–660. <https://doi.org/10.1079/PNS2004399>

- Raghubir, P. – Srivastava, J. (2008): *Monopoly money: The effect of payment coupling and form on spending behavior*. Journal of Experimental Psychology: Applied, 14(3): 213–225. <https://doi.org/10.1037/1076-898X.14.3.213>
- Raghubir, P. – Srivastava, J. (2009): *The denomination effect*. Journal of Consumer Research, 36(4): 701–713. <https://doi.org/10.1086/599222>
- Ritzl, I. – Száraz, A. – Bódi-Schubert, A. (2026): *Megtakarítási reflexiók és döntések analízise a hazai lakosság körében végzett fókuszcsoporthoz tartozók interjúk alapján (Analysis of savings reflections and decisions based on focus group interviews conducted among the domestic population)*. Statisztikai Szemle (Statistical Review), 104(1): 5–43. <https://doi.org/10.20311/stat2026.01.hu0005>
- Ritzlné Kazimir, I. – Máténé Bella, K. (2020): *A gazdasági és a szabályozási környezet változásának hatása az áfaelkerülés 2006 és 2016 közötti alakulására Magyarországon (The impact of changes in the economic and regulatory environment on tax evasion in Hungary, between 2006 and 2016)*. Statisztikai Szemle (Statistical Review), 98(2): 107–132. <https://doi.org/10.20311/stat2020.2.hu0107>
- Rogoff, K.S. (2016): *The Curse of Cash*. Princeton University Press, Princeton, Oxford. <https://doi.org/10.1515/9781400883219>
- Thaler, R.H. – Shefrin, H.M. (1981): *An economic theory of self-control*. Journal of Political Economy, 89(2): 392–406. <https://doi.org/10.1086/260971>
- Xiao, J.J. – Anderson, J.G. (1997). *Hierarchical financial needs reflected by household financial asset shares*. Journal of Family and Economic Issues, 18(4): 333–355. <https://doi.org/10.1023/a:1024991304216>
- Xiao, J.J. – Noring, F.E. (1994): *Perceived saving motives and hierarchical financial needs*. Journal of Financial Counseling and Planning, 5: 25–41. https://digitalcommons.uri.edu/hdf_facpubs/198
- Zamora-Pérez, A. (2021): *The paradox of banknotes: understanding the demand for cash beyond transactional use*. Economic Bulletin, 2021/2: Article, 2. https://www.ecb.europa.eu/press/economic-bulletin/articles/2021/html/ecb.ebart202102_03~58cc4e1b97.en.html. Downloaded: 20 November 2025.

A Meta-Learning Model of Philippine Bank Lending Behaviour*

Christian S. de Leon 

This study develops a meta-learning framework to predict the lending behaviour of Philippine commercial banks using aggregate bank financial ratios and macroeconomic variables. Five baseline machine learning models – Boosting, k-Nearest Neighbours, Neural Networks, Random Forest, and Support Vector Machine – were employed, with their outputs synthesised through LASSO-regularised regression. Results demonstrate that the metamodel consistently achieves superior accuracy, lower error levels, and closer proximity to perceived bank lending behaviour. Robustness checks confirmed stability across volatile and low-variance regimes using Ridge and Elastic Net, while feature importance highlighted profitability and asset quality as key drivers of lending behaviour.

Journal of Economic Literature (JEL) codes: C45, E58, G21

Keywords: machine learning, metamodeling, bank lending behaviour

1. Introduction

Bank lending behaviour shapes economic activity, financial stability, and the transmission of monetary policy. Lending decisions by banks directly influence the availability of credit to households and firms, thereby affecting investment, consumption, and overall economic growth (Anyanwu *et al.* 2017). In emerging economies such as the Philippines, where banking institutions serve as the primary channel of financial intermediation, understanding the determinants of lending behaviour is essential for regulators, policymakers, and market participants.

Traditional analyses of lending behaviour often rely on linear econometric models that assume stable relationships between bank-specific indicators and

* The papers in this issue contain the views of the authors which are not necessarily the same as the official views of the Magyar Nemzeti Bank.

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macroeconomic variables. However, empirical evidence suggests that lending outcomes are shaped by complex, nonlinear interactions that vary across economic cycles and institutional contexts (Dou et al. 2023). These limitations have prompted growing interest in machine learning techniques, which can uncover hidden patterns and improve predictive accuracy in financial systems (Adegbite 2024; Olowe et al. 2024).

Recent studies have applied machine learning to diverse banking challenges, including credit risk assessment, fraud detection, and non-performing loan prediction (Hashemi et al. 2023; Muslim et al. 2023). Yet, few have focused on forecasting lending behaviour itself, despite its representation of the banking system's collective stance of credit standards and its centrality to monetary policy transmission and systemic stability. Moreover, reliance on single-model approaches often results in overshooting, lagging, or miscalibrated forecasts, reflecting the inherent uncertainty of financial data-generating processes (Wu – Levinson 2021). Given these limitations, this study sought to answer two main questions, (i) *Can a meta-learning model outperform benchmark and individual machine learning models in predicting bank lending behaviour?* (ii) *Which bank-specific and macroeconomic indicators are most influential in predicting bank lending behaviour?*

The questions are addressed by developing a two-layered meta-learning framework that integrates multiple machine learning models – Boosting, k-Nearest Neighbours, Neural Networks, Random Forest, and Support Vector Machine – into a unified and regularised metamodel. Using quarterly data from 2009 to 2024, the framework captures both aggregate bank financial ratios (e.g. capital adequacy, asset quality, profitability) and macroeconomic variables (e.g. GDP growth, inflation, policy rates). Synthesising the strengths of individual learners enables the metamodel to deliver more robust and accurate forecasts of lending behaviour, particularly during periods of volatility such as the COVID-19 pandemic.

The contribution of this paper is threefold. First, it introduces a novel application of meta-learning to predict lending behaviour in the Philippine banking sector. Second, it demonstrates the resilience and superiority of the metamodel over single-model approaches in capturing structural breaks and regime shifts. Third, it provides practical insights for regulators and policymakers by identifying the most influential drivers of lending behaviour, thereby supporting more effective monitoring of systemic risk and monetary policy transmission.

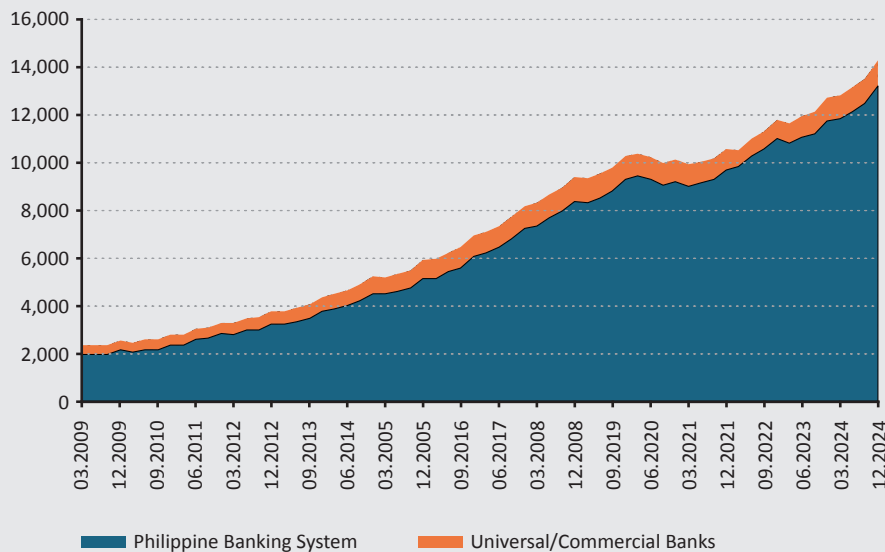
2. Related works

2.1. The Philippine banking industry

The Philippine banking system serves as the backbone of financial intermediation. It is characterised by four primary groups, each serving distinct functions. As of 2024, a total of 44 universal and commercial banks dominate the industry's total assets (27.4 trillion pesos) at 93.8 per cent (*Bangko Sentral ng Pilipinas 2025a*). These banks primarily offer full-service banking, investment services, and large corporate lending. There are also 41 thrift banks focusing on retail, consumer credit, and housing loans; 383 rural and cooperative banks focusing on community-based lending primarily for agricultural and micro- and small-sized enterprises; and six digital banks that offer end-to-end banking through digital platforms without physical branches.

Lending activity is one of the primary functions of banks. The total loan portfolio of the system amounted to approximately at 14.3 trillion pesos in 2024. The distribution of these loans is mainly dominated by universal and commercial banks, which account for 92.3 per cent. *Figure 1* shows the loan portfolios of the Philippine banking system and of the universal and commercial banks, showing a stable uptrend over the years.

Figure 1
Total loan portfolio of the Philippine banking system and universal/commercial banks (2009–2024)



Note: Values in billions of Philippine pesos.

Source: Bangko Sentral ng Pilipinas' (2025a) report on Philippine banking system

2.2. Machine learning and metamodeling

One central challenge in forecasting is model uncertainty. Traditional approaches often assume the existence of a true model that can fully describe the data-generating process. However, empirical evidence shows that single models frequently underperform as they fail to capture the actual complexity and variability inherent in real-world financial systems. *Siebert et al. (2016)* stated that ignoring model uncertainty results in biased parameter estimates and overly narrow prediction intervals, leading to inaccurate forecasts. Moreover, *Makridakis and Bakas (2016)* found that accurately propagating uncertainty about the model structure is often overlooked, which can lead to overconfident predictions and insufficient hedging against uncertainties.

The limitations of a single-model prediction have driven this study's interest in employing a meta-learning approach. *Lin et al. (2019)* suggested a combination of multiple models to improve forecasting reliability and address model uncertainty. *Wu and Levinson (2021)* noted that reliance on a single model often underperforms and is more prone to erroneous results, whereas combining single models offsets each of their weaknesses within, producing more accurate and less erroneous results. This is also proven by *Rane et al. (2024)* wherein they showed that combining forecast techniques outperforms individual models when accuracy and diversity are balanced. Building on this, *Montero-Manso et al. (2020)* introduced meta-learning algorithms that automatically select and weigh forecasts, demonstrating that averages surpass both simple combinations and the best single models. These advances address the challenge of identifying optimal weights without bias or instability.

In addition, meta-learning allows for small and limited data as it inherently acquires and improves on the initial parameters from other models. This learning-to-learn approach was shown to adapt better on minimal data. For instance, it can produce personalised recommendations for new users of e-commerce despite limited interaction history (*Naser 2026*). Also, *Safonova et al. (2023)* mentioned that problems with small sample size can be addressed through ten techniques. Those include combining individual models that learned differently and training the models several times to reduce biases and over-optimistic performance. Moreover, to avoid overfitting, regularisation approaches through least absolute shrinkage and selection operator (LASSO), Ridge, or Elastic Net, allows maximisation of information even for small datasets (*Naser 2026*). Hence, this study considered an expanding window scheme and two-layer meta-learning through regularisation to account for few observations.

Existing banking studies using the integration of machine learning techniques through a metamodel showed significant results in addressing challenges such as credit risk and operational efficiency. *Kavirathne et al. (2022)* developed a meta-learning model to predict non-performing loans in Sri Lankan financial institutions, achieving high accuracy and demonstrating effectiveness in managing credit risk. Moreover, *Savolainen and Collan (2020)* showed how metamodels reduce the complexity and computational demand of simulations in investments, allowing faster and effective risk analyses. *Paz et al. (2025)* supported this using optimisation techniques for feature selection in credit risk assessment, enhancing the robustness and efficiency of machine learning models.

2.3. Machine learning applications in banking

Machine learning has been widely applied in the banking sector, particularly in risk management and fraud detection. *Donepudi (2017)* and *Olowe et al. (2024)* stated that the integration of advanced machine learning techniques not only enhances efficiency but also improves decision-making and customer experience in banking operations. *Leo et al. (2019)* found that these techniques are being utilised to better manage various banking risks, such as credit, market, operational, and liquidity risks. *Guerra and Castelli (2021)* found that these also apply to bank stress testing, showing promise in developing early warning systems for bankruptcy. *Hashemi et al. (2023)*, on the other hand, employed machine learning to improve the detection of fraudulent transactions, achieving high performance metrics. In terms of lending behaviour, machine learning is being used to enhance credit risk assessment and improve loan approvals as it has shown significant effectiveness in predicting loan defaults and assessing creditworthiness (*Anand et al. 2022; Chen 2022*).

Based on the existing literature, *Leo et al. (2019)* stated that the usability of machine learning still requires exploration in future research. Hence, this study used machine learning for a different approach: to predict the lending behaviour of commercial banks in the Philippines using aggregate bank financial ratios and macroeconomic variables as features. *Abdolshah et al. (2020)* found that macroeconomic shocks influence banks' lending based on risk profile. Also, *Yitayaw (2021)* revealed that capital adequacy enhances lending while macroeconomic shocks can have adverse effects. *Ahmed et al. (2021)* showed that non-performing loans are a result of lending activities as influenced by gross domestic product growth.

2.4. Bank lending behaviour and its predictors

The systematic monitoring and analysis of bank lending behaviour, particularly in terms of tightening or easing credit standards, is imperative for several reasons. First, lending standards directly influence the availability and cost of financing for businesses and households, thereby shaping investment decisions, consumption

patterns, and overall economic activity (Anyanwu et al. 2017; Bernanke 2018). When banks tighten credit standards, access to financing becomes restricted, limiting opportunities for growth and expansion. Conversely, easing credit standards increases access to funds, stimulating borrowing and investment. Second, understanding changes in lending behaviour enables central banks and regulators to evaluate the effectiveness of monetary policy transmission. For example, if adjustments in interest rates do not correspond to changes in credit standards, the intended impact of monetary policy on the real economy may be muted or ineffective (Aikman et al. 2016; Fung et al. 2000). Third, the drivers of credit standards provide valuable insights into potential vulnerabilities within the banking system. Identifying these drivers allows policymakers to design interventions that mitigate systemic risks and prevent financial crises (Bernanke 2018; Claessens – Kodres 2014). Moreover, quantifying the influence of economic and bank-specific factors on lending adjustments is essential for addressing underlying issues during periods of excessive tightening or easing (Ahmed et al. 2021; Bassett et al. 2014).

Existing research highlights the significant role of macroeconomic indicators in shaping lending behaviour. Inflation, for instance, has been consistently linked to tighter credit standards. Rostagno et al. (2021) found that central bank interventions aimed at controlling inflation often reduce credit supply, as banks respond to stricter monetary policies by adopting more cautious lending practices. Ashraf (2021) and Nguyen et al. (2025) further emphasised that high inflation generates uncertainty for banks, particularly regarding repayment risks, leading to stricter loan covenants and collateral requirements. By contrast, strong GDP growth rates are generally associated with an easing of credit standards. Naili and Lahrichi (2020) and Yurdakul (2014) demonstrated that favourable macroeconomic conditions reduce perceived credit risk, encouraging banks to extend more loans. This behaviour reflects the improved repayment capacity of borrowers in a growing economy, which incentivises banks to ease lending terms and expand credit lines.

Beyond macroeconomic conditions, bank financial ratios also play a critical role in determining lending behaviour. Capital adequacy, for example, has been shown to enhance a bank's capacity to lend. Madugu et al. (2020) and Olawale (2024) revealed that higher capital adequacy ratios allow banks to maintain or even ease credit standards across different economic cycles. Kozak (2021) similarly argued that well-capitalised banks are more resilient and possess greater capacity to absorb shocks, enabling them to adopt more flexible credit policies. Asset quality, measured through the past due ratio, is another important determinant. Schiantarelli et al. (2016) concluded that increases in non-performing loans prompt banks to adopt more cautious lending policies to safeguard liquidity and prevent further losses. Naili and Lahrichi (2020) added that past due ratios reflect not only the performance of a bank's existing borrowers but also broader industry conditions, making them a reliable indicator of heightened credit risk.

Profitability measures such as return on assets and return on equity are also closely associated with lending behaviour. *Miglo (2018)* and *Parker (2002)* reported that higher profitability increases a bank's risk-bearing capacity, incentivising it to expand lending through more lenient credit standards. Profitable banks are better positioned to attract borrowers by offering favourable terms, thereby increasing lending volumes. *Bancel and Mittoo (2011)* further noted that profitability enhances financial flexibility, allowing banks to sustain high lending activity even during periods of economic uncertainty. Hence, the importance of profitability as a driver of credit expansion reflects its role in shaping banks' willingness to ease lending standards.

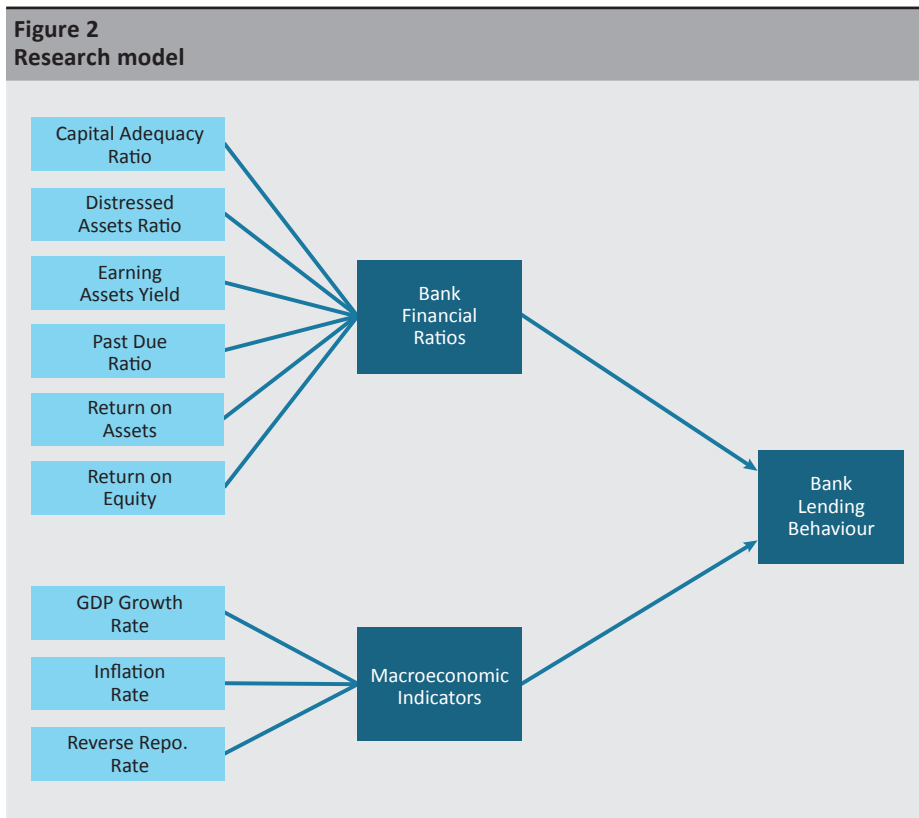


Figure 2 illustrates the research framework linking bank-specific financial indicators and macroeconomic conditions to the lending behaviour of Philippine commercial banks. The model emphasises how internal measures of financial health interact with external economic forces to shape lending decisions.

3. Methods

3.1. Data description and sources

This study utilised quarterly data covering the period 2009–2024, retrieved from the Bangko Sentral ng Pilipinas (BSP). The objective is to predict bank lending behaviour using a combination of aggregate bank financial ratios and macroeconomic variables. The target variable is the BSP Senior Bank Loan Officers’ Survey (SLOS) diffusion index capturing the tightening or easing of credit standards. The survey provides collective perceptions of banks in managing their corporate and household loans – the willingness to extend credit – under the prevailing conditions.

Table 1 Descriptive statistics of features and target for first-layer learners (2009–2024, n=64)							
Variable	Unit	Min	Mean	SD	Median	Max	r
Bank Lending Behaviour	%	−9.700	11.461	13.790	9.900	65.200	–
Capital Adequacy Ratio	%	15.000	16.656	0.954	16.500	19.200	−0.265
Distressed Assets Ratio	%	2.200	5.106	2.038	5.150	9.800	0.170
Earning Assets Yield	%	3.800	4.706	0.821	4.550	6.800	−0.335
GDP Growth Rate	%	−15.000	7.848	5.201	9.000	15.200	−0.523
Inflation Rate	%	−0.200	3.509	1.770	3.300	8.700	0.209
Past Due Ratio	%	1.500	3.072	1.010	3.300	4.700	0.362
Return on Assets	%	0.800	1.305	0.256	1.300	2.000	−0.537
Return on Equity	%	6.500	10.877	1.939	10.550	15.800	−0.535
Reverse Repurchase Rate	%	2.000	3.938	1.215	4.000	6.500	−0.105
Note: SD – standard deviation. Positive correlations (r) are expected to tighten while negative correlations are expected to ease credit standards.							

As shown in *Table 1*, the positive and negative correlation values indicate the relationships of features with bank lending behaviour. Positive correlation means a tightening of credit standards, while negative correlation means an easing of such. Based on the results, increases in distressed assets, loan delinquencies, and inflation are associated with tightening. Conversely, higher capital adequacy, profitability, and reverse repurchase rate are associated with easing.

3.1.1. Bank lending behaviour

The SLOS diffusion index is a net measure of tightening versus easing lending responses, computed as the proportion of banks reporting tightening minus the proportion reporting easing. A positive net index indicates that more banks have tightened credits standards than those that eased, while a negative net index indicates the opposite. Because the index is a direct survey-based measure, it is

treated as an operational proxy for banks' collective lending stance to both bank financial metrics and external economic pressures. The SLOS only covers universal and commercial banks.

3.1.2. Aggregate bank financial ratios

The aggregate bank financial ratios provide an estimate of how the financial health of banks influences their lending behaviour. These ratios are calculated as averages of the total number of universal and commercial banks in the Philippines. Ratios from other types of banks, such as thrift, cooperative, and rural banks, were excluded from this analysis because they are not respondents of the SLOS. While individual bank-level data can offer specific insights, this paper utilises aggregate financial ratios because of two reasons. First, the target variable in this study is the SLOS diffusion index of bank lending behaviour. Since the SLOS diffusion index captures collective perceptions of the entire universal and commercial banking industry, the predictors must be measured at the same level of aggregation to ensure consistency. Second, individual banks may exhibit outlier behaviour due to specific corporate strategies, mergers, or localised shocks that do not reflect the broader industry trend. Aggregation smooths these fluctuations, allowing the predictive models to focus on the systematic drivers of credit standards.

The capital adequacy ratio measures the sufficiency of a bank's capital relative to its risk-weighted assets. Its consistently high mean and low variability indicate sustained capital strength and lending capacity throughout the covered periods. Asset quality is captured through distressed assets and past due ratios. The distressed assets ratio represents the proportion of non-performing and restructured assets, and serves as a proxy for credit risk. The past due ratio measures delinquency levels, with higher values signalling elevated credit risk and reduced willingness to extend loans. Both indicators show fluctuations over time, suggesting shifts in the risk environment faced by banks. Profitability contributes an additional dimension to the analysis. Return on equity reflects shareholder profitability, while return on assets evaluates profitability relative to total assets. Both highlight operational efficiency. Earning assets yield measures the return generated from productive assets and provides insight into how asset performance affects lending incentives.

