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Contents

Firm entry and exit dynamics in Austria: uncovering the economic significance of insolvencies beyond simple counts

In Austria, insolvencies are usually tracked by simply counting the number of firms going insolvent. This study shows that such absolute counts offer only limited insight. Using weighted insolvency rates, we analyze insolvency patterns in Austria between 2019 and 2024. We find that insolvencies were rare, stable across time, and mostly affected small firms. Our findings moreover highlight the need for improved data and refined metrics to support future policy.

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Insolvency rates low despite challenges

Between 2019 and 2024, insolvencies remained low and stable, with unweighted insolvency rates averaging around 1%. This finding held despite the COVID-19 crisis. We moreover find a marked increase in the number of firms.

Insolvencies mostly affect smaller firms

When weighted by firms' assets, workforce and loans, insolvency rates show that larger and economically important firms are less likely to become insolvent. This finding was also confirmed when breaking down insolvency rates by sector.

Results call for a more refined approach

Our results reveal the limitations of count-based indicators and highlight the importance of improved microdata and more meaningful metrics. These are crucial for understanding how insolvency frameworks contribute to greater resilience and structural transformation in economies.

Abstract[1]

In Austria, insolvencies are often narrowly perceived as signs of economic distress and are typically tracked through absolute insolvency counts. This paper challenges the informational value of such counts and reframes insolvency within the broader context of firm turnover, emphasizing the functional role of insolvencies in facilitating resource reallocation and structural transformation. Using firm-level data from the Integrated Firm-Level Database (IFLD) of the Oesterreichische Nationalbank (OeNB), we analyze firm dynamics in Austria between 2019 and 2024. We document that insolvencies constitute a small and stable share of firm exits – averaging around 1% of the firm population – even amid post-pandemic normalization. By constructing weighted insolvency rates based on firms' total assets, employment, and credit exposure, we show that economically significant firms are less likely to become insolvent. We moreover find that insolvency patterns are concentrated in smaller, less systemically relevant segments of the economy. Sectoral breakdowns confirm these patterns and illustrate the added value of disaggregated metrics. Our results expose the limitations of count-based indicators and highlight the importance of improved microdata and more meaningful metrics to inform forward-looking and efficiency-oriented policy frameworks.

Note that while we cannot update all analyses from the paper to the most recent month, our main finding, namely that the insolvency rate remains stable, continues to hold through the first half of 2025.

1 Introduction

Insolvencies are often perceived as inherently negative events and monitored based on simple aggregate counts (e.g. KSV1870, 2025). This perception dominates public and media discourse in Austria, where increasing insolvency numbers are frequently portrayed as symptoms of broader economic distress. For example, Industriemagazin (2024) warned that "Austria faces a massive wave of corporate insolvencies in 2024,[2]" attributing this trend to a "toxic mix" of inflation, tighter financing conditions, and weak growth. Consequently, insolvency statistics are frequently invoked to justify policy interventions aimed at halting or reversing such trends (KSV1870, 2024).

This framing is problematic for three reasons. First, it promotes a narrow view of insolvency as mere failure, overlooking its institutional role in facilitating market exit, enabling structural transformation, and promoting long-term economic dynamism. Efforts to indiscriminately suppress insolvencies can distort market signals and perpetuate inefficiencies. Second, the use of simple insolvency counts as indicators of economic health is flawed and can distort policy responses. Insolvency statistics are often computed without reference to a clearly defined firm population and do not relate insolvency events to that

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[1] The authors would like to thank Philipp Roderweis and Barbara Meinx for helpful comments and valuable suggestions.

[2] German original: "Österreich steht 2024 vor einer massiven Welle von Unternehmensinsolvenzen."

population, further obscuring their interpretation. Third, insolvencies are typically lagging indicators of economic activity. Even if accurately measured, they tend to respond to downturns with delay, reflecting past conditions rather than providing early warnings. In practice, definitional ambiguities and the lack of economic weighting further reduce their informational value.

In many cases, the firm populations used include sole proprietorships that are part of the household sector. These entities, while legally classified as firms, are difficult to distinguish from households and often lack economic significance. Excluding such firms is essential for meaningful interpretation and for aligning measurement with the concept of the corporate sector (Elsinger et al., 2021). In addition, such counts do not account for the economic weight of the firms involved and thus fail to distinguish between minor and systemically important insolvencies. This lack of granularity undermines their utility as policy indicators and risks distorting the public debate.

This paper challenges the informational value of simple insolvency counts and reframes insolvency within the broader context of firm turnover (i.e. firm entries and exits) and firms' economic relevance. Using harmonized firm-level data from the Integrated Firm-Level Database (IFLD) of the Oesterreichische Nationalbank (OeNB), we construct refined indicators that relate insolvency events to the evolving firm population and weight them by economically relevant variables such as firms' total assets, number of employees, and outstanding bank credit.

Our analysis covers the period from 2019 to 2024 and yields three key findings. First, insolvencies remained a minor component of firm dynamics throughout the period under review, with the unweighted insolvency rate fluctuating around 1% – despite the COVID-19 crisis and a significant increase in the firm population. Second, when accounting for economic relevance, insolvency rates are markedly lower: In 2023, the asset-weighted insolvency rate was 0.58%, the employment-weighted rate 0.75%, and the loan volume-weighted rate 0.65%, compared to an unweighted rate of 1.02%. Third, sectoral patterns underscore the importance of distinguishing between unweighted and weighted insolvency rates. While unweighted rates peaked in sectors like construction, accommodation, and administrative services, weighted rates reveal that insolvencies in these areas particularly concerned smaller, economically less important firms that are less relevant for financial stability. In contrast, sectors such as professional services and manufacturing exhibit fewer insolvencies in absolute terms, but relatively higher rates when weighted by total assets – suggesting greater economic impact.

Note that while we cannot update all analyses from the paper to the most recent month, our main finding, namely that the insolvency rate remains stable, continues to hold through the first half of 2025.

Although the media has once again warned that 2025 would be a new record year for bankruptcies, the insolvency rate has, in fact, remained virtually unchanged. Until early May, it was slightly below the previous year's level, while since June, it has been slightly above. The only noticeable increase this year has been in the real estate and housing sector. Instead of triggering alarmism, however, this increase should rather be interpreted as an early sign of normalization within the real estate sector. Furthermore, simply counting insolvencies in this sector is particularly misleading. In the real estate industry, economic business units are often split into several legal entities. As a result, individual insolvency cases can significantly inflate the overall insolvency count without accurately reflecting the actual economic impact. What is more, the number of firm entries has markedly exceeded the number of insolvencies and other exits within the real estate sector in the last years.

These findings underscore the limitations of using absolute insolvency counts as policy indicators. Rather than treating all insolvency events as failures to be minimized, policymakers should recognize their role

in structural adjustment and focus on enabling timely, efficient exits, where appropriate. This is especially relevant in Austria, where – as recent OECD analyses have shown – the insolvency framework lags behind international best practices (see e.g. André and Demmou, 2022). We do not argue that all insolvency events are benign or that policy responses are never warranted. However, we argue that any intervention should be grounded in improved microdata and refined indicators, which provide a more accurate, evidence-based foundation for economic policymaking.

The remainder of the paper is structured as follows. Section 2 reviews the theoretical role of insolvencies in enabling resource reallocation, market selection, and economic resilience. Section 3 presents the empirical setup, including the data structure and methodology. Section 4 provides evidence on firm turnover and presents the results for weighted insolvency metrics to assess the economic significance of insolvencies. Section 5 concludes with implications for research and policy design.

2   The role of insolvencies in economic dynamism

This section explains why insolvencies are an integral part of dynamic market economies and argues against the use of raw insolvency counts as a policy metric. Section 2.1 outlines the institutional foundations of insolvency systems in economies based on debt and limited liability. It shows that insolvency law is not meant to prevent failure, but to manage it productively. It further explains how misaligned credit allocation can distort both firm survival and firm exit: Viable firms may be underfinanced, while unproductive firms may persist, ultimately undermining efficient firm dynamics and weakening the economic meaning of insolvency events. Section 2.2 reviews empirical literature that demonstrates the contribution of insolvency frameworks to productivity, innovation, and structural change, and discusses how these systems support entrepreneurship, labor reallocation, and financial stability. Section 2.3 draws policy implications, warning against using raw insolvency counts as crisis indicators and advocating for better data and tailored metrics to inform more forward-looking and efficiency-oriented policy decisions.

2.1   Institutional foundations and the role of limited liability

In any economic system that relies on debt, the occurrence of insolvencies is a natural and necessary feature – neither exceptional nor inherently undesirable. Because debt inevitably carries the possibility of default, insolvency frameworks are essential institutional tools for managing that risk. Their importance is especially pronounced in modern economies, which heavily rely on the institution of limited liability – shielding firm owners and shareholders from personal responsibility for business debt. While this legal structure facilitates entrepreneurial risk-taking and capital accumulation, it also creates moral hazard. Firms (and their owners and shareholders) can take risks and keep all the profits in case of success, but do not have to bear the full potential losses, which are instead borne by creditors and, in some cases, the public (Hansmann and Kraakman, 2000). Without a formal mechanism to manage failure and distribute losses, such moral hazard might be amplified. Therefore, insolvencies governed by insolvency laws are a necessary part of our modern economies. Their institutional role is to regulate such failures, enforcing creditor rights and enabling the reallocation of resources from failing to more productive firms (Hart, 1995; Djankov et al., 2008).

In a hypothetical economy without limited liability, owners and shareholders of firms would remain personally liable for all obligations. Creditors could pursue personal assets in case of default, and debt markets would function under different incentives and constraints. The scope for risk-taking would likely

be smaller, but so would the willingness to invest. In contrast, limited liability encourages capital formation and firm entry. However, this benefit also makes it necessary to have effective mechanisms in place to manage firm exit and default.

In practice, limited liability structures are also frequently used for non-commercial purposes such as tax optimization, intergenerational wealth transfer, or shielding personal assets from claims in divorce or litigation. This is especially relevant in jurisdictions like Austria, where private foundations and limited liability companies serve as legally sanctioned asset protection tools (Schwank, 2013; Alexander and Klemmer, 2009). Insolvency law becomes indispensable in this context. It determines how the burdens of failure are distributed, typically through a priority structure that protects secured creditors (priority structure of claims) while recognizing the rights of other stakeholders. It is not designed to prevent firm failure, but to manage it efficiently and transparently. A well-functioning insolvency regime facilitates the liquidation or restructuring of firms at minimal social cost and preserves value where possible. Crucially, it also enables the timely reallocation of capital and labor to more productive uses.

Yet, whether insolvency frameworks achieve this goal in practice crucially depends on the surrounding institutional environment – in particular, on the way credit is allocated and monitored. Credit market dynamics shape which firms receive financing, how risks are distributed, and, ultimately, which firms survive or fail. In this sense, insolvency outcomes often reflect not just business fundamentals but also systemic features of credit allocation.

In Austria, for instance, credit markets are highly concentrated, with limited effective competition and a dominance of similarly structured banks (Ferstl and Seres, 2012; Hauner, 2005). Regulatory constraints, risk assessment models, and incentives for uniform treatment (e.g. under sector-specific frameworks or regulations) often lead to homogeneous credit allocation, regardless of firm-specific fundamentals.[3]

The way insolvency risk is allocated fundamentally influences credit market behavior on both the supply and demand side (Berger and Udell, 2006). In theory, when banks retain default risk – as is typical in systems with effective insolvency regimes – they have a strong incentive to monitor borrowers, assess creditworthiness, and price loans according to expected losses for each firm separately. In practice, however, credit markets are constrained by imperfect information and transaction costs. As a result, banks often settle into second-best pooling equilibria, where low- and high-risk borrowers are priced similarly due to the difficulty of accurately distinguishing between them. This leads to adverse selection: Safer firms may exit the credit market and satisfy their demand for debt capital through other channels such as bond markets or supplier credits, while riskier firms persist. To mitigate these distortions, banks often rely on blunt instruments such as collateral size or other guarantees, which can separate risks to some extent, but introduce frictions and limit access to credit for innovative firms which may not (yet) have many assets. Although bank credit is generally cheaper and more accessible than market-based finance for most firms, distortions in pricing and monitoring can still result in inefficient equilibria, especially when screening incentives are weak.

Robust competition should encourage banks to develop better screening technologies to differentiate between borrowers and attract good borrowers. Banks that perform this screening well are more likely to survive, while those that do not are crowded out. However, in markets with limited competition, screening incentives are muted. This is particularly evident in Austria, where a small number of structurally similar banks dominates the credit market. Limited competitive pressure, combined with

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[3] Note that the same mechanisms also apply to credit to households.

regulatory harmonization – such as common risk assessment frameworks, standardized reporting rules, and centralized refinancing mechanisms – discourages innovation in credit evaluation and reinforces uniform lending practices. In such settings, banks may prefer uniform pricing and minimal differentiation, while reducing active borrower monitoring. The result is an erosion of market discipline: Even when insolvency risk formally resides with lenders, the institutional mechanisms that would normally induce screening, monitoring, and efficient capital allocation are significantly weakened. This tendency is further reinforced by recent institutional shifts in the insolvency framework such as the introduction of the Austrian Restructuring Act in July 2021[4]. By strengthening restructuring options and debtor protections, the act may raise expropriation risks for creditors and increase the reliance on collateral to mitigate potential losses.

On the demand side, credit dynamics are altered by shifting insolvency risk mainly to borrowers, for example through strong collateral enforcement or informal norms that extend liability beyond the firm (e.g. personal guarantees or family co-signing practices). Risk-averse entrepreneurs, particularly those with limited wealth or high-income volatility, may forgo investment opportunities even when a clearly positive value is expected and the investment is socially beneficial. They may particularly do so if downside risks are uninsured. This increases the effective cost of capital and suppresses credit demand, especially among liquidity-constrained or early-stage firms.

Thus, contrary to the common assumption that transferring risk to borrowers automatically boosts credit supply, the opposite may occur. In markets with limited banking competition, such as oligopolistic or highly concentrated systems, banks can engage in strategic price setting to preserve margins rather than expand lending volumes. With fewer incentives to compete for marginal borrowers, banks may limit credit access, particularly to firms lacking collateral if no detailed case-by-case assessment and monitoring is in place for the reasons mentioned above. As a result, both the willingness to lend and to borrow declines – not due to legal constraints, but because institutional structures weaken the mechanisms that would otherwise promote risk sharing and capital formation. Lower competition allows banks to engage in oligopolistic price setting, resulting in reduced credit volumes and fewer incentives to expand access to riskier or less collateralized borrowers (Stiglitz and Weiss, 1981; Crawford et al., 2018).

The outcome is a structurally weaker credit market, especially for young, innovative, or informationally opaque firms with high ex-ante uncertainty. These firms are most in need of flexible risk assessment, but least likely to receive it in a concentrated banking environment where standardization and regulation dominate.

In addition, insolvency proceedings are not always neutral in their application or effect. Firms may strategically time or structure their exit to minimize losses to owners – particularly in institutional environments where enforcement is weak, judicial capacity is limited, or creditor coordination is fragmented. Legal protections such as limited liability and insolvency law originally designed to foster entrepreneurship can be misused to shield assets, delay restructuring, or externalize costs onto creditors and the public.

Properly designed insolvency systems perform a critical economic function: They enable the orderly exit of unviable firms, facilitate the reallocation of capital and labor toward more productive uses, and maintain competitive pressure through firm turnover (Djankov et al., 2008; La Porta et al., 1998).

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[4] See https://www.ris.bka.gv.at/eli/bgbl/I/2021/147/20210726.

Insolvency should not be viewed merely as a failure, but as a key mechanism of economic dynamism and structural adjustment. Box 1 summarizes how firm exits in general contribute to productivity, innovation diffusion, and structural transformation across the economy.

Box 1: Insolvencies and economic dynamism

Productivity growth and resource reallocation: Firm exits, including insolvencies, play a critical role in reallocating economic resources – capital, labor, and technology – from unproductive entities to more efficient firms. This process prevents the stagnation of resources in declining sectors and optimizes aggregate productivity, sustaining long-term economic growth.

Firm turnover and innovation diffusion: Endogenous growth models emphasize the role of firm turnover in fostering innovation and knowledge spillovers. Entry and exit dynamics stimulate technological diffusion by ensuring that markets remain competitive and adaptive, enhancing overall economic resilience and innovation potential.

Institutional efficiency: The quality of institutional frameworks significantly affects the dynamics of firm exits. Efficient insolvency systems reduce legal uncertainty, streamline bankruptcy procedures, and lower the costs of restructuring or liquidation. By facilitating smoother and quicker firm exits, institutions enable dynamic reallocation while minimizing economic distortions.

Bankruptcy costs and market incentives: Bankruptcy costs influence firm behavior and market efficiency. While high costs deter insolvencies, asymmetric information or legal protections – such as limited liability – can make insolvency proceedings strategically beneficial for some firms. Policies aimed at reducing unnecessary barriers and transaction costs ensure that insolvencies serve their intended economic function.

Labor reallocation and structural transformation: Labor mobility is integral to economic adaptability. When firms exit, workers transition from contracting sectors to expanding ones, contributing to structural transformation. Barriers to firm exit impede this reallocation, slowing necessary adjustments to shifting technological trends and consumer demands.

Policy design and economic stability: Sound insolvency regimes balance the interests of creditors and debtors while fostering economic stability. Policies that promote early restructuring, prevent resource misallocation, and reduce personal penalties for failure encourage entrepreneurial activity, innovation, and efficient market functioning. Harmonization efforts, such as the EU's preventive restructuring frameworks, exemplify the importance of policy design in enhancing insolvency processes.

The policy challenge lies not in minimizing insolvency counts, but in fostering institutional environments that support early, efficient, and economically meaningful exits. Achieving this requires granular, high-quality and also complete microdata. It also requires tailored indicators of insolvencies (along with outcome metrics such as recovery rates and restructuring effectiveness, which are beyond the scope of this paper). Moreover, it calls for a shift away from crude aggregate measures such as raw insolvency counts, which are often misleading and strategically deployed to justify public support or the allocation of taxpayer resources.

2.2   Literature on the role of insolvencies and insolvency laws

The empirical literature reinforces the economic mechanisms summarized in box 1, providing robust evidence that insolvency systems play an important role in supporting productivity, innovation, and structural transformation. A broad consensus underscores the importance of firm turnover, with insolvencies facilitating the reallocation of resources from inefficient entities to more productive ones. This mechanism of "creative destruction," as discussed by Bartelsman et al. (2004), not only enhances productivity by reallocating resources but also increases market contestability, promoting innovation and adaptability across economies. The performance of firms, particularly new entrants, is shown to vary significantly depending on the institutional and policy environments, emphasizing the need for frameworks that minimize barriers to firm growth and resource reallocation.

McGowan and Andrews (2016) highlight how well-designed insolvency systems allow for the swift exit of non-viable firms and the restructuring of potentially viable ones, reducing the prevalence of "zombie firms" that hinder long-term growth. Caballero et al. (2008) argue that keeping unprofitable firms in the market leads to distorted competition. They depress product-market prices by maintaining excess capacity while raising wage pressures, as labor remains locked in underperforming firms with declining productivity. Similarly, Kliatskova and Savatier (2019) emphasize that timely and transparent insolvency procedures prevent resources from being trapped in unproductive enterprises and foster financial stability. The harmonization of insolvency laws within the European Union, as outlined in the 2019 Directive on preventive restructuring frameworks (European Parliament and Council, 2019), further illustrates how coherent frameworks can support economic renewal and mitigate nonperforming loans.

Recent research highlights the broader implications of insolvencies for entrepreneurship and innovation. Fu et al. (2020) demonstrate that lenient insolvency laws reduce the stigma and risks associated with business failure, thereby encouraging high-growth and opportunity-driven entrepreneurship.

André and Demmou (2022) stress the importance of early-warning systems and streamlined insolvency procedures, particularly for small and medium-sized enterprises (SMEs), to address unique challenges and promote entrepreneurial activity. Coutinho et al. (2023) further argue that harmonized insolvency mechanisms enhance economic resilience during periods of financial distress by addressing credit misallocations and freeing resources for productive use.

Evidence from the Banque de France (Bureau and Libert, 2016) also highlights the role of bankruptcies in economic restructuring, noting significant productivity gains when less efficient firms exit the market. This process, driven by insolvencies, fosters innovation and efficiency improvements among established firms while reducing productivity gaps between failing and surviving entities.

Additionally, Jamet et al. (2023) discuss the importance of harmonizing insolvency laws across Europe. They emphasize the potential of reforms to lower costs, enhance transparency, and accelerate firm exits, thereby facilitating economic renewal and financial integration.

Improved insolvency laws typically lead to a rise in observed insolvencies. This rise is not a sign of economic distress, but serves as evidence of a more responsive institutional framework that facilitates productive exits, encourages market entry, and strengthens overall economic adaptability.

2.3   Policy implications

Efforts to harmonize insolvency frameworks across jurisdictions reflect a growing recognition of their central role in promoting efficient resource allocation and economic resilience. The 2019 Directive on preventive restructuring frameworks (European Parliament and Council, 2019) exemplifies this push, aiming to establish shared principles that enable quicker and more predictable restructuring processes while lowering barriers to firm exit.

In contrast, policy interventions that seek to suppress firm exits, such as indiscriminate subsidies or administrative barriers to insolvency, may offer short-term stability, but often undermine long-term economic adaptability. Prolonging the life of inefficient firms distorts market signals, hampers productivity growth, and reduces incentives for innovation. It also risks creating moral hazard, particularly when firms come to rely on public support rather than operational improvements.

Historical examples such as fossil fuel subsidies and large-scale bailouts during the 2008 financial crisis and the COVID-19 pandemic underscore the risks of poorly targeted support. While such interventions may have stabilized employment or credit markets in the short term, they often lacked mechanisms to align public risk-taking with future gains, effectively socializing losses while privatizing profits. As a side effect, they also tend to conserve existing distributions of wealth and economic power, particularly in economies where firm ownership is highly concentrated. Rather than facilitating broader access to opportunity or supporting structural transformation, such measures can reinforce entrenched inequalities and institutional inertia.

Forward-looking policies should therefore strike a balance between immediate stabilization needs and longer-term structural goals. This includes fostering efficient firm turnover, strengthening early-warning systems, and reducing the procedural and informational frictions that hinder timely exit and resource reallocation. Investments in digital infrastructure, streamlined insolvency procedures, and institutional capacity building are critical to this agenda. As highlighted in recent OECD analyses, Austria's insolvency framework in particular lags behind best practices. It lacks comprehensive pre-insolvency mechanisms and early-warning tools – especially for SMEs – resulting in fewer timely restructurings and a higher prevalence of inefficient firms remaining on the market (André and Demmou, 2022; McGowan et al., 2016). These institutional shortcomings reduce the effectiveness of capital and labor reallocation, ultimately weakening the productivity-enhancing function of firm turnover.

Moreover, when public resources are allocated to support firms – whether through subsidies, credit guarantees, or bailouts – economic theory suggests that such interventions should be designed to internalize the positive externalities. From a welfare economics perspective, failing to require some return to the public – whether through profit-sharing, conditional reinvestment, or equity participation – can result in a misallocation of surplus and reinforce distributive imbalances. Well-designed subsidy schemes should therefore include mechanisms that align private gains with social contributions, ensuring that public risk-taking yields reciprocal public benefit.

Ultimately, insolvency should be understood not as an economic failure to be suppressed, but as a mechanism of adjustment that – when properly governed – supports innovation, competitiveness, and sustainable growth. As OECD evidence has shown, countries with more responsive and accessible insolvency frameworks experience faster capital reallocation and stronger productivity growth. While Austria has made some institutional strides, particularly with the implementation of EU restructuring directives, significant gaps remain, especially in terms of SME accessibility, creditor coordination, and early intervention mechanisms (André and Demmou, 2022; McGowan and Andrews, 2016).

3 Data and methodology

This section introduces the data sources and empirical strategy used to analyze firm dynamics and insolvency patterns in Austria. The analysis is based on the Integrated Firm-Level Database (IFLD) of the Oesterreichische Nationalbank (OeNB), a harmonized microdata infrastructure that links official administrative data from multiple sources[5]. The database provides consistent information on firm characteristics, financial statements, employment, and credit exposures at the firm level. In section 3.1, we describe the structure of the dataset, define the populations used for different parts of the analysis, and report data availability and completeness. Section 3.2 then explains how we construct both unweighted and weighted insolvency indicators and motivates the choice of economic weighting variables to better capture the relevance of insolvency events.

3.1 Data sources and design of subsets

The empirical analysis draws on the Integrated Firm-Level Database (IFLD) of the Oesterreichische Nationalbank (OeNB), a harmonized microdata infrastructure that merges several official data sources. More precisely, the IFLD links firm-level records from the Austrian commercial register, annual financial statements, employment statistics, and loan-level credit data compiled under the AnaCredit Regulation ((EU) 2016/867). This rich data environment enables consistent identification of firm entries, exits, and insolvency events while also providing detailed information on firm size, workforce, and credit exposure.

To address different analytical objectives, we define two distinct samples:

1. Full firm population for turnover analysis (2019–2024):
   For the analysis of firm stocks and flows over time – including entries, exits, and insolvencies – we use the full population of entities classified as nonfinancial corporations under ESA sector 1100. This includes all market-producing firms registered in the Austrian commercial register, regardless of their actual economic activity, and irrespective of their legal form. Crucially, this means that the dataset also comprises entities that do not engage in regular business operations and exist primarily for legal or financial structuring purposes – for instance, asset protection, tax optimization, or liability segregation. However, since economic inactivity is not directly observable for most firms, we do not exclude such cases ex ante, and they remain part of the population under study. The size of this comprehensive firm population increased from approximately 239,000 in 2019 to around 280,000 in 2024. This growth in the firm stock is crucial for interpreting the relative scale of insolvency flows.

   Firm dynamics are defined as follows:

   - Entry: A firm newly appears in year *t+1* after not being present in year *t*.
   - Exit: A firm disappears from the Austrian commercial register (Firmenbuch) in year *t+1* after being present in year *t*, including both voluntary and involuntary closures.
   - Insolvency: Insolvencies are identified using judicial records from the Austrian legal notices database (Ediktsdatei), including bankruptcies, formal restructuring procedures, and cases where proceedings were rejected due to insufficient assets. Multiple

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[5] Some parts of it also use an extended set of data from the production data structure of the IFLD we call UDS (Unternehmensdatensatz).

insolvency events for the same firm are only counted separately if they are more than 90 days apart.

2. Restricted firm sample for insolvency analysis (2023):
    To assess the structural characteristics of firms that became insolvent in 2023, we link insolvency events in that year to financial and employment data from 2021. We also merge in credit exposure information from Austria's central credit register as of end-2021. This allows us to construct two additional indicators: a binary variable for whether a firm held bank loans, and the total volume of outstanding bank liabilities. By referencing a point in time well before the insolvency event, we enable a comparison of firm characteristics. We focus on 2023 insolvencies because 2021 is the most recent year for which harmonized and complete balance sheet, employment, and loan-level data are available across firms. Using 2021 data ensures that the weighting variables reflect the pre-insolvency characteristics of both insolvent and surviving firms. We are currently working on extending the IFLD to enable consistent linkage of financial and employment variables across multiple years, which will allow future analyses to track changes in firm characteristics and insolvency dynamics over time. This restricted sample only includes firms with legal forms that are required to submit annual financial statements to the commercial register. These are limited liability companies (GmbH), stock corporations (AG), limited partnerships with limited liability (GmbH & Co KG), general partnerships with limited liability, and European companies (SE). Overall, the sample for 2023 comprises about 193,000 firms that are required to submit annual financial statements. Somewhat surprisingly, however, almost 10% of firms legally required to submit financial statements did not do so in 2023 (see also table 2 in section 4.2).

The two subsets listed above form the empirical basis for the analyses that follow, with one subset covering the full firm population over time, and one the firms required to submit annual financial statements, which enables a focus on firm-level characteristics before insolvency. The next section outlines the methodology for constructing both unweighted and weighted insolvency indicators based on these data.