3.1.3. Macroeconomic indicators

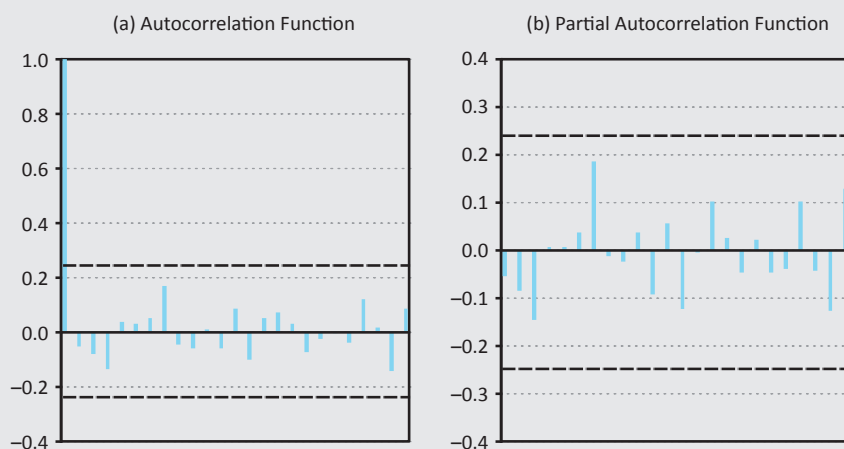
The macroeconomic indicators contextualise the broader environment in which banks make lending decisions. The GDP growth rate represents overall economic activity, and higher growth generally supports increased credit demand. It is the most volatile predictor in the dataset, with an average value close to its standard deviation, indicating exposure to significant economic shocks across the covered period. The inflation rate captures price stability and affects real returns as well as

banks' perceptions of lending risk. The reverse repurchase rate serves as the BSP's primary monetary policy instrument and directly influences funding costs, liquidity conditions, and the overall credit environment. Movements in both inflation and policy rates reflect active monetary adjustments and changing macroeconomic conditions that shape the lending behaviour of commercial banks.

3.2. Data preprocessing and model training

The dataset contains no missing observations. It was transformed to improve the performance of the benchmark and first-layer machine learning models. The target and input variables are adjusted and individually assessed if they are stationary. Non-stationarity persisted using only the raw data. After applying first-order difference ($d = 1$), stationarity was achieved as evidenced by *Figure 3* on bank lending behaviour, where lags fell within the 95-per cent confidence interval. This is further supported by the results of the Augmented Dickey–Fuller (ADF) test, $t(3) = -5.240$, $p < 0.01$, and Phillips–Perron (PP) test, $Z_p = -58.266$, $p < 0.01$, which both show significance of less than 0.05.

Figure 3
Autocorrelation and partial autocorrelation of bank lending behaviour after first-order differencing



Note: $\Lambda = 1$, $d = 1$, $D = 0$, $CI = 0.95$, CI type = white.

Furthermore, the study employed a one-quarter-ahead out-of-sample prediction design to eliminate look-ahead bias. The target variable is being predicted using bank-specific and macroeconomic features lagged by one quarter ($t-1$). The lagged

specification shows that the results are a true out-of-sample forecast, providing a multi-month lead time for policymakers before actual data is published.

3.2.1. Benchmark models

Prior to the implementation of the meta-learning framework, this paper established minimum-performance references. These benchmarks are frequently used by central banks when evaluating more complex approaches. The first benchmark model is a Random Walk (RW) with drift (0,1,0). This univariate model was selected based on the results of ADF and PP tests. In addition, two types of Autoregressive Integrated Moving Average (ARIMA) models were implemented. A non-seasonal ARIMA utilises three autoregressive terms and one moving average (3,1,1) to capture short-term dependencies in lending behaviour. Also, a seasonal ARIMA (SARIMA) was optimised through backward testing of the Akaike Information Criterion. It incorporated seasonal strand (1,0,1)_s to account for periodic cycles identified during the diagnostic phase. The diagnostic integrity of these benchmark models was verified by ensuring that the residuals followed a normal distribution and functioned as random white noise.

3.2.2. First-layer machine learning models

Then, five first-layer machine learners were employed to generate first-layer predictions prior to the construction of the metamodel (MTM). Each algorithm offers a distinct methodological bias, enabling the metamodel to leverage diverse prediction patterns.

Although the benchmark ARIMA models utilise an autoregressive component, this paper did not consider including the lagged values of SLOS diffusion index in the feature set. This decision directly aligns with addressing the research question of which bank-specific and macroeconomic indicators are most influential in predicting bank lending behaviour. Additionally, it mitigates the swamping effect and maintains the predictive capacity of the existing features. Including the lagged SLOS diffusion index would distort the feature importance scores (feature masking), making it difficult to see which indicators are truly influential. Consequently, the baseline learners are forced to extract predictive signals solely from the indicators, providing policymakers with more actionable insights into the underlying causes of lending behaviour rather than relying on the trend persistence of the SLOS diffusion index. Nonetheless, the comparison remains technically robust as all models adhere to same chronological constraint, wherein all inputs are restricted to the data available prior to the quarter being predicted.

Boosting regression (BST) was included for its ability to iteratively reduce bias by correcting residual errors in decision tree ensembles. This makes BST responsive

to nonlinearities and local structural changes in the data, such as shifts in credit standards during different economic periods. As shown in *Equation (1)*, the model was trained using a shrinkage parameter (v) of 0.1, an interaction depth of 1.0, a minimum of ten observations per terminal node, and 100 trees (M) with 50-per cent sampling under a Gaussian loss function. The $h_m(x_{t-1})$ contains individual weak learners that is iteratively added to correct the errors of previous ones. As the training window expands, the shrinkage parameter was decreased down to 0.01 and the interaction depth was increased up to 2.0 so the model can safely learn with the increasing information without overfitting to the early smaller samples.

$$\hat{y}_t^{BST} = \sum_{m=1}^M v h_m(x_{t-1}) \quad (1)$$

k-nearest neighbours (KNN) regression was employed as a simple, non-parametric learner that predicts values based on the most similar past observations. This allows it to identify localised patterns in lending behaviour, providing a flexible way to explain variance through local neighbourhood structures. The model was trained with rectangular weights and Euclidean distance, optimised from six to eight nearest neighbours (k) depending on the number of observations in the training set. This is necessary as the density of neighbourhoods increases along with the expanding window. The $N_k(x_{t-1})$ is the set of indices of the k nearest neighbours to x_{t-1} , as shown in *Equation (2)*.

$$\hat{y}_t^{KNN} = \frac{1}{k} \sum_{i \in N_k(x_{t-1})} y_i \quad (2)$$

Neural networks regression (NNR) was applied to model high-dimensional interactions and identify latent structures within the interplay of bank financial ratios and macroeconomic variables. It provides an adaptive framework for modelling dynamic patterns inherent in the financial sector. The NNR was trained using a rectified linear activation function (ϕ), a maximum of 100,000 repetitions, and a topology optimised through a genetic-algorithm procedure that scaled within the expanding window size. This procedure searched a population size of 20, evolving from a shallow architecture of one hidden layer in early windows up to three layers and ten nodes per layer. The w represents the weights and b represents the optimised biases, as shown in *Equation (3)*. Parent selection followed a roulette wheel approach with 10-per cent mutation probability and 10-per cent fitness-based survival.

$$\hat{y}_t^{NNR} = \sigma \left(\sum_{j=1}^H w_j \cdot \phi \left(\sum_{i=1}^D w_{ij} x_{i,t-1} + b_i \right) + b_j \right) \quad (3)$$

Random forest regression (RFR) was selected for its robustness and variance-reduction properties. By averaging predictions across multiple decorrelated decision trees, it provides a reliable baseline that mitigates the risk of overfitting; which is a common issue when dealing with the inherent uncertainty of data. As shown in *Equation (4)*, the model was trained with 50-per cent coverage per tree across an ensemble of 100 trees. B is the total number of trees and $T_b(x_{t-1})$ is the prediction of a single tree.

$$\hat{y}_t^{RFR} = \frac{1}{B} \sum_{b=1}^B T_b(x_{t-1}) \quad (4)$$

Support vector machine regression (SVM) was employed for its margin maximisation and effectiveness in high-dimensional contexts. It offers a structured approach to regression, which is useful for maintaining accuracy even when the feature space is complex. It was trained with linear weights, a termination tolerance of 0.001, an insensitive-loss function of 0.01, and a violation cost of up to five, which was adjusted upward as the expanding window provides more evidence. As shown in *Equation (5)*, the $\alpha_i - \alpha_i^*$ are Lagrange multipliers and $\langle x_i, x_{t-1} \rangle$ is the inner product of the feature vectors.

$$\hat{y}_t^{SVM} = \sum_{i=1}^n (\alpha_i - \alpha_i^*) \langle x_i, x_{t-1} \rangle + b \quad (5)$$

In *Equation (6)*, all baseline learners estimate a prediction function where x_{t-1} includes both lagged bank-specific indicators and macroeconomic variables. Although each algorithm approximates $f(\cdot)$ differently, they all share the same equation as:

$$\hat{y}_t = f(x_{t-1}) + \epsilon_t, \quad x_{t-1} = [CAR_{t-1}, DAR_{t-1}, EAY_{t-1}, \dots] \quad (6)$$

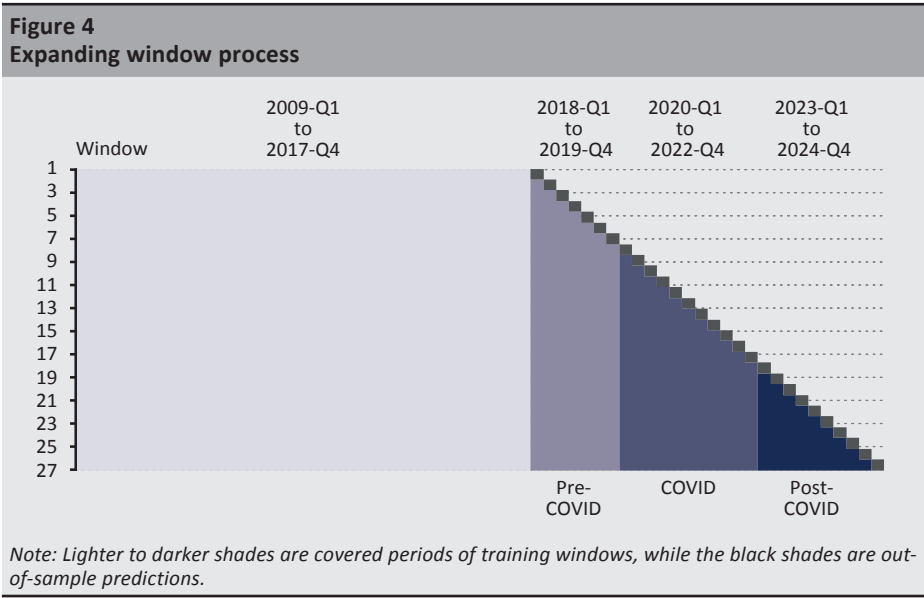
All out-of-sample predictions, both for benchmark and first-layer learners, were converted back from first-order differenced values to the original scale. Together, these baseline learners produce prediction patterns essential for the meta-learning strategy of this study. Their complementary strengths and weaknesses provide the diversity of signals that the metamodel synthesises into a more accurate and stable forecast of bank lending behaviour.

3.3. Expanding window protocol

The benchmark and machine learning models are trained under a strictly chronological expanding-window protocol. The dataset covering 16 years from 2009 to 2024 is divided into training and test subsets without shuffling. Given a total of only 64 quarterly observations per variable, this study addresses problems

with small and limited data through expanding window, meta-learning, and regularisation, as recommended by *Naser (2026)* and *Safonova et al. (2023)*.

As shown in *Figure 4*, the first training window covers the actual data of both the feature and target variables from the first quarter of 2009 to the last quarter of 2017, representing an initial training ratio of about 56.25 per cent of the sample. Then, the succeeding test subsets were added with additional quarters until the third quarter of 2024. The entire process produced a total of 28 one-quarter-ahead out-of-sample predictions.



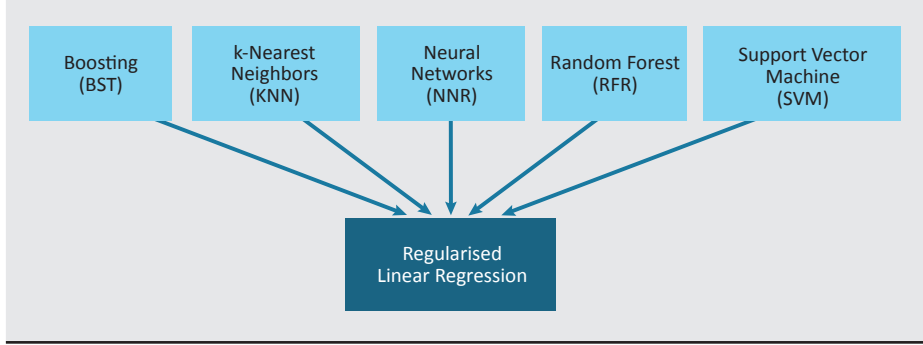
The out-of-sample predictions under this protocol covers three window frames. The first frame covered one-quarter-ahead predictions of a pre-COVID condition from the first quarter of 2018 to the last quarter of 2019, totalling eight quarter predictions. Then, the models continued to expand the training coverage to produce similar predictions during the pandemic (2020-Q1–2022-Q4, 12 quarter predictions) until the post-pandemic frames (2023-Q1 to 2024-Q4, eight quarter predictions).

3.4. Metamodeling framework

A two-level metamodel architecture as shown in *Figure 5* is implemented to predict lending behaviour of banks in the Philippines. In the first layer, all models at every step of the expanding window process are refitted using only the data available

up to the quarter immediately before the one being predicted ($t-1$). Each model then produces a single-quarter-ahead out-of-sample prediction as discussed in the protocol. The hyperparameters are tuned only within the data available in each training windows to prevent exposure to look-ahead bias.

Figure 5
Metamodel architecture



This study acknowledges that each first-layer learner exhibits different strengths. BST emphasises error correction, KNN leverages local similarity, NNR capture high dimensional patterns, RFR provides stability through averaging, and SVM applies margin-based regression. Hence, combining their strengths reduces overall variance and improves predictive capacity. To do so, the first-layer predictions are passed to a meta-learner in the second level using regularised linear regression with a LASSO penalty. It serves as the primary specification for three practical reasons: (1) LASSO can zero-weight base learners that contribute little, (2) it shrinks and selects base learners to mitigate weight instability and reduce overfitting under small samples, and (3) it tempers the tendency to overreact to idiosyncratic patterns in any one learner, which is valuable around structural breaks such as the COVID-19 spikes.

The regression equation for a metal-learner can be shown as:

$$\hat{y}_t^{MTM} = \alpha + \beta_1 \hat{y}_t^{BST}(x_{t-1}) + \beta_2 \hat{y}_t^{KNN}(x_{t-1}) + \beta_3 \hat{y}_t^{NNR}(x_{t-1}) + \beta_4 \hat{y}_t^{RFR}(x_{t-1}) + \beta_5 \hat{y}_t^{SVM}(x_{t-1}) + \epsilon_t \quad (7)$$

With LASSO penalty:

$$\frac{\min}{\beta} \left\{ \sum_{t=1}^n (y_t - \hat{y}_t^{MTM}(x_{t-1}))^2 + \lambda \sum_{j=1}^5 |\beta_j| \right\} \quad (8)$$

To demonstrate that the results are not an artifact of the LASSO penalty, this paper implemented two alternative meta-learners: Ridge and Elastic Net. Ridge provides stable shrinkage when predictors are strongly collinear but retains all learners with small positive weights, while Elastic Net blends the sparsity of LASSO with the grouping stability of Ridge. The regularisation strengths, including the Elastic Net mixing parameter, were selected through the same expanding-window used for the first-layer out-of-sample construction, ensuring no future data informs the tuning process. Equation for regularized regression with Ridge penalty:

$$\frac{\min}{\beta} \left\{ \frac{1}{n} \sum_{t=1}^n (y_t - \hat{y}_t^{MTM}(x_{t-1}))^2 + \lambda \sum_{j=1}^5 |\beta_j^2| \right\} \quad (9)$$

While for regularized regression with Elastic Net penalty:

$$\frac{\min}{\beta} \left[\frac{1}{n} \sum_{t=1}^n (y_t - \hat{y}_t^{MTM}(x_{t-1}))^2 + \lambda \left(\frac{1-\alpha}{2} \sum_{j=1}^5 \beta_j^2 + \alpha \sum_{j=1}^5 |\beta_j| \right) \right] \quad (10)$$

3.5. Performance metrics and directional evaluation

The predictions generated are compared with the corresponding actual data. Performance metrics, such as root mean square errors (RMSE) and mean absolute errors (MAE) are computed for every expanding window to assess whether predictive performance improves as the training samples increase. A declining *RMSE* and *MAE* values indicate that the models continue to learn effectively from the additional data subject of the expanding window process. These metrics also serve as the basis to compare benchmark models against the machine learners and identify which model provides the most accurate prediction of bank lending behaviour. Determination coefficients (R^2) are likewise computed to measure the strengths of explained variance to target variables.

$$RMSE = \sqrt{\frac{1}{n} \sum_{t=1}^n (y_t - \hat{y}_t)^2} \quad (11)$$

$$MAE = \frac{1}{n} \sum_{t=1}^n |y_t - \hat{y}_t| \quad (12)$$

To further the evaluation, the actual data and overall predicted results of target variable were binarised. The objective of binarisation is to determine whether the predictions follow the same direction of the actual data. This became a secondary

diagnostic test for prediction outcomes. To do this, the value of a previous quarter is subtracted from the value of the current quarter ($x_t - x_{t-1}$), producing either a positive or negative change. A positive change (or increased tightening) is assigned as 1 and a negative change (or decreased easing) is assigned as -1. Since a neutral outcome does not exist, assignment of any value is not considered.

Then, confusion metrics were computed. The predicted data was compared to the actual data to derive true positives (TP), false positives (FP), true negatives (TN), and false negatives (FN). These results were further evaluated using accuracy, precision, recall, F1 score, and false discovery.

$$Accuracy = \frac{TP + TN}{TP + FP + TN + FN} \quad (13)$$

$$Precision = \frac{TP}{TP + FP} \quad (14)$$

$$Recall = \frac{TP}{TP + FN} \quad (15)$$

$$F1\ Score = \frac{2 \times Precision \times Recall}{Precision + Recall} \quad (16)$$

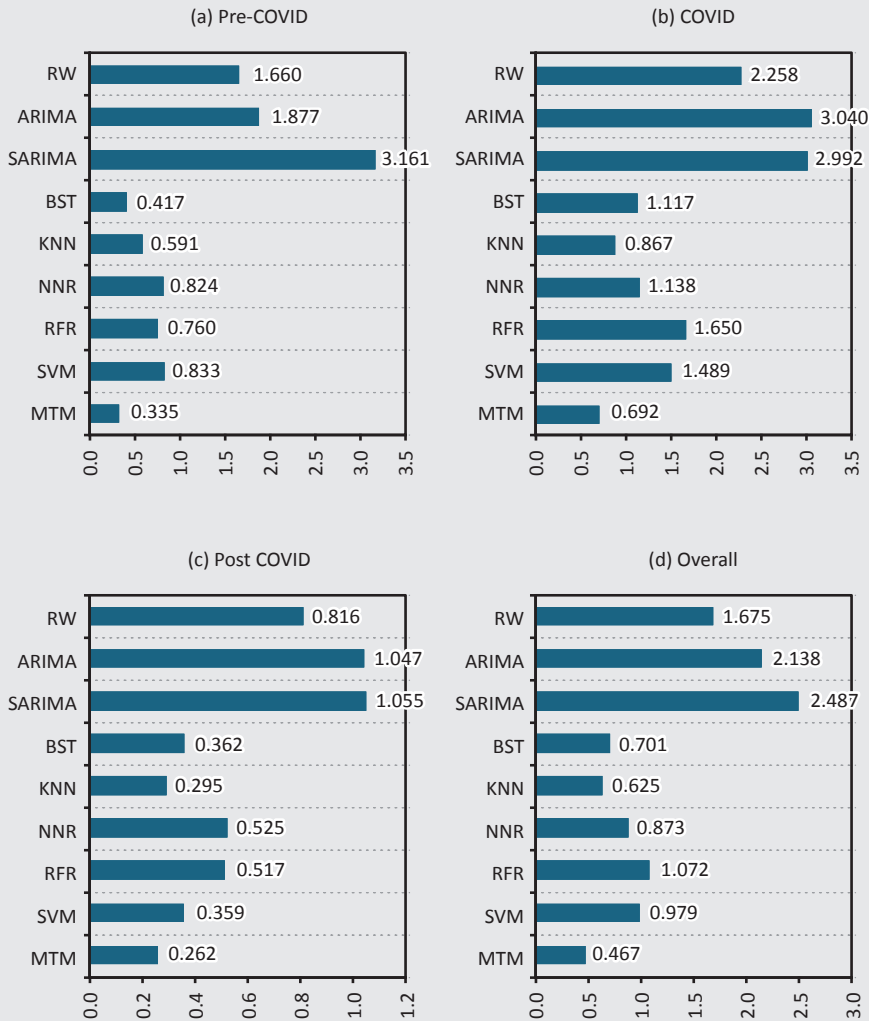
$$False\ Discovery = \frac{FP}{TP + FP} \quad (17)$$

4. Results and discussion

4.1. Prediction accuracy per error metrics RMSE and MAE

Figure 6 compares how well each model predicts lending behaviour across three different periods using average *RMSE*. It measures how far a model's predictions are from actual values. Before the pandemic (2018-Q1–2019-Q4), bank lending behaviour was relatively stable. In this frame, the MTM shows the lowest *RMSE* at 0.335, indicating that it provides the closest predictions to actual SLOS diffusion index. First-layer learners such as BST at 0.417 and KNN at 0.591 also performed reasonably well, but they did not match the consistency of MTM. Meanwhile, benchmark models produce higher errors, showing that they struggle to capture the early patterns in the data.

Figure 6
Average RMSE per window frame of one-quarter-ahead out-of-sample predictions



Note: Lower RMSE means better accuracy.