3.2 Construction of indicators and metrics

The most basic measure for assessing the prevalence of insolvencies is the unweighted insolvency rate, defined as the proportion of insolvent firms relative to the total number of firms in a given population:

$$Insolvency\ rate = \frac{Number\ of\ insolvent\ firms}{Total\ number\ of\ firms} \times 100.$$

This formulation treats all firms equally, regardless of their economic size or systemic relevance. It relates the number of insolvent firms to the total firm population, which changes continuously. While intuitively and informationally superior to mere insolvency counts, it still has serious limitations in environments such as Austria, where the firm population includes a large share of economically marginal entities. These include dormant holding companies, tax-optimization vehicles, or firms created solely for asset isolation, which inflate the firm population without being economically relevant entities with a relevant business model. On top of that, the failure of a small company is treated identically to the insolvency of a large employer or a major credit client, despite their vastly different implications for employment, creditor exposure, and economic reallocation. This limitation is particularly relevant in the Austrian context, where

the firm size distribution is highly skewed, with many very small firms and only a small fraction of large firms (Hirsch et al., 2025).

To overcome these shortcomings, we adopt a weighted insolvency rate that accounts for each firm's economic significance. The general form of the weighted rate is:

$$Weighted\ insolvency\ rate = \frac{\sum_{i=1}^{N} w_i \cdot d_i}{\sum_{i=1}^{N} w_i} \times 100,$$

where w_i denotes the weight assigned to firm i, d_i is a binary indicator equal to 1 if firm i is insolvent in 2023 and 0 otherwise, and N is the total number of firms in the respective subset.

The choice of the weighting variable reflects the economic dimension we seek to analyze. We construct four variants of the weighted insolvency rate:

1. Asset-weighted: using total assets to capture the share of balance sheet resources at risk.
2. Employment-weighted: using the number of employees to reflect labor market exposure.
3. Loan-dummy weighted: assigning a weight of 1 to firms with bank loans to isolate insolvencies among bank credit-taking firms.
4. Loan-volume weighted: using outstanding bank liabilities to measure the potential financial risk to the banking system.

All weights are derived from firm characteristics observed in 2021, while insolvency events are recorded for the year 2023. This approach accounts for the fact that balance sheet data are often missing or incomplete at the time of insolvency – particularly for firms that fail early in the year or do not file final accounts. Relying on 2021 data ensures that the information used for weighting is not only available and consistent but also reflects the pre-distress situation of both insolvent firms and their non-insolvent peers. This allows for meaningful comparisons across firms and ensures that all weighting variables – such as firm assets, employment, and loan exposures – refer to a common reference point prior to the insolvency event. The weighted approach improves interpretability by allowing us to assess whether insolvencies are concentrated among small, economically marginal firms or whether they disproportionately affect larger, more economically significant entities. If the weighted insolvency rate exceeds the unweighted one, this signals that larger or more exposed firms are relatively more affected. In contrast, a lower weighted rate indicates that insolvencies are primarily occurring among smaller firms with limited macroeconomic relevance. Therefore, the approach also provides a simple decomposition of the unweighted rate, which simply assumes equal weight across all firms. By applying economically meaningful weights, we preserve the firm-level structure while shifting analytical focus toward the aggregate material impact. Asset-weighted rates can simply be interpreted as a percentage of total assets, employee-weighted rates as a percentage of total employees, and loan-weighted rates as a percentage of total loans held or employed by firms that are affected by insolvencies. This enables a clearer distinction between the frequency of insolvencies and their economic significance.

4 Empirical results

This section presents the empirical results on firm dynamics and insolvency patterns in Austria, drawing on the IFLD described earlier. We begin with an overview of aggregate firm stocks, entries, exits, and insolvency trends over time (section 4.1). We then assess the economic relevance of insolvencies using weighted measures that account for firm size, employment, and credit exposure (section 4.2). Finally, we explore the age profile of insolvent firms to examine the life-cycle dimension of business (section 4.3).

4.1 Firm stocks, flows, and insolvency trends

Table 1 presents an overview of firm dynamics in Austria from 2019 to 2024. The stock of firms increased from 238.7 thousand in 2019 to 279.7 thousand in 2024, reflecting overall stable and continuous growth – even through the Covid-19 pandemic.

Firm turnover, defined as the sum of firm entries and exits, ranged between 25.2 thousand and 29.3 thousand firms annually. Entry numbers were relatively stable, fluctuating between 16.2 thousand and 20.2 thousand per year, with a slight decline after 2021. Exits remained comparatively low during the pandemic years 2020 and 2021, with about 9.0 thousand exits annually, before rising to 11.8 thousand in 2023 and decreasing to 10.6 thousand in 2024.

Insolvencies decreased sharply during the COVID-19 crisis, falling to 1.5 thousand cases in 2020 and 2021. By 2024, insolvencies rose to 3.2 thousand, doubling compared to the pandemic lows. However, even at their 2024 peak, insolvencies remained a minor component of total firm turnover, with entries and voluntary exits dominating firm dynamics.

Overall, the rise in insolvencies in 2023 and 2024 must be viewed in the context of a growing firm population and continued high levels of entries. In our view, the data can be best described as representing a gradual normalization of firm dynamics rather than a crisis.

Table 1

Firm stock and flows from 2019 to 2024

	Stock of firms	Entries	Exits	Turnover (sum of entries and exits)	Insolvencies
Thousands					
2019	238.7	16.3	9.7	26.0	2.2
2020	245.3	16.2	9.0	25.2	1.5
2021	256.5	20.2	9.1	29.3	1.5
2022	266.5	19.2	9.0	28.2	2.0
2023	274.1	16.6	11.8	28.4	2.5
2024	279.7	17.3	10.6	27.9	3.2

Note: Data includes all registered firms which are non-financial firms (ESA sector 1100) in Austria. All values in thousand firms.

Source: IFLD 2021.

To illustrate this point more accurately, we present relative indicators in chart 1. Despite fluctuations in absolute firm numbers, the turnover rate – defined as the sum of entries and exits relative to the total firm stock – remained remarkably stable, ranging between 10% and 11.5% throughout the period under review. In contrast, insolvencies as a share of total turnover reveal a clear upward trend: From a low of

5.2% in 2021, this share rose steadily to reach 11.4% by 2024. This shift suggests that, while the overall level of firm turnover held steady, a growing proportion of exits were due to insolvencies rather than other (including voluntary) exits.

Measured against the total firm population, however, insolvency rates remained far more stable, hovering around 1% – with a low of 0.59% in 2021 and a modest increase to 1.14% by 2024. This relative stability, despite the rise in absolute insolvency cases, reflects the continuous growth of the firm base and indicates that insolvencies remain a minor component of broader firm dynamics.

Taken together, these findings point to a normalization in the composition of exits following the artificial suppression of insolvencies during the pandemic, rather than to a sign of systemic distress.

Chart 1

Firm turnover (entries and exits) and insolvencies

Turnover in % of total firms (left-hand scale)
Insolvencies in % of total turnover (left-hand scale)
Insolvencies in % of total firms (right-hand scale)
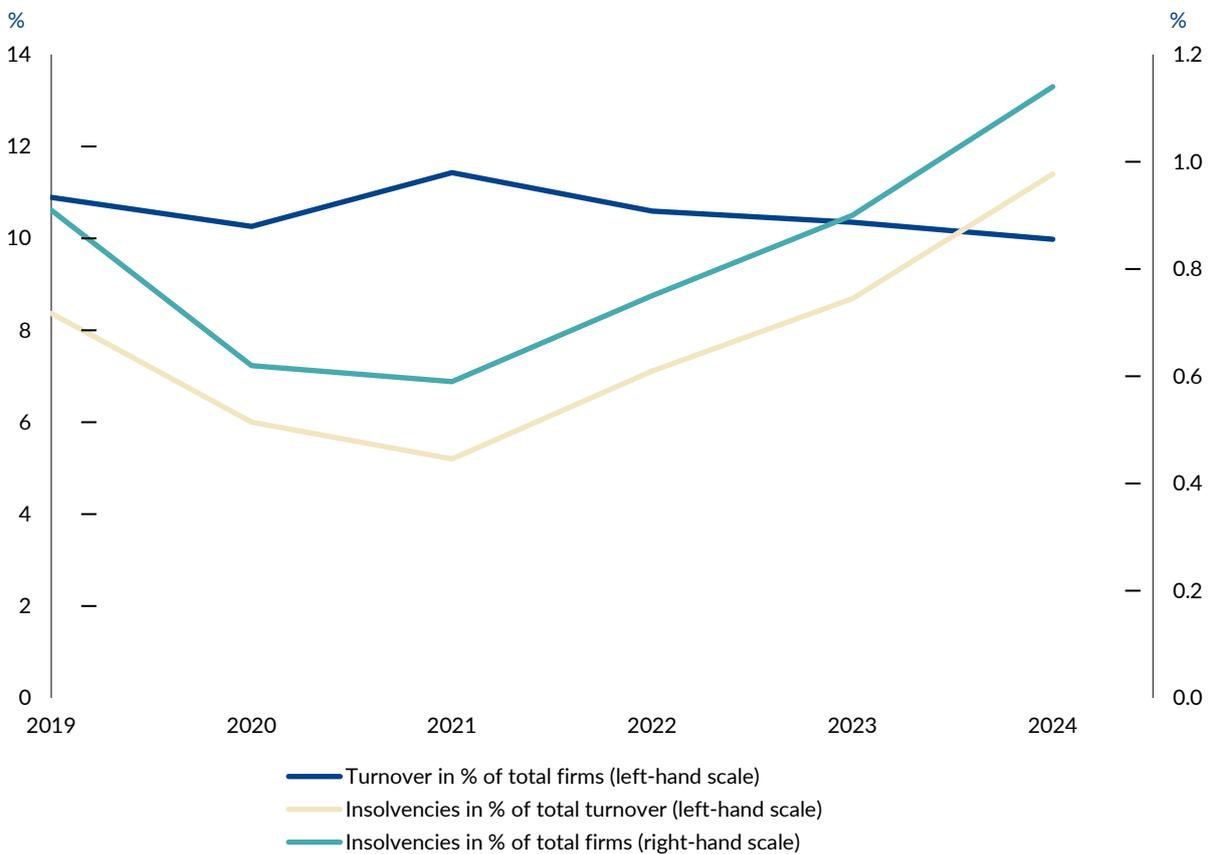
Source: OeNB, UDS.

4.2 Insights from weighted insolvency rates

As outlined in section 3.1, this analysis focuses on the restricted population of firms that are legally required to submit annual financial statements. In 2021, this sample amounted to approximately 193,000 firms. Within this group, not all firms provide complete data for the variables used in our weighting approaches. While bank loan information is available for the entire sample, a substantial share of firms has missing values for total assets or employment figures. It is surprising that almost 10% of firms lack

balance sheet information, even at the more aggregated balance sheet levels. After all, they are legally required to provide such data. This lack of information is a severe problem for data analyses.

In what follows, we refer to a full available sample when each insolvency rate is calculated based on the largest possible subset for that variable. Alternatively, we refer to a complete-data subsample when restricting the analysis to firms with non-missing values across all dimensions. This smaller, fully observed subsample allows for a robustness check that ensures comparability across weighting methods. Analyses based on the full available sample that claim to make statements about the full population of firms required to submit statements rely on the assumption that data are missing at random and support greater external validity. By contrast, analyses based on the complete-data subsample improve internal validity by holding the population constant. At the same time, however, these analyses throw away a lot of information – at the cost of potentially excluding systematically different firms and risking external validity.

Table 2

Subsets with regard to available data

Subset	Number of firms
Thousands	
All firms required to submit annual financial statements	**193.2**
Asset data available (and possibly employee data)	175.1
Employee data available (and possibly asset data)	150.9
Both available	**150.5**
Only asset data available	24.6
Only employee data available	0.4
Both missing	17.6

Note: All counts in thousand firms.

Source: IFLD 2021.

Before calculating weighted insolvency rates, it is important to assess the structure of the underlying data. Table 3 presents descriptive statistics for the restricted sample of firms that are legally required to submit annual financial statements, including those with missing values for key variables. We deliberately report these figures for the full available sample – rather than limiting the analysis to the complete-data subsample – to provide a transparent view of data coverage, missingness patterns, and reporting practices. This approach highlights the practical challenges associated with administrative microdata and informs the subsequent decision to construct both variable-specific and fully observed subsamples.

Table 3 reveals that missing values are particularly common for data on employment (21.9% of all firms and 32.3% of insolvent firms) and on total assets (9.3% and 25.5%, respectively). While bank liability data are complete, a substantial share of firms – especially those that became insolvent – also report zero or negative values for key financial items. Notably, 17.1% of all firms and 35.4% of insolvent firms report negative equity capital (already at least one year before the insolvency event), which is consistent with deteriorated financial positions. These patterns underscore the heterogeneity of firm size and financial health in the firm population, the importance of considering economic weight in insolvency measures, and the need for robustness checks that control for missing data in a systematic way.

Table 3

Information on missing, negative, and positive values

		Missing	< 0	0	> 0	Total
%						
Total assets	All firms	9.3	0.0	0.7	90.0	100
	Insolvent firms	25.5	0.1	0.8	73.6	100
Equity capital	All firms	9.3	17.1	0.6	73.0	100
	Insolvent firms	25.5	35.4	0.6	38.5	100
Total liabilities	All firms	9.6	0.1	5.0	85.2	100
	Insolvent firms	25.9	0.1	1.6	72.4	100
Outstanding bank liabilities	All firms	0.0	0.0	64.0	36.0	100
	Insolvent firms	0.0	0.0	58.6	41.4	100
Equity ratio	All firms	10.0	16.5	0.5	73.0	100
	Insolvent firms	26.4	34.6	0.5	38.5	100
Liability ratio	All firms	10.5	0.0	4.9	84.7	100
	Insolvent firms	26.9	0.0	1.5	71.7	100
Number of employees	All firms	21.9	0.0	24.2	53.9	100
	Insolvent firms	32.3	0.0	14.2	53.5	100

Notes: Firm statistics from the year 2021; insolvency in the year 2023; number of all firms is 193,178; number of insolvent firms is 1,977.

Source: IFLD 2021, OeNB.

Table 4 presents descriptive statistics for these variables. Values are shown separately for the firms belonging to the restricted sample (193,178 firms) and for firms that became insolvent in 2023 (1,977 firms). To ensure comparability and interpretability of financial ratios, we limit the calculation of the equity ratio to firms with non-negative equity capital. While negative equity is economically meaningful – indicating deep financial distress – it renders the equity ratio undefined or misleading and is therefore excluded from ratio-based summaries.

Table 4 highlights several structural differences between all firms and insolvent firms. Insolvent firms are markedly smaller in terms of assets (median of EUR 249,500 vs. EUR 548,000). Moreover, they report significantly weaker balance sheets, with a lower median equity ratio (0.24 vs. 0.52) and a higher 99th percentile liability ratio (27.1 vs. 11.6), reflecting extreme leverage in some cases. Interestingly, median employment is slightly higher among insolvent firms (4 vs. 2 employees), suggesting that insolvencies are concentrated not among the smallest, probably inactive entities, but among micro and small firms with some workforce. However, the mean number of employees is lower for insolvent firms (13 vs. 15), indicating that they are less likely to include large employers. The patterns detailed above justify the need for weighted insolvency measures, as they help distinguish between the frequency and the economic significance of insolvencies.

Table 4

Descriptive information for relevant statistics

		P1	P20	Median	Mean	P80	P99
Total assets	All firms	1.0	90.0	548.0	7,269.0	2,784.0	87,642.6
	Insolvent firms	0.0	54.0	249.5	4,989.8	1,088.0	21,952.4
Equity capital	All firms	-1,398.7	1.0	123.0	3,531.2	896.0	43,975.4
	Insolvent firms	-3,277.7	−154.0	2.5	3,188.9	110.0	4,492.5
Total liabilities	All firms	0	18.0	203.0	3,188.1	1,356.0	36,032.0
	Insolvent firms	0.0	55.0	270.0	1,636.3	1,057.4	17,665.3
Outstanding bank liabilities	All firms	0.0	0.0	0.0	865.3	285.2	12,698.9
	Insolvent firms	0.0	0.0	0.0	363.8	208.2	6,474.7
Equity ratio (excl. neg. equity)	All firms	0.002	0.189	0.517	0.521	0.852	1.000
	Insolvent firms	0.000	0.081	0.244	0.324	0.559	1.000
Liability ratio	All firms	0.000	0.095	0.477	3.361	0.956	11.601
	Insolvent firms	0.000	0.517	0.926	2.910	1.646	27.056
Number of employees	All firms	0	0	2	15	11	203
	Insolvent firms	0	0	4	13	12	122

Notes: Firm statistics from the year 2021; insolvency in the year 2023; total assets, outstanding bank liabilities, equity capital, total liabilities and equity as well as liabilities in EUR thousand; number of all firms is 193,178; number of insolvent firms is 1,977.

Source: IFLD 2021, OeNB.

Insolvency rates are weighted as described in section 3.2 by four key variables: total assets, number of employees, and credit exposure – measured, first, by a binary indicator for having outstanding bank loans and, second, by the volume of those liabilities. To ensure statistical robustness and meaningful comparisons, we restrict the sectoral analysis to NACE sectors with at least 50 insolvencies in 2023. This threshold prevents distortions from very small samples while retaining the vast majority of economically relevant insolvency events.

Chart 2 presents unweighted and weighted insolvency rates across these sectors, using the full available sample for each weighting variable.

The unweighted insolvency rate is highest in construction (1.99%), followed by transportation and storage (1.63%), and administrative and support services (1.60%). At the lower end, professional, scientific, and technical activities exhibit a relatively low unweighted insolvency rate (0.41%). However, when weighted by total assets, this sector shows a markedly higher rate (1.25%), indicating that the firms becoming insolvent were, on average, larger and more economically significant than suggested by their unweighted insolvency rate. In contrast, sectors like transportation and real estate record very low asset-weighted rates (0.08% and 0.09%, respectively), signaling that insolvencies in these areas tend to affect small firms with limited balance sheet size.

When weighted by employment, the sectors construction, accommodation and food services as well as wholesale and retail trade stand out with relatively high insolvency rates, suggesting notable labor market exposure. Meanwhile, sectors such as administrative services and manufacturing display lower employment-weighted insolvency rates, indicating that affected firms are typically smaller employers.

Loan-weighted rates provide insight into potential bank exposure. Construction, accommodation, and wholesale trade again show relatively high values – both on a loan-dummy and loan-volume basis. Real

estate and transportation, by contrast, display low loan-weighted rates, reinforcing the view that many insolvent firms in these sectors are small and pose limited credit risk.

Overall insolvency rates are calculated across the full sample of firms, not just as an average of the selected sectors with at least 50 insolvencies. As such, these rates provide a baseline against which the sector-specific patterns can be assessed.

Taken together, chart 2 highlights the importance of moving beyond unweighted insolvency counts. Weighting by economically relevant firm characteristics reveals substantial heterogeneity in the actual economic significance of insolvencies across sectors. One notable pattern is that employment-weighted and loan-weighted insolvency rates are generally much lower than their unweighted counterparts, indicating that many insolvencies involve firms with relatively few workers or limited exposure to the banking system.

It is important to note that chart 2 is based on the maximum available sample for each weighting variable. As a result, the underlying firm populations differ across measures. This approach assumes that missing data are missing at random – a strong assumption. To test the robustness of our findings, we next compute insolvency rates using the complete-data subsample, in which data are available for all weighting variables. These results are shown in chart 3.

Chart 2

Insolvency rates by NACE sector (full available sample)
Comparison of unweighted and weighted rates
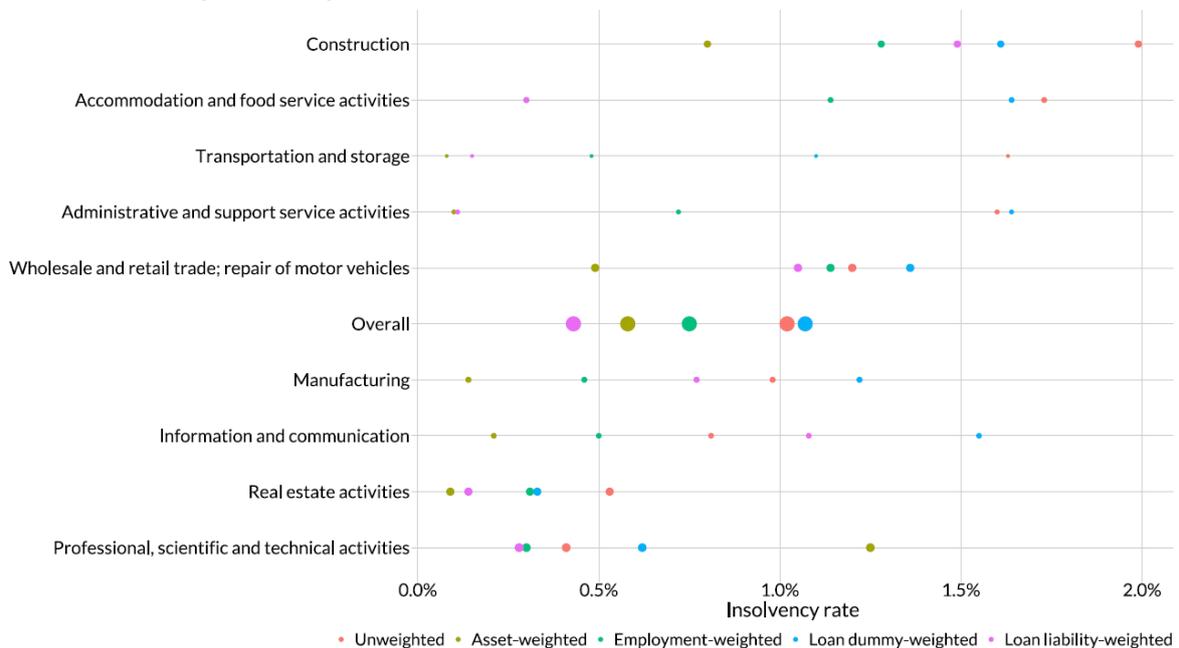
Source: IFLD 2021, OeNB.

Chart 3 presents the weighted and unweighted insolvency rates by NACE sector for the complete-data subsample – i.e. firms for which information on total assets, employment, and bank loans is available. Unlike in chart 2, all rates here are calculated based on exactly the same firm population, which enhances internal validity and allows for fully aligned cross-weight comparisons.

Despite the restriction of using the complete-data subsample, the sectoral patterns remain largely consistent with those of the full available sample shown in chart 2, confirming the robustness of our results. Notably, sectors such as construction as well as accommodation and food services still show high unweighted rates, but markedly lower asset- and loan-weighted rates. Professional, scientific, and technical activities, on the other hand, again exhibit low unweighted, but higher asset-weighted insolvency rates. These results suggest that the observed differences are not artifacts of missing data and that the weighting patterns are statistically and economically stable.

While the complete-data approach ensures consistency across all weighting indicators, it necessarily excludes a non-trivial share of firms, which may reduce external validity. We therefore treat this approach as a robustness check rather than a definitive benchmark. In future work, we aim to impute missing values to expand coverage while maintaining comparability and external validity.

Chart 3

Insolvency rates by NACE sector (complete-data sample)
Comparison of unweighted and weighted rates (complete cases only)
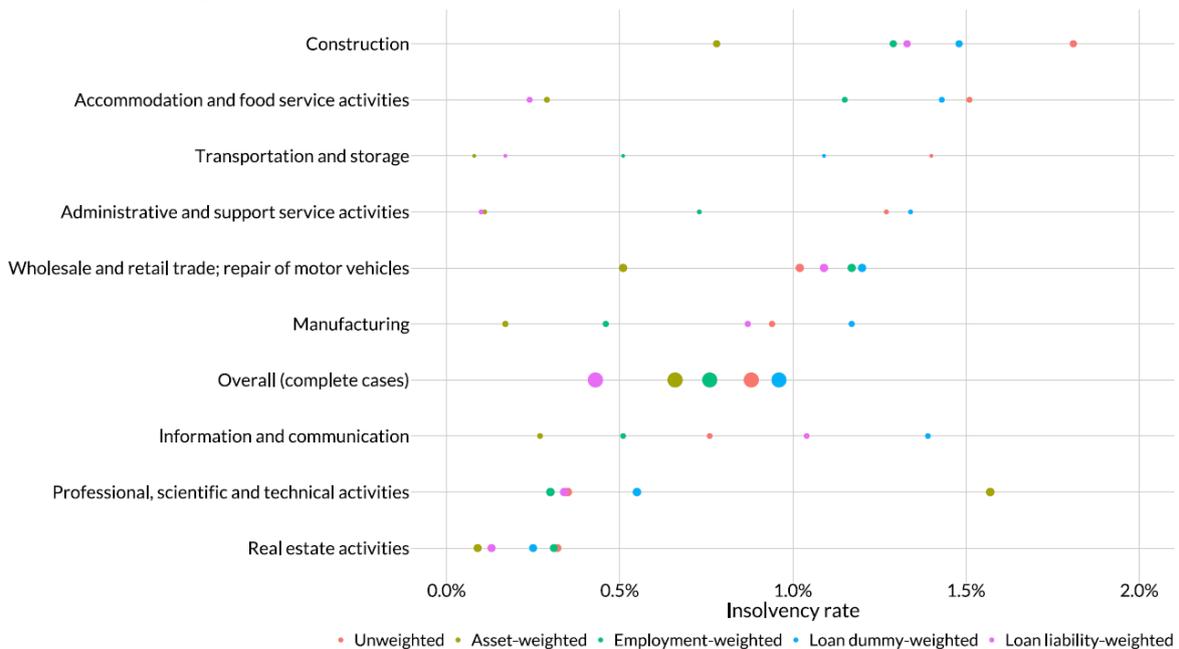
Source: IFLD 2021, OeNB.

To sum up, insolvency rates are somewhat higher among firms with bank loans, but drop markedly when weighted by loan amounts, employment, or total assets. This suggests that insolvent, credit-taking firms tend to be economically smaller. This pattern holds across both the full available sample and the complete-data subsample. No sector with over 50 insolvencies in 2023 exceeds a 2% unweighted rate, and most fall below a 1% rate once weighted, highlighting that insolvencies remain a relatively minor component of firm dynamics when assessed in economic terms. This is also due to Austria's large number of firms that exist primarily for legal or financial structuring purposes such as tax planning, asset shielding, or inheritance arrangements. Such firms inflate the firm count without reflecting active economic engagement.

4.3   Firm life cycle

Chart 4 presents the age distribution of firms across NACE sectors with at least 50 insolvencies in 2023, distinguishing between active firms, firms that exited in 2023, and firms that became insolvent in 2023. For this purpose, we defined mutually exclusive categories: "Firms that became insolvent in 2023" includes all firms formally recorded as insolvent in 2023, while "Firms that exited in 2023 (excl. insolvencies)" comprises all firms that disappeared from the Austrian commercial register in 2023 without having become insolvent earlier that year. Firms that were both insolvent and absent in 2024 are assigned exclusively to the category of insolvent firms. For clarity, firm ages are trimmed at the (overall) 95th percentile.

While insolvency may lead to exit, the two are not synonymous: Many firms exit voluntarily, through mergers or succession, or for nonfinancial reasons, and not all insolvencies result in immediate deregistration. The distributions reveal several consistent patterns: Both insolvencies and exits are disproportionately concentrated among younger firms, particularly in the first 10 to 15 years – a pattern consistent with early-stage fragility in firm development. At the same time, insolvencies occur across the entire age spectrum, indicating that structural decline can also affect older firms.

When compared to active firms, exits show a wider age spread, reflecting the diversity of exit pathways beyond financial distress. Insolvencies, while more narrowly distributed, still span all life-cycle stages.

These findings underscore the role of insolvency as part of a broader and continuous market selection process. A well-functioning insolvency regime must therefore accommodate both early restructuring for viable firms and timely exit mechanisms for those no longer competitive, regardless of firm age.

Chart 4

Firm age distribution by sector (min. 50 insolvencies)
Density by firm status in 2023: active, insolvent, or exited
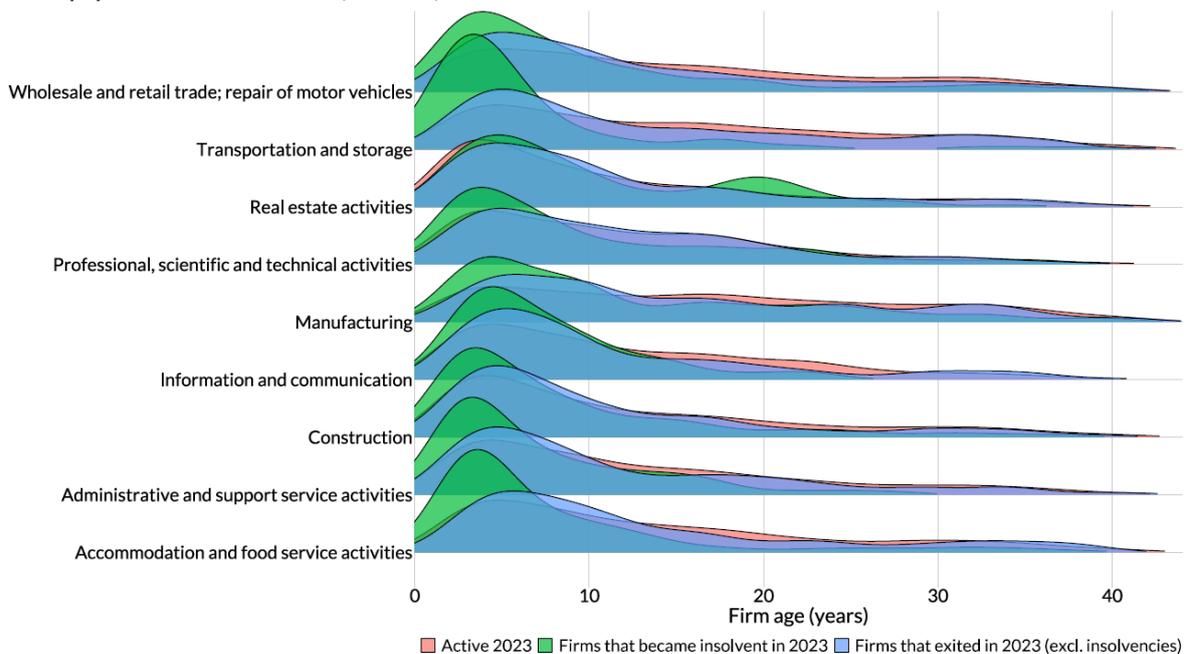
Source: IFLD 2021, OeNB.

5 Conclusions

Insolvencies are not inherently negative events but essential mechanisms of structural adjustment in modern market economies built on limited liability. Yet in Austria, they are often misunderstood and monitored through headline counts that obscure their economic function. Moreover, these counts are frequently instrumentalized by interest groups to create crisis narratives, mobilize public support, and exert pressure for favorable policies or taxpayer-funded support.

The in-depth analysis of insolvency data from the period 2019–2024 conducted in this paper shows that simple insolvency counts provide limited insight. Simplified extensions using data from the first half of 2025 support the results achieved here: Simple counts neglect firm heterogeneity, ignore the broader dynamics of firm turnover (exits and entries), and fail to capture firms' economic relevance. Using granular firm-level microdata, we developed weighted insolvency rates based on firm assets, employment, and bank credit exposure. The rates reveal that insolvencies were not only rare – around 1% annually – but also remarkably stable, even during the pandemic. Furthermore, they were concentrated among small firms. However, insolvency rates are likely depressed by a large number of marginal legal entities that exist for tax, asset protection, or succession purposes rather than for active business operations. We did not adjust for this issue, meaning that many economically inactive firms remained in the denominator.

Recognizing these limitations underscores the importance of integrated firm-level microdata for building more meaningful indicators that can inform targeted, evidence-based policy.

In future research, we seek to extend the metrics used in this paper over time to also capture structural trends. Such longitudinal perspectives are critical for understanding how insolvency systems contribute to resilience and productive transformation in the broader economy. In addition, we plan to systematically identify firms that are economically active – i.e. those engaged in meaningful production and market activity – to obtain more meaningful benchmarks for firm dynamics, including insolvency rates. In parallel, we plan to impute missing data to reduce potential biases arising from incomplete reporting and enhance the robustness of future analyses.

Looking ahead, we hope that our findings not only support policymakers in designing more effective insolvency frameworks and strengthening the enforcement of firms' reporting obligations; we also hope that our results foster a more constructive understanding of insolvency – as a necessary mechanism for structural adjustment rather than a purely negative event.

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The impact of US tariffs on EU industries: results from a global input-output model

In this study, we analyze the economic effects of US tariff increases on EU industries during President Trump's second term. We simulate three different scenarios of escalating tariffs and find that EU GDP could decline by up to 0.5 % in the medium term. Our simulations show a wide range of impacts for different industries, with pharmaceutical manufacturing being hit hardest. Ireland, Denmark, Belgium and Germany are among the most affected countries according to our analysis.

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Significant sectoral impacts

In our most severe scenario, pharmaceutical manufacturing is the most affected sector in the EU, with a potential decline of value added of 10.4%. Other vulnerable industries include manufacture of transport equipment and basic metals.

Country-level vulnerability

Ireland faces a GDP loss of 2.7% in the most severe scenario, mainly due to its reliance on pharmaceutical exports to the US. Denmark (–1.0%), Belgium (–0.7%) and Germany (–0.5%) would also rank among the most affected EU countries in terms of GDP losses in this scenario.

About the study

The study uses a global input-output model based on OECD data, incorporating tariff elasticities and tariff changes at a detailed product level to simulate medium-term effects (five years). We find strong heterogeneity regarding the impacts of US tariffs on different industries. Aggregate results are in line with other relevant recent studies.

Abstract

We simulate the impacts of the US tariff increases of President Trump's second term (cut-off date May 12) on the EU industries using detailed data at the product group level on tariffs, tariff elasticities and a global input-output model. We simulate three different tariff scenarios. In the most severe scenario with 25% tariffs on US imports from the EU for steel, aluminum, automobiles and automobile parts and 20% on all other products including pharmaceuticals, GDP in the EU would fall by 0.5% in the medium term (five years) against the baseline of no tariff increases. The pharmaceutical manufacturing industry is particularly affected, with output declining by 10.4%. Other heavily affected industries are: manufacture of other transport equipment, of basic metals and of motor vehicles. Looking at individual countries, Ireland is expected to be hit hardest, followed by Denmark, Belgium and Germany. The results are subject to several limitations. Investment and consumption restraint due to high uncertainty, trade diversion of Chinese goods to the EU and relocation of production to the US could further dampen economic activity in the EU on top of the direct trade effects estimated in this study.

1   A short timeline of the US trade war of 2025 so far

Since the start of his second term in office on January 20, 2025, US President Trump has introduced numerous new US import tariffs. In the following, we outline the scope of some of these tariffs that are relevant for the EU countries. Those are the tariffs on steel, aluminum, automobiles, automobile parts and the broad-based tariff increases of April 2, 2025.[1] The 25% tariffs on steel and aluminum products came into effect on March 12, covering all countries exporting to the US. On April 3, the 25% tariff on automobiles took effect and was extended to also cover automobile parts on May 3. Imports from Canada and Mexico satisfying the rules of origin requirements of the United States-Mexico-Canada Agreement (USMCA) were exempt from these tariffs. The escalation gained momentum on April 2 ("liberation day"), when President Trump imposed additional tariffs of 10% on a broad range of products from all major trading partners of the US, effective as of April 5. The official aim of these tariffs is to reduce the bilateral trade deficits of the US with its trading partners via "reciprocal tariffs." To achieve this, even higher country-specific tariff rates, replacing the 10% tariff for 57 trading partners[2], came into force on April 9. This increased the tariffs for goods imported from the EU to 20%.

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[1]   The overview of measures presented here was compiled with the help of the timeline of the Peterson Institute for International Economics.

[2]   The 57 countries are listed in Annex I of the executive order.

Table 1

Summary of the most relevant US tariff announcements for the EU (cut-off date May 12, 2025)

Tariff measure and legal document	Effective as of	Affected goods	Affected countries	Tariff
Steel and Aluminum Proclamations 10895 and 10896 (February 10)	March 12	Steel and aluminum	Worldwide	25%
Automobiles and automobile parts Proclamation 10908 (March 26)	April 3 (automobiles) and May 3 (parts)	Automobiles and automobile parts	Except USMCA-conform trade with Canada and Mexico	25%
"Liberation day reciprocal tariffs" Executive Order 14257 (April 2) Amendment (April 8) Executive Order 14266 (April 9) Presidental Memorandum (April 11) Executive Order 14297 (May 12)	April 5 and April 9 (higher rate suspended for 90 days on April 9 all countries except China and on May 14 for China)	all goods; except steel, aluminum, automobiles and automobile parts, goods from annex II (copper, pharmaceuticals, energy, lumber, semiconductors, etc.) and as of April 11 products including semi-conductors (i.e. smart phones)	Worldwide; except Canada, Mexico, Russia, Belarus, North Korea, Cuba	10% or higher country-specific rate (e.g., EU 20%)

Source: Peterson Institute for International Economics, https://www.whitehouse.gov/, https://hts.usitc.gov/, authors' draft.

However, several countries and product groups were exempt from these tariffs. Among the excluded countries are Canada, Mexico, Russia, North Korea, Belarus and Cuba.[3] Additionally, the specific products listed in annex II of the executive order (including energy, semiconductors, copper, pharmaceuticals and lumber) and products already subject to tariffs under other decrees (steel, aluminum, automobiles and automobile parts) were exempt. On April 11, a presidential memorandum extended the list of exempt products to also cover smartphones and electronic devices containing semiconductors in general. Yet, some products were subject to multiple tariffs. For instance, automobile parts made of aluminum or steel were to face a tariff rate of 50%. An executive order[4] on April 29 clarified that the tariffs on aluminum, steel and automobiles / automobile parts do not stack.[5]

On April 9, President Trump partially backtracked in light of the turmoil in financial markets and lowered the April-2 tariffs on imports from all countries except China to 10% for 90 days. This lowered the additional tariff for the EU from 20% to 10%. The US President also announced that, should the EU fail to reach an agreement with the US by the end of those 90 days, the tariffs were going to revert to 20%. We also expected additional tariffs on previously exempt products in this case. On April 1, the Secretary of Commerce launched an investigation to determine the national security impact of the importation of drugs and pharmaceutical ingredients. The International Emergency Economic Powers Act (IEEPA) authorizes the US President to act in response to threats to US national security in the event of a national emergency. This includes the imposition of tariffs. Thus, we expected the removal of exemptions for pharmaceutical products after the end of the 90-day suspension period.

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[3] For the last four countries, far-reaching trade sanctions were already in force and significantly restricting trade even before the tariffs were imposed. Canada and Mexico were exempt since they had already been subject to tariffs of 25% in February 2025.

[4] See Executive Order 14289: Addressing Certain Tariffs on Imported Articles – The White House.

[5] This also covers the tariffs that were imposed on products from Canada and Mexico in February and March but does not apply to the prior tariffs on products from China. Also note that according to this executive order steel tariffs still stack with aluminum tariffs. The latter applies to 5 HS3 6-digit products.

Since the tariffs described above affect the EU directly, we compiled a detailed list of affected products from the US 2025 Harmonized Tariff Schedule (HTS) Revision 12 (May 13, 2025).[6] For the tariffs on US imports from Canada, Mexico and China, we relied on a few assumptions to simplify the analysis.

Since February, almost all products imported from Canada and Mexico are subject to a 25% tariff unless they comply with the rules of origin requirements of the USMCA trade agreement. We set the mean tariff rate for Mexican and Canadian products to 25% times the share of non-USMCA conforming exports. As an estimate for these non-conforming exports we use 50% for Mexico and 62% for Canada as was communicated by a White House official (see CNBC news coverage).

Tariffs for products from China were increased by 10% in early February and then by another 10% in early March 2025. Since China retaliated against the tariffs from April 2, the US President increased the additional tariffs on imports from China from an initial 34% to ultimately 125%. Furthermore, the US ended the de minimis exemptions (i.e. duty-free status) of low-value shipments from China. On May 12, China and the US reached an agreement which lowered the April-2 tariff rate imposed on US imports from China to 10%.

2   Description of scenarios

The above timeline demonstrates that so far during Trump's second term, his trade policy has been very dynamic. To reflect the rapidly changing environment we developed three scenarios that we consider to be relevant and likely. In all three scenarios, we assume that the tariffs on steel, aluminum, automobiles and automobile parts will stay at the levels of our cut-off date (May 12). This amounts to additional tariffs of 25% for all countries (including EU countries) and an additional 45% for China (which also include the 20% from February and March). Furthermore, we do not assume any retaliatory measures from trading partners and have not included the retaliation measures already implemented by China against the US. Note that while our analysis focuses on the results for EU countries, all simulations also include indirect impacts of the tariff increases on non-EU countries.

The first scenario (S1 "90 days") represents the status quo (cut-off date: May 12). Pharmaceutical products are exempt and all countries (including EU countries and China) benefit from the 90-day relief from the April-2 tariffs. Therefore, all products imported to the US from the EU are subject to an additional 10% tariff rate, all imports from China to an additional 30%. Scenario 2 (S2 "Liberation") depicts the status quo after the 90-day relief. In this scenario the country-specific "reciprocal" tariff rates are applied to all products covered by the executive order issued on April 2. This corresponds for instance to 20% for EU countries and 145% for China. However, pharmaceutical (HS3 2-digit: 30) products are still exempt. In the third scenario (S3 "Pharma") we assume that the exemption for pharmaceutical[7] products is lifted for each country. As we explained above, this seems likely given that an investigation on national security grounds has been launched in early April. All other assumptions are similar to S2.

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[6]   For more details see annex I: data and tariff mapping.

[7]   Note that a significant share of Europe's exposure to the US in terms of pharmaceuticals is via Ireland. A significant share of this exposure, as measured by the input-output tables, consists of royalty payments, which may be differently affected by the tariffs than typical goods trade. As we cannot address this issue within our methodological framework, the results of this analysis should be interpreted with caution.

Table 2

Simulated tariff increase in scenario

Scenario	Steel and aluminum	Automobiles and automobile parts	Pharmaceuticals	All other products (not exempt)
S1 "90 days"	EU 25% / CN 45%	EU 25% / CN 45%	-	April 2 base rate of 10% EU 10% / CN 30%
S2 "Liberation"	EU 25% / CN 45%	EU 25% / CN 45%	-	April 2 annex I "reciprocal" rates EU 20% / CN 145%
S3 "Pharma"	EU 25% / CN 45%	EU 25% / CN 45%	April 2 annex I "reciprocal" rates EU 20% / CN 145%	April 2 annex I "reciprocal" rates EU 20% / CN 145%

Source: Authors' draft.

We mapped the tariffs at a detailed product level to the similarly detailed bilateral trade data for 2023 and calculated the trade-weighted average tariffs by product group and country.[8] Table 3 shows the average tariff of the EU-27 for the ten product groups that make up the highest share in total exports to the US in 2023. With a share of nearly 20% of all EU-27 exports, pharmaceutical products are on top of the list. Since most of the products included in this group are exempt, additional tariffs are only marginal in scenarios S1 and S2 but increase by 20 percentage points (pp) in S3 as per scenario assumption. Mechanical machineries (HS3 chapter 84) and automobiles and automobile parts (HS3 87) follow with shares of 16% and 12% of total EU exports to the US, respectively. As expected, steel, aluminum, automobiles and automobile parts show the highest average tariff increases in all three scenarios.[9] At the bottom of the ten most important export product groups are beverages (HS3 22) and cosmetics (HS3 33). Since none of the products in these groups are exempt from the tariffs, their average tariff rates increase by exactly 10 (S1) and 20 (S2 and S3) pp, respectively.

Table 4 shows the average tariff increases for the ten EU countries for which, in terms of shares of total exports, the US is the largest export market. These country-wide tariff exposures depend on the export structure of the specific country. In scenario S1, the EU exports to the US are subject to tariff increases of around 10 pp. However, this masks substantial country heterogeneity with much smaller increases for Ireland (2.4 pp) and Denmark (6.2 pp) and much larger ones for Slovakia (23.5 pp) and Germany (13.4 pp). The lower tariffs for Ireland and Denmark reflect their large shares of exports of pharmaceutical products to the US. Lifting the exemption for those products in S3 would increase the average tariff on Irish as well as Danish products to the US by around 10 pp. This would particularly hit Ireland, since nearly a third of its goods exports are shipped to the US market. By contrast, Slovakia already faces a high tariff increase of 23.5 pp in our least severe scenario S1. Ending the 90-day relief or imposing additional tariffs on pharmaceuticals leaves the tariff increases nearly unchanged. This reflects the higher share of goods with higher tariff rates of 25% in Slovakian exports, with automobiles and automobile parts playing a particularly important role. We observe a similar pattern for Germany and Austria. These two countries also export noticeable amounts of steel and pharmaceutical products to the US.

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[8] For more details see annex I: data and tariff mapping.

[9] Since steel and aluminum tariffs may stack, the average tariff of HS3 87 is more than 25%.

Table 3

US import tariffs for selected EU industries[1]

| | HS3 code | Tariff increase (pp) in scenario … | | | Share of EU in total US imports of good j, % (2023) | Share of US in industry j's total exports, % (2023)[2] | Share of good j in total EU-exports to the US, % (2023) |
		S1 "90 days"	S2 "Liberation"	S3 "Pharma"			
Total		10.4	14.9	18.8	18.1	8.4	100.0
Pharmaceutical products	30	0.1	0.2	20.0	60.1	20.4	19.7
Nuclear reactors, boilers, machinery and mechanical appliances; parts thereof	84	14.0	21.1	21.1	19.5	10.5	16.3
Vehicles; other than railway or tramway rolling stock, and parts and accessories thereof	87	25.3	25.6	25.6	17.3	7.9	11.9
Electrical machinery and equipment and parts thereof; sound recorders and reproducers; television image and sound recorders and reproducers, parts and accessories of such articles	85	13.2	18.5	18.5	8.4	6.2	7.0
Optical, photographic, cinematographic, measuring, checking, medical or surgical instruments and apparatus; parts and accessories	90	10.4	20.1	20.1	28.2	14.8	6.1
Organic chemicals	29	0.9	1.7	1.7	45.0	16.8	5.1
Mineral fuels, mineral oils and products of their distillation; bituminous substances; mineral waxes	27	0.0	0.0	0.0	6.1	4.1	3.0
Aircraft, spacecraft and parts thereof	88	14.6	21.5	21.5	39.3	12.6	2.3
Beverages, spirits and vinegar	22	10.0	20.0	20.0	36.4	13.5	2.0
Essential oils and resinoids; perfumery, cosmetic or toilet preparations	33	10.0	20.0	20.0	54.3	11.7	1.9

1 Industries are sorted according to the share of exports in total exports to the US.
2 Total exports of industry j include intra- and extra-EU exports.

Source: Authors' calculations based on BACI data for 2023 (see Gaulier and Zignago, 2010), HTSUS, White House.

Table 4

US import tariffs for selected EU countries

| | Tariff increase (pp) in scenario … | | | Share of country i in total US imports (2023), % | Share of US in country i's total exports (2023)[1], % |
	S1 "90 days"	S2 "Liberation"	S3 "Pharma"		
EU-27	10.4	14.9	18.8	18.1	8.4
EA-20	10.2	14.7	18.6	16.0	9.1
Ireland	2.4	4.6	14.7	2.3	28.9
Finland	8.4	14.7	16.8	0.3	11.3
Italy	11.2	17.3	19.6	2.4	11.0
Denmark	6.2	10.5	19.5	0.4	10.3
Germany	13.4	17.6	20.4	5.2	10.0
Sweden	12.9	16.9	20.0	0.6	9.6
Austria	12.5	16.6	20.4	0.6	8.7
France	10.1	17.3	18.8	1.7	8.0
Portugal	8.4	12.5	16.9	0.2	7.7
Slovakia	23.5	24.5	24.5	0.3	7.2

1 EU-27 and EA-20 exports include both intra- and extra-EU-27 (EA-20) exports.

Source: Authors' calculations based on BACI data for 2023 (see Gaulier and Zignago, 2010), HTSUS, White House.

3 Method

We simulated the effects of the tariffs on Austria using a global input-output model which is based on the OECD's global input-output table for 2019.[10] The model comprises 77 regions (76 countries and the rest of the world) and 45 sectors / product groups according to the International Standard Industrial Classification of All Economic Activities (ISIC) Rev. 4 classification. It maps the interdependencies between the economic sectors of the countries by depicting national and international production networks, international trade in finished products and the value added resulting from production in a matrix structure. For each industry, in addition to the domestic intermediate input linkages, the imports flowing into domestic production are also included in detail by industry and country of origin. The model can be used to simulate the effects of demand shocks on the economic sectors in all countries.

3.1 Deriving the decrease in import demand using tariff elasticities

The global input-output model requires changes in final demand or intermediate inputs as simulation inputs. To translate the change in US tariffs to changes in US import demand we employ tariff elasticities. For example, a tariff elasticity of –0.5 means that a tariff increase of 1 pp leads to a reduction in import demand of 0.5 pp. In the empirical literature, the magnitude of elasticity estimates can differ substantially depending on the methods and data used and which countries and goods are covered. For illustration purposes, we cite two examples from the large literature. Devarajan et al. (2023) estimated elasticities of around –0.6 for developing and –1.4 for high-income countries. A survey of Schwarz et al. (2020) of 3,524 previous estimates found a median elasticity of –3.8 with a range from –2.5 to –5.1.

The elasticities we use are based on two sources. To cover the variation between product groups, we use the trade elasticities from Fontagné et al. (2022), which are available at the Harmonized System (HS) 3 (2007) subheadings (6-digit) product level (5,052 products).[11] They found substantial variation between products, ranging from –3.6 for highly differentiated products like footwear to –19 for standardized products like mineral products. Since the elasticities found by Fontagné et al. (2022) are rather large (Median of –5.6) – potentially reflecting long-term relationships – we use the aggregate elasticities estimated by Boehm et al. (2023) to cover the medium-term perspective (five years). Using a thorough identification strategy, they find a short-term (one year after the tariff increase) elasticity of –0.76. After five years, the elasticity increases to –1.24. Since we are interested in medium-term effects of the tariff increases, we scale the elasticities of Fontagné et al. (2022) to a (US trade-weighted) average of –1.24 (the five-year elasticity of Boehm et al., 2023). This gives us detailed elasticities at product level β_k:

$$\beta_k = (\varepsilon_k - 1)/\omega, \tag{1}$$

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[10]   See https://www.oecd.org/en/data/datasets/inter-country-input-output-tables.html.

[11]   Their estimates employ trade data from the BACI database and MAcMap-HS6 tariff data for a total of 5,052 product groups, 189 exporting, 152 importing countries and include the years 2001, 2004, 2207, 2010, 2013, 2016 and 2019.

with ε_k being the HS3 6-digit trade elasticity from the dataset of Fontagné et al. (2022) and ω being the scaling factor chosen so that the US import-weighted mean tariff elasticity equals –1.24. The distribution of the scaled elasticities is displayed in chart 1. Boehm et al. (2023) also estimated elasticities for a subset of aggregate HS chapters (2 digits). These include, among other items, plastics, wood, paper, textiles, metals and machinery. We may compare those elasticities for the medium term (five years) with the trade-weighted (US imports from EU-27) scaled versions of the Fontagné et al. (2022) elasticities we use in this analysis. Boehm et al. (2023) reported their estimated sector-specific elasticities only in a graph. This complicates a comparison. However, their estimates for the fifth year roughly vary between –0.2 and –4.0. Our scaled estimates for comparable HS chapters vary between –0.5 and –1.3, which is within the range of their results.

Chart 1

Distribution of tariff elasticities over 5,052 HS3 6-digit product categories

Scaled to -1.24, cut-off at -5
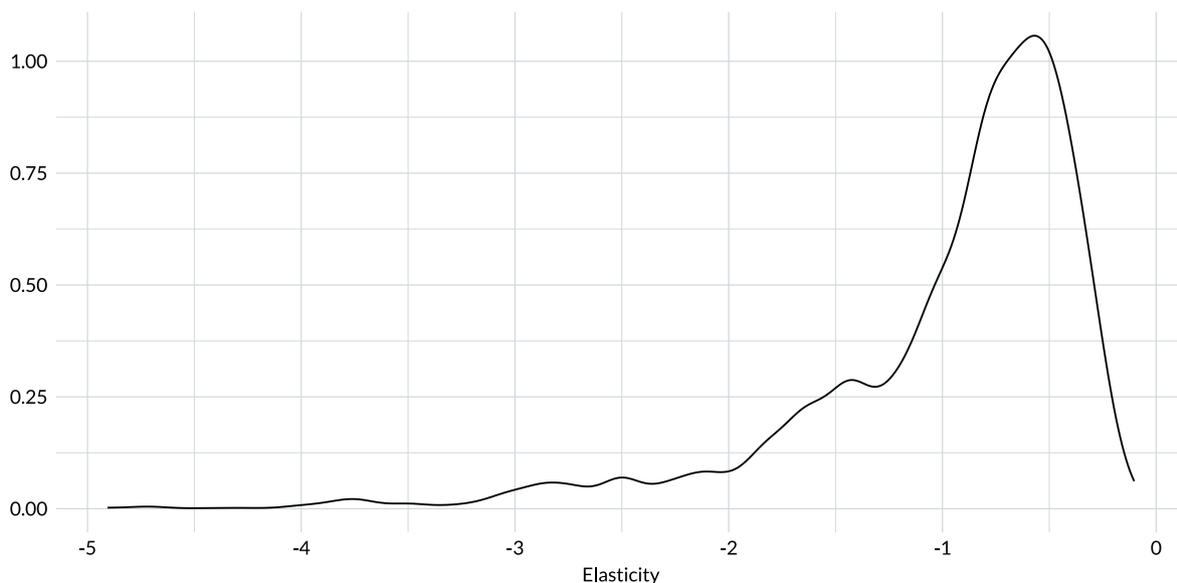
Source: Authors' calculations based on Fontagné et al. (2022).

To convert the increases in US tariffs into a reduction in US import demand, we first allocate the tariff increases to the 5,052 6-digit HS3 product groups of each exporter (for further details, see annex I: data and tariff mapping). We then calculate the percentage change in each tariff relative to its corresponding baseline tariff rate. Our baseline tariff rates stem from the latest MAcMap-HS6 tariff data (i.e. 2019), which matches the product classification of the trade and elasticity data we use. These data include the WTO most-favoured-nation (MFN) and preferential tariff rates but excludes tariffs imposed via special and temporary legislation such as the tariffs from Trump's first term. The tariff change multiplied by the tariff elasticities[12] gives the change in US import demand at the level of HS3 subheadings (6-digit) for each exporter. We then aggregate these impacts to the dimensions of our global input-output model (77 countries x 77 countries x 45 product groups) using mapping matrices (see annex I). Formally this is:

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[12] The tariff elasticity is calculated as $\beta = \varepsilon - 1$ with ε being the trade elasticity available from Fontagné et al. (2022).

$$\Delta \ln(X_{US,j,k}) = \beta_k \left[\ln(1 + \hat{\tau}_{US,j,k}) - \ln(1 + \tau_{US,j,k}) \right], \tag{2}$$

with $X_{US,j,k}$ being the US imports of trading partner j of HS3 6-digit subheadings k. The difference operator is given by Δ which yields the percentage change of US imports in equation (2). The initial (before the tariff increase) US import tariff rate with trading partner j and product group k is given by $\tau_{US,j,k}$. The new tariff rate – i.e. after the increase implied by the respective scenario– is given by $\hat{\tau}_{US,j,k}$.[13]

We assume that the exporters affected by the tariffs do not adjust their prices. Several empirical studies on the impact of tariffs during Trump's first term found evidence in favor of that assumption (see Fajgelbaum et al., 2020; Cavallo et al., 2021 or Amiti et al., 2019). As Amiti et al. (2019) note, however, this contrasts with studies on price reactions to exchange rate shocks or empirical estimates that imply rising export supply curves (Gopinath, et al., 2010; Broda et al., 2008). One of the reasons for the lack of transmission cited by Amiti et al. (2019) is that Trump's tariffs may not be perceived as permanent measures by exporters due to the high level of uncertainty (his erratic trade policy). In such a case, it would be difficult for exporters to increase previously lowered prices if the tariffs are lifted. As trade policy in Donald Trump's second term is similarly erratic and characterized by even greater uncertainty (as measured, for example, by the Trade Policy Uncertainty Index), we do not assume a strong reaction in export prices this time either and therefore assume a full transmission to US import prices. However, it should be noted that the higher tariff rate increases of Trump's second term could very well have impacts on export prices, especially if strong non-linearities are present.