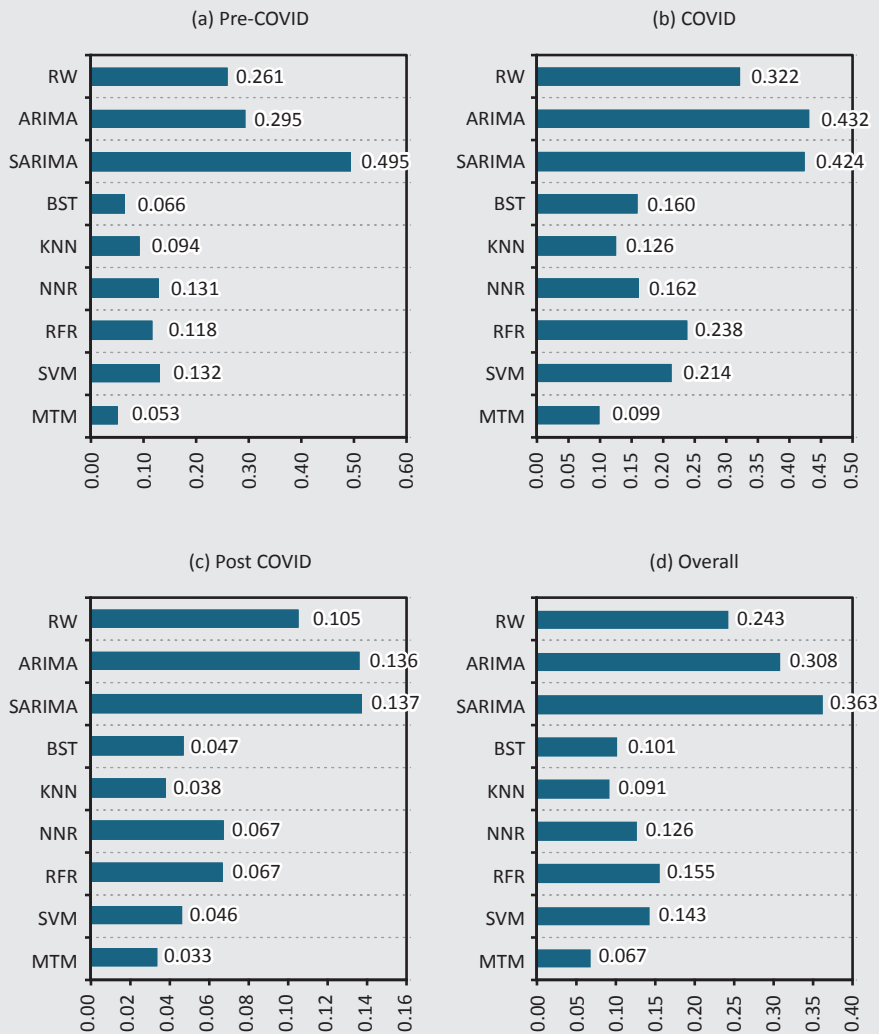
The COVID-19 frame (2020-Q1–2022-Q4) introduced sudden, large swings in lending standards. *Panel (b) of Figure 6* shows that even under turbulent conditions, MTM at 0.692 remains the most accurate among all models ranging from 0.867 to 3.040. All models experienced increase in errors, indicating that they faced difficulty to predict lending behaviour during the pandemic, as they were only trained under normal conditions. As they continued to learn under the expanding-window protocol, their

performance in predicting the post COVID frame (2023-Q1–2024-Q4) was more robust, and even better than the pre-COVID frame.

For the whole panel (2018-Q1–2024-Q4), the overall *RMSE* showed that MTM is effective in predicting bank lending behaviour at 0.467. This is followed by KNN at 0.625 and BST at 0.701. The single learners vary in performance depending on the period. Benchmarks remain consistently less accurate across all frames.

Figure 7

Average MAE per window frame of one-quarter-ahead out-of-sample predictions



Note: Lower MAE means better accuracy.

Figure 7 presents the average MAE across the three frames. Like RMSE, lower MAE means better prediction accuracy, and it focuses on the typical size of errors rather than giving extra weight to large mistakes. Across all panels, MTM records the lowest MAE, confirming that it consistently produces the smallest average deviation from actual lending standards.

Overall, MTM produces the most consistently accurate quarter-ahead predictions regardless of window frames. Also, first-layer learners outperformed benchmark models, but none surpassed MTM. By complementing both error metrics, MTM not only reduces large errors but also keeps one-quarter-ahead prediction mistakes smaller, making it the most dependable for tracking shifts in bank lending behaviour.

4.2. Overall predictive performance

Table 2 presents the overall performance metrics of benchmark machine learners to determine the most robust and accurate predictive model. Among the individual models, KNN had the lowest MSE, RMSE, and MAE, indicating that its predictions had the smallest average error magnitude and minimal average distance to the actual values. Together with BST and NNR, they were classified as having a strong coefficient of determination, with KNN achieving the highest explained variance. The remaining base learners underperformed relative to the top three, achieving only moderate strength of explained variance and suggesting greater sensitivity to outliers and prediction errors.

Meanwhile, the benchmark models have high errors with weak to moderate explained variance. This shows that using autoregressive terms to account for historical momentum of the SLOS diffusion index is not sufficient to effectively predict lending behaviour. Since baseline learners performed better than benchmark models, bank-specific and macroeconomic indicators are better predictors compared to simple autoregressive patterns.

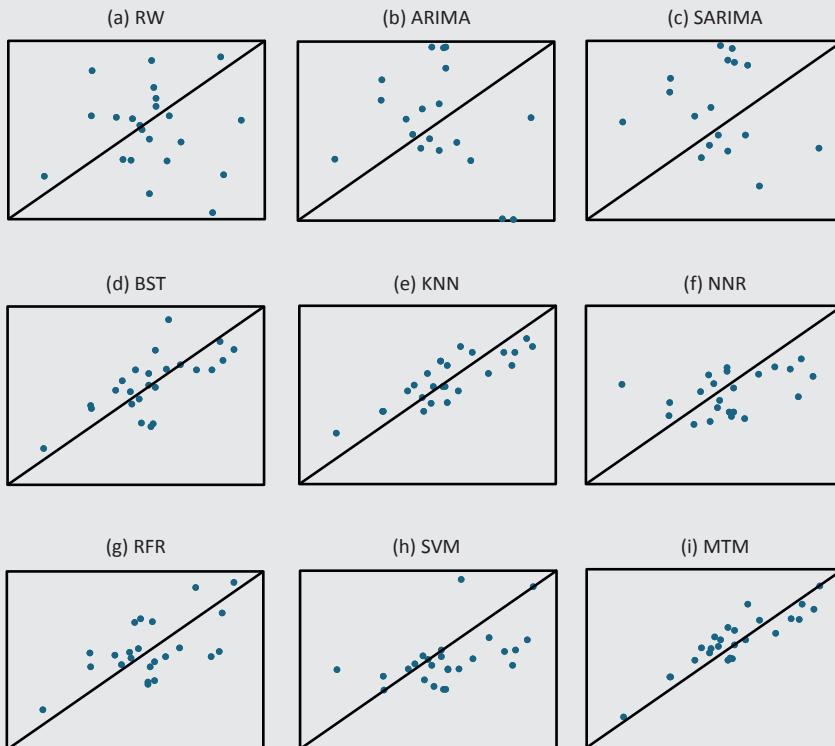
Table 2					
Overall predictive performance of one-quarter-ahead out-of-sample predictions (2018-Q1–2024-Q4)					
Model	MSE	RMSE	MAE	R ²	Strength
RW	2.807	1.675	0.243	0.519	Moderate
ARIMA	4.572	2.138	0.308	0.464	Weak
SARIMA	6.185	2.487	0.363	0.340	Weak
BST	0.491	0.701	0.101	0.902	Strong
KNN	0.390	0.625	0.091	0.931	Strong
NNR	0.762	0.873	0.126	0.875	Strong
RFR	1.149	1.072	0.155	0.750	Moderate
SVM	0.958	0.979	0.143	0.846	Moderate
MTM	0.218	0.467	0.067	0.963	Strong
Note: Boldfaced values indicate better performance compared to other models. Values are average for all windows.					

Collectively, MTM achieved the lowest errors across all models, confirming its superiority in minimising both overall error magnitude and penalty for large errors while maintaining the strongest predictive power. This establishes MTM as the optimal predictive model for this study. Its core advantage lies in its ability to synthesise the specific strengths of baseline models as they adapt to expanding periods. A key observation from the window-by-window analysis is that the peak performance of individual models is distributed throughout the entire expanded window coverage. This shifting pattern of accuracy is what MTM captures to maintain reliable performance even when baseline models fluctuate.

4.3. Out-of-sample prediction pointwise accuracy

To evaluate the predictive performance of the various predictive tools, *Figure 8* presents panels of scatter plots comparing the pointwise predicted values against the actual observed values on the overall test dataset. The y-axis contains the actual values, while the x-axis contains the predicted values. The diagonal line represents

Figure 8
Pointwise prediction accuracy for one-quarter-ahead out-of-sample predictions



Note: The diagonal line indicates perfect prediction. Proximity to the line reflects model accuracy and calibration.

a perfect prediction where the predicted value equals the actual value. The relative accuracy and calibration of each model can be inferred by the proximity of the data points to this line, with a tighter clustering indicating superior predictive power and lower variance in error.

Benchmark models are scattered far from the prediction line. RW missed major ups and downtrends while ARIMA and SARIMA tended to pull predictions toward average values, resulting in under-predicted high points and over-predicted low points. Meanwhile, first-layer machine learners behaved better. BST captured patterns, but some points overreacted, producing values that jumped too high or too low. KNN produced neat clusters of points as it performed well compared to the rest. NNR had more scattered and inconsistent points with noticeable difficulty finding patterns. RFR generally stayed near the diagonal at middle values, but underpredicted extreme highs, pulling predictions toward safer mid-range levels. Finally, SVM followed a straight trend, but was too rigid to react to sudden changes, leading to scattered points when values moved sharply.

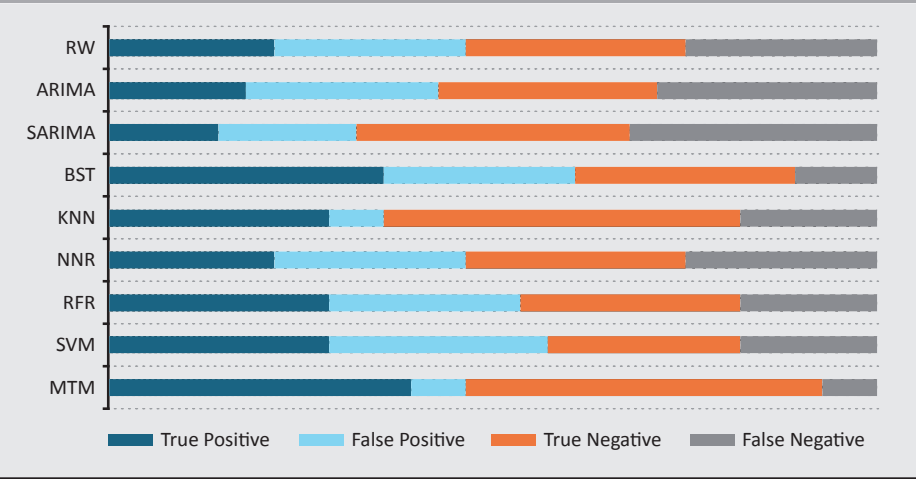
MTM performed most effectively. Most of the points were tightly packed around the diagonal line, showing that its predictions are very close to actual values. It avoids large mistakes, and it captures both gentle and sharp movements in lending behaviour. This pattern reflects the MTM's ability to combine the strengths of all first-layer machine learners while minimising their weaknesses. Hence, MTM is the most reliable predictor of tightening and easing bank lending behaviour.

4.4. Directional accuracy

This study's target variable can be binarised given that a net positive index is equivalent to tightening and a net negative index represents an easing of credit standards. From that, an assessment of how the learners were able to correctly determine directional accuracy was conducted. As shown in *Figure 9*, the predictions are categorised into four components: true positive, true negative, false positive, and false negative. The MTM produced a true positive rate of 0.846, which is higher than the other models that ranged from 0.308 to 0.769. This indicates that 84.6 per cent of predicted positive values were correctly identified as positive based on the actual dataset. Additionally, MTM produced a true negative rate of 0.867, outperforming the rest with results ranging from 0.467 to 0.667. This means that 86.7 per cent of the actual negative values were correctly identified.

In terms of errors, MTM performed more effectively than individual models. The false positive rate is 0.133 similar to KNN, which is notably lower than others that ranged from 0.333 to 0.667. This implies that the probability of a Type 1 error, or incorrectly labelling actual negative data as positive, is only 13.3 per cent. Moreover, the false negative rate of the MTM is 0.154, remaining lower than the rest of the models, which ranged from 0.231 to 0.692. This means that the probability of a Type 2 error, or incorrectly labelling actual positive data as negative, is only 15.4 per cent.

Figure 9
Confusion cardinality metrics of predicted values across models



When evaluating only the individual models, BST performed best at predicting true positive and reducing false negative values. However, it proved to be less effective at predicting true negatives and reducing false positive values. Meanwhile, KNN demonstrated better performance in predicting true negatives and reducing false positives. SARIMA performed the worst in terms of predicting true positives and reducing false negatives.

Table 3
Discriminatory metrics of predicted values across models

Model	Accuracy	Precision	Recall	F1 Score	False Discovery
RW	0.500	0.462	0.462	0.462	0.538
ARIMA	0.464	0.417	0.385	0.400	0.583
SARIMA	0.500	0.444	0.308	0.364	0.556
BST	0.643	0.588	0.769	0.667	0.412
KNN	0.750	0.800	0.615	0.696	0.200
NNR	0.500	0.462	0.462	0.462	0.538
RFR	0.571	0.533	0.615	0.571	0.467
SVM	0.536	0.500	0.615	0.552	0.500
MTM	0.857	0.846	0.846	0.846	0.154

Note: Boldfaced values indicate superior results compared to other models.

To further determine the directional reliability of the predicted values, the models were further analysed to see whether they can discriminate between tightening and easing behaviour. Results in *Table 3* show that MTM achieved the highest accuracy at 0.857, including precision, recall, and F1 score both at 0.846. This suggests that while baseline models are similarly effective at tracking trends, the MTM can maintain higher performance even during periods of significant volatility, as represented in the actual data. Furthermore, MTM produced the lowest false discovery rate at 0.154 compared to other learners ranging from 0.200 to 0.583.

4.5. Feature importance

Table 4 reports the mean dropout loss for each predictor variable across the five baseline machine learning models. The mean dropout loss based on 50 permutations quantifies the decline in model performance when a feature is removed, thereby serving as a proxy for feature importance. Higher values indicate stronger contributions to predictive accuracy.

Table 4 Permutation feature importance metrics							
Feature	Mean dropout loss					Average	Rank
	BST	KNN	NNR	RFR	SVM		
Capital Adequacy Ratio	8.514	7.213	10.71	8.679	9.665	8.956	7
Distressed Assets Ratio	8.380	7.169	12.16	7.018	10.331	9.012	6
Earning Assets Yield	10.663	6.802	13.19	6.275	11.141	9.614	4
GDP Growth Rate	8.820	11.612	11.80	6.942	10.184	9.872	3
Inflation Rate	8.195	7.438	11.56	6.078	9.512	8.557	9
Past Due Ratio	10.673	8.017	13.61	6.707	12.132	10.228	2
Return on Assets	7.958	6.535	12.22	9.141	9.966	9.164	5
Return on Equity	13.789	6.633	14.32	9.847	10.668	11.051	1
Reverse Repurchase Rate	8.109	6.833	12.00	7.242	9.313	8.699	8
Note: Boldfaced values are the highest mean dropout loss per model across the expanded window.							

The results reveal several consistent patterns. Return on Equity (ROE) emerges as the most influential feature, ranking first overall with the highest average dropout loss across models. This underscores its central role in explaining lending behaviour, reflecting how profitability strongly conditions banks’ willingness to extend credit. Past Due Ratio (PDR) ranks second, highlighting the importance of asset quality and delinquency levels in shaping lending outcomes. Elevated past due exposures reduce banks’ risk appetite, making this feature a critical determinant of predictive accuracy.

Other features such as GDP Growth Rate and Earning Assets Yield also rank highly, suggesting that both macroeconomic conditions and the efficiency of asset utilisation materially influence lending behaviour. Their importance confirms the dual role of external economic environment and internal performance metrics in driving credit decisions. By contrast, features such as Inflation Rate and Reverse Repurchase Rate exhibit lower average dropout losses, indicating that while they contribute to the predictive framework, their marginal impact is less pronounced relative to profitability and asset quality indicators.

The finding that ROE and PDR ranked highest, surpassing GDP Growth Rate, suggests that lending behaviour is heavily contingent on a bank's internal capacity to bear risks. Higher profitability enhances this risk-bearing capacity to provide financial flexibility needed to sustain lending activity even during economic uncertainty. Meanwhile, higher PDR reflects the cautionary side of the lending behaviour. Elevated delinquency levels prompt banks to adopt defensive lending policies to safeguard liquidity and satisfy regulatory standards.

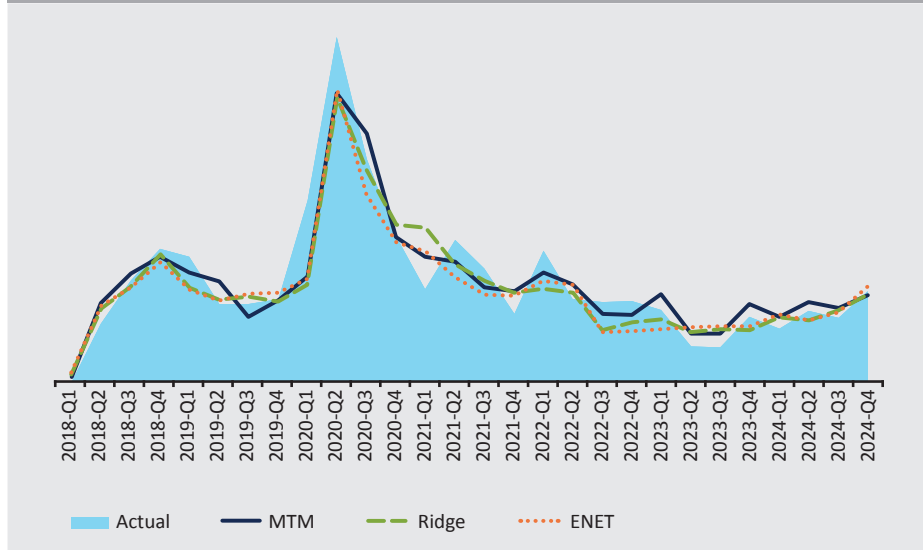
While GDP Growth Rate creates demand for credit, ROE and PDR create a threshold line. Even in periods with high GDP growth, if a bank's profitability is weak or its loan defaults are rising, the supply-side constraints will likely override the demand-side incentives. Hence, banks first ensure their own financial stability before responding to broader economic signals.

The distribution of feature importance across models also highlights methodological diversity. NNR and SVM tend to assign higher dropout losses to profitability and asset quality variables, reflecting their sensitivity to nonproportional interactions. On the other hand, KNN emphasises macroeconomic variables, consistent with its structural bias toward variance explanation. Overall, lending behaviour is most strongly conditioned by profitability measures and asset quality indicators, with macroeconomic growth providing additional explanatory power. MTM benefits from this distribution by synthesising the diverse emphases of individual learners, ensuring that the most informative features are retained while less influential ones are penalised.

4.6. Robustness checks

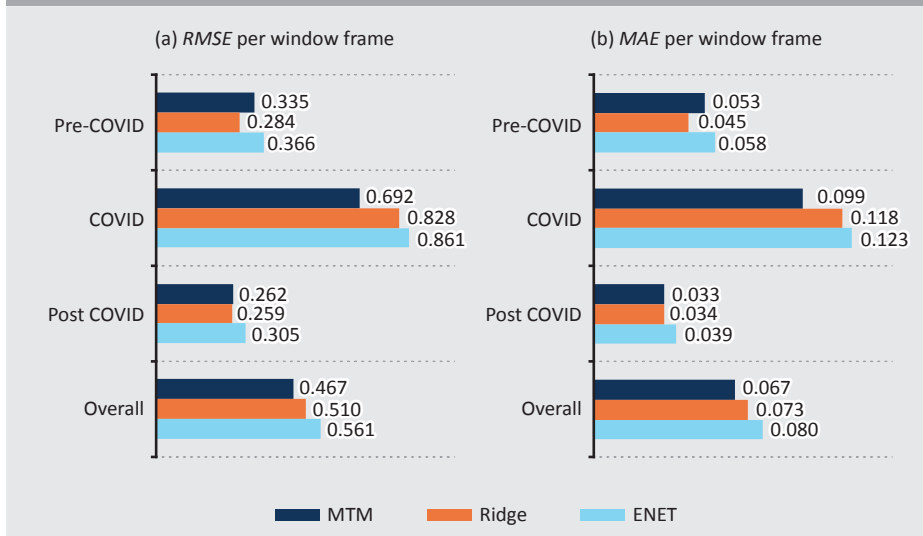
This paper ran two alternative meta-learners to check whether regularising the outcomes of first-layer learners can produce similar results not only with a LASSO penalty. These two alternatives follow the same expanding window process under Ridge and Elastic Net penalties. As shown in *Figure 10*, one-quarter-ahead out-of-sample predictions of the three meta-learners share almost similar capacity to predict bank lending behaviour.

Figure 10
Predictive behaviour of regularised metamodels through LASSO, Ridge, and Elastic Net



The coefficients of determination for the metamodel with Ridge penalty is 0.953 and Elastic Net is 0.960, indicating that the strengths of the metamodel even under the two different regularisation approach is strong. This is further supported by the performance metrics with *RMSE* and *MAE* in *Figure 11* showing minimal differences in their performance.

Figure 11
RMSE and *MAE* of regularised metamodels through LASSO, Ridge, and Elastic Net



Additionally, feature importance metrics with the same permutations as the first-layer learners show that the mean dropout loss for Ridge and Elastic Net are almost similar to the results of MTM. For Ridge, KNN produced the highest mean dropout loss 8.673 followed by BST at 8.255 and NNR at 7.494. For Elastic Net, BST produced the highest at 8.995, followed by KNN at 6.070 and NNR at 6.468. Those three first-layer learners provided the biggest contribution in predicting bank lending behaviour.

5. Conclusions and implications

This study developed and evaluated a LASSO-regularised meta-learning model that synthesises five machine learners – Boosting, k-Nearest Neighbours, Neural Networks, Random Forest, and Support Vector Machine – to forecast the lending behaviour of Philippine universal and commercial banks. Across an expanding window out-of-sample evaluation from 2009 to 2024, the metamodel delivered lower prediction errors and higher directional accuracy than individual learners and conventional benchmarks. Robustness checks using Ridge and Elastic Net penalties produced similar results and confirmed the stability of the approach.

Moreover, the results highlight several important insights. First, profitability and asset quality emerged as the most influential drivers of lending behaviour. This reinforces the critical role of internal bank performance in shaping credit allocation decisions. Second, macroeconomic conditions such as GDP growth were shown to exert external pressures, reflecting the broader environment in which banks operate. Third, the meta-learning approach demonstrated superior adaptability to extreme events, such as the sudden and significant spike during the COVID-19 pandemic, compared to single machine learners.

These findings carry policy implications for regulators, policymakers, and banking practitioners not just for the Philippines but for other small open economies (SOE) as well.

First, this paper contributes to the global discourse on integrating machine learning in banking supervision. The two-layered metamodeling architecture establishes a forecasting benchmark in data-scarce environments. While advanced economies work on high-frequency big data, many emerging markets face reporting lags and smaller datasets. Hence, the use of meta-learning can extract high-predictive value by balancing the strengths of diverse algorithms.

Second, this paper further justifies the establishment of supervisory technologies (SupTech) for central banks. The reporting lag for bank lending surveys creates

a blind spot in monetary policy transmission. Hence, a policy shift toward machine-learning-driven analysis of quarterly financial statements can bridge this gap. The raw financial data already submitted by banks contains sufficient predictive power to forecast their subsequent lending behaviour. Implementing the study's model into a SupTech platform would enhance the proactive measures of central banks in adjusting policy rates and liquidity measures.

Third, monitoring aggregate bank ratios provides early warning indications as deteriorating profitability and asset quality could likely result in the tightening of credit standards. Adopting the model as part of central banks' surveillance toolkit strengthens systemic risk monitoring. Policymakers must anchor policies based on movements of these bank ratios, so that adverse consequences of stress events can be reduced or prevented.

Fourth, the identification of those key drivers offers guidance in designing interventions that strengthen financial stability and resilience. Based on the results, the effectiveness of monetary policy adjustments depends not only on interest rate changes for example, but also to the underlying financial health of banks. Hence, during a crisis such as the COVID-19 pandemic, policy interventions may focus on bolstering bank profitability and cleaning up the balance sheet (supply-side support) as well as on stimulating the broader economy (demand-side support). This ensures that the transmission of monetary policy remains effective given a stable and willing suppliers of credit.

Fifth, the robustness of the model across volatile regimes, including the COVID-19 pandemic, demonstrates its utility in terms of stress testing and scenario analysis. Regulators can use the framework to simulate lending responses under adverse conditions, improving preparedness for future shocks. For instance, stressing the values of bank-specific and macroeconomic indicators based on assumed worst scenarios can predict potential behavioural response of banks. However, it is important to note that while the SLOS diffusion index is a useful proxy for lending behaviour, it reflects perceptions rather than actual loan disbursements. Hence, regulators should treat model outputs as complementary information for decision-making, ensuring balanced reliance on both sentiment and realised lending activity.

Sixth, the Philippine experience provides an example for other SOEs that feature bank-centric financial systems with certain level of exposure to the global economy. In these environments, the meta-learning approach offers a robust method to enhance their early-warning systems, allowing for more precise calibrations of macroprudential tools. For instance, they can use the model to determine the appropriate timing for the release or accumulation of countercyclical capital buffers,

consistent with Basel III standards to prevent excessive credit growth during booms and ensuring credit availability during downturns. By identifying a potential easing or tightening of credit standards before it fully manifests, the SOEs can implement pre-emptive measures.

Seventh, insights from the model can inform coordination between monetary and fiscal authorities. For instance, if profitability constrains banks' willingness to extend credit despite accommodative monetary policy, fiscal measures such as credit guarantees or targeted subsidies may be necessary to sustain credit flow to households and businesses.

Finally, for banks, the results underscore the importance of maintaining profitability and asset quality to support strong lending practices. This underscores the importance of having an effective credit risk management system. A loan portfolio that is built on appropriate credit risk management, sound credit granting process, and robust credit measurement and control policies, ensures that credit continues to perform despite stress events. Profitability not only enhances a bank's capacity to absorb shocks, but also provides the flexibility to extend credit under favourable terms, thereby stimulating economic activity. At the same time, strong asset quality reduces credit risk exposure, ensuring that lending growth does not compromise financial stability. Together, these factors highlight that lending is not merely about expanding loan portfolios, but also about balancing growth with resilience. Banks that prioritise profitability and asset quality are better positioned to navigate volatile macroeconomic conditions, align with regulatory expectations, and contribute to the effective transmission of monetary policy.

Future research should expand on this study by extending the framework with other machine learners or considering other bank-specific and macro-economic variables that could further improve the predictive capacity of the metamodel.

References

- Abdolshah, F. – Moshiri, S. – Worthington, A. (2020): *Macroeconomic shocks and credit risk stress testing the Iranian banking sector*. Journal of Economic Studies, 48(2): 275–295. <https://doi.org/10.1108/jes-11-2019-0498>
- Adegbite, A. (2024): *Finance modeling approach using machine learning*. IOSR Journal of Economics and Finance, 15(5): 29–41. <https://doi.org/10.9790/5933-1505072941>
- Ahmed, S. – Majeed, M. – Thalassinou, E. – Thalassinou, Y. (2021): *The impact of bank specific and macro-economic factors on non-performing loans in the banking sector: Evidence from an emerging economy*. Journal of Risk and Financial Management, 14(5), 217. <https://doi.org/10.3390/jrfm14050217>

- Aikman, D. – Bush, O. – Taylor, A. (2016): *Monetary versus macroprudential policies: Causal impacts of interest rates and credit controls in the era of the UK Radcliffe report*. NBER Working Paper 22380. <https://doi.org/10.3386/w22380>
- Anand, M. – Velu, A. – Whig, P. (2022): *Prediction of loan behaviour with machine learning models for secure banking*. Journal of Computer Science and Engineering, 3(1): 1–13. <https://doi.org/10.36596/jcse.v3i1.237>
- Anyanwu, F.A. – Ananwude, A.C. – Okoye, N.T. (2017): *An empirical assessment of the impact of commercial banks' lending on economic development of Nigeria*. International Journal of Applied Economics, Finance and Accounting, 1(1): 14–29. <https://doi.org/10.33094/8.2017.11.14.29>
- Ashraf, B.N. (2021): *Is economic uncertainty a risk factor in bank loan pricing decisions? International evidence*. Risks, 9(5), 81. <https://doi.org/10.3390/risks9050081>
- Bancel, F. – Mittoo, U.R. (2011): *Financial flexibility and the impact of the global financial crisis: Evidence from France*. International Journal of Managerial Finance, 7(2): 179–216. <https://doi.org/10.1108/17439131111122157>
- Bangko Sentral ng Pilipinas (2025a): *Balance Sheet – Philippine Banking System* [Dataset]. Bangko Sentral ng Pilipinas. <https://www.bsp.gov.ph/SitePages/Statistics/BSFinancialStatements.aspx?TabId=1>
- Bangko Sentral ng Pilipinas (2025b): *Senior Bank Loan Officers' Survey* [Dataset]. Bangko Sentral ng Pilipinas. https://www.bsp.gov.ph/Pages/MediaAndResearch/PublicationsAndReports/regular_slos.aspx
- Bangko Sentral ng Pilipinas (2025c): *Media and Research – Prices* [Dataset]. Bangko Sentral ng Pilipinas. <https://www.bsp.gov.ph/SitePages/Statistics/Prices.aspx?TabId=1>
- Bassett, W.F. – Chosak, M.B. – Driscoll, J.C. – Zakrajšek, E. (2014): *Changes in bank lending standards and the macroeconomy*. Journal of Monetary Economics, 62: 23–40. <https://doi.org/10.1016/j.jmoneco.2013.12.005>
- Bernanke, B.S. (2018): *The real effects of disrupted credit: Evidence from the global financial crisis*. Brookings Papers on Economic Activity, 2018(2): 251–342. <https://doi.org/10.1353/eca.2018.0012>
- Chen, H. (2022): *Prediction and analysis of financial default loan behavior based on machine learning model*. Computational Intelligence and Neuroscience, 2022, 7907210. <https://doi.org/10.1155/2022/7907210>
- Claessens, S. – Kodres, L. (2014): *The regulatory responses to the global financial crisis: Some uncomfortable questions*. IMF Working Paper 14/46. <https://doi.org/10.5089/9781484335970.001>

- Donepudi, P.K. (2017): *Machine learning and artificial intelligence in banking*. Engineering International, 5(2): 83–86. <https://doi.org/10.18034/ei.v5i2.490>
- Dou, W.W. – Fang, X. – Lo, A.W. – Uhlig, H. (2023): *Macro-finance models with nonlinear dynamics*. Annual Review of Financial Economics, 15(1): 407–432. <https://doi.org/10.1146/annurev-financial-110921-112053>
- Fung, M.K.-Y. – Ho, W.-M. – Zhu, L. (2000): *The impact of credit control and interest rate regulation on the transforming Chinese economy: An analysis of long-run effects*. Journal of Comparative Economics, 28(2): 293–320. <https://doi.org/10.1006/jcec.2000.1655>
- Guerra, P. – Castelli, M. (2021): *Machine learning applied to banking supervision a literature review*. Risks, 9(7), 136. <https://doi.org/10.3390/risks9070136>
- Hashemi, S.K. – Mirtaheri, S.L. – Greco, S. (2023): *Fraud detection in banking data by machine learning techniques*. IEEE Access, 11(1): 3034–3043. <https://doi.org/10.1109/access.2022.3232287>
- Kavirathne, G.P.R.A. – Perera, V.A.S. – Karunathunge, L.C.R. – Dewapura, B.N. – Karunasena, A. – Pemadasa, M.G.N.M. (2022): *A Meta-learning approach to predict non-performing loans in Sri Lankan financial institutions*. 13th International Conference on Computing Communication and Networking Technologies (ICCCNT), Kharagpur, India, pp. 1–6. <https://doi.org/10.1109/iccant54827.2022.9984519>
- Kozak, S. (2021): *The impact of COVID-19 on bank equity and performance: The case of Central Eastern South European countries*. Sustainability, 13(19), 11036. <https://doi.org/10.3390/su131911036>
- Leo, M. – Sharma, S. – Maddulety, K. (2019): *Machine learning in banking risk management: A literature review*. Risks, 7(1): 1–22. <https://doi.org/10.3390/risks7010029>
- Lin, Y. – Yang, M. – Wan, C. – Wang, J. – Song, Y. (2019): *A multi-model combination approach for probabilistic wind power forecasting*. IEEE Transactions on Sustainable Energy, 10(1): 226–237. <https://doi.org/10.1109/tste.2018.2831238>
- Madugu, A.H. – Ibrahim, M. – Amoah, J.O. (2020): *Differential effects of credit risk and capital adequacy ratio on profitability of the domestic banking sector in Ghana*. Transnational Corporations Review, 12(1): 37–52. <https://doi.org/10.1080/19186444.2019.1704582>
- Makridakis, S. – Bakas, N. (2016): *Forecasting and uncertainty: A survey*. Risk and Decision Analysis, 6(1): 37–64. <https://doi.org/10.3233/rda-150114>
- Miglo, A. (2018): *Credit rationing, signaling by risk-bearing, flexibility theory and other theories of financing for entrepreneurial firms*. SSRN Electronic Journal. <https://doi.org/10.2139/ssrn.3147650>

- Montero-Manso, P. – Athanasopoulos, G. – Hyndman, R.J. – Talagala, T.S. (2020): *FFORMA: Feature-based forecast model averaging*. International Journal of Forecasting, 36(1): 86–92. <https://doi.org/10.1016/j.ijforecast.2019.02.011>
- Muslim, M.A. – Nikmah, T.L. – Pertiwi, D.A.A. – Subhan – Jumanto – Dasril, Y. et al. (2023): *New model combination meta-learner to improve accuracy prediction P2P lending with stacking ensemble learning*. Intelligent Systems with Applications, 18, 200204. <https://doi.org/10.1016/j.iswa.2023.200204>
- Naili, M. – Lahrichi, Y. (2020): *The determinants of banks' credit risk: Review of the literature and future research agenda*. International Journal of Finance & Economics, 27(1): 334–360. <https://doi.org/10.1002/ijfe.2156>
- Naser, M.Z. (2026): *A review of machine learning with small and limited data*. Journal of Big Data, 13, article 18. <https://doi.org/10.1186/s40537-025-01346-9>
- Nguyen, T. – Minhaj, A.B. – Doan, A.-T. (2025): *How do economic policy uncertainty and inflation individually and collectively influence bank loan pricing decisions in China?*. Journal of Chinese Economic and Foreign Trade Studies, 18(3): 398–428. <https://doi.org/10.1108/jcefts-09-2024-0072>
- Olawale, A. (2024): *Capital adequacy and financial stability: A study of Nigerian banks' resilience in a volatile economy*. GSC Advanced Research and Reviews, 21(1): 001–012. <https://doi.org/10.30574/gscarr.2024.21.1.0346>
- Olowe, K.J. – Edoh, N.L. – Zouo, S.J.C. – Olamijuwon, J. (2024): *Review of predictive modeling and machine learning applications in financial service analysis*. Computer Science & IT Research Journal, 5(11): 2609–2626. <https://doi.org/10.51594/csitrj.v5i11.1731>
- Parker, S.C. (2002): *Do banks ration credit to new enterprises? And should governments intervene?*. Scottish Journal of Political Economy, 49(2): 162–195. <https://doi.org/10.1111/1467-9485.00227>
- Paz, Á. – Crawford, B. – Monfroy, E. – Barrera-García, J. – Peña Fritz, Á. – Soto, R. et al. (2025): *Machine learning and metaheuristics approach for individual credit risk assessment: A systematic literature review*. Biomimetics, 10(5), 326. <https://doi.org/10.3390/biomimetics10050326>
- Rane, N. – Choudhary, S.P. – Rane, J. (2024): *Ensemble deep learning and machine learning: Applications, opportunities, challenges, and future directions*. Studies in Medical and Health Sciences, 1(2): 18–41. <https://doi.org/10.48185/smhs.v1i2.1225>
- Rostagno, M. – Altavilla, C. – Carboni, G. – Lemke, W. – Motto, R. – Saint Guilhem, A. et al. (2021): *Monetary policy in times of crisis: A Tale of Two Decades of the European Central Bank*. Oxford University Press. <https://doi.org/10.1093/oso/9780192895912.001.0001>

- Safonova, A. – Ghazaryan, G. – Stiller, S. – Main-Knorn, M. – Nendel, C. – Ryo, M. (2023): *Ten deep learning techniques to address small data problems with remote sensing*. International Journal of Applied Earth Observation and Geoinformation, 125, 103569. <https://doi.org/10.1016/j.jag.2023.103569>
- Savolainen, J. – Collan, M. (2020): *Using meta-models in simulation-based investment analysis: Studying the financing mix of metal mining investments*. Fuzzy Economic Review, 25(01). <https://doi.org/10.25102/fer.2020.01.04>
- Schiantarelli, F. – Stacchini, M. – Strahan, P. (2016): *Bank quality, judicial efficiency and borrower runs: Loan repayment delays in Italy*. National Bureau of Economic Research. <https://doi.org/10.3386/w22034>
- Siebert, S. – Sansom, P.G. – Williams, R.M. (2016): *Parameter uncertainty in forecast recalibration*. Quarterly Journal of the Royal Meteorological Society, 142(696): 1213–1221. <https://doi.org/10.1002/qj.2716>
- Wu, H. – Levinson, D. (2021): *The ensemble approach to forecasting: A review and synthesis*. Transportation Research Part C: Emerging Technologies, 132(1), 103357. <https://doi.org/10.1016/j.trc.2021.103357>
- Yitayaw, M. (2021): *Firm-specific, industry-specific and macroeconomic determinants of commercial banks' lending in Ethiopia: Panel data approach*. Cogent Economics & Finance, 9(1). <https://doi.org/10.1080/23322039.2021.1952718>
- Yurdakul, F. (2014): *Macroeconomic modelling of credit risk for banks*. Procedia – Social and Behavioral Sciences, 109: 784–793. <https://doi.org/10.1016/j.sbspro.2013.12.544>

Appendix

A. Publication schedule of features and target

Variable	Report	Data Periodicity	Publication Schedule
SLOS Diffusion Index	Senior Bank Loan Officer's Survey	Quarterly	~ 1 month after the reference period
Capital Adequacy Ratio	Selected Performance Indicators of Universal/Commercial Bank Group	Monthly	~ 2 weeks after the reference period
Distressed Assets Ratio	Selected Performance Indicators of Universal/Commercial Bank Group	Monthly	~ 2 weeks after the reference period
Earning Assets Yield	Selected Performance Indicators of Universal/Commercial Bank Group	Monthly	~ 2 weeks after the reference period
Past Due Ratio	Selected Performance Indicators of Universal/Commercial Bank Group	Monthly	~ 2 weeks after the reference period
Return on Assets	Selected Performance Indicators of Universal/Commercial Bank Group	Monthly	~ 2 weeks after the reference period
Return on Equity	Selected Performance Indicators of Universal/Commercial Bank Group	Monthly	~ 2 weeks after the reference period
GDP Growth Rate	Selected Philippine Economic Indicators	Monthly	~ 2 weeks after the reference period
Inflation Rate	Inflation Rate Press Release	Monthly	~ 1 week after the reference period
Reverse Repurchase Rate	BSP Policy Rates	Daily	1:00 pm every working day

Note: It would take approximately four months to identify the actual bank lending behaviour for a certain quarter. Features are already available approximately two weeks after the previous period (last data of training set). For instance, predicting lending behaviour for December 2024 (to be published in January 2025) would need aggregate bank lending ratios and macroeconomic indicators of September 2024 (data already available on the second week of October 2024). This allows a lead time to implement proactive policies in addressing consequences of either tightening or easing credit standards.

Source: Bangko Sentral ng Pilipinas' Advance Release Calendar <https://www.bsp.gov.ph/Statistics/Advance%20Release%20Schedule/AdvanceReleaseSchedule.aspx>

B. Stationarity of features and target after first-order differencing

Observation	Augmented Dickey-Fuller t	Phillips-Perron	Remarks
Bank Lending Behaviour	-5.240**	-58.266**	Stationary
Capital Adequacy Ratio	-3.086*	-53.341**	Stationary
Distressed Assets Ratio	-2.459*	-64.660**	Stationary
Earning Assets Yield	-2.133*	-42.927**	Stationary
GDP Growth Rate	-5.658**	-54.070**	Stationary
Inflation Rate	-5.538**	-53.841**	Stationary
Past Due Ratio	-2.217*	-90.611**	Stationary
Return on Assets	-4.541**	-42.638**	Stationary
Return on Equity	-4.909**	-33.919**	Stationary
Reverse Repurchase Rate	-3.354*	-30.629**	Stationary
Note: * $p < 0.05$, ** $p < 0.01$.			

C. Normality of residuals of benchmark models and metamodels

Models	Shapiro-Wilk W	p-value	Lilliefors D	p-value	Remarks
RW	0.394	0.962	0.123	0.344	Normally distributed
ARIMA	0.995	0.266	0.106	0.582	Normally distributed
SARIMA	0.939	0.104	0.145	0.140	Normally distributed
MTM-LASSO	0.945	0.171	0.140	0.170	Normally distributed
MTM-Ridge	0.934	0.078	0.138	0.192	Normally distributed
MTM-Elastic net	0.955	0.264	0.143	0.151	Normally distributed
Note: p-values more than 0.05 indicates normal distribution.					

D. RMSE window-by-window

Window	RW	ARIMA	SARIMA	BST	KNN	NNR	RFR	SVM	MTM	Ridge	ENET
2018-Q1	0.559	1.118	2.325	0.354	0.822	2.374	0.455	1.717	0.164	0.242	0.280
2018-Q2	0.649	0.170	0.570	0.756	0.548	0.391	0.161	0.143	0.606	0.444	0.546
2018-Q3	1.377	1.916	2.722	0.022	0.344	0.347	0.592	0.947	0.219	0.179	0.214
2018-Q4	3.273	4.643	6.502	0.793	0.577	0.768	0.408	1.591	0.221	0.145	0.379
2019-Q1	4.154	4.333	6.213	0.839	0.336	0.844	1.515	1.390	0.434	0.872	0.937
2019-Q2	2.207	0.887	0.905	0.027	0.733	0.414	1.011	0.002	0.653	0.120	0.105
2019-Q3	0.549	0.518	1.822	0.375	0.724	0.539	0.937	0.182	0.351	0.215	0.289
2019-Q4	0.513	1.432	4.229	0.166	0.641	0.915	1.001	0.693	0.030	0.056	0.177
2020-Q1	1.327	1.484	0.488	1.734	2.803	0.312	3.960	2.410	2.076	2.295	2.148
2020-Q2	5.957	7.164	7.045	4.074	2.691	2.568	6.125	5.596	1.519	1.643	1.431
2020-Q3	3.880	3.895	4.281	0.555	0.605	0.798	1.991	1.783	0.673	0.283	0.967
2020-Q4	1.804	1.697	2.560	0.640	0.707	1.346	0.616	0.002	0.036	0.284	0.169
2021-Q1	0.257	1.984	1.174	1.471	0.700	3.026	2.083	1.601	0.857	1.608	0.982
2021-Q2	1.032	7.161	6.516	0.645	0.368	1.415	0.253	1.357	0.568	0.622	0.954
2021-Q3	5.951	2.494	2.879	0.455	0.581	0.411	0.836	0.566	0.480	0.318	0.661
2021-Q4	3.938	3.203	3.790	0.700	0.576	0.298	1.038	0.001	0.572	0.541	0.456
2022-Q1	0.385	1.020	1.250	0.130	0.790	1.645	1.343	1.739	0.536	0.959	0.741
2022-Q2	0.245	1.853	1.448	0.830	0.415	0.199	0.403	0.648	0.365	0.155	0.366
2022-Q3	1.537	2.688	2.649	1.101	0.067	0.747	0.464	1.075	0.283	0.689	0.723
2022-Q4	0.788	1.837	1.827	1.065	0.107	0.885	0.693	1.097	0.339	0.538	0.734
2023-Q1	0.106	2.065	2.085	0.830	0.106	0.252	0.979	0.800	0.371	0.235	0.470
2023-Q2	2.298	2.093	2.128	0.449	0.361	0.582	0.611	0.001	0.302	0.348	0.474
2023-Q3	1.146	1.557	1.763	0.537	0.365	0.255	0.979	0.365	0.317	0.438	0.491
2023-Q4	0.336	0.600	0.649	0.150	0.362	0.625	0.126	0.455	0.296	0.332	0.231
2024-Q1	0.653	0.632	0.707	0.473	0.442	0.400	0.477	0.101	0.286	0.256	0.324
2024-Q2	0.038	0.264	0.182	0.162	0.279	0.395	0.245	0.211	0.218	0.219	0.224
2024-Q3	0.668	0.352	0.289	0.171	0.013	0.578	0.279	0.175	0.217	0.166	0.123
2024-Q4	1.288	0.813	0.637	0.125	0.431	1.117	0.442	0.765	0.089	0.080	0.102