3.2 Simulating the impacts of the US tariff increases with a global input-output model

Imports before and after the tariff increase for each exporter and product group are mapped from the HS3 6-digit product group level to the ISIC Rev. 4 industry classification (see annex I: data and tariff mapping). The change in US imports[14] at this level is then used in the global input-output model to simulate the direct and indirect impacts on value added.

In our global input-output model, simulating a demand shock involves quantifying how changes in final demand propagate through the world economy's interconnected industries. The Leontief inverse matrix $L = (I - \theta)^{-1}$, where θ is the matrix of technical coefficients, plays a central role. θ is derived by dividing intermediate inputs per industry and country by the output of industry i in country j. When a demand shock $\epsilon = (\epsilon_1, \dots, \epsilon_s)$ hits the final demand vector d, the resulting change in sectoral outputs is calculated as $\Delta x = L\epsilon$. In our global input-output model, the final demand vector has the dimension 3,465 (=77 countries x 45 goods). This framework allows us to trace cascading impacts of reduced US imports across the global production network.

Note that the global input-output model delivers the impacts of the tariff increases from a comparative static perspective. As such, these impacts do not have a specific time span (short, medium, long) or development path attached to them. However, one could argue that it takes some time for the tariff

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[13] Note that using this formula, there will be minor inaccuracies if we start from an approximate baseline tariff level, since the percentage change in the tariff rate (which is used in the formula) does not equal the change in the tariff rate in percentage points.

[14] Note that we did not simulate the impacts of the direct import change for services industries. The trade recorded in the OECD input-output tables for these industries will be mostly trade in services. But our direct import change is derived from trade data on goods only. Applying the goods import change to a service industry would thus overestimate the impacts of the tariffs.

impacts to feed through the entire production network, which we simulate by employing the Leontief inverse matrix. Because of that and since we are scaling the tariff elasticities to impacts after five years (as explained above), we would argue that our results represent medium-term effects.[15]

4 Results

Chart 2 gives an overview of the results of all three scenarios for the most affected industries and countries. The bars for scenario S1 show the change of value added relative to the baseline in %, the stacked bars for scenarios S2 and S3 show the additional impact relative to S1 (S2) in the medium term, i.e. after five years. In scenario S1 ("90 days": with 25% tariffs on steel, aluminum, automobiles and automobile parts from the EU), real GDP in the EU and the euro area decreases by 0.20% (see the right panel of chart 2). The countries with the strongest declines are Ireland, Denmark, Belgium, Germany and Slovakia.

In scenario S2 ("Liberation": with additional tariffs of 10% for all other goods from the EU that are not exempt), the additional GDP loss (EU: –0.08 pp) is relatively small compared to scenario S1. The size of the additional impact on the EU's GDP in scenario S3 ("Pharma": with additional tariffs of 20% on pharmaceutical exports from the EU) is very similar to the impact in the first scenario (–0.19 pp).

Chart 2

Impact of US import tariff increases on Europe: main results for scenarios S1 to S3

EU-27 industries
Change in real value added, %

Countries
Change in real value added, %
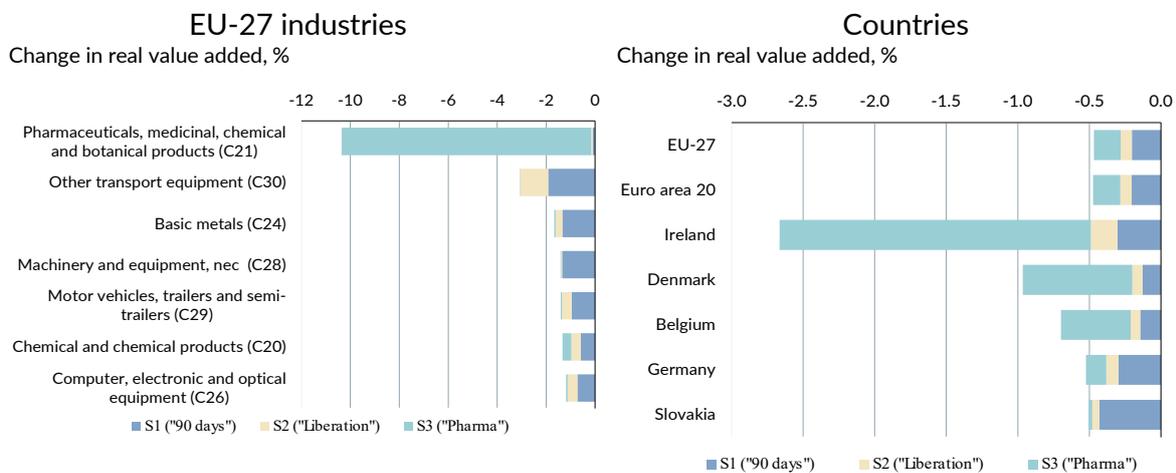
Source: Authors' calculations.
Note: For scenario S2 (S3), the bars represent the additional impact relative to scenario S1 (S2).

In the following, we will focus on the discussion of the results of the most encompassing scenario S3. For more detailed results of S1 and S2, consult annex II: detailed results in tables. The US tariff increases cover a wide range of industries, with manufacture of pharmaceutical products (C21) being hit particularly hard with a decline of value added of 10.4% in the EU. The US is the single largest export

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[15] Nevertheless, our results are subject to a series of caveats that we discuss in detail in the concluding section.

market for pharmaceutical products from the EU. These products accounted for around 20% of all EU exports to the US in 2023. In 17 out of the 27 EU countries, this industry shows the highest relative losses in value added, with Ireland (−21.2%), Denmark (−15.2%) and Belgium (−10.1%) being hit hardest (see table 5). The second most affected industry is manufacture of other transport equipment (C30), which encompasses the production of a wide range of vehicles and equipment used for transportation, excluding motor vehicles, trailers, and semi-trailers (which are covered under NACE C29). Value added in this industry falls by 3.1% in the EU, with Poland (−5.7%), France (−4.7%) and Latvia (−3.5%) being most severely affected. The third highest loss of value added for the EU (−1.7%) we find for basic metals (C24), with Greece, Ireland and Sweden being hit hardest.

Table 5

Impact of US import tariffs on the EU: ten most affected industries and five most affected countries per industry for scenario S3 ("Pharma")

ISIC Rev. 4 industries	EU-27	EA-20	5 most affected countries per industry (code | value added, %)								
C21: Pharmaceuticals, medicinal chemical and botanical products	−10.4	−10.6	IE	−21.2	DK	−15.2	BE	−10.1	DE	−7.1	NL	−6.9
C30: Other transport equipment	−3.1	−3.1	PL	−5.7	FR	−4.7	LV	−3.5	IT	−3.4	SE	−2.9
C24: Basic metals	−1.7	−1.7	GR	−2.9	IE	−2.5	SE	−2.5	LU	−2.3	AT	−2.1
C29: Motor vehicles, trailers and semi-trailers	−1.4	−1.5	SK	−2.9	AT	−2.4	FI	−2.1	SE	−1.9	HU	−1.8
C28: Machinery and equipment, n.e.c.	−1.4	−1.4	IE	−2.5	HU	−1.7	FR	−1.5	DE	−1.5	IT	−1.4
C20: Chemical and chemical products	−1.3	−1.4	DK	−2.5	NL	−1.8	IE	−1.6	SE	−1.5	BE	−1.4
C26: Computer, electronic and optical equipment	−1.2	−1.2	EE	−2.5	IE	−1.7	HU	−1.4	DK	−1.4	FR	−1.3
A03: Fishing and aquaculture	−1.1	−1.1	CY	−5.1	IE	−3.8	GR	−3.2	CZ	−1.8	ES	−1.5
C27: Electrical equipment	−1.0	−1.0	HU	−1.3	IE	−1.3	EE	−1.2	FI	−1.1	DE	−1.1
B07_08: Mining and quarrying, non-energy producing products	−1.0	−0.8	SE	−2.1	IE	−1.9	LU	−1.2	AT	−1.0	DE	−1.0

Source: Authors' calculations.
Note: AT: Austria, BE: Belgium, CY: Cyprus, CZ: Czechia, DE: Germany, DK: Denmark, ES: Spain, EE: Estonia, FI: Finland, FR: France, GR: Greece, HU: Hungary, IE: Ireland, IT: Italy, LU: Luxembourg, LV: Latvia, MT: NL: Netherlands, PL: Poland, SE: Sweden.

Looking at the impacts on different countries, there is one country that stands out in terms of GDP losses (see table 6). If all US import tariffs of scenario S3 will materialize, the GDP of Ireland could decline by 2.7%. This is mainly due to the important role of pharmaceutical exports to the US, but also to a high exposure in other relevant industries (repair and installation of machinery and equipment (C31–33), fishing and agriculture (A03) and manufacture of basic metals (C24)). The second most affected country is Denmark, with a GDP loss of 1.0%, driven by substantial declines in manufacture of pharmaceuticals (C21) and losses in manufacture of chemicals (C20), and fishing and agriculture (A03). The GDP of Belgium could decline by 0.7%, mainly due to manufacture of pharmaceuticals (C21), mining support activities (B09) and manufacture of vehicles (C30). Germany ranks fourth among the most affected EU countries.

Table 6

Impact of US import tariffs on the EU: ten most affected countries and five most affected industries per country for scenario S3 ("Pharma")

	GDP change, %	5 most affected industries per country (code | change of value added, %)								
EU-27	–0.5	C21	–10.4	C30	–3.1	C24	–1.7	C29	–1.4	C28	–1.4
Euro area 20	–0.5	C21	–10.6	C30	–3.1	C24	–1.7	C29	–1.5	C28	–1.4
Ireland	–2.7	C21	–21.2	C31_33	–4.3	A03	–3.8	C24	–2.5	C28	–2.5
Denmark	–1.0	C21	–15.2	C20	–2.5	A03	–1.4	C26	–1.4	C22	–1.3
Belgium	–0.7	C21	–10.1	B09	–2.7	C30	–2.3	C20	–1.4	C24	–1.4
Germany	–0.5	C21	–7.1	C30	–1.9	C24	–1.7	C29	–1.6	C28	–1.5
Slovakia	–0.5	C29	–2.9	C22	–1.6	C21	–1.2	C25	–1.2	C24	–1.2
Netherlands	–0.5	C21	–6.9	J58_60	–1.9	C20	–1.8	B09	–1.6	A03	–1.4
Sweden	–0.5	C21	–4.5	C30	–2.9	C24	–2.5	B07_08	–2.1	C29	–1.9
Slovenia	–0.4	C21	–3.3	C30	–2.5	C24	–2.0	C27	–0.8	C28	–0.8
Austria	–0.4	C21	–5.0	C29	–2.4	C24	–2.1	C30	–1.8	C28	–1.4
Hungary	–0.4	C29	–1.8	C28	–1.7	C26	–1.4	C27	–1.3	B09	–1.3

Source: Authors' calculations.
Note: A03: Fishing and aquaculture, B07_08: Mining and quarrying, non-energy producing products, B09: Mining support service activities, C20: Chemical and chemical products, C21: Pharmaceuticals, medicinal chemical and botanical products, C22: Rubber and plastics products, C24: Basic metals, C25: Fabricated metal products, C26: Computer, electronic and optical equipment, C27: Electrical equipment, C28: Machinery and equipment, n.e.c., C29: Motor vehicles, trailers and semi-trailers, C30: Other transport equipment, C31_33: Manufacturing n.e.c.; repair and installation of machinery and equipment, J58_60: Publishing, audiovisual and broadcasting activities.

5   Does the use of the global input-output table from 2019 distort our results?

Our calculations are based on the OECD global input-output table from 2019. Since then, the trade relations of some European industries with the US underwent significant changes. Total exports of goods of the EU to the US in nominal terms increased by 38%. The share of the US in extra-EU exports rose from 18% to 21%. For pharmaceutical products, the increase of EU exports into the US amounts to 85%. This implies that our global input-output model underestimates the impact of the tariffs for industries and countries where the role of the US as export market increased. In order to assess the relevance of these changes, we compare for each EU country *j* the ratio of exports of good *i* to the US, relative to the output of the industry *i* that produces this good for the years 2019 and 2024.[16] An increase of the exports to US-to-turnover ratio indicates that the impact of the US tariffs on this industry is larger than the result of the global input-output model suggests.

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[16]   We took the trade data from the Comext database. Since national account data for output have significant data gaps, we use the turnover index (of Eurostat's short-term business statistics *sts_intv_a*) which has a better coverage.

Chart 3 shows the changes of this ratio for the six most affected industries for those EU countries where data are available. For the EU and the euro area, the ratio changes are modest for most industries / goods. For manufacture of transport equipment (C30), the role of exports to the US has declined by 12% for the EU. For the five other most affected industries, the ratio increased by about 10–20%.

Chart 3

Change of the ratio of exports to US to turnover for six EU industries from 2019 to 2024

%
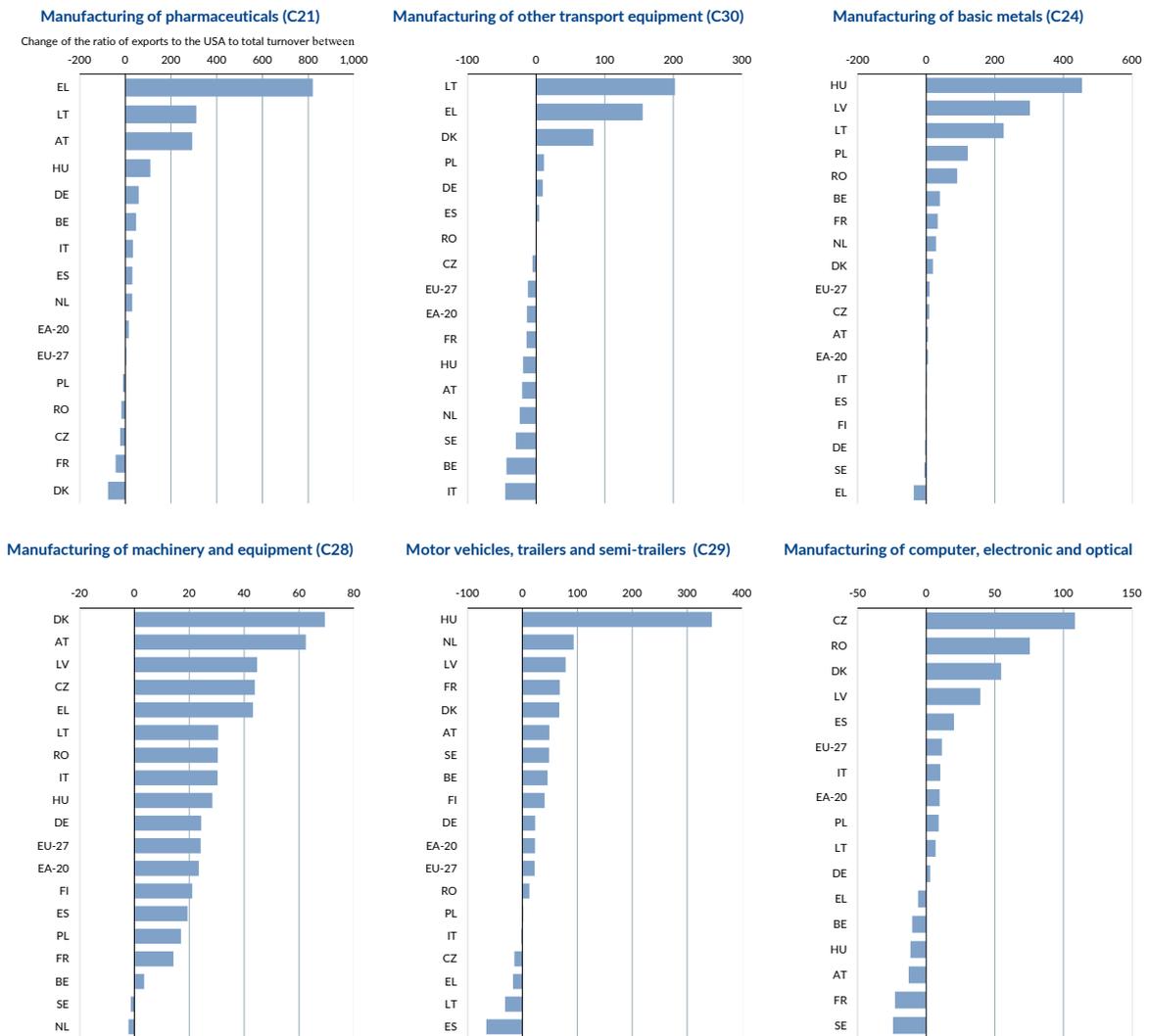
Source: Authors' calculations.

This increase does, however, not imply that the actual impact on the particular industry is 10–20% above our results. It only means that the direct exposure to the US and hence the potential direct effect is higher by this amount. However, the total impacts also contain the indirect exposures via production linkages with industries of countries outside the EU. For countries with strong downstream linkages in

international production networks these indirect effects play a stronger role.[17] Depending on how the ratios of exports to US to turnover have changed in non-EU countries since 2019, this may either increase or decrease the bias of the total impact.[18]

The industry where the direct role of exports to the US increased most is manufacture of machinery and equipment (C28). For the EU the export-to-turnover ratio increased by 24%. Five countries show an increase of more than 40% (Denmark, Austria, Latvia, Czechia and Greece, see chart 3). For manufacture of pharmaceutical products (C21), the informational content of the chart is limited for at least two reasons. The first is that Ireland – the country which is affected most strongly by the US tariffs for these goods – publishes no data for turnover in this industry. The second reason is that the regional export data for Denmark (which, for instance, exports the successful drug Ozempic to the US) were re-classified over time. Data from the Comext database on international trade in goods show a decline of 95% of exports to the US in 2017 compared to the previous year. In December 2017, the drug Ozempic was approved in the US. At the same time, exports classified under the region code QZ (countries and territories not specified for commercial or military reasons in the framework of trade with third countries) increased tenfold.[19] These likely contain exports to the US. The high growth rate for Greece's exports of pharmaceutical products (+820%) is mainly due to low exports to the US in 2019 and, consequently, a low impact of US tariffs on this industry in Greece.

For manufacture of other transport equipment (C30), the role of the US as export destination country fell between 2019 and 2024. This is especially the case for Italy, Belgium, Sweden, the Netherlands and Austria. For the other three of the six most affected industries, the exports to US-to-turnover ratio increased by 10 to 20% for the EU, indicating no significant underestimation of the effects due to the use of the global input-output tables from 2019.

6 Summary and discussion

The main result of our study is that there is strong heterogeneity regarding the impacts of US tariffs on different European industries. To our knowledge, we are the first to investigate the effects in such detail, i.e. at product- / industry-level. The aggregate results of our study for the EU – although not accurately comparable due to different scenario assumptions and underlying models – are in line with recent studies from Bruegel, the Kiel Institute for the World Economy and the European Commission (Barata de Rocha et al. (2025), Hinz et al. (2025) and European Commission (2025)). For Austria, our results are close to current estimates provided by WIFO und the Institute for Advances Studies, which found short-term effects on Austrian GDP (i.e. within one year) of −0.35% (WIFO) and −0.20% (IAS). Both estimates are consistent with our medium-term effects of −0.5%.[20]

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[17] Calculations for Austria have shown that 58% of the decline in GDP because of the tariffs are due to direct linkages and 42% to indirect effects via third countries.

[18] We have not computed the development of these ratios for countries outside the EU since only EU countries are covered by the two Eurostat databases we use.

[19] Not only the region code QZ (secret destination in extra-EU) but also QY (secret destination in intra-EU) plays an important role for many export products (gas, pharmaceuticals, chemicals, fertilizers, a.o.) in Denmark. In Finland, the Netherlands and Sweden, secret destinations also play an important role.

[20] Both institutes based their estimates on the KITE Model Suite from the Kiel Institute for the World Economy (IfW Kiel). The KITE model is a global model combining a Ricardian trade model with a multisectoral economic structure and input-output linkages.

While our global input-output approach offers valuable insights, several limitations should be considered: It assumes constant input-output relationships, does not capture adjustments in prices or general equilibrium effects[21] and omits potential effects from retaliatory tariffs or wider economic feedback mechanisms (i.e. on commodity prices). Potential production relocations and the impacts of heightened policy uncertainty[22] on investment and household consumption are not comprehensively addressed. Finally, the additional turmoil in global financial markets could significantly exacerbate the downturn, increasing the likelihood of a global recession. Given all of these considerations, we take our model results to lie at the lower end of the expected impact range.

Despite these caveats, there are some important policy conclusions that can be drawn from our analysis. For the EU as a whole, the negative impact is not negligible but manageable. However, certain industries (especially, manufacture of pharmaceuticals and transport equipment) might suffer considerably. In the short term, ongoing diplomatic initiatives to address trade disputes and to negotiate potential tariff reductions are essential for curbing further escalation dynamics. Furthermore, providing targeted support to highly exposed industries might be necessary. In the medium term, the EU should strengthen its efforts to diversify export markets, to reduce reliance on the US and to increase resilience against unilateral tariffs. In addition, enhancing integration of the EU internal market and improving the resilience of European supply chains can help cushion the effects of external trade shocks. These policy recommendations can help mitigate the negative ramifications of US tariffs and promote sustainable economic growth in the EU.

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[21] This could be done, for instance, by embedding our analysis into a dynamic multi-sector, multi-country general equilibrium model as in Quintana (2024). The development of such a model is beyond the scope of this paper.

[22] Under such conditions, companies typically restrain investments and households reduce consumption (see Baker et al., 2016; Caldara et al., 2020; Coibion et al., 2024). Deutsche Bank (DB Research 2025) estimated an additional growth-dampening effect on the euro area of 0.2 to 0.5 pp from those channels.

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8   Annex I: data and tariff mapping

As a data source for bilateral trade data, we use the BACI dataset for the year 2023 at HS3/2007 classification (see Gaulier and Zignago, 2010). This dataset covers 238 countries. As a starting point for the simulation of tariff increases, we take the ad-valorem MFN tariff rates at HS 6-digit level for 2019 contained in the Market Access Map HS6 dataset (see Guimbard et al., 2012) for 152 importing and 189 exporting countries.[23] The trade elasticities available at HS3 6-digit level are taken from the replication files of Fontagné, Guimbard and Orefice (2022).[24] As there is no tariff data on Taiwan available and the BACI data on trade[25] only contains the approximate category "Asia, not elsewhere specified (iso 490)," we subsumed Taiwan under the category "rest of the world."

The mapping of the HS3 (2007) subheadings (6-digit) import flows to the ISIC Rev. 4 classification, used in the global ICIO input-output table (see OECD, 2023), was carried out in two steps. First, the 6-digit was mapped to ISIC Rev. 3 2-digit level using the R-package "concordance" (see Liao et al., 2020). The resulting ISIC Rev. 3 2-digits were then mapped by the authors to the ISIC Rev. 4 aggregates of the ICIO IO table (for a list of the ICIO ISIC Rev. 4 industries, see table A-6). The products of the HS3 2-digit code of the pharmaceutical products were considered separately (under a newly created heading 24a, see table A-7), as they would otherwise have been assigned to an ISIC Rev. 3 2-digit code together with chemical products (24).

Tariffs in the US are recorded in the Harmonized Tariff Schedule (HTS) of the United States International Trade Commission (USITC) at detailed 8-digit HS product level. For example, 52042000 would correspond to cotton threads. Tariffs are imposed or exempt at this level. Given this level of detail in the tariff schedules and because usually not all products in an industry are affected by the tariffs of an executive order, a more detailed product group-specific recording of the impact of tariff increases is advised.

For the classification, we used the tariff schedule 2025 HTS Revision 12 (05/13/2025), which was the latest available schedule at the cut-off date (May 12) of the analysis.[26] For each product at HS 8-digit level, it is possible to look up which duty applies to which country. However, we record the tariffs' impact on the products at the HS 6-digit level, as our supplementary foreign trade, tariff and tariff elasticity data are also available at this level.[27] For example, the HS subheading 840734 stands for the vehicle component "Engines; reciprocating piston engines, of a kind used for the propulsion of vehicles of chapter 87, of a cylinder capacity exceeding 1000cc."

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[23]   This database does not include the tariffs outside the WTO framework. Thus, tariffs from Trump's first term in office and those imposed by President Biden, which are recorded under special and temporary legislation in section 22 chapter 99 of the US HTS, are not included.

[24]   See Tariff-Based Product-Level Trade Elasticities – Mendeley Data. We replaced positive, insignificant and missing elasticities with the mean of the next higher aggregation level.

[25]   The BACI database is based on UN COMTRADE and the UN does not provide trade data for Taiwan.

[26]   See Harmonized Tariff Schedule. The tariffs of the executive orders and proclamations go beyond the MFN tariffs of the WTO framework and are thus contained in the notes and tables of chapter 99, subchapter III.

[27]   We re-classified the tariffs recorded in the tariff schedules in the HS6 (2022) revision to the HS3 (the classification of our supplementary data) revision using the R package "concordance" (see Liao et al., 2020).

9 Annex II: detailed results in tables

Table A-1

US import tariffs for the EU and its member states

| | Tariffs (%) in scenario … | | | Share of country i in total US imports (2023), % | Share of US in country i's total exports (2023), % |
	S1 ("90 days")	S2 ("Liberation")	S3 ("Pharma")		
EU-27	10.4	14.9	18.8	18.1	8.4
EA-20	10.2	14.7	18.6	16.0	9.1
Austria	12.5	16.6	20.4	0.6	8.7
Belgium	7.7	11.1	17.5	0.8	5.2
Bulgaria	10.7	17.4	17.8	0.1	3.0
Croatia	7.4	12.8	19.3	0.0	3.9
Cyprus	10.1	19.9	19.9	0.0	2.6
Czechia	14.0	19.5	20.1	0.2	3.1
Denmark	6.2	10.5	19.5	0.4	10.3
Estonia	9.9	15.3	15.3	0.0	3.9
Finland	8.4	14.7	16.8	0.3	11.3
France	10.1	17.3	18.8	1.7	8.0
Germany	13.4	17.6	20.4	5.2	10.0
Greece	11.4	18.7	19.0	0.1	3.9
Hungary	14.1	16.8	21.8	0.3	6.5
Ireland	2.4	4.6	14.7	2.3	28.9
Italy	11.2	17.3	19.6	2.4	11.0
Latvia	8.5	14.0	14.0	0.0	3.1
Lithuania	7.2	11.7	12.0	0.1	5.3
Luxembourg	17.5	22.1	22.1	0.0	3.5
Malta	7.0	10.0	10.6	0.0	2.4
Netherlands	7.1	10.6	16.7	1.1	5.5
Poland	13.5	20.6	20.6	0.4	3.7
Portugal	8.4	12.5	16.9	0.2	7.7
Romania	15.3	19.9	20.7	0.1	3.7
Slovakia	23.5	24.5	24.5	0.3	7.2
Slovenia	13.4	18.8	20.6	0.0	1.8
Spain	9.9	15.4	17.6	0.8	5.7
Sweden	12.9	16.9	20.0	0.6	9.6

Source: Authors' own calculations based on BACI data for 2023 (see Gaulier and Zignago, 2010), HTSUS, White House.