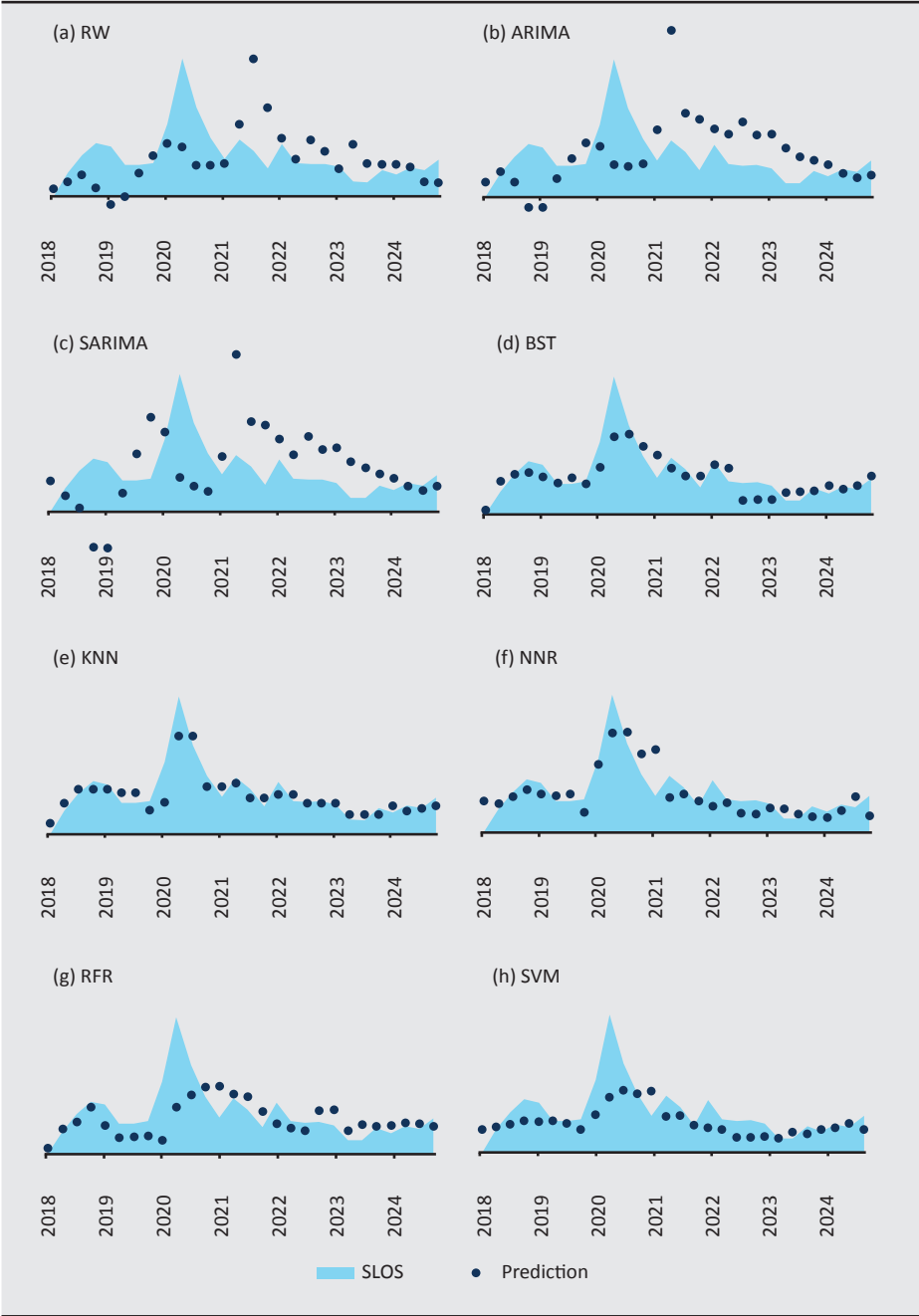
E. MAE window-by-window

Window	RW	ARIMA	SARIMA	BST	KNN	NNR	RFR	SVM	MTM	Ridge	ENET
2018-Q1	0.092	0.184	0.382	0.058	0.135	0.391	0.075	0.282	0.027	0.040	0.046
2018-Q2	0.105	0.028	0.093	0.123	0.095	0.064	0.026	0.023	0.098	0.072	0.089
2018-Q3	0.221	0.307	0.436	0.004	0.055	0.056	0.095	0.152	0.035	0.029	0.034
2018-Q4	0.518	0.734	1.028	0.125	0.091	0.121	0.065	0.252	0.035	0.023	0.060
2019-Q1	0.649	0.677	0.970	0.131	0.052	0.132	0.237	0.217	0.068	0.136	0.146
2019-Q2	0.341	0.137	0.140	0.004	0.113	0.064	0.156	0.000	0.101	0.018	0.016
2019-Q3	0.084	0.079	0.278	0.057	0.111	0.082	0.143	0.028	0.054	0.033	0.044
2019-Q4	0.077	0.216	0.638	0.025	0.097	0.138	0.151	0.105	0.005	0.009	0.027
2020-Q1	0.198	0.221	0.073	0.259	0.418	0.047	0.590	0.359	0.310	0.342	0.320
2020-Q2	0.878	1.056	1.039	0.601	0.397	0.379	0.903	0.825	0.224	0.242	0.211
2020-Q3	0.566	0.568	0.625	0.081	0.088	0.117	0.290	0.260	0.098	0.041	0.140
2020-Q4	0.260	0.245	0.370	0.092	0.102	0.194	0.089	0.000	0.005	0.041	0.024
2021-Q1	0.037	0.283	0.168	0.210	0.100	0.432	0.298	0.229	0.122	0.230	0.140
2021-Q2	0.146	1.013	0.922	0.091	0.052	0.200	0.036	0.192	0.080	0.088	0.135
2021-Q3	0.833	0.349	0.403	0.064	0.081	0.058	0.117	0.079	0.067	0.045	0.093
2021-Q4	0.546	0.444	0.526	0.097	0.080	0.041	0.144	0.000	0.079	0.075	0.063
2022-Q1	0.053	0.140	0.172	0.018	0.109	0.226	0.185	0.239	0.074	0.132	0.102
2022-Q2	0.033	0.252	0.197	0.113	0.057	0.027	0.055	0.088	0.050	0.021	0.050
2022-Q3	0.207	0.362	0.357	0.149	0.009	0.101	0.063	0.145	0.038	0.093	0.098
2022-Q4	0.105	0.246	0.244	0.142	0.014	0.118	0.093	0.147	0.045	0.072	0.098
2023-Q1	0.014	0.274	0.276	0.110	0.014	0.033	0.130	0.106	0.049	0.031	0.062
2023-Q2	0.302	0.275	0.279	0.059	0.047	0.076	0.080	0.000	0.040	0.046	0.062
2023-Q3	0.149	0.203	0.230	0.070	0.048	0.033	0.128	0.048	0.041	0.057	0.064
2023-Q4	0.043	0.077	0.084	0.019	0.047	0.081	0.016	0.059	0.038	0.043	0.030
2024-Q1	0.084	0.081	0.091	0.061	0.057	0.051	0.061	0.013	0.037	0.033	0.042
2024-Q2	0.005	0.034	0.023	0.021	0.036	0.050	0.029	0.027	0.028	0.028	0.025
2024-Q3	0.084	0.044	0.036	0.022	0.002	0.073	0.035	0.022	0.024	0.021	0.015
2024-Q4	0.161	0.102	0.080	0.016	0.054	0.140	0.055	0.096	0.011	0.010	0.013

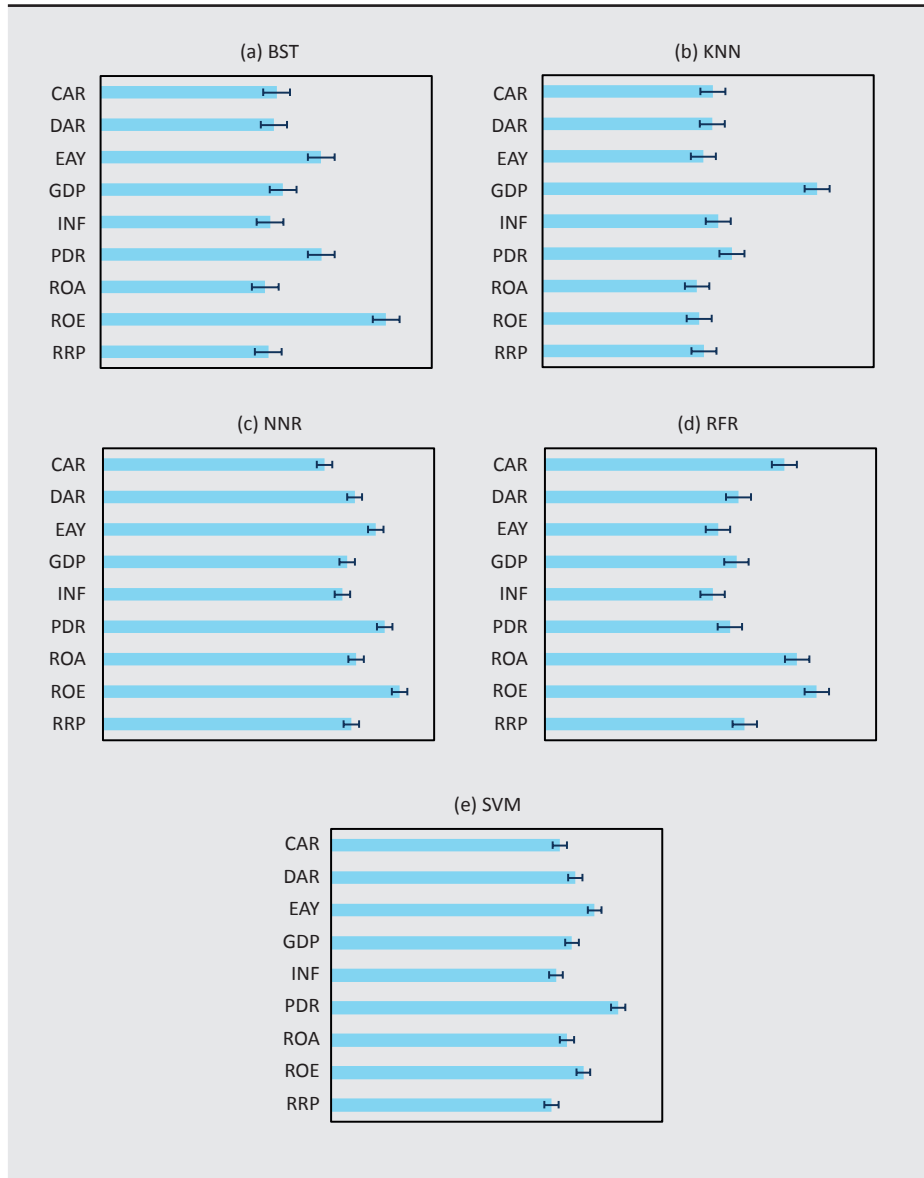
F. Binarised prediction results of benchmark and first-layer models

	TP	FP	TN	FN	TP Rate	FP Rate	TN Rate	FN Rate
RW	11	2	13	2	0.846	0.133	0.867	0.154
ARIMA	8	8	7	5	0.615	0.533	0.467	0.385
SARIMA	8	7	8	5	0.615	0.467	0.533	0.385
BST	6	7	8	7	0.462	0.467	0.533	0.538
KNN	8	2	13	5	0.615	0.133	0.867	0.385
NNR	10	7	8	3	0.769	0.467	0.533	0.231
RFR	4	5	10	9	0.308	0.333	0.667	0.692
SVM	5	7	8	8	0.385	0.467	0.533	0.615

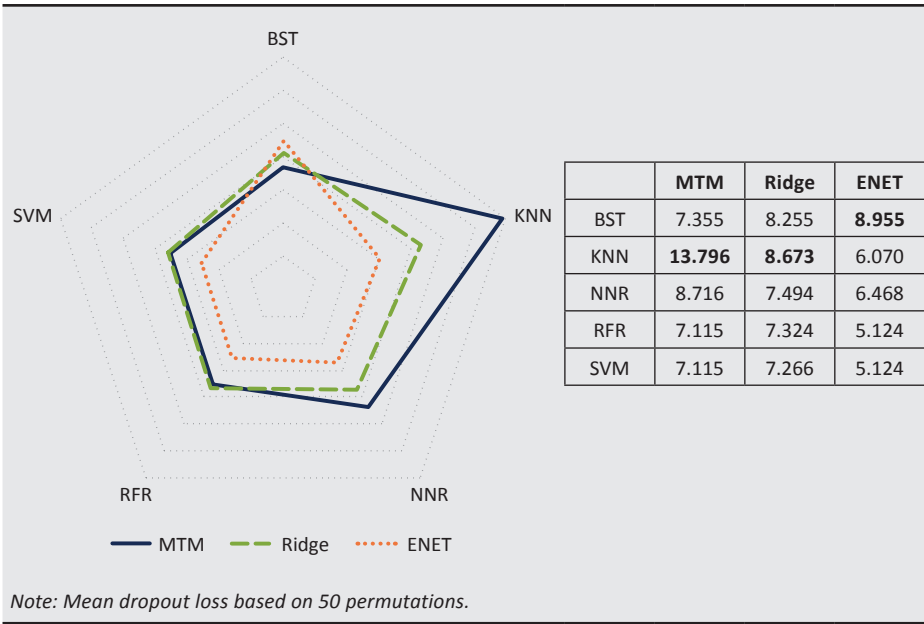
G. Predictive behaviour of benchmark and first-layer models



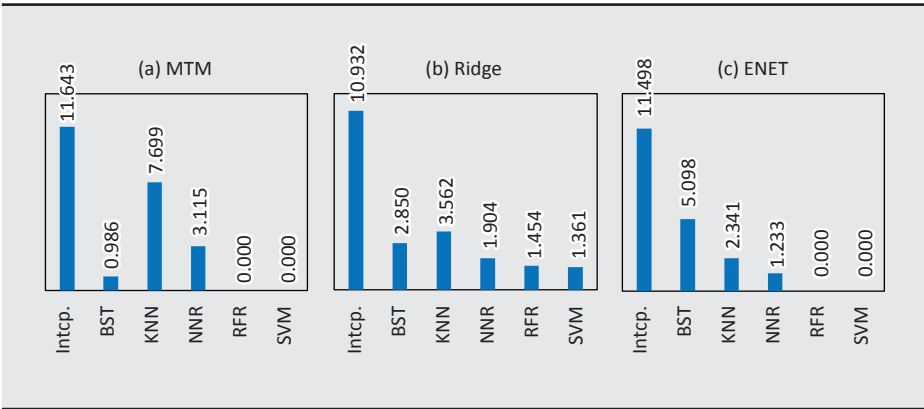
H. Mean dropout loss of features based on 50 permutations with whiskered standard errors



I. Feature importance of alternative metamodels



J. Regression coefficients based on the last expanded window



ESG Ratings and Financial Markets: Evidence, Measurement Noise and Misinterpretations*

Károly Gasteiger 

This essay examines the measurement limitations that arise when ESG ratings are interpreted as financial information. It argues that composite ESG scores should not be treated as stable risk factors, but rather as information signals shaped by provider-specific methodologies, data sources, disclosure practices and aggregation choices. This essay discusses the separation between disclosure and actual ESG outcomes, the model risk created by rating divergence, and the frequent misinterpretation of the green premium and ESG performance. From a banking perspective, the implication is not to discard ESG information, but rather to use external ESG data with discipline. Without financial materiality, data quality controls, exposure-based assessments and internal governance, ESG cannot serve as a defensible input in financial decision-making.

Journal of Economic Literature (JEL) classification: G12, G14, G21, Q56

Keywords: ESG ratings, financial markets, measurement error, rating divergence, information noise, prudential risk management

1. Introduction: Why is ESG confusing in finance?

ESG¹ (Environmental, Social, and Governance) refers to the set of environmental, social and governance considerations relating to firms' environmental impact, social conduct and governance practices, which investors and lenders increasingly incorporate into risk assessment and decision-making. In market practice, the term "ESG firm" usually refers to a company that receives a favourable assessment in an ESG rating system or displays performance that can be evaluated in terms of sustainability-related dimensions. Over the past decade, ESG considerations have become integral to financial decision-making. ESG data and ESG risk information are increasingly used in corporate valuation, portfolio allocation, banking risk

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¹ The term ESG (Environmental, Social and Governance) is used in this essay not as a normative framework, but as an umbrella term for the heterogeneous metrics and ratings used in market practice, including ESG ratings, ESG scores and disclosure-based indicators. Where the term refers to a different meaning, such as actual performance or commitment, this is stated explicitly.

management and supervisory frameworks, often as if they were well-defined, stable information signals. This practice raises a fundamental financial question: What type of information do ESG measures actually contain, and how are they incorporated into prices and risk decisions? While the Hungarian literature has addressed the institutional and regulatory dimensions of ESG integration, the link between signal quality and pricing mechanisms has received less attention. This issue is especially important when ESG and climate metrics are used for financial or risk management purposes.

A classical insight of financial economics is that publicly available information does not, by itself, guarantee persistent excess returns, as such information is incorporated into prices (*Fama 1970; Grossman and Stiglitz 1980*). However, this principle applies only when the information is well-defined, consistently interpretable and uniformly processed. In the case of ESG, precisely these conditions are violated: ESG assessments of the same firms may differ substantially across providers, while the measurement decisions underlying the scores often remain opaque (*Berg et al. 2022; Christensen et al. 2022*). Among these measurement choices, the definition of scope is particularly important: omitting indirect emissions, especially Scope 3² emissions, can materially distort sector rankings and exposure assessments (*Szendrey – Dombi 2023*).

In the Hungarian literature, the dilemma of measurability and comparability has already appeared in discussions of the numerical evaluation of ESG reports and critiques of the oversupply of ESG tools and frameworks (*Hajdu et al. 2023*). This is also reflected in empirical findings showing no direct effect of ESG ratings on financial indicators and accounting valuation (*Reizingerné Ducsay – Hajdu 2024*). Hungarian empirical evidence does not robustly support the view that ESG screening generates persistent excess returns or resilience during crises, and several results explicitly highlight specification sensitivity (*Szepesi 2020*). This is complemented by central bank evidence on climate risk measurement: missing data, heterogeneous data sources, the absence of unified methodologies and the limitations of rating systems all make it difficult to assess the climate exposure of financial assets in a comparable manner (*Kolozsi et al. 2022*).

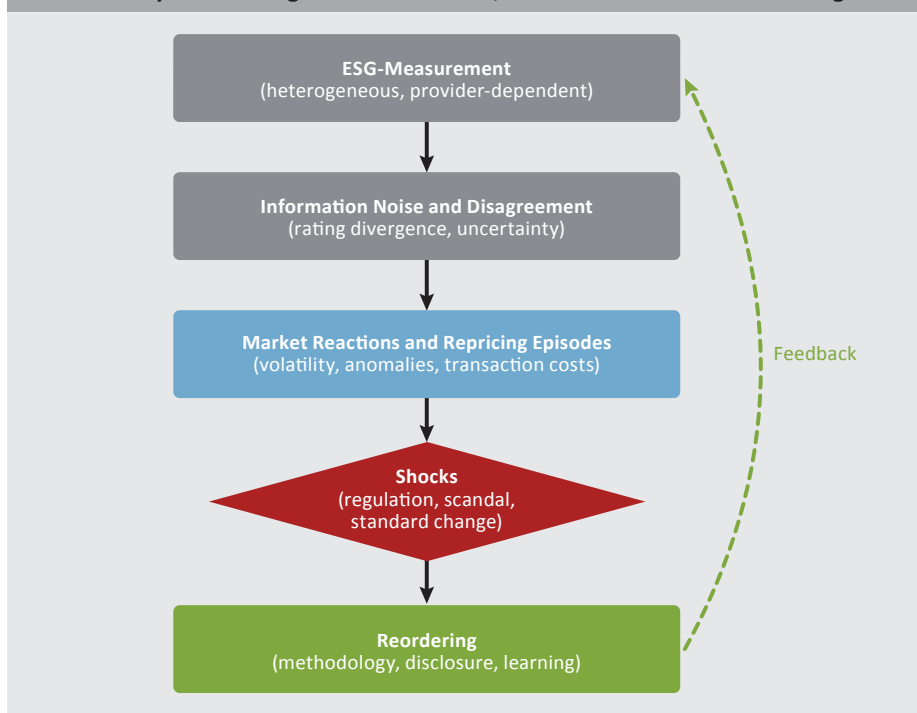
² Scope 1 emissions refer to direct greenhouse gas emissions from a company's own operations. Scope 2 emissions include indirect emissions associated with purchased energy, such as electricity, heat, or steam. Scope 3 emissions refer to other indirect emissions generated along the company's value chain, including supplier emissions, transport, business travel, and the use and life cycle of products. Scope 3 measurement is particularly data- and methodology-intensive, and is therefore often incomplete or based on estimates.

This essay approaches the debate from the perspective of signal quality. It treats the internal heterogeneity of ESG measures, rating divergence and specification sensitivity as the main explanatory channels. Internal heterogeneity means that the label “ESG” may conceal different indicator choices, scopes and weighting schemes, so that measures carrying the same name do not necessarily capture the same underlying construct. Rating divergence is a measurable consequence of these differences: the same firm may receive materially different assessments from different providers. Specification sensitivity means that empirical conclusions depend on the ESG dimension, data source, time horizon and control variables chosen by the researcher. The purpose is not to introduce a new theoretical framework, but rather to show how measurement disorder translates into financial and prudential consequences.

The central premise of this essay is that ESG is not a unified financial factor, but a noisy information signal (*Black 1986*) that enters financial decision-making through different interpretations and processing rules. In this sense, noise, is not merely a statistical measurement error: it is a form of structural uncertainty that may trigger different responses across different layers of the financial system. Therefore, an ESG signal may distort not only individual investment decisions, but also generate instability at the aggregate level. The structural nature of this noise is reflected in the fact that exposure measurement is sensitive to decisions about scope and indicator selection, which can lead to unstable classifications and divergent conclusions in practice (*Szendrey – Dombi 2023*).

Consequently, understanding the financial effects of ESG requires moving beyond the treatment of ESG as a single quality measure. Market reactions to ESG may reflect several distinct pricing mechanisms, including demand shifts driven by investor preferences, changes in perceived risk and temporary repricing episodes associated with new information (*Pástor et al. 2021; Pedersen et al. 2021*). Sustainability preferences may also directly influence investment decisions. Hungarian survey evidence suggests that some investors are willing to sacrifice part of their return for sustainable investments, but this points to a preference-based demand channel rather than a stable ESG premium (*Nagy – Steiner 2025*).

This essay aims to show how measurement heterogeneity and information noise become problems for financial markets and banking risk management. The focus is on the internal structure of ESG measures, the divergence between ratings and the process through which a noisy ESG signal may lead to financial consequences through market reactions, repricing episodes and the reassessment of risks. *Figure 1* summarises this interpretive framework.

Figure 1**ESG as a noisy financial signal: measurement, market reaction and reordering**

2. What do we measure when measuring ESG?

One fundamental feature of ESG measurement is that it does not capture a single, clearly defined financial characteristic but combines different concepts and objectives under a common label. As a result, the informational content of ESG indicators becomes fragmented at the measurement level. The structural patterns of the ESG-finance empirical literature between 2015 and 2025 also suggest that a substantial part of the findings depends on the measurement construct, identification strategy and outcome under investigation; therefore, ESG should be treated as a noisy information signal rather than a stable factor (Gasteiger 2026). Thus, many financial misinterpretations arise not from market irrationality but from ignoring the fault lines of measurement. The measurement problem becomes financially relevant along four main fault lines: (1) the separation between disclosure and actual outcomes; (2) the loss of information caused by aggregation; (3) methodological instability over time and (4) the misinterpretation of the financial channel. These are discussed in the following four subsections.