Table A-2

US import tariffs for the industries of the EU (1/2)

	HS3 code	Tariffs (%) in scenario …			Share of EU in total US imports of good j (2023), %	Share of US in industry j's total exports (2023), %	Share of good j in total EU-exports to the US (2023), %
		S1 ("90 days")	S2 ("Liberation")	S3 ("Pharma")			
Total		10.4	14.9	18.8	18.1	8.4	100.0
Pharmaceutical products	30	0.1	0.2	20.0	60.1	20.4	19.7
Nuclear reactors, boilers, machinery and mechanical appliances; parts thereof	84	14.0	21.1	21.1	19.5	10.5	16.3
Vehicles; other than railway or tramway rolling stock, and parts and accessories thereof	87	25.3	25.6	25.6	17.3	7.9	11.9
Electrical machinery and equipment and parts thereof; sound recorders and reproducers; television image and sound recorders and reproducers, parts and accessories of such articles	85	13.2	18.5	18.5	8.4	6.2	7.0
Optical, photographic, cinematographic, measuring, checking, medical or surgical instruments and apparatus; parts and accessories	90	10.4	20.1	20.1	28.2	14.8	6.1
Organic chemicals	29	0.9	1.7	1.7	45.0	16.8	5.1
Mineral fuels, mineral oils and products of their distillation; bituminous substances; mineral waxes	27	0.0	0.0	0.0	6.1	4.1	3.0
Aircraft, spacecraft and parts thereof	88	14.6	21.5	21.5	39.3	12.6	2.3
Beverages, spirits and vinegar	22	10.0	20.0	20.0	36.4	13.5	2.0
Essential oils and resinoids; perfumery, cosmetic or toilet preparations	33	10.0	20.0	20.0	54.3	11.7	1.9
Natural, cultured pearls; precious, semi-precious stones; precious metals, metals clad with precious metal, and articles thereof; imitation jewellery; coin	71	6.7	13.3	13.3	13.5	10.4	1.9
Plastics and articles thereof	39	7.5	15.0	15.0	13.1	3.8	1.7
Iron or steel articles	73	24.8	24.9	24.9	16.6	6.7	1.6
Chemical products n.e.c.	38	6.1	12.2	12.2	32.2	7.2	1.5
Ships, boats and floating structures	89	10.0	20.0	20.0	69.3	20.8	1.2
Furniture; bedding, mattresses, mattress supports, cushions and similar stuffed furnishings; lamps and lighting fittings, n.e.c.; illuminated signs, illuminated name-plates and the like; prefabricated buildings	94	16.6	23.4	23.4	8.5	6.5	1.1
Iron and steel	72	23.3	24.1	24.1	17.1	3.6	1.0
Rubber and articles thereof	40	18.7	22.9	22.9	13.9	6.7	0.9
Inorganic chemicals; organic and inorganic compounds of precious metals; of rare earth metals, of radio-active elements and of isotopes	28	2.3	4.6	4.6	23.3	9.5	0.7
Paper and paperboard; articles of paper pulp, of paper or paperboard	48	10.0	20.0	20.0	18.2	3.9	0.7
Works of art; collectors' pieces and antiques	97	10.0	20.0	20.0	51.6	42.0	0.7
Articles of leather; saddlery and harness; travel goods, handbags and similar containers; articles of animal gut (other than silk-worm gut)	42	10.0	20.0	20.0	24.2	9.2	0.6
Footwear; gaiters and the like; parts of such articles	64	10.0	20.0	20.0	12.6	7.0	0.6
Wood and articles of wood; wood charcoal	44	2.4	4.7	4.7	12.9	5.1	0.6
Preparations of cereals, flour, starch or milk; pastrycooks' products	19	10.0	20.0	20.0	17.3	4.4	0.5
Aluminium and articles thereof	76	24.5	24.8	24.8	8.9	3.4	0.5
Apparel and clothing accessories; not knitted or crocheted	62	10.0	20.0	20.0	6.3	4.4	0.4
Preparations of vegetables, fruit, nuts or other parts of plants	20	10.0	20.0	20.0	16.6	6.0	0.4
Tools, implements, cutlery, spoons and forks, of base metal; parts thereof, of base metal	82	10.0	20.0	20.0	20.3	9.4	0.4
Animal or vegetable fats and oils and their cleavage products; prepared animal fats; animal or vegetable waxes	15	10.0	20.0	20.0	13.9	5.4	0.4
Ceramic products	69	10.0	20.0	20.0	30.2	10.3	0.4
Arms and ammunition; parts and accessories thereof	93	10.0	20.0	20.0	46.1	21.9	0.4
Stone, plaster, cement, asbestos, mica or similar materials; articles thereof	68	10.0	20.0	20.0	20.4	8.7	0.4
Dairy produce; birds' eggs; natural honey; edible products of animal origin, not elsewhere specified or included	04	10.0	20.0	20.0	48.3	2.7	0.4
Glass and glassware	70	10.3	20.1	20.1	20.6	5.8	0.3
Miscellaneous edible preparations	21	10.0	20.0	20.0	15.1	4.0	0.3
Albuminoidal substances; modified starches; glues; enzymes	35	10.0	20.0	20.0	43.0	8.6	0.3
Copper and articles thereof	74	0.0	0.0	0.0	10.6	2.8	0.3
Metal; miscellaneous products of base metal	83	19.5	23.2	23.2	10.1	4.9	0.3
Tanning or dyeing extracts; tannins and their derivatives; dyes, pigments and other colouring matter; paints, varnishes; putty, other mastics; inks	32	7.6	15.1	15.1	29.7	4.1	0.3
Fish and crustaceans, molluscs and other aquatic invertebrates	03	10.0	20.0	20.0	6.5	4.9	0.2
Cocoa and cocoa preparations	18	10.0	20.0	20.0	19.7	4.0	0.2
Toys, games and sports requisites; parts and accessories thereof	95	15.2	21.7	21.7	2.8	4.5	0.2
Apparel and clothing accessories; knitted or crocheted	61	10.0	20.0	20.0	2.4	2.4	0.2
Soap, organic surface-active agents; washing, lubricating, polishing or scouring preparations; artificial or prepared waxes, candles and similar articles, modelling pastes, dental waxes and dental preparations with a basis of plaster	34	9.1	18.2	18.2	18.6	3.0	0.2
Nickel and articles thereof	75	9.0	18.1	18.1	20.0	9.5	0.2
Metals; n.e.c., cermets and articles thereof	81	2.5	5.1	5.1	22.6	15.7	0.2
Sugars and sugar confectionery	17	10.0	20.0	20.0	10.2	3.7	0.1

Source: Authors' calculations based on BACI data for 2023 (see Gaulier and Zignago, 2010), HTSUS, White House.

Table A-2

US import tariffs for the industries of the EU (2/2)

	HS3 code	Tariffs (%) in scenario ...			Share of EU in total US imports of good j (2023), %	Share of US in industry j's total exports (2023), %	Share of good j in total EU-exports to the US (2023), %
		S1 ("90 days")	S2 ("Liberation")	S3 ("Pharma")			
Wadding, felt and nonwovens, special yarns; twine, cordage, ropes and cables and articles thereof	56	10.0	20.0	20.0	24.0	6.3	0.1
Salt; sulphur; earths, stone; plastering materials, lime and cement	25	9.6	19.1	19.1	11.5	4.6	0.1
Animals; live	01	10.0	20.0	20.0	15.4	4.0	0.1
Products of the milling industry; malt, starches, inulin, wheat gluten	11	10.0	20.0	20.0	20.8	4.8	0.1
Printed books, newspapers, pictures and other products of the printing industry; manuscripts, typescripts and plans	49	1.9	3.7	3.7	11.5	4.2	0.1
Meat and edible meat offal	02	10.0	20.0	20.0	4.4	0.9	0.1
Coffee, tea, mate and spices	09	10.0	20.0	20.0	5.3	3.9	0.1
Miscellaneous manufactured articles	96	10.9	20.3	20.3	8.4	5.4	0.1
Railway, tramway locomotives, rolling-stock and parts thereof; railway or tramway track fixtures and fittings and parts thereof; mechanical (including electro-mechanical) traffic signalling equipment of all kinds	86	10.0	20.0	20.0	16.6	3.0	0.1
Food industries, residues and wastes thereof; prepared animal fodder	23	10.0	20.0	20.0	10.0	1.4	0.1
Meat, fish or crustaceans, molluscs or other aquatic invertebrates; preparations thereof	16	10.0	20.0	20.0	7.2	2.2	0.1
Textile fabrics; impregnated, coated, covered or laminated; textile articles of a kind suitable for industrial use	59	10.0	20.0	20.0	18.1	6.1	0.1
Vegetables and certain roots and tubers; edible	07	10.0	20.0	20.0	3.1	1.4	0.1
Textiles, made up articles; sets; worn clothing and worn textile articles; rags	63	10.0	20.0	20.0	2.7	3.7	0.1
Lac; gums, resins and other vegetable saps and extracts	13	10.0	20.0	20.0	29.0	13.6	0.1
Oil seeds and oleaginous fruits; miscellaneous grains, seeds and fruit, industrial or medicinal plants; straw and fodder	12	10.0	20.0	20.0	14.1	2.5	0.1
Fertilizers	31	7.0	13.9	13.9	3.8	2.3	0.1
Photographic or cinematographic goods	37	10.0	20.0	20.0	25.7	11.9	0.1
Man-made filaments; strip and the like of man-made textile materials	54	10.0	20.0	20.0	17.4	4.4	0.1
Man-made staple fibres	55	10.0	20.0	20.0	19.9	4.6	0.1
Pulp of wood or other fibrous cellulosic material; recovered (waste and scrap) paper or paperboard	47	10.0	20.0	20.0	8.6	2.1	0.1
Trees and other plants, live; bulbs, roots and the like; cut flowers and ornamental foliage	06	10.0	20.0	20.0	9.1	2.0	0.1
Explosives; pyrotechnic products; matches; pyrophoric alloys; certain combustible preparations	36	9.7	19.5	19.5	25.0	13.3	0.1
Cork and articles of cork	45	10.0	20.0	20.0	91.0	14.3	0.1
Raw hides and skins (other than furskins) and leather	41	10.0	20.0	20.0	41.3	3.4	0.0
Musical instruments; parts and accessories of such articles	92	10.0	20.0	20.0	13.9	12.5	0.0
Clocks and watches and parts thereof	91	10.0	20.0	20.0	3.2	3.1	0.0
Cereals	10	10.0	20.0	20.0	6.0	0.6	0.0
Carpets and other textile floor coverings	57	10.0	20.0	20.0	5.9	4.7	0.0
Animal originated products; not elsewhere specified or included	05	10.0	19.9	19.9	16.9	4.6	0.0
Fruit and nuts, edible; peel of citrus fruit or melons	08	10.0	20.0	20.0	0.8	0.6	0.0
Headgear and parts thereof	65	10.0	20.0	20.0	4.8	5.0	0.0
Fabrics; knitted or crocheted	60	10.0	20.0	20.0	14.1	3.9	0.0
Zinc and articles thereof	79	8.0	15.9	15.9	4.5	1.7	0.0
Fabrics; special woven fabrics, tufted textile fabrics, lace, tapestries, trimmings, embroidery	58	10.0	20.0	20.0	12.5	4.6	0.0
Tobacco and manufactured tobacco substitutes	24	10.0	20.0	20.0	4.3	0.4	0.0
Ores, slag and ash	26	8.1	16.1	16.1	3.1	0.7	0.0
Cotton	52	10.0	20.0	20.0	11.4	2.2	0.0
Wool, fine or coarse animal hair; horsehair yarn and woven fabric	51	10.0	20.0	20.0	33.0	2.0	0.0
Vegetable textile fibres; paper yarn and woven fabrics of paper yarn	53	10.0	20.0	20.0	33.9	4.0	0.0
Tin; articles thereof	80	0.3	0.6	0.6	8.5	5.7	0.0
Furskins and artificial fur; manufactures thereof	43	10.0	20.0	20.0	36.1	3.9	0.0
Feathers and down, prepared; and articles made of feather or of down; artificial flowers; articles of human hair	67	10.0	20.0	20.0	0.7	3.6	0.0
Umbrellas, sun umbrellas, walking-sticks, seat sticks, whips, riding crops; and parts thereof	66	12.3	20.8	20.8	2.4	3.2	0.0
Silk	50	10.0	20.0	20.0	23.4	2.6	0.0
Lead and articles thereof	78	10.0	20.0	20.0	1.0	0.5	0.0
Manufactures of straw, esparto or other plaiting materials; basketware and wickerwork	46	10.0	20.0	20.0	2.0	3.2	0.0
Vegetable plaiting materials; vegetable products not elsewhere specified or included	14	10.0	20.0	20.0	5.3	3.9	0.0

Source: Authors' calculations based on BACI data for 2023 (see Gaulier and Zignago, 2010), HTSUS, White House.

Table A-3

Impact of US import tariffs on the EU: detailed results for scenario S1 ("90 days")[1]

PP

Country / Industry

Industry	EU-27	EA-20	Austria	Belgium	Bulgaria	Cyprus	Czechia	Germany	Denmark	Spain	Estonia	Finland	France	Greece	Croatia	Hungary	Ireland	Italy	Lithuania	Luxembourg	Latvia	Malta	Netherlands	Poland	Portugal	Romania	Slovakia	Slovenia	Sweden
Total economy	-.2	-.2	-.2	-.1	-.1	.0	-.2	-.3	-.1	-.1	-.1	-.2	-.1	-.1	-.1	-.3	-.3	-.2	-.1	-.2	-.1	-.1	-.2	-.2	-.1	-.1	-.4	-.2	-.2
Industry and services (2)																													
Industry (B-E)	-.6	-.6	-.7	-.4	-.3	-.1	-.5	-.8	-.3	-.4	-.3	-.5	-.5	-.4	-.1	-.8	-.6	-.6	-.2	-.8	-.2	-.2	-.4	-.4	-.4	-.3	-1.0	-.4	-.8
Services (G-S)	-.1	-.1	-.1	-.1	-.1	.0	-.1	-.1	-.1	-.1	-.1	-.1	-.1	-.1	.0	-.1	-.1	-.1	-.1	-.1	-.1	-.1	-.1	-.1	-.1	-.1	-.2	-.1	-.1
NACE 1-digit industries (20)																													
Agriculture, Forestry and Fishing (A)	-.2	-.2	-.2	-.2	-.2	-.3	-.1	-.1	-.2	-.2	-.2	-.3	-.1	-.2	-.1	-.1	-.6	-.1	-.1	-.1	-.2	.0	-.2	-.1	-.2	-.1	-.2	-.1	-.2
Mining and Quarrying (B)	-.4	-.4	-.6	-.3	-.5	.0	-.3	-.5	-.2	-.3	-.1	-.5	-.4	-.6	-.1	-.4	-1.0	-.3	-.2	-.9	-.1	-.1	-.4	-.2	-.5	-.1	-.3	-.4	-1.5
Manufacturing (C)	-.7	-.7	-.8	-.4	-.4	-.1	-.5	-.9	-.4	-.4	-.4	-.5	-.6	-.4	-.2	-.8	-.7	-.7	-.3	-.8	-.2	-.3	-.5	-.4	-.4	-.3	-1.2	-.5	-.9
Electricity, Gas, Steam and Air Conditioning Supply (D)	-.2	-.2	-.2	-.2	-.2	.0	-.1	-.2	-.1	-.2	-.1	-.2	-.1	-.3	-.1	-.2	-.2	-.2	-.1	-.6	-.1	-.1	-.1	-.1	-.1	-.1	-.2	-.2	-.2
Water Supply; Sewerage, Waste Management and Remediation Activities (E)	-.3	-.3	-.4	-.4	-.1	.0	-.3	-.3	-.1	-.2	-.1	-.4	-.2	-.1	.0	-.2	-.2	-.3	-.1	-.8	-.1	.0	-.1	-.2	-.3	.0	-.1	-.4	-.5
Construction (F)	.0	.0	-.1	.0	-.1	.0	.0	-.1	.0	.0	.0	.0	.0	.0	.0	.0	.0	-.1	.0	.0	.0	.0	.0	-.1	.0	.0	-.1	-.1	-.1
Wholesale and Retail Trade; Repair of Motor Vehicles and Motorcycles (G)	-.2	-.2	-.3	-.2	-.2	.0	-.3	-.2	-.2	-.2	-.1	-.2	-.2	-.1	-.1	-.3	-.2	-.2	-.1	-.2	-.1	-.1	-.2	-.2	-.1	-.1	-.4	-.2	-.3
Transportation and Storage (H)	-.2	-.2	-.2	-.2	-.1	-.2	-.2	-.3	-.2	-.1	-.2	-.3	-.2	-.2	-.1	-.2	-.2	-.2	-.2	-.2	-.1	-.1	-.2	-.2	-.1	-.1	-.3	-.2	-.2
Accommodation and Food Service Activities (I)	.0	.0	.0	.0	.0	.0	.0	-.1	.0	.0	.0	.0	.0	.0	.0	.0	-.1	-.1	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	-.1
Publishing, Broadcasting, and Content Production and Distribution Activities (J)	-.1	-.1	-.1	-.1	-.1	-.1	-.1	-.2	-.1	-.1	-.1	-.1	-.1	.0	.0	-.2	-.1	-.1	-.1	-.1	-.1	-.1	-.1	-.1	-.1	-.1	-.2	-.1	-.1
Telecommunication, Computer Programming, Consulting, Computing Infrastructure, and other Information Service Activities (K)	-.1	-.1	-.2	-.1	-.1	-.1	-.1	-.1	-.1	-.1	-.1	-.1	-.1	-.1	-.1	-.1	-.1	-.2	-.1	-.1	-.1	.0	-.1	-.1	-.1	-.1	-.2	-.1	-.1
Financial and Insurance Activities (L)	-.1	.0	-.1	.0	.0	.0	-.1	-.1	.0	.0	.0	.0	.0	.0	.0	-.1	.0	-.1	.0	.0	.0	.0	.0	.0	.0	.0	-.1	.0	-.1
Real Estate Activities (M)	-.2	-.2	-.2	-.2	-.1	-.1	-.2	-.2	-.1	-.1	-.1	-.2	-.1	-.1	-.1	-.3	-.2	-.2	-.1	-.2	-.1	-.2	-.2	-.2	-.1	-.1	-.4	-.2	-.2
Professional, Scientific and Technical Activities (N)	-.2	-.2	-.2	-.1	-.1	-.1	-.2	-.3	-.1	-.1	-.1	-.2	-.2	-.1	-.1	-.3	-.2	-.2	-.1	-.2	-.1	-.1	-.2	-.1	-.1	-.1	-.4	-.2	-.2
Administrative and Support Service Activities (O)	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	-.1	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0
Public Administration and Defence; Compulsory Social Security (P)	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0
Education (Q)	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0
Human Health and Social Work Activities (R)	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	-.1	-.1	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	-.1
Other service activities (S)	.0	.0	.0	-.1	.0	.0	-.1	.0	.0	.0	.0	.0	-.1	.0	.0	-.1	-.2	.0	.0	-.1	.0	.0	-.1	.0	.0	-.1	.0	-.1
Activities of households as employers; undifferentiated goods- and services-producing activities of households for own use (T)	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0
ICIO industries (45)																													
Agriculture, hunting, forestry (A01_02)	-.1	-.1	-.2	-.2	-.2	.0	-.1	-.1	-.2	-.1	-.2	-.3	-.1	-.1	-.1	-.1	-.5	-.1	-.1	-.1	-.2	.0	-.2	-.1	-.2	-.1	-.2	-.1	-.2
Fishing and aquaculture (A03)	-.6	-.6	.0	-.1	.0	-2.7	-.9	-.3	-.7	-.8	-.1	-.1	-.2	-1.7	-.1	.0	-2.0	.0	.0		-.1	.0	-.7	-.1	-.2	.0	-.3	-.1	-.2
Mining and quarrying, energy producing products (B05_06)	-.2	-.2	-.3		-.1	.0	-.3	-.3	-.2	-.1	-.1	-.2	-.2	-.2	-.1	-.2	-.3	-.2	-.1		-.2	-.1	-.2	-.2		-.1	-.3	-.4	-.6
Mining and quarrying, non-energy producing products (B07_08)	-.6	-.5	-.7	-.3	-.6	.0	-.4	-.6	-.1	-.4	-.6	-.1	-.4	-.7	-.5	-.6	-.1	-.3	-1.1	-.4	-.2	-.9	-.1	-.1	-.3	-.3	-.5	-.2	-.4
Mining support service activities (B09)	-.5	-.7	-.7	-1.5	-.4	-.1	-.3	-.7	-.2	-.7	-.4	-.3	-.4	-1.0	-.1	-.7	-.4	-.6	-.2		-.1	-.1	-.9	-.2	-.6	-.3	-.4	-.4	-.5
Food products, beverages and tobacco (C10T12)	-.2	-.2	-.3	-.2	-.1	.0	-.1	-.1	-.2	-.2	-.1	-.2	-.2	-.1	-.1	-.4	-.4	-.2	-.1	.0	-.3	.0	-.2	-.1	-.1	.0	.0	.0	-.1
Textiles, textile products, leather and footwear (C13T15)	-.3	-.3	-.2	-.3	-.3	.0	-.3	-.2	-.1	-.2	-.2	-.1	-.2	-.1	-.1	-.3	-.3	-.4	-.2	-.6	-.2	.0	-.1	-.2	-.2	-.2	-.3	-.2	-.2
Wood and products of wood and cork (C16)	-.3	-.3	-.2	-.2	-.2	.0	-.3	-.2	-.2	-.2	-.3	-.2	-.4	-.2	-.1	-.3	-.2	-.3	-.3	-.2	-.2	-.1	-.2	-.3	-.9	-.2	-.3	-.3	-.2
Paper products and printing (C17_18)	-.4	-.4	-.3	-.3	-.1	-.1	-.3	-.4	-.3	-.3	-.2	-.1	-.3	-.1	-.1	-.3	-.2	-.3	-.2	-.3	-.1	-.2	-.3	-.2	-.1	-.1	-.3	-.2	-.7
Coke and refined petroleum products (C19)	-.2	-.2	-.2	-.2	-.1	.0	-.2	-.2	-.2	-.1	-.1	-.2	-.1	-.2	-.1	-.2	-.4	-.2	-.1		-.1	-.1	-.2	-.2	-.1	-.1	-.3	-.2	-.2
Chemical and chemical products (C20)	-.6	-.6	-.5	-.4	-.3	-.1	-.4	-.7	-.4	-.4	-.4	-.5	-.6	-.3	-.1	-.5	-.4	-.5	-.5	-.6	-.2	-.1	-.8	-.4	-.4	-.3	-.5	-.4	-.6
Pharmaceuticals, medicinal chemical and botanical products (C21)	-.1	-.1	-.1	-.1	.0	.0	-.1	-.1	-.1	-.1	.0	-.1	-.1	.0	.0	-.1	-.1	-.1	.0	.0	.0	-.1	-.1	.0	.0	-.2	.0	-.1
Rubber and plastics products (C22)	-.6	-.6	-.5	-.4	-.3	-.1	-.8	-.6	-.4	-.5	-.3	-.4	-.5	-.3	-.2	-.8	-1.1	-.5	-.3	-.5	-.2	-.5	-.5	-.4	-.8	-.6	-1.4	-.5	-.6
Other non-metallic mineral products (C23)	-.4	-.4	-.3	-.2	-.2	-.1	-.3	-.4	-.2	-.2	-.2	-.5	-.1	-.3	-1.0	-.1	-.4	-.6	-.6	-.1	-.3	-.1	-.2	-.3	-.1	-.4	-.4	-.3
Basic metals (C24)	-1.3	-1.4	-1.8	-1.1	-.9	-.3	-1.0	-1.4	-.7	-1.0	-.9	-1.2	-1.3	-2.7	-.3	-.9	-1.7	-1.5	-.3	-2.0	-.5	-.4	-1.0	-.8	-1.0	-1.0	-1.0	-1.7	-2.0
Fabricated metal products (C25)	-.6	-.6	-.9	-.4	-.4	-.1	-.7	-.7	-.4	-.5	-.4	-.5	-.5	-.4	-.2	-.8	-.6	-.7	-.3	-.3	-.5	-.5	-.4	-.6	-.6	-.5	-1.0	-.4	-.6
Computer, electronic and optical equipment (C26)	-.7	-.7	-.7	-.4	-.5	-.1	-.5	-.8	-.7	-.3	-1.4	-.4	-.8	-.2	-.2	-1.1	-1.0	-.4	-.4	-.3	-.3	-.8	-.4	-.6	-.6	-.5	-.4	-.5	-.7
Electrical equipment (C27)	-.7	-.7	-.7	-.5	-.5	-.1	-.6	-.8	-.5	-.8	-.7	-.7	-.7	-.2	-.3	-1.1	-.9	-.6	-.5	-.6	-.4	-.5	-.6	-.6	-.6	-.7	-.1	-.6
Machinery and equipment, n.e.c. (C28)	-1.0	-1.0	-.9	-.6	-.5	-.1	-.7	-1.1	-.7	-.5	-.9	-.7	-1.0	-.2	-.3	-1.1	-1.5	-.9	-.3	-.5	-.3	-.5	-.9	-.8	-.4	-.6	-.8	-.5	-.9
Motor vehicles, trailers and semi-trailers (C29)	-1.3	-1.4	-2.3	-1.0	-.4	-.2	-1.0	-1.4	-.7	-.3	-3	-2.0	-.3	-.1	-1.8	-.2	-1.4	-.2	.0	-.8	-.6	-.5	-.4	-2.9	-.5	-1.8
Other transport equipment (C30)	-1.9	-1.9	-1.3	-1.4	-.3	.0	-.9	-1.1	-.4	-1.0	-.1	-.4	-2.9	-.8	-.1	-.4	-.1	-2.4	-.2	-.3	-2.3	-.2	-.9	-3.3	-.5	-.7	-.2	-1.6	-1.6
Manufacturing n.e.c.; repair and installation of machinery and equipment (C31T33)	-.5	-.6	-.4	-.6	-.6	-.2	-.3	-.5	-.4	-.2	-.4	-.4	-.3	-.2	-.2	-.4	-2.5	-.5	-.4	-.4	-.3	-.2	-.3	-.3	-.3	-.3	-.4	-.4	-.5
Electricity, gas, steam and air conditioning supply (D)	-.2	-.2	-.2	-.2	-.2	.0	-.1	-.2	-.1	-.2	-.1	-.2	-.1	-.3	-.1	-.2	-.2	-.2	-.1	-.6	-.1	-.1	-.1	-.1	-.1	-.1	-.2	-.2	-.2
Water supply; sewerage, waste management and remediation activities (E)	-.3	-.3	-.4	-.4	-.1	.0	-.3	-.3	-.1	-.2	-.1	-.4	-.2	-.1	.0	-.2	-.2	-.3	-.1	-.8	-.1	.0	-.1	-.2	-.3	.0	-.1	-.4	-.5
Construction (F)	.0	.0	-.1	.0	-.1	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	-.1	.0	.0	.0	.0	.0	-.1	.0	.0	-.1	-.1	-.1
Wholesale and retail trade; repair of motor vehicles (G)	-.2	-.2	-.3	-.2	-.2	.0	-.3	-.2	-.2	-.2	-.1	-.2	-.2	-.1	-.1	-.3	-.2	-.2	-.1	-.2	-.1	-.1	-.2	-.2	-.1	-.1	-.4	-.2	-.3
Land transport and transport via pipelines (H49)	-.2	-.2	-.2	-.2	-.2	.0	-.2	-.3	-.2	-.2	-.1	-.2	-.2	-.1	-.1	-.2	-.2	-.2	-.2	-.2	-.1	-.1	-.2	-.2	-.1	-.1	-.3	-.2	-.3
Water transport (H50)	-.2	-.2	-.1	-.2	-.1	-.2	-.1	-.3	-.3	-.1	-.2	-.2	-.2	-.2	-.1	-.2	-.2	-.2	-.3	-.1	-.2	-.2	-.1	-.2	-.2	-.1	-.3
Air transport (H51)	-.1	-.1	-.1	-.1	-.1	-.1	-.1	-.1	-.1	-.1	-.1	-.1	-.1	.0	-.1	-.2	-.1	-.1	-.1	-.1	-.1	-.1	-.1	-.1	-.1	-.1	-.1
Warehousing and support activities for transportation (H52)	-.2	-.2	-.2	-.2	-.2	-.2	-.2	-.3	-.3	-.2	-.2	-.4	-.2	-.1	-.1	-.3	-.2	-.2	-.2	-.2	-.1	-.1	-.2	-.2	-.1	-.1	-.3	-.2	-.2
Postal and courier activities (H53)	-.2	-.2	-.2	-.2	-.1	-.1	-.2	-.2	-.1	-.1	-.2	-.1	-.1	-.2	-.2	-.2	-.1	-.2	-.1	-.1	-.2	-.1	-.1	-.2	-.1	-.2
Accommodation and food service activities (I)	.0	.0	.0	.0	.0	.0	.0	-.1	.0	.0	.0	.0	.0	.0	.0	.0	-.1	-.1	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	-.1
Publishing, audiovisual and broadcasting activities (J58T60)	-.1	-.1	-.1	-.1	-.1	-.1	-.1	-.2	-.1	-.1	-.1	-.1	-.1	.0	.0	-.1	-.1	-.1	.0	-.1	.0	-.1	-.2	-.1	-.1	-.1	-.1	-.1
Telecommunications (J61)	-.1	-.1	-.1	-.1	-.1	.0	-.1	-.1	-.2	-.1	-.1	-.1	-.1	-.1	.0	-.1	-.2	-.2	.0	-.1	.0	.0	-.1	-.1	-.1	-.1	-.1	-.1
IT and other information services (J62_63)	-.1	-.1	-.1	-.1	-.1	-.1	-.1	-.1	-.1	-.1	-.1	-.1	-.1	-.1	-.1	-.2	-.1	-.2	-.1	-.1	-.1	.0	-.1	-.1	-.1	-.1	-.2	-.1	-.1
Financial and insurance activities (K)	-.1	-.1	-.2	-.1	-.1	-.1	-.1	-.1	-.1	-.1	-.1	-.1	-.1	-.1	-.1	-.2	-.1	-.2	-.1	-.1	-.1	.0	-.1	-.1	-.1	-.1	-.2	-.1	-.1
Real estate activities (L)	-.1	.0	-.1	.0	.0	.0	-.1	-.1	.0	.0	-.1	.0	.0	.0	.0	-.1	.0	-.1	.0	-.1	.0	.0	.0	.0	.0	-.1	.0	-.1
Professional, scientific and technical activities (M)	-.2	-.2	-.2	-.2	-.1	-.1	-.2	-.3	-.1	-.1	-.1	-.2	-.1	-.1	-.1	-.3	-.2	-.2	-.1	-.2	-.1	-.2	-.2	-.1	-.1	-.4	-.2	-.2
Administrative and support services (N)	-.2	-.2	-.2	-.1	-.1	-.1	-.2	-.3	-.1	-.1	-.1	-.2	-.2	-.1	-.1	-.3	-.2	-.2	-.1	-.2	-.1	-.1	-.2	-.1	-.1	-.1	-.4	-.2	-.2
Public administration and defence; compulsory social security (O)	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	-.1	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0
Education (P)	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0
Human health and social work activities (Q)	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0
Arts, entertainment and recreation (R)	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	-.1	-.1	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0
Other service activities (S)	.0	.0	.0	-.1	.0	.0	-.1	.0	.0	.0	.0	.0	-.1	.0	.0	-.1	-.2	.0	.0	-.1	.0	.0	-.1	.0	.0	-.1	.0	-.1
Activities of households as employers; undifferentiated goods- and services-producing activities of households for own use (T)	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0

[1] Tariffs for EU: Steel, aluminium, automobiles, automobile parts: 25%. All other goods (excl. critical goods): 10%.