2.1. Disclosure and actual outcomes: communication versus performance

The first and most important fault line lies between the disclosure and actual outcomes. Disclosure-based approaches primarily measure corporate communication, policies and commitments, whereas outcome-based approaches focus on actual environmental and social performance and its financial relevance. There is no automatic correspondence between the two dimensions: more extensive disclosure does not necessarily imply better outcomes, but it can materially influence the judgement of external evaluators and, through this channel, ESG ratings as well (*Khan et al. 2016; Christensen et al. 2022*). From a financial perspective, this means that the measured signal often contains reputational and narrative elements rather than actual risk information. Evidence from the content analysis of Hungarian disclosures also suggests that selective corporate reporting may contribute to the divergence between disclosure-based ESG measurements and actual performance (*Lippai-Makra et al. 2024*). The gap between disclosure and actual outcomes matters not only because of neutral measurement errors. Firms may have incentives to present their sustainability performance in a more favourable narrative than their actual environmental or social performance would justify. In such cases, the measurement problem is not merely symmetric noise but a systematic bias. Disclosure-based ESG indicators may overestimate reputational communication while underestimating actual risk and environmental outcomes. Therefore, greenwashing is not only a communication or ethical issue but also a data quality and model risk problem.

2.2. Aggregation: information compression or information loss

The second fault line concerns the aggregation. Composite ESG scores are convenient, because they compress environmental, social and governance dimensions into a single number, but this necessarily entails a loss of information. ESG rating providers work with different scopes, apply different measurement procedures and assign different weights to individual dimensions. As a result, “ESG” often becomes more of a provider identifier than a stable firm-level characteristic of the firm.

Empirical evidence shows that the primary source of rating divergence is heterogeneity in measurement and scope rather than differences in weighting (*Berg et al. 2022*), which makes ESG more of a measurement construct than a stable corporate attribute. The concept of scope requires clarification. In the context of ESG ratings, it refers to the topics, indicators and data sources included by the rating provider. This must be distinguished from Scope 1, Scope 2, and Scope 3 classifications used in emissions accounting. Including indirect emissions, especially Scope 3, can substantially reorder sectoral exposure rankings, illustrating that aggregate ESG scores are often the result of methodological choices (*Szendrey – Dombi 2023*).

2.3. Temporality and methodological instability

The third fault line is temporal instability. ESG scores do not exclusively reflect changes in firm behaviour but also changes in measurement methodology. If a provider changes its definitions, data sources or weighting scheme, the time series breaks, and an apparent improvement or deterioration may partly be the result of redefinition. At the research level, this creates a reproducibility problem, while at the practical level, it generates model risk: the same decision rule may produce a different risk profile when applied to different inputs (*Christensen et al. 2022; Gibson Brandon et al. 2021*).

2.4. Misinterpreting the financial channel

The fourth fault line concerns the interpretation of financial channels. The financial relevance of sustainability typically appears through risk and the cost of capital, not as a direct promise of higher return. There is empirical evidence for the cost-of-capital channel, but these findings are strongly context-dependent and model sensitive (*El Ghouli et al. 2011*). Similarly, for theoretical and empirical arguments concerning the risk channel, the key question is which ESG dimension is being measured and which tail states or adverse conditions the analysis is sensitive to (*Albuquerque et al. 2019*). A substantial part of financial misinterpretation arises because these channels are not clearly delineated.

Table 1 Key fault lines in ESG measurement and their financial implications			
Dimension	What does it measure?	Typical measurement error	Financial implication
Disclosure	Corporate communication, policies, commitments	Selective reporting and greenwashing	Overrepresentation of the reputational channel; distorted risk signal
Outcome	Actual environmental and social performance	Incomplete, estimated or non-comparable data	Delayed pricing; uncertain risk impact (cost of capital, downside risk)
Aggregation	Composite score condensed into a single metric	Information loss due to compression; arbitrary weighting	Model risk; divergent portfolios under the same “ESG” label
Time dimension	Changes over time	Definition and methodology shifts; structural breaks	Spurious trends; unstable backtesting and stress-test results

2.5. Aggregability and heterogeneity

One recurring question in the ESG literature is the extent to which empirical findings can be aggregated. Although meta-analyses³ synthesise large numbers of studies, one of their most important lessons is that the robustness of observed relationships is fundamentally a matter of methodological discipline. Under heterogeneous measurement, the average “ESG effect” can easily become misleading, because heterogeneity is not noise but information about the mixture of different channels and mechanisms (*Friede et al. 2015; Busch – Friede 2018*).

Finally, ESG is often embedded in the broader narrative of intangible firm-level factors that markets may not immediately price. Evidence on the relationship between employee satisfaction and stock prices, for example, suggests that some non-financial factors may affect prices only after a delay (*Edmans 2011*). Therefore, disclosure-centred ESG measurement may easily conflate reputational narratives with actual risk transmission channels. *Table 1* summarises the main fault lines in ESG measurement and their financial implications.

3. Rating divergence, information noise and reallocation

Rating divergence refers to differences across providers in the ESG ratings assigned to the same firm and represents an independent dimension of financial uncertainty. When different ESG rating providers assign materially different assessments to the same firm, the informational basis for investor decision-making becomes fragmented. This uncertainty is not neutral; divergent ESG signals may lead to different risk interpretations and decision rules, even when firm fundamentals are unchanged.

The financial relevance of rating divergence is two-fold. First, it creates informational instability, because the same firm appears as a different signal to different investors and institutions. Second, it creates model risk: the same investment or risk management rule can produce different portfolio compositions and exposures when applied to different provider inputs. This is especially problematic when ESG metrics are linked to exclusion rules, limits, portfolio screening or internal decision rules. In banking and supervisory settings, the implication is that an aggregate ESG score cannot serve as a stand-alone decision basis. On the contrary, external ESG data and ratings can only be used under documented controls for data sources, methodology, data quality and model risk. *Figure 2* illustrates the financial consequences of rating divergence, showing how different ESG provider assessments may lead to

³ Meta-analysis refers to a quantitative synthesis that summarises the results of several independent empirical studies within a unified statistical framework, while accounting for heterogeneity and the possibility of publication bias.

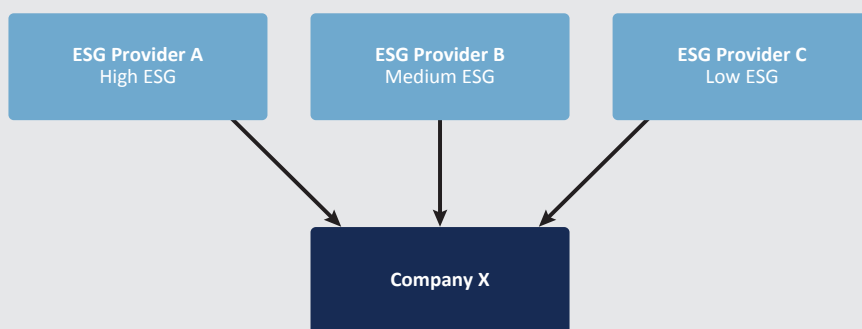
different portfolio decisions and risk interpretations, even when the underlying firm fundamentals are the same.

At this point, the chain from mismeasurement through noise and shocks to reallocation becomes more tangible. Under flawed or heterogeneous measurements, markets partly react to noise. Regulatory signals, sectoral controversies, litigation risks, emissions incidents and changes in reporting standards can be treated as shocks that suddenly alter the interpretation of the ESG signal. In the subsequent reallocation process, providers may change their methodologies, firms may adjust their disclosure practices and investors may adapt their exposure to their revised interpretation of risk. This dynamic is closer to the logic of noisy trading than to a stable factor-like pricing mechanism (*Black 1986; Barberis et al. 1998*).

In this context, financial theory is not a critique of ESG application, but rather its disciplining framework. The efficient market hypothesis reminds us that an average public signal does not automatically imply a stable financial advantage (*Fama 1970*). The theory of informational markets, in turn, emphasises that when information is costly and the signal is noisy, prices will not be perfect; however, this is not a market failure but an equilibrium outcome (*Grossman–Stiglitz 1980*). Consequently, the first rule of ESG application is that signal uncertainty must be measured and controlled in the same way as any other risk proxy; risk controls cannot be replaced by narrative expectations (*Sharpe 1964; Fama – French 1993*).

Figure 2

Provider rating divergence as financial uncertainty



Divergent ESG signal → divergent portfolio decision → divergent risk

4. What does the international evidence show without overinterpretation?

The international literature on the financial effects of ESG is extensive, but difficult to interpret because the signal under investigation is unstable. Empirical findings are not lacking; however, they are highly context-dependent and sensitive to measurement constructs, sample selection and the controls applied. A substantial part of the seemingly contradictory evidence does not stem from weak data but from the mixing of different financial channels.

Several studies have found associations between specific environmental and social dimensions and lower risk, particularly under adverse market conditions. These findings suggest that certain ESG characteristics may play a protective role during stressful periods. However, the effect is not universal and depends strongly on which dimension is measured and over what time horizon (*Albuquerque et al. 2019*). Similarly, empirical evidence exists for the cost-of-capital channel, but the findings are sensitive to measurement definitions and model specifications, which calls for caution when drawing general conclusions (*El Ghouli et al. 2011*).

The literature examining the relationship between corporate disclosure and firm value also documents empirical associations, but these do not imply that the composite ESG score constitutes a financial channel. The effect of environmental, social and governance disclosure is typically conditional, industry- and firm-specific and can easily turn into narrative dominance when measurement is weak or based on dimensions that are not financially material (*Brooks – Oikonomou 2018; Christensen et al. 2022*).

The ownership and corporate behaviour channels are also relevant but highly heterogeneous. Institutional investors and active ownership tools can influence corporate decisions, but the outcomes depend heavily on who acts, when they act and with what incentives. Therefore, the financial effects of ownership pressure are not mechanical, but rather context-dependent, and often appear through the channel of transitional repricing (*Dyck et al. 2019; Heinkel et al. 2001; Pástor et al. 2021*).

At the level of asset classes and investment products, green bonds and the green premium⁴ illustrate the role of preference-based demand. Empirical findings suggest that investor preferences can create price differentials, but their magnitude and stability are not universal and may vary over time (*Baker et al. 2018; Zerbib 2019*). In the case of sustainable investment funds, performance depends strongly

⁴ The green premium, or greenium, refers to the possibility that green-labelled bonds trade at lower yields, and therefore higher prices, than otherwise comparable conventional bonds with similar risk characteristics. This reflects preference-based demand rather than an automatic risk premium or performance advantage.

on the style, costs and selection rules. Consequently, the relationship between sustainability labels and past performance is often more a question of benchmarks and selection than of an independent “ESG effect” (Bauer *et al.* 2005; Renneboog *et al.* 2008).

The expansion of ESG-labelled investment products affects capital market structures. However, it is important to distinguish demand-based pricing from a performance promise. Capital flows and product design can generate short- and medium-term price effects, while in the absence of proper risk adjustment, the narrative can easily run ahead of the evidence. ESG-linked funds, for example, may concentrate investor demand, thereby altering the liquidity and risk environment, but this does not imply an automatic financial advantage (Geczy *et al.* 2021; Barber *et al.* 2021). Rating divergence is therefore not merely a data-quality problem: it is also an independent dimension of uncertainty with pricing consequences, which may operate as a noisy signal and trigger unstable reallocations in portfolios and risk interpretations.

Finally, ESG is not only an environmental issue as it is also linked to social norms and preferences. Certain norms and investor expectations may persistently exclude industries, with implications for pricing and liquidity (Hong – Kacperczyk 2009). Institutional investors’ approaches to climate risk are typically built around risk and reputational narratives, rather than explicit promises of a modelled return premium (Krueger *et al.* 2020; Pedersen *et al.* 2021). The purpose of this section is not to judge whether an ESG effect exists, but rather to demonstrate that positive and negative findings can be traced back to identifiable differences in measurement and financial channels.

5. Three pitfalls in the financial use of ESG

Recurring interpretation errors surround the financial aspects of ESG. These errors do not arise primarily from a lack of data, but rather from a lack of conceptual and methodological discipline. These misinterpretations have in common that they treat ESG as a financial object whose meaning is stable and identical across contexts, even though the underlying signal is heterogeneous and temporally unstable. However, it is important to emphasise that the critique primarily concerns the mechanical financial use of aggregate ESG ratings and ESG scores, not a general denial of the economic relevance of ESG factors.

5.1. First misinterpretation: treating ESG as a factor

The first and perhaps most common misinterpretation is treating ESG as a factor. In this interpretation, ESG appears as a stable risk exposure, although the measurement itself contains a mixture of preference-based, informational and

narrative elements. Equilibrium models show that the pricing effect of sustainable preferences is time-varying and strongly dependent on the investor composition. Consequently, the financial content of ESG-related claims cannot be treated as stable, especially when standard risk factors and portfolio styles are not controlled for (*Sharpe 1964; Fama – French 1993; Pástor et al. 2021; Pedersen et al. 2021*).

5.2. Second misinterpretation: treating the ESG score as truth

The second misinterpretation arises from treating the composite ESG score as objective truth and then being surprised when empirical results are not reproducible. Divergence across raters and differences driven by disclosure are sufficient to generate different answers to the same research questions. In this sense, rating divergence is not merely noise, but measurable uncertainty that constitutes model risk for financial decision-making (*Berg et al. 2022; Christensen et al. 2022*). Therefore, a substantial part of the reproducibility problem is not an empirical failure, but rather a measurement consequence.

5.3. Third misinterpretation: interpreting price differentials automatically as performance

The third misinterpretation concerns the misreading of price differentials observed in the investment products market. Demand for green bonds or sustainable investment funds can generate price differentials, but these should not automatically be interpreted as promises of financial performance. Such differentials often reflect preference-based demand, institutional constraints, and sampling and measurement features. When sentiment cycles are added to this, excessive narrative expectations and subsequent corrections become almost inevitable (*Baker et al. 2018; Zerbib 2019; Barberis et al. 1998; Black 1986*). The measurable willingness of domestic investors to sacrifice returns also indicates that price differentials are often driven by preference-based demand, rather than by a stable risk premium (*Nagy – Steiner 2025*).

To impose discipline on ESG-related financial claims, three questions should be considered before every analysis. First, which ESG dimension is being measured: disclosure or actual outcome, and according to which materiality principle (*Khan et al. 2016*)? Second, how large is rating divergence and how does it change over time, particularly in relation to methodological breaks (*Berg et al. 2022; Christensen et al. 2022*)? Third, against which risk benchmark are the results interpreted, and are standard risk factors controlled for (*Sharpe 1964; Fama – French 1993*)? Without answering these questions, ESG-related claims can only be interpreted as financial evidence in a limited sense and may easily become narrative claims. *Table 2* summarises the misinterpretations identified in this section.

Table 2 Common ESG misinterpretations and their financial misreadings		
Misinterpretation	What actually happens	Why it is misleading
ESG as a risk factor	Multiple, overlapping transmission channels	Not a stable risk exposure
ESG score as objective truth	Measurement-dependent signal	Model risk
Greenium = superior performance	Preference-driven pricing	Not a financial performance premium

6. ESG in banking risk management: from rating noise to an exposure-based prudential framework

Banking ESG risk management does not mechanically use aggregate ESG scores. The starting point of banking and supervisory logic is not the composite ESG rating assigned to a firm by an external provider, but rather the financially material risk channels through which ESG factors affect clients, exposures, collateral, portfolios, business models and capital positions. Therefore, the measurement problems of composite ESG ratings do not provide a stand-alone risk management model in a banking context. Rather, they warn that external ESG data, client disclosures, provider inputs and estimates can be used responsibly only under data quality, methodological and internal control safeguards.

This direction is consistent with the recent international, European and Hungarian prudential frameworks. The Basel Committee on Banking Supervision’s principles for climate-related financial risks provide an international prudential reference point for the management and supervision of climate risks in banks (*BCBS 2022*). The European Banking Authority’s 2025 guideline sets minimum standards and reference methods for the identification, measurement, management and monitoring of ESG risks, and requires the assessment of short-, medium- and long-term effects (*EBA 2025*). In Hungary, Recommendation 2/2026 of the Magyar Nemzeti Bank (central bank of Hungary, MNB) adapts this framework to the domestic credit institution environment and – compared to the earlier green banking recommendation – incorporates not only environmental but also social and governance risks into banking risk management (*MNB 2026*). MNB Recommendation 7/2025 defines a minimum ESG information questionnaire to be applied in the assumption, measurement, management and control of credit risk, with the aim of standardising the collection of ESG information (*MNB 2025*). *Gyura et al. (2023)* present the broader institutional context of domestic supervisory and green finance developments.

The first condition for a prudentially defensible banking application is the assessment of financial materiality. Not all ESG data and factors carry the same financial relevance. For a bank, the decisive question is the channel through which a given environmental, social or governance factor affects credit risk, market risk, liquidity risk, operational or reputational risk, business-model risk, concentration risk or the value of collateral. This logic differs sharply from the simplified practice of attempting to derive direct banking risk conclusions from aggregate ESG scores (EBA 2025; MNB 2026).

The second condition is the data quality and exposure-based assessment. Banking ESG risk management can support decision-making only if the institution knows what data it uses, where the data come from, which methodology produced them, what deficiencies they contain, and what estimates they rely on. The relevant unit is not the abstract ESG label but the specific borrower, asset, collateral, sector, transaction and portfolio. External ESG data are therefore not neutral facts: they are the outcomes of methodological choices, coverage limitations, estimates and provider procedures (EBA 2025; MNB 2025).

The third condition is forward-looking, portfolio- and scenario-sensitive risk management. The time horizon for ESG risks may differ from that for traditional short-term financial risks. Transition risks may materialise through regulatory, technological and market changes, while physical risks may create vulnerabilities at the geographical, asset and collateral levels. Evidence from the Hungarian banking system also indicates that the impact of a carbon-price shock may differ across sectors and bank portfolios, which means that the assessment of transition risks requires a sectoral and exposure-based approach (Várgedő 2022). The banking implication is clear: ESG risk management is not the mechanical application of scores, but rather a matter of data, processes and controls (BCBS 2022; EBA 2025).

Therefore, the banking relevance of rating divergence is secondary, but not irrelevant. This is important, because banking ESG risk management should be based on aggregate ratings, but it makes the measurement uncertainty of external ESG information visible. In the banking context, this does not imply that the average of several ratings should be used automatically. This implies that the source, methodology, limitations and decision role of external ESG inputs must be documented. The same applies to greenwashing: if corporate communication presents a more favourable sustainability picture than actual performance would justify, measurement error becomes a systematic bias.

Therefore, a prudentially defensible integration of ESG into banking does not rest on the search for a single indicator. A defensible practice connects several questions: whether the ESG factor is financially material; into which risk category

it is transmitted; what client, asset, collateral or portfolio-level data support it; over what time horizon it may materialise; what methodological uncertainty is attached to it; and what internal control ensures that external data do not become an unaudited black box. *Table 3* summarises this approach.

Table 3 Prudential logic of banking ESG risk management and the role of measurement risk		
Banking element	Prudential logic	Link to the measurement problem
Materiality assessment	Identifying the financial relevance of ESG risks	Not every ESG signal is material
ESG data collection	Collecting client-, asset- and portfolio-level information	Data quality and data gaps must be explicitly addressed
Exposure-based assessment	Assessing clients, collateral, sectors and business models	A composite score cannot substitute for the underlying risk channel
Sectoral and portfolio analysis	Identifying concentrations, transition exposures and physical exposures	Measurement scope may distort rankings
Scenario analysis	Assessing short-, medium- and long-term vulnerabilities	Model assumptions need to be documented
Internal control	Defining the role of the first, second and third lines of defence	External ESG inputs must not become an unaudited black box

Therefore, the banking and supervisory implications are twofold. The measurement noise embedded in ESG ratings does not imply that ESG risks are irrelevant. Quite the opposite: precisely because of measurement uncertainty, ESG data can only be used together with financial-materiality assessment, exposure-based evaluation, data-quality controls and a documented internal allocation of responsibilities. The lesson is not to discard ESG, but rather to use ESG data with discipline.

7. Conclusions

The financial relevance of ESG is not a myth, but it is also not an automatic promise of performance. The central claim of this essay is that the composite ESG score is not a stable risk factor, but rather a noisy, construct-dependent information signal. This does not deny the importance of ESG risk; instead, it means that the financial use of ESG data is defensible only with measurement discipline.

This essay identified three main misreadings. First, ESG is often treated as a stable factor, even though the underlying signal mixes preference-based, informational and risk channels. Second, the composite ESG score is frequently used as an objective truth, although rating divergence and methodological instability create model risk. Third, the green premium and price differentials associated with the ESG label are often interpreted as performance advantages, although in many cases they reflect preference-based demand or transitional repricing.

From a banking perspective, the lesson is that ESG ratings do not provide a direct prudential basis for decision-making. On the contrary, external ESG data, client disclosures, estimates and provider inputs can only be used together with financial-materiality assessment, exposure-based evaluation, data-quality controls and a documented internal allocation of responsibilities. Recent European and domestic regulatory developments point in the same direction: ESG risk management is not a matter of score use: it is a matter of data, processes, and controls.

Therefore, several basic questions must always be clarified before making ESG-related financial claims: what is being measured, from which data source, through which financial channel, over what time horizon, against which benchmark and with how much measurement uncertainty. Without these questions, ESG can easily become a narrative label. However, it can serve as a useful financial information signal, but only within a limited, transparent and disciplined interpretive framework.