Source: Authors' calculations.

Table A-4

Impact of US import tariffs on the EU: detailed results for scenario S2 ("Liberation")[1]

PP

Industry \ Country	EU-27	EA-20	Austria	Belgium	Bulgaria	Cyprus	Czechia	Germany	Denmark	Spain	Estonia	Finland	France	Greece	Croatia	Hungary	Ireland	Italy	Lithuania	Luxembourg	Latvia	Malta	Netherlands	Poland	Portugal	Romania	Slovakia	Slovenia	Sweden
Total economy	-.3	-.3	-.3	-.2	-.2	-.1	-.3	-.4	-.2	-.2	-.2	-.3	-.2	-.1	-.1	-.3	-.5	-.3	-.2	-.2	-.1	-.1	-.2	-.3	-.2	-.2	-.5	-.3	-.3
Industry and services (2)																													
Industry (B-E)	-.8	-.8	-.9	-.6	-.5	-.1	-.6	-1.0	-.5	-.5	-.5	-.8	-.9	-.5	-.2	-.9	-1.1	-.9	-.4	-1.0	-.3	-.3	-.7	-.6	-.5	-.3	-1.1	-.6	-1.1
Services (G-S)	-.1	-.1	-.2	-.1	-.1	-.1	-.1	-.2	-.1	-.1	-.1	-.1	-.1	-.1	-.1	-.2	-.2	-.2	-.1	-.2	-.1	-.1	-.1	-.2	-.1	-.1	-.2	-.1	-.2
NACE 1-digit industries (20)																													
Agriculture, Forestry and Fishing (A)	-.3	-.3	-.3	-.3	-.4	-.5	-.2	-.2	-.4	-.3	-.3	-.5	-.2	-.4	-.1	-.2	-1.1	-.2	-.2	-.2	-.3	-.1	-.4	-.2	-.3	-.1	-.2	-.2	-.4
Mining and Quarrying (B)	-.6	-.6	-.7	-.4	-.7	-.1	-.4	-.7	-.3	-.5	-.2	-.7	-.6	-.8	-.2	-.7	-1.7	-.5	-.2	-1.1	-.2	-.1	-.5	-.3	-.7	-.2	-.4	-.5	-2.0
Manufacturing (C)	-.9	-.9	-1.0	-.6	-.5	-.1	-.7	-1.1	-.6	-.5	-.6	-.9	-1.0	-.6	-.2	-1.0	-1.1	-1.0	-.4	-1.1	-.4	-.4	-.7	-.6	-.6	-.4	-1.3	-.6	-1.1
Electricity, Gas, Steam and Air Conditioning Supply (D)	-.3	-.3	-.3	-.3	-.3	.0	-.2	-.3	-.1	-.2	-.2	-.3	-.2	-.3	-.1	-.3	-.4	-.3	-.1	-.7	-.1	-.1	-.2	-.2	-.2	-.2	-.2	-.3	-.3
Water Supply; Sewerage, Waste Management and Remediation Activities (E)	-.3	-.4	-.5	-.5	-.2	.0	-.4	-.4	-.2	-.2	-.2	-.5	-.2	-.1	-.1	-.3	-.2	-.4	-.1	-.9	-.1	-.1	-.2	-.2	-.4	.0	-.1	-.4	-.6
Construction (F)	-.1	-.1	-.1	-.1	-.1	.0	-.1	-.1	-.1	.0	.0	.0	.0	.0	-.1	.0	.0	-.1	.0	-.1	.0	-.1	.0	-.1	.0	.0	-.1	-.1	-.1
Wholesale and Retail Trade; Repair of Motor Vehicles and Motorcycles (G)	-.3	-.3	-.3	-.3	-.3	-.1	-.3	-.3	-.3	-.2	-.2	-.3	-.3	-.1	-.1	-.3	-.3	-.3	-.2	-.3	-.2	-.2	-.3	-.3	-.2	-.2	-.4	-.3	-.3
Transportation and Storage (H)	-.3	-.3	-.3	-.3	-.2	-.2	-.4	-.4	-.3	-.2	-.3	-.4	-.2	-.2	-.1	-.3	-.3	-.3	-.2	-.2	-.3	-.3	-.2	-.2	-.3	-.2	-.3	-.2	-.3
Accommodation and Food Service Activities (I)	-.1	.0	-.1	-.1	.0	.0	-.1	-.1	.0	.0	.0	.0	.0	.0	.0	.0	-.1	-.1	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	-.1
Publishing, Broadcasting, and Content Production and Distribution Activities (J)	-.2	-.2	-.2	-.1	-.1	-.1	-.1	-.2	-.1	-.1	-.1	-.2	-.1	-.1	-.1	-.2	-.2	-.2	-.1	-.2	-.1	-.1	-.2	-.2	-.1	-.1	-.2	-.1	-.2
Telecommunication, Computer Programming, Consulting, Computing Infrastructure, and other Information Service Activities (K)	-.2	-.2	-.2	-.1	-.2	-.1	-.2	-.2	-.1	-.1	-.1	-.2	-.1	-.1	-.1	-.2	-.1	-.2	-.1	-.1	-.1	-.1	-.1	-.1	-.1	-.1	-.2	-.1	-.2
Financial and Insurance Activities (L)	-.1	-.1	-.1	.0	.0	.0	-.1	-.1	-.1	.0	-.1	.0	.0	.0	.0	-.1	.0	-.1	-.1	-.1	.0	.0	-.1	-.1	.0	.0	-.1	.0	-.1
Real Estate Activities (M)	-.2	-.2	-.3	-.2	-.2	-.2	-.2	-.3	-.2	-.1	-.2	-.3	-.2	-.2	-.1	-.3	-.2	-.2	-.1	-.2	-.1	-.2	-.3	-.3	-.2	-.2	-.3	-.2	-.3
Professional, Scientific and Technical Activities (N)	-.3	-.3	-.3	-.2	-.1	-.1	-.2	-.3	-.2	-.2	-.2	-.2	-.2	-.1	-.1	-.4	-.3	-.3	-.1	-.3	-.1	-.2	-.2	-.2	-.2	-.2	-.4	-.2	-.3
Administrative and Support Service Activities (O)	.0	.0	.0	.0	.0	.0	.0	-.1	.0	.0	.0	-.1	.0	.0	.0	.0	.0	-.1	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	-.1
Public Administration and Defence; Compulsory Social Security (P)	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	-.1	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0
Education (Q)	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0
Human Health and Social Work Activities (R)	.0	-.1	-.1	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	-.1	.0	-.2	-.1	.0	-.1	.0	-.1	-.1	.0	.0	.0	.0	.0	-.1
Other service activities (S)	-.1	-.1	.0	-.1	-.1	.0	-.1	-.1	-.1	-.1	-.1	.0	-.1	.0	.0	-.1	-.3	-.1	.0	-.2	.0	.0	-.1	-.1	.0	-.1	-.1	-.1	-.1
Activities of households as employers; undifferentiated goods- and services-producing activities of households for own use (T)	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0
ICIO industries (45)																													
Agriculture, hunting, forestry (A01_02)	-.3	-.3	-.3	-.3	-.4	.0	-.2	-.2	-.4	-.2	-.4	-.5	-.2	-.2	-.1	-.2	-1.0	-.2	-.2	-.2	-.3	.0	-.3	-.2	-.3	-.1	-.2	-.2	-.4
Fishing and aquaculture (A03)	-1.1	-1.1	-.1	-.1	-.1	-5.1	-1.8	-.4	-1.3	-1.5	-.1	-.1	-.3	-3.2	-.1	.0	-3.8	-.1	-.1		-.2	-.1	-1.4	-.2	-.4	.0	-.4	-.1	-.3
Mining and quarrying, energy producing products (B05_06)	-.3	-.3	-.4		-.2	.0	-.4	-.4	-.3	-.2	-.2	-.4	-.3	-.2	-.2	-.4	-.3	-.2			-.2	-.2	-.3	-.3		-.2	-.4	-.4	-.8
Mining and quarrying, non-energy producing products (B07_08)	-.9	-.8	-.9	-.4	-.8	-.1	-.5	-.9	-.2	-.6	-.2	-.9	-.7	-.9	-.2	-.5	-1.8	-.7	-.2	-1.1	-.2	-.1	-.4	-.4	-.7	-.2	-.5	-.5	-2.0
Mining support service activities (B09)	-.8	-1.1	-.8	-2.6	-.6	-.1	-.4	-1.2	-.4	-1.1	-.7	-.5	-.6	-1.6	-.2	-1.2	-.5	-1.0	-.3		-.2	-.1	-1.5	-.3	-1.0	-.3	-.3	-.6	-.8
Food products, beverages and tobacco (C10T12)	-.3	-.3	-.6	-.3	-.1	-.1	-.1	-.1	-.4	-.3	-.1	-.1	-.3	-.3	-.1	-.2	-.8	-.4	-.1		-.5	-.1	-.3	-.2	-.2	.0	.0	-.1	-.1
Textiles, textile products, leather and footwear (C13T15)	-.5	-.6	-.3	-.5	-.5	.0	-.4	-.3	-.2	-.4	-.3	-.2	-.3	-.2	-.2	-.5	-.5	-.8	-.4	-1.3	-.3	-.1	-.3	-.3	-.8	-.3	-.5	-.4	-.3
Wood and products of wood and cork (C16)	-.4	-.5	-.3	-.3	-.3	-.1	-.4	-.4	-.2	-.4	-.4	-.4	-.7	-.4	-.3	-.5	-.3	-.5	-.5	-.3	-.3	-.2	-.2	-.4	-1.6	-.4	-.4	-.4	-.3
Paper products and printing (C17_18)	-.6	-.6	-.6	-.5	-.2	-.1	-.5	-.7	-.5	-.4	-.3	-1.9	-.4	-.2	-.1	-.4	-.3	-.4	-.1	-.2	-.5	-.3	-.2	-.4	-.3	-.2	-.4	-.3	-1.2
Coke and refined petroleum products (C19)	-.3	-.3	-.3	-.2	.0	.0	-.3	-.3	-.2	-.2	-.2	-.2	-.2	-.2	-.2	-.3	-.5	-.2	-.2		-.2	-.1	-.3	-.2	-.1	-.2	-.3	-.2	-.3
Chemical and chemical products (C20)	-1.0	-1.0	-.8	-1.1	-.4	-.2	-.6	-1.1	-1.5	-.7	-.7	-.9	-1.1	-.4	-.2	-.8	-.6	-.8	-.8	-.9	-.4	-.2	-1.4	-.6	-.6	-.4	-.7	-.5	-1.0
Pharmaceuticals, medicinal chemical and botanical products (C21)	-.2	-.1	-.1	-.1	-.1	-.1	-.1	-.2	-.2	-.1	.0	-.2	-.1	.0	.0	-.1	-.2	-.1	-.1	-.1	-.1	-.1	-.2	-.1	.0	-.2	-.1	-.2
Rubber and plastics products (C22)	-.8	-.8	-.7	-.7	-.5	-.1	-1.0	-.8	-.6	-.7	-.4	-.6	-.7	-.4	-.2	-.9	-1.8	-.7	-.4	-.7	-.3	-.7	-.7	-.6	-1.0	-.7	-1.5	-.6	-.8
Other non-metallic mineral products (C23)	-.6	-.6	-.5	-.3	-.3	-.1	-.5	-.6	-.3	-.8	-.2	-.4	-.4	-1.9	-.2	-.5	-.9	-.9	-.2	-.4	-.3	-.2	-.4	-.5	-.1	-.5	-.6	-.5
Basic metals (C24)	-1.6	-1.6	-2.1	-1.3	-1.2	-.4	-1.2	-1.7	-.9	-1.2	-1.4	-1.6	-1.6	-2.8	-.4	-1.0	-2.4	-1.8	-.4	-2.3	-.7	-.6	-1.2	-1.2	-1.1	-1.1	-1.1	-1.9	-2.4
Fabricated metal products (C25)	-.8	-.8	-1.1	-.5	-.5	-.1	-.8	-.9	-.6	-.6	-.5	-.7	-.6	-.6	-.5	-1.0	-.8	-1.0	-.7	-1.0	-.4	-.4	-.6	-.6	-.6	-.3	-1.2	-.7	-.9
Computer, electronic and optical equipment (C26)	-1.1	-1.1	-1.0	-.6	-.8	-.2	-.7	-1.2	-1.2	-.4	-2.5	-.7	-1.2	-.3	-.3	-1.4	-1.6	-.6	-.7	-.4	-.4	-1.1	-.6	-1.0	-.9	-.7	-.6	-.7	-.3
Electrical equipment (C27)	-.9	-1.0	-1.0	-.6	-.6	-.1	-.8	-1.0	-.8	-.7	-1.2	-1.0	-1.0	-.3	-.4	-1.3	-1.2	-.9	-.6	-.7	-.5	-.7	-.5	-.8	-.7	-.8	-.9	-.8	-.9
Machinery and equipment, n.e.c. (C28)	-1.4	-1.4	-1.4	-.9	-.8	-.2	-.7	-1.5	-1.0	-.7	-1.2	-1.0	-1.5	-.4	-.4	-1.6	-2.4	-1.4	-.5	-.8	-1.3	-1.1	-.6	-.8	-1.1	-.8	-1.4
Motor vehicles, trailers and semi-trailers (C29)	-1.4	-1.5	-2.3	-1.1	-.4	.0	-.7	-1.6	-.3	-.7	-.3	-2.1	-.4	-.2	-1.8	-2.4	-1.5	-.3	-.1	-.2	.0	-.8	-.7	-.5	-.5	-2.9	-.5	-1.8
Other transport equipment (C30)	-3.1	-3.1	-1.8	-2.2	-.4	.0	-1.5	-1.8	-.5	-1.5	-.1	-.7	-4.7	-1.3	-.1	-.6	-.3	-3.4	-.4	-.4	-3.4	-.1	-1.2	-5.7	-.8	-1.0	-.4	-2.5	-2.9
Manufacturing n.e.c.; repair and installation of machinery and equipment (C31T33)	-.8	-.9	-.5	-1.1	-1.1	-.3	-.4	-.7	-.7	-.3	-.6	-.6	-.6	-.3	-.3	-.6	-4.2	-.6	-.4	-.4	-.5	-.5	-.4	-.5	-.7
Electricity, gas, steam and air conditioning supply (D)	-.3	-.3	-.3	-.3	-.3	.0	-.2	-.3	-.1	-.2	-.2	-.3	-.2	-.3	-.1	-.3	-.4	-.3	-.1	-.7	-.1	-.1	-.2	-.2	-.2	-.2	-.2	-.3	-.3
Water supply; sewerage, waste management and remediation activities (E)	-.3	-.4	-.5	-.5	-.2	.0	-.4	-.4	-.2	-.3	-.2	-.5	-.2	-.1	-.1	-.3	-.2	-.4	-.1	-.9	-.1	-.1	-.2	-.2	-.4	.0	-.1	-.4	-.6
Construction (F)	-.1	-.1	-.1	-.1	-.1	.0	-.1	-.1	-.1	.0	.0	.0	.0	.0	-.1	.0	.0	-.1	.0	-.1	.0	-.1	.0	-.1	.0	.0	-.1	-.1	-.1
Wholesale and retail trade; repair of motor vehicles (G)	-.3	-.3	-.3	-.3	-.3	-.1	-.3	-.3	-.3	-.2	-.2	-.3	-.3	-.1	-.1	-.3	-.3	-.3	-.2	-.3	-.2	-.2	-.3	-.3	-.2	-.2	-.4	-.3	-.3
Land transport and transport via pipelines (H49)	-.3	-.3	-.3	-.3	-.2	-.1	-.3	-.4	-.3	-.2	-.2	-.4	-.2	-.2	-.1	-.3	-.2	-.3	-.2	-.2	-.3	-.3	-.2	-.3	-.3	-.3
Water transport (H50)	-.4	-.3	-.2	-.3	-.2	-.2	-.1	-.4	-.4	-.1	-.3	-.4	-.3	-.1	-.2	-.3	-.3	-.2	-.2	-.2	-.2	-.1	-.4
Air transport (H51)	-.2	-.2	-.2	-.2	-.1	-.1	-.2	-.2	-.2	-.1	-.1	-.2	-.2	-.2	-.3	-.2	-.2	-.4	-.1	-.2	-.2	-.1	-.1	-.1	-.1	-.2
Warehousing and support activities for transportation (H52)	-.3	-.3	-.3	-.3	-.2	-.1	-.3	-.4	-.3	-.2	-.3	-.6	-.3	-.2	-.1	-.3	-.2	-.3	-.3	-.3	-.3	-.2	-.2	-.3	-.2	-.2
Postal and courier activities (H53)	-.3	-.3	-.2	-.2	-.1	-.2	-.2	-.4	-.2	-.2	-.2	-.4	-.2	-.1	-.1	-.2	-.2	-.2	-.2	-.2	-.1	-.2	-.2	-.2	-.2	-.2
Accommodation and food service activities (I)	-.1	.0	-.1	-.1	.0	.0	-.1	-.1	.0	.0	.0	.0	.0	.0	.0	.0	-.1	-.1	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	-.1
Publishing, audiovisual and broadcasting activities (J58T60)	-.1	-.1	-.2	-.1	-.1	-.1	-.1	-.1	-.1	-.1	-.1	-.2	-.1	.0	-.1	-.2	-.1	-.1	.0	-.2	-.1	-.1	-.1	-.2	-.1	-.1	-.1	-.1	-.2
Telecommunications (J61)	-.1	-.1	-.2	-.1	-.1	-.1	-.1	-.1	-.1	-.1	-.1	-.1	.0	.0	-.1	-.2	-.2	-.1	-.1	-.1	-.1	-.1	-.1	-.1	-.1	-.1	-.2
IT and other information services (J62_63)	-.2	-.2	-.2	-.1	-.2	-.1	-.1	-.3	-.1	-.1	-.1	-.2	-.1	-.1	-.1	-.2	-.1	-.2	-.1	-.2	-.1	-.1	-.2	-.1	-.1	-.1	-.3	-.1	-.2
Financial and insurance activities (K)	-.2	-.2	-.2	-.1	-.2	-.1	-.1	-.2	-.1	-.1	-.1	-.2	-.1	-.1	.0	-.2	-.1	-.2	-.1	-.1	.0	-.1	-.1	-.2	-.1	.0	-.1	.0	-.1
Real estate activities (L)	-.1	-.1	-.1	.0	.0	.0	-.1	-.1	-.1	.0	-.1	.0	.0	.0	.0	-.1	.0	-.1	-.1	.0	-.1	.0	.0	-.1	.0	.0	-.1	.0	-.1
Professional, scientific and technical activities (M)	-.2	-.2	-.3	-.2	-.2	-.2	-.2	-.3	-.2	-.1	-.2	-.3	-.2	-.2	-.1	-.4	-.3	-.3	-.1	-.3	-.1	-.2	-.2	-.2	-.2	-.2	-.5	-.2	-.3
Administrative and support services (N)	-.3	-.3	-.3	-.2	-.1	-.1	-.2	-.3	-.2	-.2	-.2	-.2	-.2	-.1	-.1	-.4	-.3	-.3	-.1	-.3	-.1	-.2	-.2	-.2	-.2	-.2	-.4	-.2	-.3
Public administration and defence; compulsory social security (O)	.0	.0	.0	.0	.0	.0	.0	-.1	.0	.0	.0	-.1	.0	.0	.0	.0	.0	-.1	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	-.1
Education (P)	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	-.1	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0
Human health and social work activities (Q)	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0
Arts, entertainment and recreation (R)	.0	-.1	.0	-.1	.0	.0	.0	.0	.0	.0	.0	.0	.0	-.1	.0	-.2	-.1	.0	-.1	.0	-.1	-.1	.0	.0	.0	.0	.0	-.1
Other service activities (S)	-.1	-.1	.0	-.1	-.1	.0	-.1	-.1	-.1	-.1	-.1	.0	-.1	.0	.0	-.1	-.3	-.1	.0	-.2	.0	.0	-.1	-.1	.0	-.1	-.1	-.1	-.1
Activities of households as employers; undifferentiated goods- and services-producing activities of households for own use (T)	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0

[1] Tariffs for EU: Steel, aluminium, automobiles, automobile parts: 25%. All other goods (excl. critical goods): 10%.

Source: Authors' calculations.

Table A-5

Impact of US import tariffs on the EU: detailed results for scenario S3 ("Pharma")[1]

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Industry	EU-27	EA-20	Austria	Belgium	Bulgaria	Cyprus	Czechia	Germany	Denmark	Spain	Estonia	Finland	France	Greece	Croatia	Hungary	Ireland	Italy	Lithuania	Luxembourg	Latvia	Malta	Netherlands	Poland	Portugal	Romania	Slovakia	Slovenia	Sweden
Total economy	-.5	-.5	-.4	-.7	-.2	-.1	-.3	-.5	-1.0	-.2	-.2	-.4	-.3	-.2	-.2	-.4	-2.7	-.4	-.2	-.3	-.2	-.3	-.5	-.3	-.2	-.2	-.5	-.4	-.5
Industry and services (2)																													
Industry (B-E)	-1.4	-1.5	-1.1	-2.2	-.5	-.1	-.7	-1.3	-3.5	-.7	-.5	-1.0	-1.1	-.5	-.4	-1.0	-6.9	-1.1	-.4	-1.1	-.4	-.4	-1.0	-.6	-.6	-.4	-1.2	-1.0	-1.4
Services (G-S)	-.2	-.2	-.2	-.4	-.2	-.1	-.2	-.3	-.4	-.1	-.2	-.2	-.2	-.1	-.1	-.2	-.3	-.2	-.2	-.3	-.1	-.2	-.4	-.2	-.1	-.1	-.3	-.2	-.3
NACE 1-digit industries (20)																													
Agriculture, Forestry and Fishing (A)	-.3	-.3	-.4	-.4	-.4	-.5	-.2	-.2	-.6	-.3	-.4	-.6	-.2	-.4	-.2	-.3	-1.2	-.3	-.2	-.2	-.3	-.1	-.5	-.2	-.3	-.1	-.2	-.3	-.5
Mining and Quarrying (B)	-.7	-.7	-.8	-.6	-.7	-.1	-.5	-.8	-.6	-.5	-.2	-.8	-.7	-.8	-.2	-.7	-1.8	-.6	-.3	-1.2	-.2	-.2	-.7	-.4	-.8	-.2	-.4	-.6	-2.0
Manufacturing (C)	-1.6	-1.7	-1.3	-2.5	-.6	-.2	-.7	-1.4	-4.4	-.8	-.6	-1.1	-1.3	-.6	-.5	-1.1	-7.1	-1.2	-.5	-1.1	-.4	-.5	-1.1	-.7	-.7	-.4	-1.4	-1.1	-1.6
Electricity, Gas, Steam and Air Conditioning Supply (D)	-.3	-.4	-.4	-.5	-.3	-.1	-.2	-.4	-.5	-.3	-.2	-.3	-.3	-.3	-.1	-.4	-1.2	-.4	-.2	-.8	-.1	-.2	-.3	-.2	-.2	-.2	-.3	-.4	-.4
Water Supply; Sewerage, Waste Management and Remediation Activities (E)	-.4	-.4	-.6	-.7	-.2	.0	-.4	-.5	-.5	-.3	-.2	-.6	-.3	-.1	-.1	-.3	-.6	-.5	-.1	-1.0	-.1	-.2	-.4	-.2	-.4	-.1	-.2	-.5	-.7
Construction (F)	-.1	-.1	-.1	-.2	-.1	.0	-.1	-.1	-.2	.0	.0	.0	.0	.0	-.1	.0	.0	-.1	.0	-.1	.0	-.1	-.1	-.1	-.1	.0	.0	-.2	-.1
Wholesale and Retail Trade; Repair of Motor Vehicles and Motorcycles (G)	-.4	-.4	-.4	-.5	-.3	-.1	-.4	-.4	-.6	-.3	-.3	-.3	-.3	-.2	-.2	-.4	-.5	-.4	-.2	-.5	-.2	-.2	-.5	-.3	-.2	-.2	-.4	-.4	-.5
Transportation and Storage (H)	-.4	-.4	-.4	-.5	-.3	-.3	-.3	-.5	-.5	-.3	-.3	-.5	-.3	-.3	-.1	-.3	-.4	-.4	-.3	-.5	-.3	-.3	-.4	-.3	-.2	-.2	-.4	-.3	-.4
Accommodation and Food Service Activities (I)	-.1	-.1	-.1	-.2	.0	.0	-.1	-.1	-.5	.0	.0	.0	-.1	.0	.0	.0	-.2	-.1	.0	-.1	.0	.0	-.1	-.1	.0	.0	.0	-.1	-.2
Publishing, Broadcasting, and Content Production and Distribution Activities (J)	-.3	-.3	-.2	-.4	-.2	-.1	-.2	-.4	-.5	-.2	-.2	-.3	-.1	-.1	-.1	-.3	-.3	-.3	-.1	-.3	-.2	-.2	-1.0	-.2	-.1	-.2	-.2	-.3	-.3
Telecommunication, Computer Programming, Consulting, Computing Infrastructure, and other Information Service Activities (K)	-.2	-.2	-.3	-.4	-.2	-.1	-.2	-.2	-.3	-.1	-.1	-.2	-.2	-.1	-.2	-.2	-.2	-.3	-.1	-.2	-.1	-.1	-.3	-.2	-.1	-.2	-.3	-.2	-.2
Financial and Insurance Activities (L)	-.1	-.1	-.1	-.1	-.1	.0	-.1	-.2	-.3	-.1	-.1	-.1	-.1	-.1	.0	-.1	.0	-.1	.0	.0	-.1	-.1	-.1	-.1	.0	-.1	-.1	-.1	-.1
Real Estate Activities (M)	-.4	-.4	-.4	-.8	-.2	-.2	-.3	-.5	-.9	-.2	-.3	-.4	-.3	-.2	-.3	-.5	-.6	-.4	-.2	-.4	-.2	-.4	-.6	-.4	-.2	-.2	-.5	-.5	-.4
Professional, Scientific and Technical Activities (N)	-.6	-.6	-.4	-1.4	-.2	-.2	-.4	-.6	-1.0	-.3	-.3	-.7	-.5	-.1	-.2	-.6	-.9	-.5	-.5	-1.6	-.2	-1.1	-1.1	-.2	-.3	-.3	-.4	-.5	-.7
Administrative and Support Service Activities (O)	-.1	-.1	.0	-.1	.0	.0	.0	-.1	-.1	.0	.0	-.1	.0	.0	.0	.0	-.1	-.1	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	-.1
Public Administration and Defence; Compulsory Social Security (P)	-.1	-.1	.0	-.2	.0	.0	.0	-.1	-.1	.0	.0	-.1	-.1	.0	.0	.0	-.1	.0	.0	.0	.0	.0	.0	.0	.0	-.1	.0	.0	.0
Education (Q)	.0	.0	.0	.0	.0	.0	.0	.0	-.2	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0
Human Health and Social Work Activities (R)	-.1	-.1	-.1	-.2	.0	.0	-.1	-.1	-.1	.0	.0	.0	.0	-.1	-.1	-.1	-.4	-.3	.0	-.1	.0	-.2	-.3	.0	.0	.0	.0	-.1	-.1
Other service activities (S)	-.1	-.1	-.1	-.3	-.1	.0	-.1	-.1	-.3	-.1	-.1	-.1	-.1	.0	-.1	-.1	-.8	-.1	.0	-.2	.0	.0	-.1	-.1	.0	-.1	-.1	-.1	-.1
Activities of households as employers; undifferentiated goods- and services-producing activities of households for own use (T)	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0
ICIO industries (45)																													
Agriculture, hunting, forestry (A01_02)	-.3	-.3	-.4	-.4	-.4	-.1	-.2	-.2	-.6	-.3	-.4	-.6	-.2	-.2	-.2	-.3	-1.1	-.3	-.2	-.2	-.3	-.1	-.4	-.2	-.3	-.1	-.2	-.3	-.5
Fishing and aquaculture (A03)	-1.1	-1.1	-.1	-.2	-.1	-5.1	-1.8	-.5	-1.4	-1.5	-.1	-.2	-.3	-3.2	-.1	-.1	-3.8	-.1	-.1		-.2	-.1	-1.4	-.2	-.4	.0	-.5	-.1	-.4
Mining and quarrying, energy producing products (B05_06)	-.4	-.4	-.5		-.2	.0	-.4	-.6	-.3	-.2	-.3	-.3	-.2	-.3	-.3	-.2	-.5	-.3		-.3	-.2	-.5	-.5	-.8	-.2	-.4	-.5	-.6	-.4
Mining and quarrying, non-energy producing products (B07_08)	-1.0	-.8	-1.0	-.6	-.9	-.1	-.5	-1.0	-.6	-.7	-.2	-1.0	-.8	-.9	-.2	-.5	-1.9	-.8	-.2	-1.2	-.2	-.2	-.5	-.5	-.8	-.2	-.5	-.6	-2.1
Mining support service activities (B09)	-.9	-1.2	-.9	-2.7	-.6	-.1	-.5	-1.3	-.8	-1.2	-.7	-.6	-.7	-1.6	-.2	-1.3	-.8	-1.1	-.3		-.3	-.2	-1.6	-.3	-1.1	-.4	-.3	-.7	-.9
Food products, beverages and tobacco (C10T12)	-.3	-.4	-.6	-.3	-.1	-.1	-.1	-.2	-.6	-.3	-.1	-.1	-.3	-.1	-.1	-.2	-.5	-.1	-.4	-.1	-.5	-.1	-.4	-.2	-.2	.0	-.1	-.1	-.2
Textiles, textile products, leather and footwear (C13T15)	-.6	-.6	-.3	-.6	-.5	.0	-.5	-.3	-.3	-.4	-.3	-.2	-.4	-.2	-.3	-.5	-.5	-.8	-.4	-1.3	-.3	-.1	-.2	-.3	-.8	-.3	-.5	-.4	-.4
Wood and products of wood and cork (C16)	-.5	-.5	-.4	-.4	-.4	-.1	-.4	-.4	-.4	-.4	-.5	-.8	-.4	-.3	-.5	-.8	-.4	-.3	-.2	-.4	-.4	-1.6	-.4	-.4	-.5	-.8	-.4	-.5	-.4
Paper products and printing (C17_18)	-.8	-.8	-.7	-.8	-.3	-.1	-.6	-.9	-.9	-.6	-.4	-2.0	-.6	-.2	-.2	-.5	-.4	-.6	-.4	-.6	-.2	-.3	-.8	-.4	-.9	-.2	-.5	-.7	-1.4
Coke and refined petroleum products (C19)	-.4	-.5	-.4	-.5	-.2	.0	-.3	-.4	-.4	-.2	-.3	-.3	-.3	-.2	-.2	-.3	-.8	-.3	-.2	-.3	-.2	-.2	-.4	-.5	-.2	-.4	-.4	-.6	-.4
Chemical and chemical products (C20)	-1.3	-1.4	-1.1	-1.4	-.5	-.3	-.7	-1.4	-2.5	-.9	-.8	-1.1	-1.3	-.5	-.3	-.9	-1.6	-1.1	-1.0	-1.2	-.5	-.5	-1.8	-.7	-.8	-.4	-.8	-.7	-1.5
Pharmaceuticals, medicinal chemical and botanical products (C21)	-10.4	-10.6	-5.0	-10.1	-1.4	-.4	-1.6	-7.1	-15.2	-3.7	-.3	-3.0	-4.5	-.3	-5.0	-1.1	-21.2	-6.0	-.7	-.8	-.2	-1.8	-6.9	-.8	-2.9	-.4	-1.2	-3.3	-4.5
Rubber and plastics products (C22)	-.9	-.9	-.8	-.9	-.5	-.2	-1.1	-1.0	-1.3	-.8	-.5	-.7	-.8	-.4	-.3	-1.0	-2.1	-.9	-.5	-.8	-.4	-.8	-.9	-.6	-1.0	-.7	-1.6	-.7	-1.0
Other non-metallic mineral products (C23)	-.7	-.7	-.6	-.6	-.4	-.1	-.5	-.7	-.6	-.9	-.2	-.5	-.5	-1.9	-.3	-.6	-1.0	-1.0	-.2	-.5	-.3	-.3	-.4	-.6	-.2	-.6	-.7	-.6	-.6
Basic metals (C24)	-1.7	-1.7	-2.1	-1.4	-1.3	-.4	-1.3	-1.7	-1.1	-1.2	-1.4	-1.6	-1.7	-2.9	-.4	-1.1	-2.5	-1.9	-.4	-2.3	-.7	-.7	-1.3	-1.2	-1.1	-1.2	-2.0	-2.0	-2.5
Fabricated metal products (C25)	-.9	-.9	-1.1	-.6	-.6	-.1	-.9	-.9	-.9	-.6	-.5	-.7	-.7	-.6	-.5	-1.0	-1.0	-1.0	-.7	-1.1	-.4	-.4	-.7	-.7	-.7	-.3	-1.2	-.8	-1.0
Computer, electronic and optical equipment (C26)	-1.2	-1.2	-1.0	-.8	-.8	-.2	-.8	-1.2	-1.1	-.4	-2.5	-1.1	-1.3	-.3	-.3	-1.4	-1.7	-.7	-.4	-.5	-1.2	-.6	-1.0	-.9	-.7	-.6	-.8	-1.2	-1.2
Electrical equipment (C27)	-1.0	-1.0	-1.0	-.8	-.6	-.1	-.9	-1.1	-.9	-.8	-1.2	-1.1	-1.0	-.3	-.4	-1.3	-1.3	-1.0	-.6	-.8	-.5	-.7	-.8	-.8	-.8	-.9	-.8	-1.0	-1.0
Machinery and equipment, n.e.c. (C28)	-1.4	-1.4	-1.4	-1.0	-.8	-.2	-1.0	-1.5	-1.2	-.7	-1.2	-1.2	-1.5	-.4	-.4	-1.7	-2.5	-1.4	-.5	-.8	-.4	-.8	-1.4	-1.2	-.6	-.8	-1.1	-.8	-1.4
Motor vehicles, trailers and semi-trailers (C29)	-1.4	-1.5	-2.4	-1.1	-.5	.0	-.7	-1.6	-.3	-.8	-.3	-2.1	-.4	-.2	-.7	-.3	-1.8	-.2	-1.5	-.3	-.1	-.9	-1.7	-.5	-.5	-2.9	-.6	-.6	-1.9
Other transport equipment (C30)	-3.1	-3.1	-1.8	-2.3	-.4	.0	-1.5	-1.9	-.6	-1.5	-.2	-.7	-4.7	-1.3	-.2	-.7	-.3	-3.4	-.4	-.5	-3.5	-.1	-1.2	-5.7	-.8	-1.0	-.4	-2.5	-2.9
Manufacturing n.e.c.; repair and installation of machinery and equipment (C31T33)	-.9	-.9	-.6	-1.3	-1.1	-.4	-.5	-.7	-1.0	-.3	-.6	-.6	-.6	-.3	-.3	-.6	-4.3	-.8	-.6	-.7	-.5	-.4	-.6	-.5	-.5	-.4	-.5	-.6	-.8
Electricity, gas, steam and air conditioning supply (D)	-.3	-.4	-.4	-.4	-.3	-.1	-.2	-.4	-.5	-.3	-.2	-.3	-.3	-.3	-.1	-.4	-1.2	-.4	-.2	-.8	-.1	-.2	-.3	-.2	-.2	-.2	-.3	-.4	-.4
Water supply; sewerage, waste management and remediation activities (E)	-.4	-.4	-.6	-.7	-.2	.0	-.4	-.5	-.5	-.3	-.2	-.6	-.3	-.1	-.1	-.3	-.6	-.5	-.1	-1.0	-.1	-.2	-.4	-.2	-.4	-.1	-.2	-.5	-.7
Construction (F)	-.1	-.1	-.1	-.2	-.1	.0	-.1	-.1	-.2	.0	.0	.0	.0	.0	-.1	.0	.0	-.1	.0	-.1	.0	-.1	-.1	-.1	.0	.0	-.2	-.2	-.1
Wholesale and retail trade; repair of motor vehicles (G)	-.4	-.4	-.4	-.5	-.3	-.1	-.4	-.4	-.6	-.3	-.3	-.3	-.3	-.2	-.2	-.4	-.5	-.4	-.2	-.5	-.2	-.2	-.5	-.3	-.2	-.2	-.4	-.4	-.5
Land transport and transport via pipelines (H49)	-.4	-.4	-.4	-.5	-.3	-.1	-.3	-.5	-.5	-.3	-.3	-.4	-.3	-.2	-.1	-.3	-.4	-.4	-.3	-.2	-.5	-.3	-.2	-.5	-.3	-.2	-.4	-.4	-.4
Water transport (H50)	-.4	-.4	-.3	-.6	-.2	-.3	-.1	-.5	-.5	-.2	-.3	-.4	-.5	-.4	-.2	-.2	-.5	-.4	-.1	-.4	-.4	-.2	-.2	-.3	-.2	-.2	-.4	-.1	-.5
Air transport (H51)	-.3	-.3	-.2	-.3	-.2	-.2	-.2	-.3	-.3	-.2	-.2	-.3	-.2	-.1	-.2	-.5	-.3	-.2	-.7	-.2	-.3	-.4	-.3	-.2	-.2	-.2	-.1	-.3	-.3
Warehousing and support activities for transportation (H52)	-.4	-.4	-.4	-.4	-.3	-.4	-.3	-.5	-.5	-.3	-.4	-.7	-.4	-.3	-.1	-.4	-.4	-.4	-.4	-.5	-.3	-.4	-.4	-.3	-.2	-.2	-.3	-.3	-.4
Postal and courier activities (H53)	-.5	-.5	-.4	-.5	-.1	-.2	-.2	-.7	-.7	-.3	-.4	-.7	-.2	-.1	-.3	-.4	-.3	-.3	-.3	-.3	-.4	-.1	-.4	-.2	-.2	-.3	-.3	-.3	-.4
Accommodation and food service activities (I)	-.1	-.1	-.1	-.2	.0	.0	-.1	-.1	-.5	.0	.0	.0	-.1	.0	.0	.0	-.2	-.1	.0	-.1	.0	.0	-.1	-.1	.0	.0	.0	-.1	-.2
Publishing, audiovisual and broadcasting activities (J58T60)	-.3	-.3	-.2	-.4	-.1	-.1	-.1	-.2	-.4	-.2	-.2	-.3	-.1	-.1	-.1	-.4	-.2	-.2	-.1	-.3	-.1	-.2	-1.9	-.1	-.1	-.2	-.2	-.3	-.4
Telecommunications (J61)	-.2	-.2	-.2	-.4	-.1	-.1	-.1	-.2	-.3	-.1	-.1	-.2	-.1	-.1	-.1	-.2	-.2	-.2	-.1	-.2	-.1	-.1	-.1	-.1	-.1	-.2	-.2	-.2	-.2
IT and other information services (J62_63)	-.3	-.4	-.2	-.5	-.2	-.2	-.2	-.4	-.5	-.2	-.2	-.4	-.1	-.1	-.2	-.4	-.3	-.3	-.1	-.4	-.2	-.2	-1.0	-.3	-.2	-.3	-.3	-.3	-.3
Financial and insurance activities (K)	-.2	-.2	-.3	-.4	-.1	.0	-.2	-.2	-.3	-.1	-.2	-.2	-.1	-.2	-.2	-.2	-.3	-.1	-.1	-.2	-.1	-.1	-.3	-.1	-.1	-.3	-.2	-.2	-.2
Real estate activities (L)	-.1	-.1	-.1	-.1	-.1	.0	-.1	-.2	-.2	-.1	-.1	-.1	-.1	.0	-.1	-.1	.0	-.1	.0	.0	-.1	-.1	-.3	-.1	-.1	.0	-.2	-.1	-.1
Professional, scientific and technical activities (M)	-.4	-.4	-.4	-.8	-.2	-.2	-.3	-.5	-.9	-.2	-.3	-.4	-.3	-.2	-.3	-.5	-.6	-.4	-.2	-.4	-.2	-.4	-.6	-.4	-.2	-.2	-.5	-.5	-.4
Administrative and support services (N)	-.6	-.6	-.4	-1.4	-.2	-.2	-.4	-.6	-1.0	-.3	-.3	-.7	-.5	-.1	-.2	-.6	-.9	-.5	-.5	-1.6	-.2	-1.1	-1.1	-.2	-.3	-.3	-.4	-.5	-.7
Public administration and defence; compulsory social security (O)	-.1	-.1	.0	-.1	.0	.0	.0	-.1	-.1	.0	.0	-.1	-.1	.0	.0	.0	-.1	.0	.0	.0	-.1	.0	.0	.0	-.1	.0	.0	.0	-.1
Education (P)	-.1	-.1	.0	-.2	.0	.0	.0	-.1	-.1	.0	.0	-.1	-.1	.0	.0	.0	-.1	.0	.0	.0	.0	.0	-.1	.0	.0	.0	-.1	.0	.0
Human health and social work activities (Q)	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0
Arts, entertainment and recreation (R)	-.1	-.1	-.1	-.2	.0	.0	-.1	-.1	-.1	.0	.0	.0	.0	-.1	-.1	-.4	-.3	.0	-.1	.0	-.2	-.3	.0	.0	.0	.0	-.1	-.1	-.1
Other service activities (S)	-.1	-.1	-.1	-.3	-.1	.0	-.1	-.1	-.3	-.1	-.1	-.1	-.1	.0	-.1	-.1	-.8	-.1	.0	-.2	.0	.0	-.1	-.1	.0	-.1	-.1	-.1	-.1
Activities of households as employers; undifferentiated goods- and services-producing activities of households for own use (T)	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0

[1] Tariffs for EU: Steel, aluminium, automobiles, automobile parts: 25%. All other goods (excl. critical goods): 10%.

Source: Authors' calculations.

Table A-6

OECD ICIO industry classification

ISIC Rev. 4	Name
A01_02	Agriculture, hunting, forestry
A03	Fishing and aquaculture
B05_06	Mining and quarrying, energy producing products
B07_08	Mining and quarrying, non-energy producing products
B09	Mining support service activities
C10T12	Food products, beverages and tobacco
C13T15	Textiles, textile products, leather and footwear
C16	Wood and products of wood and cork
C17_18	Paper products and printing
C19	Coke and refined petroleum products
C20	Chemical and chemical products
C21	Pharmaceuticals, medicinal chemical and botanical products
C22	Rubber and plastics products
C23	Other non-metallic mineral products
C24	Basic metals
C25	Fabricated metal products
C26	Computer, electronic and optical equipment
C27	Electrical equipment
C28	Machinery and equipment, n.e.c.
C29	Motor vehicles, trailers and semi-trailers
C30	Other transport equipment
C31T33	Manufacturing n.e.c.; repair and installation of machinery and equipment
D	Electricity, gas, steam and air conditioning supply
E	Water supply; sewerage, waste management and remediation activities
F	Construction
G	Wholesale and retail trade; repair of motor vehicles
H49	Land transport and transport via pipelines
H50	Water transport
H51	Air transport
H52	Warehousing and support activities for transportation
H53	Postal and courier activities
I	Accommodation and food service activities
J58T60	Publishing, audiovisual and broadcasting activities
J61	Telecommunications
J62_63	IT and other information services
K	Financial and insurance activities
L	Real estate activities
M	Professional, scientific and technical activities
N	Administrative and support services
O	Public administration and defence; compulsory social security
P	Education
Q	Human health and social work activities
R	Arts, entertainment and recreation
S	Other service activities
T	Activities of households as employers; undifferentiated goods- and services-producing activities of households for own use

Source: OECD.

Table A-7

Mapping ISIC Rev. 3 to ICIO (ISIC Rev. 4)

ISIC Rev. 3 2-digit	ISIC Rev. 3 name	ICIO (ISIC Rev. 4)
01	Agriculture, hunting and related service activities	A01_02
02	Forestry, logging and related service activities	A01_02
05	Fishing, operation of fish hatcheries and fish farms; service activities incidental to fishing	A03
10	Mining of coal and lignite; extraction of peat	B05_06
11	Extraction of crude petroleum and natural gas; service activities incidental to oil and gas extraction excluding surveying	B05_06
12	Mining of uranium and thorium ores	B07_08
13	Mining of metal ores	B07_08
14	Other mining and quarrying	B09
15	Manufacture of food products and beverages	C10T12
16	Manufacture of tobacco products	C10T12
17	Manufacture of textiles	C13T15
18	Manufacture of wearing apparel; dressing and dyeing of fur	C13T15
19	Tanning and dressing of leather; manufacture of luggage, handbags, saddlery, harness and footwear	C13T15
20	Manufacture of wood and of products of wood and cork, except furniture; manufacture of articles of straw and plaiting materials	C16
21	Manufacture of paper and paper products	C17_18
22	Publishing, printing and reproduction of recorded media	C17_18
23	Manufacture of coke, refined petroleum products and nuclear fuel	C19
24	Manufacture of chemicals and chemical products	C20
24a	Pharmaceuticals	C21
25	Manufacture of rubber and plastics products	C22
26	Manufacture of other non-metallic mineral products	C23
27	Manufacture of basic metals	C24
28	Manufacture of fabricated metal products, except machinery and equipment	C25
29	Manufacture of machinery and equipment n.e.c.	C28
30	Manufacture of office, accounting and computing machinery	C26
31	Manufacture of electrical machinery and apparatus n.e.c.	C27
32	Manufacture of radio, television and communication equipment and apparatus	C26
33	Manufacture of medical, precision and optical instruments, watches and clocks	C26
34	Manufacture of motor vehicles, trailers and semi-trailers	C29
35	Manufacture of other transport equipment	C30
36	Manufacture of furniture; manufacturing n.e.c.	C31T33
37	Recycling	E
40	Electricity, gas, steam and hot water supply	D
41	Collection, purification and distribution of water	E
45	Construction	F
50	Sale, maintenance and repair of motor vehicles and motorcycles; retail sale of automotive fuel	G
51	Wholesale trade and commission trade, except of motor vehicles and motorcycles	G
52	Retail trade, except of motor vehicles and motorcycles; repair of personal and household goods	G
55	Hotels and restaurants	I
60	Land transport; transport via pipelines	H49
61	Water transport	H50
62	Air transport	H51
63	Supporting and auxiliary transport activities; activities of travel agencies	H52
64	Post and telecommunications	H53
65	Financial intermediation, except insurance and pension funding	K
66	Insurance and pension funding, except compulsory social security	K
67	Activities auxiliary to financial intermediation	K
70	Real estate activities	L
71	Renting of machinery and equipment without operator and of personal and household goods	M
72	Computer and related activities	M
73	Research and development	M
74	Other business activities	M
75	Public administration and defence; compulsory social security	O
80	Education	P
85	Health and social work	Q
90	Sewage and refuse disposal, sanitation and similar activities	C24
91	Activities of membership organizations n.e.c.	Q
92	Recreational, cultural and sporting activities	R
93	Other service activities	S
95	Private households with employed persons	T
99	Extra-territorial organizations and bodies	T

Source: Authors' compilation.

Friend-shoring in migration? Investigating the links between geopolitical fragmentation and global migration

Geopolitical tensions have been on the rise in recent years, sparking discussion about their impact on global trade and capital flows. This study investigates whether shifts in geopolitical indicators coincide with shifts in migration patterns. Using migration flow estimates from 1990 to 2020 and UN voting, a measure of geopolitical distance between countries, we find a clear association between bilateral migration and geopolitics: Migration between countries tends to decrease as they drift apart geopolitically.

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Less migration when geopolitical distance increases

Geopolitics could have a significant impact on global bilateral migration patterns. An increase in geopolitical fragmentation by one standard deviation is associated with a 10% reduction in bilateral migration. Therefore, EU immigration could decline as geopolitical blocs become more fragmented.

Factors determining strength of relationship

Increased geopolitical distance tends to have a greater impact on migration between geopolitical friends than between rivals. The effect is also larger when either the country of origin or destination has a relatively low GDP per capita. By contrast, cultural similarities reduce the impact of geopolitics.

Further research needed

This study is a first attempt to analyze the link between migration and geopolitics. While it does not demonstrate causality, it shows that there is a strong association between geopolitics and migration. As a result, there is a need for further research into this topic.

Abstract

Is there a migration-equivalent to *friend-shoring,* a concept often discussed in the context of global trade and capital flows? Does migration increase between countries that are growing geopolitically closer together and decrease between countries that are drifting apart? Our hypothesis is that geopolitical fragmentation increases the cost of migration, and thus migration increases as countries become geopolitical "friends" and decreases as they become "foes," *ceteris paribus.* We address this hypothesis empirically with Poisson pseudo-maximum-likelihood estimations of migration gravity models with a full set of fixed effects. We use estimated data on global bilateral migration flows (1990–2020) and a UN-voting-based measure of geopolitical distance between countries. Our findings suggest that increases in geopolitical distance between two countries are indeed associated with lower migration between them. The estimated coefficient exhibits nonlinearities – it is stronger (more negative) for geopolitically close countries than for distant ones – and heterogeneities: it is stronger for migrants from relatively poor origins and for migrants moving to relatively poor destinations. We further find that cultural similarities between countries lower the estimated impact of geopolitical distance on migration. We illustrate the magnitude of the estimated coefficient by assessing how further geopolitical fragmentation could change immigration to the EU and find that possible implications are economically sizable.

1 Introduction

Geoeconomic fragmentation and its implications have garnered significant attention in recent years.[1] At least since the global financial crisis in 2008/09, skepticism about the benefits of global economic integration has grown louder; Brexit and increasing trade protectionism followed. The war in Ukraine highlighted the fragility of the international supply system, prompting many countries to seek greater autonomy. The escalating trade policy disputes and the revival of tariffs are further altering the dynamics of globalization, likely resulting in even greater fragmentation. Not least since the IMF prominently made it a focal point of its flagship reports in April 2023 (IMF, 2023b; IMF, 2023c), the interest and economic research dedicated to understanding the consequences of geoeconomic fragmentation has grown rapidly.

The term geoeconomic fragmentation has been described as a process of a policy-driven reversal of global economic integration, distinct from fragmentation due to preferences or technological changes, and it encompasses all different channels through which countries engage with each other economically: trade, capital flows, migration, international payments, multilateralism etc. (Aiyar et al., 2023). Geoeconomic fragmentation can be seen as an outcome that may be influenced by broader geopolitical dynamics – such as shifting geopolitical alliances or reduced international cooperation. Research on what geopolitical fragmentation can imply for geoeconomic fragmentation has been growing recently. The IMF published analyses that focus on the relationship between geopolitical (dis)alignment between countries and FDI (IMF, 2023b) and trade (IMF, 2023c), respectively, and also how commodity markets are affected (IMF, 2023a; Alvarez et al., 2023). Several studies followed (see Abelianski et al., 2024; Fletcher et al., 2024; Aiyar et al., 2024; Cevik, 2024; D'Orazio et al., 2024), and most recently, the ECB published a report on the

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implications of trade fragmentation for central banks (Attinasi et al., 2025). Overall, the literature finds that geopolitical fragmentation has important implications for bilateral trade and capital flows and commodity markets.

While a large body of literature has analyzed the nexus between trade and capital flows and geopolitical changes, we are not aware of an assessment of the link between international migration and geopolitical fragmentation in this context. It is important to understand how migration dynamics might react to changes in geopolitics, not only to inform labor market and fiscal policy makers, but also due to its relevance for monetary policy. Migration influences labor markets, changes the labor force and can alter wage and price dynamics (see for example Mayrhuber et al., 2025, for a discussion on links to inflation). Our aim is to contribute to the understanding of how geopolitical fragmentation may relate to global migration, an area that remains under-explored. This perspective can offer insights that support the anticipation of changing migration trends.

Recent evidence suggests that global migration dynamics are changing: While migration became increasingly globalized between the 1960s and 1980s, the degree of migration globalization has slowed down more recently (Fitter et al., 2024). Driving forces have not been investigated, however. There are related studies that suggest that globalization and migration are often intertwined, with economic integration fostering migration through trade and investment linkages (Hatzigeorgiou and Lodefalk, 2021; Rapoport, 2016). However, geopolitical fragmentation – characterized by rising protectionism, economic nationalism and political tensions – may disrupt established migration pathways (Talani, 2022; Lewis and Freeman, 2021). Some evidence suggests that geopolitical fragmentation can act as a barrier to mobility, while others argue it may also increase migration pressures by exacerbating economic and political instability (Lewis and Swannell, 2018). While economic openness has historically been associated with migration facilitation (Fernández-Villaverde et al., 2024), restrictive policies and declining cooperation in fragmented geopolitical contexts may hinder labor mobility and exacerbate irregular migration flows. These findings highlight the importance of a nuanced understanding of migration dynamics in a rapidly evolving global landscape.