References

- Albuquerque, R. – Koskinen, Y. – Zhang, C. (2019): *Corporate social responsibility and firm risk: Theory and empirical evidence*. Management Science, 65(10): 4451–4469. <https://doi.org/10.1287/mnsc.2018.3043>
- Baker, M. – Bergstresser, D. – Serafeim, G. – Wurgler, J. (2018): *Financing the response to climate change: The pricing and ownership of U.S. green bonds*. NBER Working Paper No. 25194. <https://doi.org/10.3386/w25194>
- Barber, B.M. – Morse, A. – Yasuda, A. (2021): *Impact investing*. Journal of Financial Economics, 139(1): 162–185. <https://doi.org/10.1016/j.jfineco.2020.07.008>
- Barberis, N. – Shleifer, A. – Vishny, R. (1998): *A model of investor sentiment*. Journal of Financial Economics, 49(3): 307–343. [https://doi.org/10.1016/S0304-405X\(98\)00027-0](https://doi.org/10.1016/S0304-405X(98)00027-0)
- Bauer, R. – Koedijk, K. – Otten, R. (2005): *International evidence on ethical mutual fund performance and investment style*. Journal of Banking and Finance, 29(7): 1751–1767. <https://www.sciencedirect.com/science/article/pii/S0378426604001372>
- BCBS (2022): *Principles for the effective management and supervision of climate-related financial risks*. Basel Committee on Banking Supervision, Bank for International Settlements, June. <https://www.bis.org/bcbs/publ/d532.htm>
- Berg, F. – Kölbel, J.F. – Rigobon, R. (2022): *Aggregate confusion: The divergence of ESG ratings*. Review of Finance, 26(6): 1315–1344. <https://doi.org/10.1093/rof/rfac033>
- Black, F. (1986): *Noise*. Journal of Finance, 41(3): 529–543. <https://doi.org/10.1111/j.1540-6261.1986.tb04513.x>

- Brooks, C. – Oikonomou, I. (2018): *The effects of environmental, social and governance disclosures and performance on firm value: A review of the literature in accounting and finance*. The British Accounting Review, 50(1): 1–15. <https://doi.org/10.1016/j.bar.2017.11.005>
- Busch, T. – Friede, G. (2018): *The robustness of the corporate social and financial performance relation: A second-order meta-analysis*. Corporate Social Responsibility and Environmental Management, 25(4): 583–608. <https://doi.org/10.1002/csr.1480>
- Christensen, D.M. – Serafeim, G. – Sikochi, A. (2022): *Why is corporate virtue in the eye of the beholder? The case of ESG ratings*. The Accounting Review, 97(1): 147–175. <https://doi.org/10.2308/TAR-2019-0506>
- Dyck, A. – Lins, K.V. – Roth, L. – Wagner, H.F. (2019): *Do institutional investors drive corporate social responsibility? International evidence*. Journal of Financial Economics, 131(3): 693–714. <https://doi.org/10.1016/j.jfineco.2018.08.013>
- EBA (2025): *Guidelines on the management of ESG risks*. EBA/GL/2025/01, 8 January. European Banking Authority. <https://www.eba.europa.eu/activities/single-rulebook/regulatory-activities/sustainable-finance/guidelines-management-esg-risks>
- Edmans, A. (2011): *Does the stock market fully value intangibles? Employee satisfaction and equity prices*. Journal of Financial Economics, 101(3): 621–640. <https://doi.org/10.1016/j.jfineco.2011.03.021>
- El Ghoul, S. – Guedhami, O. – Kwok, C.C.Y. – Mishra, D.R. (2011): *Does corporate social responsibility affect the cost of capital?*. Journal of Banking and Finance, 35(9): 2388–2406. <https://doi.org/10.1016/j.jbankfin.2011.02.007>
- Fama, E.F. (1970): *Efficient capital markets: A review of theory and empirical work*. Journal of Finance, 25(2): 383–417. <https://doi.org/10.1111/j.1540-6261.1970.tb00518.x>
- Fama, E.F. – French, K.R. (1993): *Common risk factors in the returns on stocks and bonds*. Journal of Financial Economics, 33(1): 3–56. [https://doi.org/10.1016/0304-405X\(93\)90023-5](https://doi.org/10.1016/0304-405X(93)90023-5)
- Friede, G. – Busch, T. – Bassen, A. (2015): *ESG and financial performance: Aggregated evidence from more than 2000 empirical studies*. Journal of Sustainable Finance and Investment, 5(4): 210–233. <https://doi.org/10.1080/20430795.2015.1118917>
- Gasteiger, K. (2026): *The inference architecture of ESG-finance: corridor concentration, sparsity, and the admissibility frontier (2015–2025)*. Cogent Economics & Finance, under review.

- Geczy, C. – Stambaugh, R.F. – Levin, D. (2021): *Investing in socially responsible mutual funds*. The Review of Asset Pricing Studies, 11(2): 309–351. <https://doi.org/10.1093/rapstu/raab004>
- Gibson Brandon, R.– Krueger, P. – Schmidt, P. (2021): *ESG rating disagreement and stock returns*. Financial Analysts Journal, 77(4): 104–127. <https://doi.org/10.1080/0015198X.2021.1963186>
- Grossman, S.J. – Stiglitz, J.E. (1980): *On the impossibility of informationally efficient markets*. American Economic Review, 70(3): 393–408. <https://www.jstor.org/stable/1805228>
- Gyura, G. – Holczinger, N. – Kim, D. (2023): *Zöld pénzügyek a felügyelet tevékenységében (Green finance in supervision activities)*. In: Kandrács, C. (eds.): Stabilitás és bizalom: A magyar pénzügyi felügyelés története (Stability and Trust: The History of Hungarian Financial Supervision). Magyar Nemzeti Bank, Budapest, pp. 836–856.
- Hajdu, T. – Lukács, J. – Reizingerné Ducsa, A. (2023): *Squaring the Circle, or a Quantified Rating of ESG Reports*. Public Finance Quarterly, 69(2): 99–117. https://doi.org/10.35551/PFQ_2023_2_6
- Heinkel, R. – Kraus, A. – Zechner, J. (2001): *The effect of green investment on corporate behavior*. Journal of Financial and Quantitative Analysis, 36(4): 431–449. <https://doi.org/10.2307/2676219>
- Hong, H. – Kacperczyk, M. (2009): *The price of sin: The effects of social norms on markets*. Journal of Financial Economics, 93(1): 15–36. <https://doi.org/10.1016/j.jfineco.2008.09.001>
- Khan, M.– Serafeim, G. – Yoon, A. (2016): *Corporate sustainability: First evidence on materiality*. The Accounting Review, 91(6): 1697–1724. <https://doi.org/10.2308/accr-51383>
- Kolozsi, P.P. – Ladányi, S. – Straubinger, A. (2022): *Measuring the Climate Risk Exposure of Financial Assets – Methodological Challenges and Central Bank Practices*. Financial and Economic Review, 21(1): 113–140. <https://doi.org/10.33893/FER.21.1.113>
- Krueger, P. – Sautner, Z. – Starks, L.T. (2020): *The importance of climate risks for institutional investors*. Review of Financial Studies, 33(3): 1067–1111. <https://doi.org/10.1093/rfs/hhz137>
- Lippai-Makra, E. – Kovács, Z.I. – Bodó, R. (2024): *A magyar vállalatok fenntarthatósági közzétételének vizsgálata tartomelemzéssel, a változó szabályozás tükrében (Content analysis of Hungarian companies' sustainability reporting practices in the light of the changing regulations)*. Vezetéstudomány – Budapest Management Review, 55(KSZ): 5–16. <https://doi.org/10.14267/VEZTUD.2024.KSZ.01>

- MNB (2025): *A Magyar Nemzeti Bank 7/2025. (VI.23.) számú ajánlása a hitelkockázat vállalása, mérése, kezelése és kontrollja során a környezeti, társadalmi és vállalatirányítási információk felmérését szolgáló minimum kérdéssor alkalmazásáról* (Recommendation No. 7/2025. (VI.23.) of Magyar Nemzeti Bank on the application of a minimum set of questions for assessing environmental, social and corporate governance information during the assumption, measurement, management and control of credit risk). Magyar Nemzeti Bank. <https://www.mnb.hu/letoltes/7-2025-esg-kerdoiv-ajanlas.pdf>
- MNB (2026): *A Magyar Nemzeti Bank 2/2026. (III.6.) számú ajánlása a környezeti, társadalmi és irányítási kockázatok kezeléséről, valamint a környezeti fenntarthatósági szempontok érvényesítéséről a hitelintézeti tevékenységben* (Recommendation No. 2/2026. (III.6.) of the Magyar Nemzeti Bank on the management of environmental, social and governance risks and the implementation of environmental sustainability aspects in credit institution activities). Magyar Nemzeti Bank. <https://www.mnb.hu/letoltes/2-2026-zoldi-banki-ajanlas.pdf>
- Nagy, A.Z. – Steiner, B. (2025): *Fenntarthatóság vagy hozam? Mekkora áldozatot vállalnak a befektetők a felelős jövőért?* (Sustainability or return? How much are investors willing to sacrifice for a responsible future?). *Közgazdasági Szemle* (Economic Review), 72(9–10): 919–939. <https://doi.org/10.18414/Ksz.2025.9-10.919>
- Pástor, L. – Stambaugh, R.F. – Taylor, L.A. (2021): *Sustainable investing in equilibrium*. *Journal of Financial Economics*, 142(2): 550–571. <https://doi.org/10.1016/j.jfineco.2020.12.011>
- Pedersen, L.H. – Fitzgibbons, S. – Pomorski, L. (2021): *Responsible investing: The ESG-efficient frontier*. *Journal of Financial Economics*, 142(2): 572–597. <https://doi.org/10.1016/j.jfineco.2020.11.001>
- Reizingerné Ducsay, A. – Hajdu, T.Z. (2024): *Pénzügyi teljesítmény és fenntarthatóság: az ESG-minősítés hatása a társaságok számviteli értékelésére* (Financial Performance and Sustainability: The Impact of ESG Rating on the Accounting Valuation of Companies). *Magyar Tudomány*, 185(2): 171–183. <https://doi.org/10.1556/2065.185.2024.2.2>
- Renneboog, L. – Ter Horst, J. – Zhang, C. (2008): *Socially responsible investments: Institutional aspects, performance and investor behavior*. *Journal of Banking and Finance*, 32(9): 1723–1742. <https://doi.org/10.1016/j.jbankfin.2007.12.039>
- Sharpe, W.F. (1964): *Capital asset prices: A theory of market equilibrium under conditions of risk*. *Journal of Finance*, 19(3): 425–442. <https://doi.org/10.1111/j.1540-6261.1964.tb02865.x>
- Szendrey, O. – Dombi, M. (2023): *Measuring Climate Risks with Indirect Emissions*. *Financial and Economic Review*, 22(1): 57–76. <https://doi.org/10.33893/FER.22.1.57>

- Szepesi, N.J. (2020): *Are sustainable investments crisis resistant? A study of the performance of ESG stock portfolios in crisis periods*. *Economy and Finance*, 7(4): 489–508. <https://doi.org/10.33908/EF.2020.4.8>
- Várgedő, B. (2022): *Climate Stress Test: The Impact of Carbon Price Shock on the Probability of Default in the Hungarian Banking System*. *Financial and Economic Review*, 21(4): 57–82. <https://doi.org/10.33893/FER.21.4.57>
- Zerbib, O.D. (2019): *The effect of pro-environmental preferences on bond prices: Evidence from green bonds*. *Journal of Banking and Finance*, 98: 39–60. <https://doi.org/10.1016/j.jbankfin.2018.10.012>

The Economic Dimensions of Sustainable Development*

Bettina Balázs 

Péter Halmai (ed.):

Fenntarthatóság a közgazdaság-tudományban: Elméleti alapok, alkalmazások

[Sustainability in Economics: Theoretical Foundations, Applications]

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The aim of this collection of studies is nothing less than to explore, understand and present the fundamental economic dimensions of sustainability. The studies cover all key areas of sustainability, including macroeconomic and international economic approaches to this issue, an examination of competitiveness and economic growth, the demographic dimensions of sustainability, issues concerning public finance, challenges arising from the networked structure of global supply chains and the structure of the international financial system, and, in particular, green finance. Each of the more than thirty authors is an outstanding, recognised expert in their field, ensuring that readers will encounter interesting, relevant and forward-looking essays.

Sustainability has emerged as a new paradigm in economics. In our day and age, it is now essential to take into account the natural, economic and social limits of development. This volume is a pioneering work in Hungary, as it comprehensively captures previously under-explored economic dimensions of sustainability. The wide-ranging analysis extends from macroeconomic equilibrium issues to green finance and from demographic and international economic interrelationships to the sustainability of public finances, highlighting the impacts of global challenges such as climate change.

* The papers in this issue contain the views of the authors which are not necessarily the same as the official views of the Magyar Nemzeti Bank.

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The volume begins with the editor's *Introduction*,¹ followed by a comprehensive, in-depth introductory study covering the entire work. Structurally, the work can be divided into three main parts, with macroeconomic issues, international economic dimensions and green finance forming separate sections. The macroeconomic aspects of sustainability are reviewed in a total of six studies, comprising the most extensive section of the volume. The second section on international contexts and the third section on green finance are of nearly equal length: the second section contains three studies, while the third contains five.

In his comprehensive study entitled *Sustainability in Economics – Starting Points and Questions to Be Answered*,² Péter Halmai convincingly emphasises that, in addition to environmental contexts, the economic and social dimensions of sustainability also require special attention. After defining the theoretical framework, Halmai outlines earlier studies considered groundbreaking in the field, such as the Club of Rome's 1972 report "The Limits to Growth" (Meadows et al. 1972), the 1988 Brundtland Report, the 2006 Stern Review, Nordhaus's 1994 DICE model and the asset-based approach of the 2021 Dasgupta Review. This broad theoretical background helps to contextualise the book's main ideas. The study reviews the main economic impacts of climate change and the role of central banks in mitigating the effects of climate change. The study's central concern is macroeconomic sustainability, specifically within the framework of growth theory, public finance and ageing; economic resilience (Halmai 2020); and the interpretation of sustainability at the international system level (Halmai 2023). The study also briefly summarises the main points of the papers included in the volume.

The contribution by Lóránt Kaszab, Endre Morvay, Balázs Világi and Balázs Vonnák entitled *Recent Developments in the Economics of Climate Change*³ outlines possible future scenarios, in addition to a thorough analysis of the causes and consequences of climate change. In terms of challenges, two sectors were singled out: energy and food production systems. The effects of climate change vary by region, and certain sectors, such as the energy sector and agriculture, which are discussed in detail, are particularly vulnerable to these uneven impacts. The conclusion is that while it is not possible to stop global warming, limiting its extent is achievable by transforming the energy sector, expanding renewable energy sources, reducing emissions, and promoting sustainable lifestyles and agriculture practices. However, this requires appropriate climate policy measures, government commitment and public education.

¹ Bevezető.

² Fenntarthatóság a közgazdaságtanban – kiindulópontok és megválaszolandó kérdések.

³ Friss fejlemények a klímaváltozás közgazdaságtanában.

Péter Halmai's study *Sustainable Growth, Growth Potential*⁴ approaches the topic of sustainability from the perspective of macroeconomic equilibria. The economy's sustainable level of output, which also reflects macroeconomic equilibrium, is potential output. Current output exceeding this level leads to imbalances and overheating, i.e. unsustainable growth performance, while output falling short of it signifies recession or stagnation. Consequently, potential growth and its trends, as well as the exploration of the effects of individual factors, are exceptionally important in terms of the economic theory of sustainability (Halmai 2021). The study provides an in-depth analysis of the growth models of fourteen EU countries. It analyses in detail the trends in potential growth, their factors and the main characteristics of individual country groups.

*The Effects of an Ageing Society from the Perspective of Fiscal Policy and Economic Growth*⁵ by Ádám Marton emphasises that declining birth rates, rising life expectancy at birth and falling mortality rates are leading to a transformation of the population age structure, with a significant impact on social and economic trends. He uses empirical methods to demonstrate that population ageing can have an adverse effect on fiscal balance and economic growth. In conclusion, Marton outlines the necessary and possible policy responses.

The study by Pál Péter Kolozsi and Ádám Banai, *Climate Change, Trust and the Central Bank*,⁶ examines the role of central banks in combating climate change, emphasising that the green transition is inconceivable without financial transformation. According to the authors, it is crucial for central banks to integrate green considerations into their activities without compromising price stability or other fundamental objectives. They emphasise the importance of trust and credibility in central banks for effective operation.

In *The Relationship Between Competitiveness Indicators and Economic Growth*,⁷ Pálma Filep-Mosberger, Péter Gábor and Judit Hevér identify the factors with the greatest impact on growth and examine the benefits of balanced development of competitiveness indicators by analysing the WEF and IMD competitiveness indices. According to their conclusions, policies aimed at enhancing the balanced development of competitiveness factors can lead to more sustainable growth in the long term. Accordingly, economic policy must focus on relatively weaker dimensions of competitiveness in order to maximise growth potential. While in less developed countries, the focus should be on infrastructure and public institutions, in more developed countries, greater emphasis should be placed on education and financial markets.

⁴ Fenntartható növekedés, növekedési potenciál.

⁵ Az idősödő társadalom hatásai a fiskális politika és a gazdasági növekedés perspektívájából.

⁶ Klímaváltozás, bizalom, jegybank.

⁷ A versenyképességi mutatók és a gazdasági növekedés kapcsolata

The study *What were the Factors that Shaped the Hungarian Cash-to-GDP Ratio After the Turn of the Millennium?*⁸ by Anikó Bódi-Schubert and Ildikó Ritzlné Kazimir examines the long-term evolution of the Hungarian cash-to-GDP ratio following the turn of the millennium, with particular attention to the fact that with the spread of digitalisation, actual data contradict the trends observable in other areas. Contrary to expectations, demand for cash has not only failed to decline in recent years, it has grown at a rapid pace. Using the Engle–Granger method, the authors found that, in addition to wealth-holding motivations, the domestic cash-to-GDP ratio is also influenced by unforeseeable international challenges, such as the COVID-19 pandemic or geopolitical conflicts.

In the section on international context, in another study entitled *The Network Building Blocks of the Global Economy – Connections and Hubs*,⁹ Anikó Bódi-Schubert and Ildikó Ritzlné Kazimir examine the complex network structures and subsystems of the global economy, identifying five key network subsystems: the business, logistics-transportation, technological-resource, geopolitical and consumer network subsystems. The aim of the research is to explore the relationships and interactions between these subsystems, as well as their implications for sustainability and efficiency, formulating guidelines to promote sustainable network efficiency.

*The Sustainability of USD Dominance from an Endogenous Monetary Theory and Geopolitical Perspective*¹⁰ by Lilla Bánkuty-Balogh, Kristóf Lehmann and Zoltán Szalai examines the sustainability of the USD-dominated financial system. The study addresses theories of money creation, the advantages and disadvantages of the current financial situation, currencies other than the US dollar, and global political trends affecting financial systems. The authors warn that major changes are expected in the financial world, but the exact direction is difficult to predict. Numerous factors will play a role in the development of the future financial system, and the balance of the international monetary system will remain dynamic.

The study by Gergely Gánics and Gábor Neszveda entitled *The Natural Real Interest Rate: r^* in Greece*¹¹ analyses the evolution of this indicator between 1997 and 2019. Thus, the authors examine the interest rate at which the economy can operate on a sustainable growth path while maintaining price stability. Their results indicate that economic and political events, as well as the green transition, influence this indicator. According to the study, real interest rates declined during crises, and country risk also had a negative impact on such.

⁸ Milyen tényezők alakították a magyar készpénztartási hányadot az ezredfordulót követően?

⁹ A globális gazdaság hálózati építőelemei – Kapcsolatok és csomópontok.

¹⁰ A dollárdominancia fenntarthatósága endogén pénzülméleti és geopolitikai megközelítésben.

¹¹ A természetes reálkamat: r^* Görögországban.

*Opportunities for the Economic Policy-Driven Diversion of Prudential Banking Regulation*¹² by László Seregdi discusses the purpose of banking regulation and the possibilities for its diversion for economic policy purposes, identifying the objectives as ensuring the prudent operation of the banking system and maintaining economic stability. The author examines the differences between the EU banking regulation system and the Basel III recommendations by analysing the practice and legal framework of banking regulation. The paper presents the possibility of deviating from a strict risk-based approach and emphasises the need to take green financing opportunities and environmental risks into account.

In *Methodological Issues and Practical Challenges of Climate-Neutral Banks*,¹³ Gábor Gyura examines a topic that has received less attention: the field of net-zero banking in light of the goals of the Paris Climate Agreement, with a focus on the need to reduce greenhouse gas emissions. He defines the conceptual foundations, including an international perspective, and also discusses specific elements of climate-neutral banking. Furthermore, he formulates recommendations and attempts to identify future research questions.

The study *Green Lending in Hungary – Experiences and Historical Background*¹⁴ by Gábor Nagy, Balázs Sárvári and Bence Varga reviews the domestic and international historical background of the European banking system, with particular regard to the sustainability practices of banks and central banks in Hungary and Poland. Drawing on data from the Magyar Nemzeti Bank (MNB) and domestic and international academic sources, the authors focus on green lending in Hungary and the MNB's green initiatives and analyse the role and performance of green loans in the green transition.

In *An Overview of Climate Change Risk Management in the Insurance Sector*,¹⁵ Gabriella Hajdu and Norbert Holczinger examine the management of risks arising from climate change in the insurance sector. Based on an analysis of specific financial and operational risks arising from climate change, it can be concluded that climate change presents challenges for the insurance sector, while also stimulating innovation within the sector and creating opportunities to promote sustainable development.

*A Methodological Presentation of the Magyar Nemzeti Bank's Short-Term Climate Stress Test*¹⁶ by Alexandra Bach, Norbert Csorba, Borbála Héjja, Donát Kim, Zoltán Monostori, Gábor Dániel Soós, Szabolcs Szentmihályi and Bálint Várgedő presents the climate stress test developed by the MNB to examine short-term lending, with

¹² *Lehetőségek a bankok prudenciális szabályozásának gazdaságpolitikai célú eltérítésére.*

¹³ *A klímasemgleges bankok módszertani kérdései és gyakorlati kihívásai.*

¹⁴ *Zöld hitelezés Magyarországon – tapasztalatok és történeti háttér.*

¹⁵ *Áttekintés az éghajlatváltozás kockázatainak kezeléséről a biztosítási szektorban.*

¹⁶ *A Magyar Nemzeti Bank rövid klímastressztesztjének módszertani bemutatása.*

the aim of establishing a methodological foundation for measuring climate risks in the Hungarian credit institution sector, particularly transition risks. The paper illustrates how the distribution of climate risks in energy-intensive industries evolves in certain scenarios and what impact these have on credit institutions. According to research findings, energy-intensive sectors are particularly vulnerable to climate policy measures, but the stress test provides a good starting point for identifying and adapting best practices.

One key strength of this groundbreaking volume is that it examines sustainability not merely in an environmental context, but also within a comprehensive economic and social framework. The studies highlight that achieving sustainability requires a fundamental shift in perspective in both economic theory and economic policy practice. At the same time, the work emphasises several times that a systemic approach to sustainability requires further research, and research questions to be explored are also presented in the work. Directions for future research include, among other things, further development of the economic models of sustainability, an examination of the sustainability impacts of innovations and technological progress, and possibilities for reforming the global financial system. The authors in this volume point out that a comprehensive approach to and management of sustainability issues is essential for achieving long-term economic and social stability.

The volume makes a fundamental contribution to the economic theory and practical application of sustainability. Given its subject matter and the depth of the studies it contains, the book can serve as a foundational text for anyone engaged with sustainability issues. Furthermore, it offers an inspiring, thought-provoking read that opens new perspectives on the economic examination of sustainability. The results presented and the questions raised encourage further reflection and research, contributing to the creation of a sustainable future.

References

- Brundtland, G.H. (1988): *Közös jövőnk. A Környezet és Fejlődés Világbizottság jelentése (Our Common Future. Report of the World Commission on Environment and Development)*. Mezőgazdasági Kiadó, Budapest.
- Dasgupta, P. (2021): *The Economics of Biodiversity: The Dasgupta Review*. HM Treasury, London. https://assets.publishing.service.gov.uk/media/602e92b2e90e07660f807b47/The_Economics_of_Biodiversity_The_Dasgupta_Review_Full_Report.pdf
- Halmi, P. (2020): *Mélyintegráció: A Gazdasági és Monetáris Unió ökonómiája (Deep Integration: The Economics of the Economic and Monetary Union)*. Akadémiai Kiadó, Budapest. <https://mersz.hu/kiadvany/701/info/>

- Halmi, P. (2021): *COVID-crisis and economic growth: Tendencies on potential growth in the European Union*. *Acta Oeconomica*, 71(S1): 165–186. <https://doi.org/10.1556/032.2021.00034>
- Halmi, P. (2023): *Globalisation versus Deglobalisation*. *Financial and Economic Review*, 22(2): 5–24. <https://doi.org/10.33893/FER.22.2.5>
- Meadows, D.H. – Meadows, D.L. – Randers, J. – Behrens, W.W. (1972): *The limits to growth. Report for the Club of Rome's Project on the Predicament of Mankind*. Universe Books, New York. <https://doi.org/10.1349/ddlp.1>
- Nordhaus, W.D. (1994): *Managing the Global Commons: The Economics of Climate Change*. MIT Press, Cambridge, MA. <https://doi.org/10.1017/s1355770x00000735>
- Stern, N. (2006): *The Economics of Climate Change. The Stern Review*. Cambridge University Press, Cambridge. <https://doi.org/10.1017/cbo9780511817434>

Report on the Lámfalussy Lectures Conference 2026*

Gábor Horváth  – Patrik Tischler 

The 11th Lámfalussy Lectures Conference, organised by the Magyar Nemzeti Bank (the central bank of Hungary, MNB), took place on 18 May 2026 under the title “Global Imbalances in a Changing World Order.” The event is named after Alexandre Lámfalussy – the “father of the euro” and a distinguished Hungarian-born economist, whose work has had a lasting impact on European economic and financial integration. The conference brought together high-level policymakers and leading international experts to discuss pressing issues shaping the global economy, with keynote speeches and panel discussions addressing the challenges of an increasingly complex and fragmented world. On this occasion, the Lámfalussy Award – established by the MNB in honour of the conference’s namesake – was presented to Adam Glapiński, Governor of the Narodowy Bank Polski (NBP).

1. In the spirit of Lámfalussy’s legacy: stability and international cooperation in a new era of the MNB

In his welcome speech, *Mihály Varga*, Governor of the Magyar Nemzeti Bank, highlighted that the 2026 edition of the conference marks the beginning of a new era, reflecting the change in the MNB’s leadership. Governor Varga paid tribute to the intellectual legacy of Alexandre Lámfalussy, the conference’s namesake, who foresaw that economic stability and growth would increasingly depend on cooperation among nations. According to Varga, recent global developments had clearly confirmed the lasting relevance of this insight. He emphasised that the global economic environment had undergone a profound transformation in recent years, as the predictability that once characterised the international economy had been replaced by persistent uncertainty.

The new leadership of MNB took office in March 2025 in this evolving global environment. *Varga* underlined that the MNB’s operations have since been placed on new foundations, with a renewed focus on its statutory core mandate. Accordingly, the primary objective of MNB remains the achievement and

* The papers in this issue contain the views of the authors which are not necessarily the same as the official views of the Magyar Nemzeti Bank.

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maintenance of price stability. At the same time, without compromising this objective, the MNB continues to support the government's economic policy within a framework of clearly-defined institutional responsibilities. He also highlighted that the MNB attaches particular importance to international cooperation, as reflected in the establishment of a dedicated Deputy Governorship for International Affairs under the new leadership.

Varga pointed out that the centres of gravity of the global economy are undergoing a significant realignment: the rise of China is challenging the long-standing dominance of the United States (US), while Europe's relative weight in the global economy is gradually declining. At the same time, rapid technological progress – particularly recent advancements in artificial intelligence – is expected to drive further economic and social transformations, many of which remain difficult to foresee.

Within this context, *Varga* recalled that Lámfalussy's thinking was profoundly shaped by his commitment to Europe's future and the goal of achieving unity and peace on the continent. This vision also provided a key motivation for the introduction of the euro as a common currency. *Varga* underlined that it was in the interests of the Hungarian economy to meet the conditions necessary for adopting the euro. At the same time, he stressed that introducing the single currency should not be seen as an end in itself, but rather as one step in a broader macroeconomic framework. He emphasised that the timing of euro adoption is appropriate only when the Hungarian economy is able to maximise its benefits while minimising the associated risks. In this process, the MNB acts as a constructive partner with the government in fulfilling the Maastricht criteria, while the final decision rests with the government.

Reviewing recent developments with regard to the MNB, *Varga* noted that inflation had been brought back within the central bank's tolerance band. At the same time, Hungary's foreign exchange and gold reserves had reached record levels – approximately EUR 60 billion and 110 tonnes, respectively – while the forint had strengthened significantly against the euro over the past year.

2. In a changing geopolitical environment central banks must serve as anchors of stability

In his "Lámfalussy Lecture", *Adam Glapiński*, Governor of Poland's central bank (Narodowy Bank Polski, NBP), approached the central theme of the conference from the perspectives of geopolitics, the European economy and the consequences for central banking. He emphasised that both geopolitics and the global economic landscape were undergoing a profound transformation. In this context, he identified three major structural trends.

First, he highlighted the global intensification of geopolitical tensions as shown by the spread of armed conflicts around the world. Second, he brought up the rise of China as a defining development, pointing out that in conjunction with its rapid economic expansion China had also strengthened its military and technological capabilities. In his view, the coming period would increasingly be shaped by strategic competition between the United States and China. Third, he pointed out Europe's relative decline, underlining that the continent's competitiveness has been steadily eroding over time. He also noted that Chinese industrial expansion now poses a growing challenge to European industry, while Europe remains overly dependent on US security guarantees.

Building on this assessment, *Glapiński* stressed that although policymakers in the European Union (EU) had recognised the need for adaptation in a changing global environment, acknowledgment alone was insufficient and must be followed by concrete policy action. At the same time, he underlined that Europe continues to possess significant strengths in terms of economic scale, human capital and social cohesion. In his view, the EU would benefit from a shift toward deregulation and greater regulatory flexibility. He argued that excessive regulatory burdens often act as a constraint on growth. As an example, he pointed out that while Europe is a global leader in climate policy, the EU accounts for only around 6 per cent of global greenhouse gas emissions. He emphasised that European climate policies have contributed to elevated energy prices, while a substantial share of the benefits of the green transition is being captured by Chinese firms.

In the second part of his presentation, *Glapiński* focused more explicitly on the challenges posed by the evolving geopolitical environment for central banks. He underlined that central banks must serve as anchors of stability, preserving confidence in the monetary system. In line with the intellectual legacy of Alexandre Lámfalussy, he stressed that central banks must remain firmly focused on their primary mandate of maintaining price stability. He also stressed that central bank independence is essential, noting that Lámfalussy himself strongly believed in this principle. At the same time, he warned that such independence has come under increasing pressure in both Europe and the United States. He argued that even if these pressures often take the form of political rhetoric, they can nevertheless have tangible economic consequences, as they may lead to an increase in inflation expectations and, indirectly, necessitate tighter monetary policy. For this reason, he concluded that central bank independence should not be viewed as a privilege, but rather as a necessity for fulfilling the central bank mandate.

Turning to developments in Poland, *Glapiński* noted that the Polish economy had demonstrated resilience in the face of recent shocks and was not characterised by macroeconomic imbalances. Given the prevailing uncertainty, the Narodowy Bank Polski continued to pursue a data-driven approach to monetary policy and

remained ready to act when necessary, while refraining from pre-committing to any specific policy path. He also pointed out that the evolving global order has implications for financial stability. Quoting John Pierpont (J.P.) Morgan's well-known statement – 'gold is money, everything else is credit' – he explained that, in order to strengthen financial security, Poland had significantly increased its gold reserves and set a target of reaching 700 tonnes.

Glapiński addressed the issue of euro adoption as well. He noted that while *Lámfalussy* was an advocate of monetary union, he was also pragmatic and recognised the risks associated with premature accession. *Lámfalussy* repeatedly emphasised that achieving sustainable convergence was a critical prerequisite for fully capturing the benefits of monetary integration. *Glapiński* stressed that Poland continues to converge toward euro area income levels, with economic growth approximately three times faster than the euro area average. He argued that, as a consequence, it was necessary to maintain higher interest rates than those prevailing in the euro area, in order to ensure balanced economic growth. In his view, premature accession of the euro area would likely result in interest rates being set below levels consistent with macroeconomic stability, which could trigger boom-bust cycles, followed by higher unemployment and an erosion of competitiveness, as had been observed in several countries which adopted the euro. He also highlighted the stabilising role of the national currency. For these reasons, he concluded that discussions on euro adoption in Poland should take place only once the country's GDP per capita had converged to the euro area average.

3. Why our changing world needs a strong euro

Martin Kocher, Governor of the Austrian central bank (Oesterreichische Nationalbank, OeNB), focused his keynote speech on the challenges arising from the rapidly changing global environment and the stabilising role of the euro. As an illustrative starting point, he presented current economic developments through the example of a fictitious, export-oriented Central European company. From the perspective of this company, "Onlyup," he highlighted that demographic shifts, rapid technological change, rising protectionism and mounting energy and labour costs jointly imposed significant adjustment pressures on European firms. He also pointed out that the rules-based international order that had previously underpinned international cooperation was in some cases being replaced by transactional, politically-driven decisions, further exacerbating global structural imbalances.

Kocher emphasised that Europe must address these challenges with a calm, analytical and forward-looking approach. Referring to *Lámfalussy's* legacy, he underlined that European integration was built on cooperation, shared responsibility and collective decision-making, in contrast to unilateral approaches. In his view, one

of the key pillars of European integration was the Economic and Monetary Union, which had played a crucial role in stabilising the European economy, reducing the costs of international transactions and strengthening the EU's competitiveness vis-à-vis other major economic regions.

Regarding the international role of the euro, *Kocher* stressed that the euro was now the world's second-most important reserve currency after the US dollar, accounting for approximately 20 per cent of global foreign exchange reserves. Moreover, around two-thirds of trade within the European Union was invoiced in euro, which, in his view, reflects strong trust in the euro both within Europe and globally. One key pillar of this trust was the independence of the European Central Bank (ECB). Citing survey evidence from the OeNB, he noted that in most Central, Eastern and Southeastern EU member states – including Hungary – with national currencies, the euro tends to enjoy higher levels of public trust than domestic currencies.

Kocher also addressed whether the euro could assume a stronger global role in the future, potentially as an alternative to the US dollar. He argued that several factors could support such a development, including concerns regarding the long-term sustainability of US government debt, the use of the dollar as a geopolitical instrument and uncertainty about the willingness of the US to continue acting as a global “insurer” in times of crisis. By contrast, the EU's institutional framework – particularly the Stability and Growth Pact (SGP) – contributed to fiscal sustainability and strengthened confidence in the euro.

Kocher further elaborated on the advantages of euro area membership. The introduction of the euro reduces transaction costs and exchange rate risk, while improving the cross-border comparability of prices. In addition, integrated financial markets broaden both savings and financing opportunities. In times of crisis, euro area members and their banks benefit from access to financial support through the European Stability Mechanism, as well as from ECB financing or liquidity. From a monetary policy perspective, euro adoption can also strengthen central bank credibility and help to anchor inflation expectations.

Turning to Hungary, *Kocher* noted that euro adoption could bring substantial economic benefits. He highlighted that the euro already plays a dominant role in Hungary's external trade, and the elimination of exchange rate-related costs could generate significant savings. At the same time, he cautioned that adopting the euro also involves trade-offs, notably the loss of monetary autonomy and reduced flexibility in responding to asymmetric shocks. However, these risks may be mitigated by the convergence process preceding adoption, by economic policy coordination within the euro area and by the ECB's monetary policy toolkit. In conclusion, he noted that inflation concerns related to euro adoption tend to be overstated, as recent estimates suggest that the introduction of the common

currency has typically resulted in only moderate and temporary increases in inflation.

4. Panel Discussion on Macroeconomic Adjustments and Policies

The first panel discussion, moderated by *Dániel Palotai*, Deputy Governor of the MNB, examined the macroeconomic implications of global economic fragmentation and rising trade tensions, with a particular focus on growth, inflation, debt dynamics, financial sector developments and current account imbalances. The panel featured *Catherine L. Mann*, Member of the Monetary Policy Committee of the Bank of England (BoE); *Carmen Reinhart*, Professor at Harvard Kennedy School; *Athanasios Orphanides*, Professor at MIT Sloan School of Management and former Governor of the Central Bank of Cyprus; and *Jeromin Zettelmeyer*, Director at Bruegel.

In his opening remarks, *Palotai* noted that the global economy had been hit by a series of shocks in recent years, creating a complex, uncertain environment and raising questions about the sustainability of global imbalances. One of the most important questions of the panel discussion was what economic policy steps would be needed for orderly adjustments, especially in the US and China.

Mann drew parallels between current developments and earlier financial crises, arguing that these episodes typically combined domestic macroeconomic imbalances with opacity in the financial sector. She stressed that the sustainability of the US current account deficit should be assessed through external debt service flows, noting in this context that 30–40 per cent of US Treasury securities were held by foreign investors. She also mentioned that it remains an open question as to how much exposure to US Treasury securities global investors were willing to tolerate in their portfolios. She pointed out that the success of industrial policy ultimately depends on its ability to generate productivity growth sufficient to ensure sustainable debt repayment, but that current data do not reflect this so far.

Orphanides argued that not all current account surpluses are beneficial and not all deficits are detrimental from a welfare perspective, as long-term economic trends also depend on domestic policy frameworks and geopolitical conditions. He cited China as a case where persistent surpluses were partly the result of successful industrial policy and strategic positioning in emerging industries. By contrast, Europe, despite maintaining a surplus, has struggled to implement effective industrial strategies due to political fragmentation, and the trends tended to point to an economy falling behind instead of moving ahead. He emphasised that the main question was how countries adapt to the process of reducing imbalances and the ensuing global economic environment. In relation to this, he criticised Europe's post-2008 macroeconomic policy framework, as in his view, Europe would benefit from a stronger investment-driven policy approach.

Reinhart noted that while current account deficits are not inherently problematic, persistent imbalances have often ended in crisis. She noted the central role of the US as the world's largest capital importer and highlighted while the US budget deficit played an important role in the persistence of these fiscal imbalances and the deterioration seen in recent years, the equity market rally associated with artificial intelligence (AI) should also be taken into account. While foreign holdings of US Treasuries had declined somewhat, foreign participation in US capital markets had expanded significantly. She pointed out the risks associated with shifts in global demand for these assets. She noted that US public debt was not on a sustainable trajectory and there were justified concerns about overinvestment, in relation to AI due to the "winner-take-all" dynamics.

Zettelmeyer argued that although global imbalances are not at historical highs, they have increased markedly since 2019. He stressed that the concerns extend beyond current account balances to broader developments, and agreed with Reinhart's assessment on developments in the US. Regarding China, he noted that while it was partly structural factors that underpinned China's surplus, its recent growth had also been driven by a reallocation of capital from the struggling real estate sector to tradable goods industries. He acknowledged concerns in the US that a correction of external imbalances could coincide with a fiscal crisis, but assessed this risk as low. Nevertheless, he identified two key vulnerabilities in such a scenario: first, historically large net international investment position imbalances, implying potentially significant global wealth effects from exchange rate adjustments; and second, the risk that US Treasury securities could lose their stabilising role in the global financial architecture. He also highlighted China's expanding goods exports as a global challenge, posing risks to industrial bases in other economies, including Europe. In addition to the direct negative effect, Europe's potential response could also have detrimental economic and political ramifications, but China's technological development was a structural issue, which could only be offset by increased investment.

Turning to policy responses, *Orphanides* argued that meaningful US fiscal adjustment was unlikely without external pressure or crisis, given political constraints. He suggested that Europe could contribute indirectly by strengthening the international role of the euro through deeper integration, thereby exerting adjustment pressure on the US.

Reinhart noted that fiscal consolidation in the US would reinforce the US dollar's global role. She argued that the dominance of the US dollar reflects, above all, the lack of viable alternatives, as the renminbi is not fully convertible and European financial markets remain fragmented.

From a European perspective, *Zettelmeyer* highlighted the need for a sustainable increase in investment across the continent, supported by deeper integration across sectors and the removal of barriers to cross-border corporate activity, complemented by national structural reforms. However, he expressed scepticism regarding the political feasibility of such reforms, noting that the momentum following the Draghi Report had faded, although emerging challenges might provide new impetus.

In terms of the institutional dimension, *Mann* stressed the importance of better understanding the incentives and behaviour of the financial sector, given its central role in mediating global imbalances. She highlighted that past crises had been managed largely through financial intermediation channels and pointed to the G20, which was created in the wake of the 2008 crisis, as a key platform for international cooperation.

In closing, Palotai asked the panellists about the potential impact of the Middle East conflict on global imbalances. While noting the difficulty of assessment, *Orphanides* explained that it would have negative economic effects through reduced productivity and wealth accumulation at the global level. *Reinhart* warned of a possible shift toward stagnation reminiscent of the 1970s. *Mann* broadly agreed with the latter, while highlighting that unlike in the 1970s, when petrodollar surpluses were recycled into US assets, revenues in the present were more likely to be directed toward rebuilding of domestic economies. *Zettelmeyer* concluded that while the risk of market correction had increased, global imbalances remain fundamentally structural in nature, and the conflict was therefore unlikely to significantly alter their trajectory.

5. Panel discussion on the future of the international monetary system

The second panel discussion examined the key challenges facing the international monetary system in the context of geopolitical fragmentation, changing trade patterns and rapid technological advancements, in particular the spread of cryptoassets. The session was moderated by *Zoltán Kurali*, Deputy Governor of the MNB, and featured *Laurence Boone*, Head of Santander Corporate and Investment Banking in France; *Beata Javorcik*, Chief Economist of the European Bank for Reconstruction and Development (EBRD); *Klaas Knot*, former President of De Nederlandsche Bank (central bank of the Netherlands); and *Robert Koopman*, former Chief Economist of the World Trade Organization (WTO) and professor at American University.

In his opening remarks, *Kurali* highlighted that the current global environment was shaped simultaneously by geopolitical conflicts and energy market shocks, posing significant stagflationary risks. Despite these uncertainties, financial markets

remain resilient, with strong performance and relatively low risk premia. Against this backdrop, he invited participants to assess ongoing global developments, particularly the transformation of international trade and the role of central banks in this evolving environment.

Boone argued that the three foundational pillars of the international monetary system – the US commitment to maintaining global order, open capital markets and a rules-based trading system – were all increasingly under strain. She emphasised that the organising logic of the global economy was undergoing a fundamental shift: efficiency, and comparative advantages were gradually being replaced by strategic autonomy and control over supply chains. In her view, key vulnerabilities of the international monetary system stem from its strong reliance on the US, the growing use of sanctions and the increasing diversification of reserve assets.

Javorcik pointed out that industrial policies were strengthening protectionism and thus deglobalisation, as they were often inherently discriminatory toward foreign partners. She stressed that these developments also had important implications for monetary policy, as the objective of stimulating investment may create pressure on central banks to maintain lower interest rates.

Knot similarly described the current period as one of deglobalisation, characterised not by gradual change but by a sequence of shocks. He highlighted that central banks must act decisively when necessary while limiting intervention as much as possible, with the anchoring of inflation expectations playing a crucial role.

By contrast, *Koopman* argued that current developments should be interpreted less as deglobalisation and more as a reorganisation of globalisation along geopolitical lines. Global value chains were increasingly deepening within major regional blocs, while trade between these blocs was moderating. He stressed that the expansion of global trade continued to be driven primarily by overall economic growth, whereas trade policy measures had a more limited impact.

The second round of discussion focused on the future shape of the international monetary system, including the role of fiat currencies, the global reserve currency status of the US dollar, and the rise of central bank digital currencies (CBDCs) and stablecoins.

Boone noted that the high cost and low speed of cross-border payments were driving demand for alternative solutions, as reflected in the development of domestic digital payment infrastructures in the Global South. *Javorcik* argued that while the dominance of the US dollar had enhanced the effectiveness of US sanctions, it had simultaneously created incentives for countries to develop alternative payment and settlement systems, as illustrated by the growing international role of the renminbi. *Knot* approached the issue from a historical

perspective, noting that the evolution of financial systems had always been shaped by the interaction between public trust and innovation. In his opinion, CBDCs could replace cash while the various forms of private money could be replaced by stablecoins, although the latter could be more limited. While he acknowledged the potential role of stablecoins, he argued that tokenised bank deposits represented a more robust alternative, given that they were fully fungible, covered by deposit insurance and interest-bearing, thereby contributing to the financing of the real economy. Finally, *Koopman* noted that digital currencies may contribute to reducing transaction costs in international trade, but also emphasised the current lack of a coherent global regulatory framework, which remained essential for ensuring trust and the smooth functioning of the system.

The panel concluded with a discussion on Hungary's potential euro adoption. *Kurali* recalled that, although the introduction of the euro had been on the policy agenda in the 2000s, it was ultimately postponed due to unmet fiscal conditions. He posed the question of whether euro adoption would represent entry into a "club of winners" or expose the country to new economic risks. *Boone* argued that economic scale was increasingly important in the current geopolitical context, suggesting that euro area membership could enhance Hungary's economic and political position. *Javorcik* highlighted that increasing sovereign debt service costs increased the pressure on central banks, and the ECB's perceived resilience to fiscal pressures may strengthen trust in the euro. *Knot*, however, on a more cautious note, emphasised that both the EU and the euro area still face significant structural challenges, including the imperfect functioning of the single market, declining cross-border banking activity despite creation of the banking union, and the lack of a deep and integrated capital market. *Koopman* concluded that while euro adoption could offer clear benefits to Hungary, it ultimately required a strategic choice between preserving monetary policy flexibility and leveraging the advantages of euro area membership.

6. Different perspectives, common messages

In his closing remarks, *Deputy Governor Palotai* expressed his gratitude to all participants, highlighting that the discussions during the conference closely reflected the key themes shaping current international economic discourse. He said that while speakers approached the issues from different perspectives, a remarkable degree of convergence emerged regarding the main messages and takeaways.

He noted that differing views on euro adoption were expressed: Governor Glapiński argued in favour of an autonomous monetary policy and a sovereign currency in the case of a converging economy, whereas Governor Kocher noted the benefits of the common currency. Governor Varga took a pragmatic approach and added that the

euro adoption was appropriate for Hungary once the country could maximise the benefits stemming from being a part of the euro area while also highlighting that it was in the interest of the Hungarian economy to meet the conditions necessary for adopting the euro.

He further highlighted the strong alignment between Governor Varga and Governor Glapiński on the importance of central bank independence. He also reiterated Governor Varga's emphasis that the new leadership of the MNB is firmly focused on its statutory core mandate, with the maintenance of price stability as its primary objective.

Finally, Palotai extended special thanks to György Szapáry, who, as a former student of Alexandre Lámfalussy – widely regarded as the “father” of the euro – played a pivotal role in establishing the conference series. In this regard, he noted that Szapáry can rightfully be considered as the “founding figure” of the Lámfalussy Lectures Conference.

In Memoriam Eszter Láng

The Editorial Board and the Publisher of the Financial and Economic Review deeply regret to announce the passing of Eszter Láng, at the age of 78, who served as the long-standing copyeditor of our Hungarian journal, *Hitelintézet* Szemle.

For more than a decade, her outstanding dedication, professional humility, and meticulous attention to detail played a fundamental role in shaping the high standards and linguistic quality of our publications. Her invaluable work behind the scenes contributed significantly to the success of numerous scientific papers and to the preservation of banking and financial terminology.

We will deeply miss her supportive spirit and professional wisdom. We extend our heartfelt condolences to her family and loved ones.

May she rest in peace.

The Editorial Office of the Financial and Economic Review

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