Is there a migration-equivalent to *friend-shoring*, i.e. a relocation of (usually trade or capital) flows from geopolitical foes to geopolitical friends and allies? Does a change in the geopolitical (di)stance between two countries affect the migration flows between them? Does a reduction in geopolitical distance lead to more migration – and vice versa? These questions are at the heart of this study, and given the relevance of migration for both migrant sending as well as migrant receiving countries, addressing them is not only interesting in their own right, but also economically important.

But why *would* international migration react to changes in geopolitical differences between countries? Our hypothesis is that geopolitical fragmentation makes migration more costly: economic connections (e.g. trade, capital flows) among geopolitical "friends" are stronger, institutional cooperation might be closer, media coverage of geopolitical allies might be more extensive and more positive, obstacles might be fewer and networks stronger. For these reasons, we would expect that migration between countries drifting apart geopolitically becomes more difficult and thus decreases, and migration between countries becoming more aligned geopolitically is facilitated and thus increases.

With this hypothesis in mind, we estimate gravity models of global bilateral migration, using Poisson pseudo-maximum-likelihood (PPML) estimators with a full set of fixed effects. We use estimates of global bilateral migration flows (Abel, 2019; Abel and Cohen, 2019) for the period from 1990 to 2020 (for every fifth year) and Ideal Point Distance (IPD), a measure of the similarity of UN General Assembly voting behavior (Bailey et al., 2017), as a proxy for the geopolitical distance between countries. Although we employ high-dimensional fixed effects to lower concerns of omitted variable bias, we cannot rule out reverse

Chart 1

Ideal point distance (IPD) over time
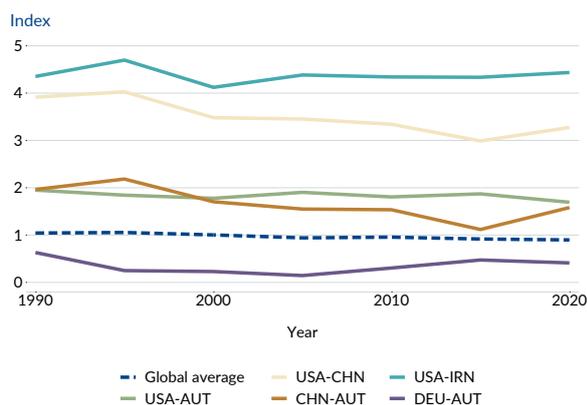
Source: Authors' calculations.

causality influencing our results. We present estimates with a lag of the geopolitical variable instead of its contemporaneous value as a robustness check, but nevertheless want to emphasize that our findings should be interpreted with caution and not as evidence of a causal relationship.

Our findings suggest that an increase in geopolitical distance between two countries is associated with lower migration flows between them, ceteris paribus. This is in line with our hypothesis that geopolitical divergence increases the costs of migrating between countries – and thus lowers migration. The estimated effect is stronger for migrants from relatively poor origin countries and for migrants that move to relatively poor destinations. We further find nonlinearities with respect to the level of geopolitical distance: the closer two countries, the stronger the estimated negative impact on migration of a change in geopolitical distance. When using interaction terms to assess whether the effects differ for the EU as a sending and receiving region of migrants, we find that the coefficient estimate is higher than the global average for immigration to the EU and for emigration out of the EU, while it is insignificant for internal migration within the EU. In order to assess the economic magnitude of the estimated coefficient, we look at changes in predicted migration flows to the EU in response to an increase in geopolitical distance between different geopolitical blocs and find meaningful changes.

The remainder of this paper is organized as follows. Section 2 presents data and descriptive statistics. Section 3 outlines the empirical strategy and section 4 discusses the results. Section 5 provides a scenario analysis and the final section 6 concludes.

2 Data and descriptive statistics

2.1 Measuring geopolitical fragmentation

Following several recent studies (IMF, 2023b; IMF, 2023c; Aiyar et al., 2024, e.g.), we use the Ideal Point Distance (IPD) by Bailey et al. (2017) to approximate the geopolitical distance between countries. The measure is based on UN General Assembly voting to estimate foreign policy preferences, with the IPD representing differences between countries. Thus, the higher the IPD, the more different are the foreign policy preferences of countries. It is an improvement over the so-called S-Score (Signorino and Ritter, 1999), which measures dyadic voting similarity based on countries' UN General Assembly voting behavior. For the S-Score, UN votes are treated as interval-scaled outcomes, with abstentions being seen as halfway between "yea" and "nay." The S-Score is calculated as the Euclidian distance between every dyad in the UN,

Chart 2

Estimated migration flows over time

Global totals

Million
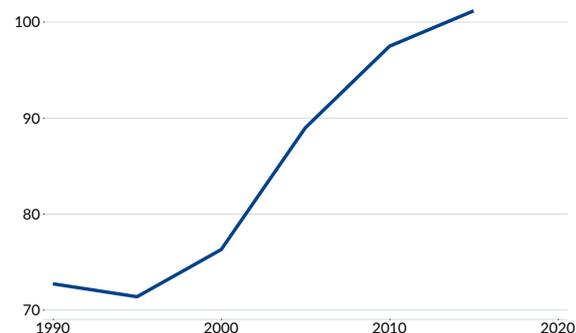
Totals by origin continent

Million
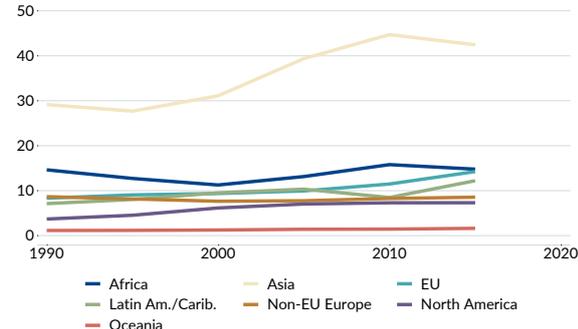
Note: All values correspond to 5-year periods where the year indicates the start of the period.
Source: Authors' calculations.

and it equals 1 if countries vote alike in all votes and –1 if they maximally disagree. The IPD improves on the S-Score, as it allows for better intertemporal comparison and corrects for agenda setting, which influences the S-Score.[2]

Table 1 provides summary statistics for the geopolitical distance variable, and chart 1 shows the development of the average geopolitical distance (IPD) since 1990, including examples of bilateral developments.[3] The average IPD over all country-pairs in the sample declined slightly between 1990 and 2020. The country-pair examples show, however, that – masked by the overall falling trend – there are bilateral increases, such as between China and Austria. When allocating countries to three blocs, a western, eastern and a neutral bloc, following Attinasi et al. (2025) (see section 5 for details), we find that the average IPD between eastern and western countries, but also within western countries, has increased somewhat recently. Slight decreases in average IPDs are found for country-pairs within the eastern bloc, and between western and neutral countries. This illustrates that dynamics in IPD are complex and that the moderately falling IPD at the global level masks diverging bilateral developments.

2.2 Bilateral migration flow estimates

It is difficult to find a dataset on migration that has a rather complete global coverage – as advised for gravity estimations (see for example Larch et al., 2025) – and is adequate for our analysis. The UN provides data on global bilateral migrant *stocks* for every fifth year between 1990 and 2020. A major disadvantage of stock data is the "inertia" in this data stemming from the fact that many migrants have migrated years or even decades ago. Hence, in stock data, current migration dynamics are diluted by historic migration movements.[4] This issue can be addressed using data by Abel (2019) and Abel and Cohen (2019)[5], who provide *estimates* of global bilateral migration *flows*. These estimates capture the total number of migrants moving between country-pairs, thus constituting gross flows (as opposed to net differences between inflows and outflows). The estimates are based on UN Migrant Stock data and are provided for every fifth

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[2]To see how agenda setting can influence the S-Score, consider the following example: Assume that two countries vote alike in nine out of ten votes. Their similarity index would be 90%. Assume that ten further decisions are tabled, all related to the one vote that the countries disagreed on. Their similarity index would drop to 45%, even though no changes in preferences might have occurred.

[3]In line with the frequency of our migration data, we use 5-year averages, where the year always indicates the start of the 5-year period, e.g. the value for 1990 is the average IPD between 1990 to 1994, the value for 1995 for 1995 to 1999, etc. The value for 2020 refers to the average between 2020 and 2023.

[4]See also Fitter et al. (2024) for further advantages of using flow over stock data.

[5]We use version 6, October 28, 2022.

Table 1
Summary statistics

Variable		Mean	Std. dev.	Min	Max	Observations
Migration flows	overall	2,872.75	31,638.53	0.00	2,911,347.00	N = 169,477
	between		27,262.00			n = 29,820
	within		15,365.16			T = 5.68
IPD (5yr-average)	overall	1.03	0.77	0.00	4.87	N = 169,477
	between		0.73			n = 29,820
	within		0.26			T = 5.68
log(GDP per capita at destination)	overall	8.27	1.53	4.47	11.63	N = 158,491
	between		1.45			n = 29,042
	within		0.49			T = 5.46
log(GDP per capita at origin)	overall	8.21	1.55	4.47	11.63	N = 158,388
	between		1.47			n = 29,079
	within		0.49			T = 5.45
Religion similarity index	overall	0.18	0.25	0.00	1.00	N = 151,826
	between		0.25			n = 26,837
	within		0.00			T = 5.66

Note: Statistics are calculated for the sample used for the basic gravity specification. Interactions with GDP per capita or the religion similarity indicator lower the number of observations. N denotes all observations, n the number of country-pairs, and T the average number of time periods each country-pair is observed.
Source: Authors' calculations.

year, starting in the period 1990–95 through 2015–20.[6] Abel and Cohen (2019) provide six different estimates of global bilateral migration flows and show validation exercises that help to choose the estimates according to the intended use. We use migration flows estimated by the closed demographic accounting method (pseudo-Bayesian), as these estimates exhibit the best performance in validation exercises, in particular when the bilateral dimension of the data is of importance, as in this application. Chart 2 provides descriptive statistics of the migration flow estimates and table 1 summary statistics.

2.3 Further data sources

In addition to the IPD measure and the migration flow estimates, we use the well-known CEPII gravity dataset (Conte et al., 2022) that provides distances between countries and indicators for common language, contiguity, common colonial history as well as a religion similarity measure that we use in the estimations. Data on GDP are taken from the IMF's World Economic Outlook database and data on population figures from the UN World Population Prospects.

3 Empirical strategy

3.1 Specification and fixed effects

Gravity models – well-known for explaining trade flows – are regularly used to estimate determinants of bilateral migration flows (see Poot et al., 2016; Beverelli, 2022, for recent examples). We conduct Poisson pseudo-maximum-likelihood (PPML) estimations (Santos Silva and Tenreyro, 2006) based on the following assumed underlying relationship

$$m_{ijt} = exp\left(\alpha + \beta G_{ijt} + \sum_{k=1}^{K} \gamma^k X_{ijt}^k + \mu_{ij} + \nu_{it} + \xi_{jt}\right)\epsilon_{ijt} \tag{1}$$

where m_{ijt} is the migration flow between origin country i and destination country j in period t, G_{ijt} the

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[6] UN migration stock data refer to the mid-points of each year, i.e. to July 1990, July 1995 etc. Consequently, the estimated flows refer to migration flows between July 1990 and July 1995, July 1995 to July 2000 etc.

geopolitical distance between countries i and j in t, X_{ijt}^k are K control variables that vary by specification, μ_{ij} are dyadic (i.e. bilateral) fixed effects, ν_{it} are origin-year fixed effects, ξ_{jt} are destination-year fixed effects, and ϵ_{ijt} is the remaining error term. In all estimations, standard errors are clustered at the country-pair levels. As the dependent variable is migration flows over five-year periods, all explanatory variables are five-year averages based on yearly data.

ν_{it} and ξ_{jt} act as important controls, as they capture crucial macroeconomic developments in origin and destination countries, such as GDP, unemployment, inflation, but also political or institutional developments or events in a given (origin or destination) country and year, such as policy changes, political unrest, wars, natural disasters, regime changes etc. In addition, origin-time fixed effects also are a way of controlling for multilateral resistance to migration (Bertoli and Fernández-Huertas Moraga, 2013; Larch et al., 2025). Known also from the literature of gravity models of trade, multilateral resistance to migration describes the fact that migration between two countries does not solely depend on the characteristics and attractiveness of the two countries, but also on the attractiveness of alternative destinations. Not accounting for it can lead to biased estimates (Bertoli and Fernández-Huertas Moraga, 2013; Beine et al., 2016; Ramos, 2016).

The bilateral fixed effects μ_{ij} control for all country-pair specific effects that are time-invariant, such as bilateral ties between countries, migration history, bilateral policies (to the degree that they are not changing over time), and also the standard gravity variables such as distance, colonial history, common language, common borders etc.

β is the coefficient of interest, and it gives the average (percentage) change in bilateral migration associated with a 1 unit change in geopolitical fragmentation (IPD), ceteris paribus. Given the included fixed effects, what we are holding constant are not only macroeconomic, political and institutional variables in origin and destination countries, but also the country-pair. This means that β tells us, *for a given country-pair*, what change in migration is associated with an increase in IPD between two countries.

In spite of the full set of fixed effects, we cannot rule out that our coefficient estimate is biased due to endogeneity and we emphasize that the estimates must not be interpreted as causal effects. Reverse causality could also introduce a bias: We cannot exclude that migration between two countries influences the geopolitical distance between them. If, for example, more migration leads to lower geopolitical distance between countries, our estimates might capture this relationship, in addition to the effect of interest. In that case our estimates might overestimate the *true* effect. Conversely, if more migration between countries leads to a higher geopolitical distance, our estimate could be biased toward zero, such that we underestimate the impact of geopolitical fragmentation on migration and our estimates are a lower bound of the *true* effect. In order to address this issue, we present our main estimates also with lagged values of the geopolitical fragmentation variable as a robustness check.

3.2 Coefficient heterogeneity

Our dataset covers around 200 countries in the world observed for six five-year periods between 1990 and 2020. β provides us with an estimate of the average relationship between geopolitical distance and migration in the whole dataset. We assume, however, that the coefficient of geopolitical distance could vary in dependence of its own level and of other variables.

Regarding the former, we assume that the relationship between IPD and migration might be non-linear, and not the same for "friends" and "foes." More specifically, we expect that drifting apart geopolitically matters more for countries that are geopolitically close than for countries that are already far apart geopolitically. We test this by dividing the IPD variable in different quantiles and allow the estimated coefficient

to vary by quantile and would expect the coefficient estimates to be the most negative for low quantiles.

On the heterogeneity with respect to other variables, we would expect that migration could respond differently to changes in geopolitics depending on GDP per capita in the source and destination countries, respectively. An increase in IPD – and thereby presumably in the costs associated with migrating – should matter less if the origin country is a comparably rich one. Note that with our full set of fixed effects, we even keep constant the country-pair we are looking at. If nothing changes for this country-pair, and only IPD increases, we would expect the migration reaction to be stronger if the origin country is a low-income country. Following the same logic, we would also expect that high-GDP-destination countries would lower the migration-reducing effect of geopolitical fragmentation. When moving to a comparably rich country, the expected return to migration is higher, and costs of migrating are easier to bear. We test this in the data with interactions of IPD with GDP per capita at origin and at destination, respectively, and with a triple interaction of IPD with origin and destination GDP per capita.

We are further particularly interested in heterogeneous effects for EU origin and destination countries and test this in the data with interactions of IPD with (origin and/or destination) EU dummy variables.

Finally, IPD might also play different roles for country-pairs that are culturally very similar than for country-pairs that are culturally very different. We use an index of religion similarity as a proxy for cultural similarity. Our hypothesis is that IPD matters most for countries that are culturally very different from each other. We also test if we find similar results for other proxies for cultural similarity, such as common colonial history or the distance between countries.

4 Results

4.1 Descriptive evidence

We first bring our hypothesis to the data by looking at a plain correlation plot that shows, for the six different time periods in our sample, a simple linear fit between geopolitical distance and bilateral migration for all countries (chart 3). It indicates that for all periods, the geopolitical distance between two countries and the magnitude of migration between them are positively correlated: the higher the geopolitical distance, the higher the migration flows. This is not surprising, however, as many relevant factors that are not accounted for in this correlation dilute the picture. For example, geopolitically distant countries often exhibit sizable gaps in GDP per capita[7], which can partially explain the high migration between them.

In order to show how the slope of the linear fit changes when different control variables and fixed effects are added, we construct three binned scatter plots[8] with linear fits in chart 4. The top panel of chart 4 shows the unconditional linear fit, just like chart 3, where the slope coefficient is 0.69 (with a p-value of 0.00). The middle panel of chart 4 controls for origin-time and destination-time fixed effects as well as for the following gravity variables: log(distance), contiguity, common language and colonial ties. The fixed effects capture origin- and destination-specific factors that change over time, such as business cycle dynamics (GDP, unemployment etc.), inflation, (unilateral) policy changes, political instability, unrest, wars, natural disasters etc. In fact, one can summarize these as pull and push factors. The slope of the linear fit declines markedly, to 0.24 (with a p-value of 0.00), but it remains positive. Only when bilateral fixed effects are included in addition to the origin-time and destination-time fixed effects (bottom panel of chart 4), the

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[7] In our sample, the higher the absolute difference in (log)GDP per capita between origin and destination countries, the higher the geopolitical distance between them. It is not surprising that advanced economies – often "western" countries – and emerging and developing markets – often not associated with the "western bloc" – differ more in their geopolitical stance than countries belonging to the same group. In addition, many advanced economies and emerging and developing countries are also clustered geographically, and similar geography can also entail similar UN voting on certain topics.

[8] For these binned scatter plots, equal-sized bins are created for the values of IPD, and the dots indicate the means of the variables on the x- and y-axis within each bin. The linear fit is based on the full set of observations. See Stepner (2013).

Chart 3

Migration and geopolitical distance: linear fits by period

Log(migration flow)
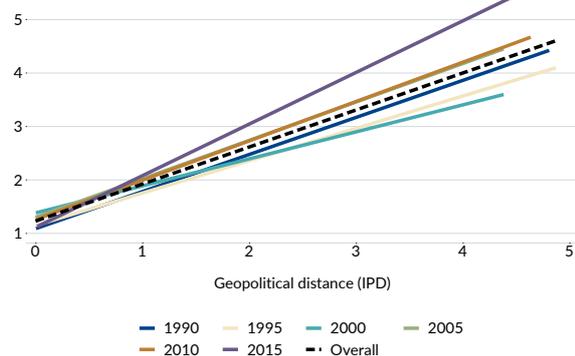
Source: Authors' calculations.

linear fit turns negative (−0.03, with a p-value of 0.01).

This means that partialling out dyadic fixed effects, i.e. controlling for all characteristics that are specific to a country-*pair* (and constant over time), reverses the sign of the slope coefficient. Econometrically, this implies that not controlling for dyadic fixed effects causes the slope coefficient to be biased due to omitted variables. In such a setting, the IPD variable (wrongly) captures factors that are not accounted for but influence migration decisions (positively). We can think of those factors as *migration facilitators* that caused some routes to become established migration routes, and others not.[9] The world's strongest migration corridors arguably were forged under asymmetric relationships. These include colonial rule, North–South guest-worker agreements and exile from conflict. This increased bilateral migration but at the same time places origin and destination countries at different sides of the UN aisle, with former colonies and other strong labor exporters traditionally having aligned with Soviet or nonaligned voting behavior. In this way, strong migration routes have been established on high-IPD corridors. By introducing bilateral fixed effects we can control – among other things – for exactly this effect: If we *could* explicitly control for the unobserved part of the established routes, they would have a positive impact on concurrent migration, and they would – following the above argumentation – be positively related to geopolitical distance. Failing to control for these established migration routes wrongly attributes their positive migration impact to IPD. And due to the – presumably – positive correlation between geopolitical distance and established migration routes, the bias is positive, i.e. we overestimate the effect of IPD when not controlling for these migration facilitators.

4.2 Gravity estimations

The PPML estimates show that with high dimensional (i.e. origin-destination, origin-time and destination-time) fixed effects, the estimated coefficient of IPD is negative and statistically significant (see column 1 in table 2): an increase in IPD is associated with lower migration, ceteris paribus. An increase in IPD by 1 unit is estimated to lower migration by 13%, ceteris paribus. This leads us to the question of what an increase in IPD by 1 unit *represents*. A 1-unit change in IPD is equivalent to the drop in IPD between China and the USA observed between the mid-1990s and the mid-2010s or to the current difference in IPD between CHN-AUT and DEU-AUT (see chart 1). A 1-unit change in IPD is just above the standard deviation in IPD in our sample, which is roughly 0.77.[10]

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[9]Controlling for typical gravity variables such as distance, common language and colonial ties capture already some of those migration facilitators. This is indicated by the decline in the slope coefficient between the top and the middle panel in chart 4. However, as they do not capture all those contributing factors, the inclusion of bilateral fixed effects makes a large difference.

[10]Hence, an increase in IPD by 1 standard deviation is associated with a 10% reduction in bilateral migration flows.

Chart 4
Migration and geopolitical distance: Binned scatter plots and linear fits

No controls

log(migration flow)

Geopolitical distance (IPD)
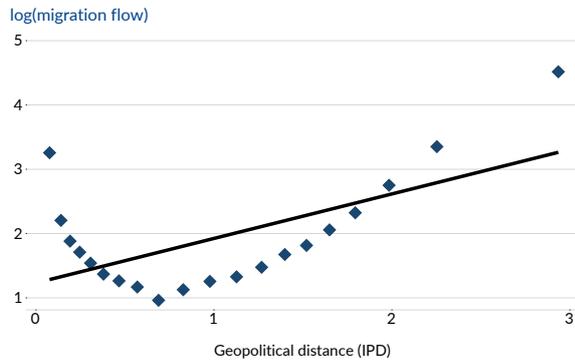
Origin-year + destination-year FE + gravity controls

log(migration flow)

Geopolitical distance (IPD)
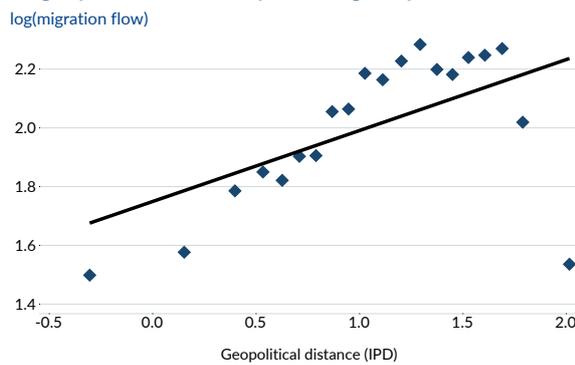
Origin-year + destination-year + origin-destination FE

log(migration flow)

Geopolitical distance (IPD)
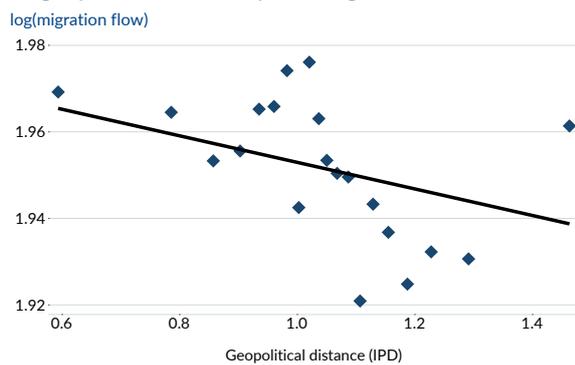
Note: Linear fits are based on full underlying data. No controls (top panel), controlled for gravity variables (distance, contiguity, common language, colonial ties) and origin-year and destination-year fixed effects (middle panel) and controlled for bilateral and for origin-year and destination-year fixed effects (bottom panel).
Source: Authors' calculations.

Table 2

PPML estimations: IPD (1), nonlinearities in IPD (2) and IPD interactions (3)-(6)

	(1)	(2)	(3)	(4)	(5)	(6)
IPD	-0.132*** (-3.26)		-0.736*** (-5.71)	-1.135*** (-6.41)		-0.209*** (-4.13)
IPD 1st quintile		-0.436*** (-2.70)				
IPD 2nd quintile		-0.225** (-2.54)				
IPD 3rd quintile		-0.151*** (-2.80)				
IPD 4th quintile		-0.0864* (-1.85)				
IPD 5th quintile		-0.162*** (-3.78)				
IPD x log(GDP ori)			0.0739*** (5.00)			
IPD x log(GDP dest)				0.115*** (6.03)		
IPD x religion similarity						0.299** (2.40)
IPD x non-EU ori x non-EU dest					-0.0948** (-1.99)	
IPD x non-EU ori x EU dest					-0.211*** (-2.69)	
IPD x EU ori x non-EU dest					-0.315*** (-3.78)	
IPD x EU ori x EU dest					0.336 (1.25)	
Observations	169,477	169,477	162,506	162,162	169,477	151,345

Note: All specifications include origin-destination, origin-year and destination-year fixed effects. Standard errors are clustered at the origin-destination-level. t statistics in parentheses. An x in the variable name indicates interactions. ori and $dest$ are abbreviations for origin and destination countries. * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$.
Source: Authors' calculations.

Chart 5
Coefficient estimates by IPD deciles

Coefficient
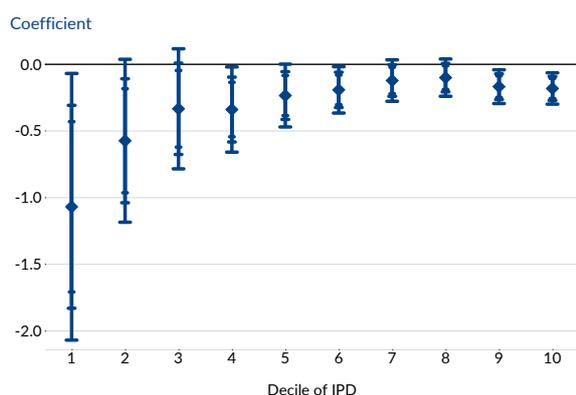
Note: Estimates are obtained using PPML, using origin-time, destination-time and origin-destination fixed effects. Standard errors are clustered at the origin-destination-level. Whiskers indicate 90/95/99% confidence levels.
Source: Authors' calculations.

Coefficient heterogeneity

In the following, we explore coefficient heterogeneity across different dimensions, i.e. we allow the estimated coefficient of the geopolitical fragmentation variable to change with its own level to capture non-linearities and by groups or values of other variables.

First, we allow the coefficient of IPD to vary for different levels of IPD. We define IPD quintiles, i.e. we categorize the observations in five groups according to their IPD values, each containing 20% of the observations.[11] The estimates in column 2 of table 2 show that coefficient estimates are more negative for country-pairs with low IPDs. This implies that for countries that are geopolitically close, a change in IPD has a stronger estimated impact on migration than the same change in IPD between countries that already have a high IPD. We estimate the same specification allowing the coefficient of IPD to change across deciles, instead of quintiles, and chart 5 summarizes the results. The estimates confirm the same finding: Changes in geopolitical distance appear to matter most for countries that are geopolitically relatively close.

Second, we allow the coefficient to change in dependence of GDP per capita in the origin country, the destination country and both. We find that the coefficient increases (moves closer to zero) with higher GDP per capita in the origin country: the richer the origin countries, the smaller the migration-hampering effect of geopolitical distance (see column 3 in table 2 and the left panel of chart 6 for a graphical representation). Based on the estimates, for over 80% of the observations in our data the effect is negative, i.e. only in less than 20% of observations, the GDP at origin is high enough for the effect to turn positive (insignificantly, thus not statistically significantly different from zero). How does the effect vary by the GDP in the destination country? The estimations show that the higher the GDP per capita in the destination country, the less negative the coefficient, i.e. the weaker the negative impact of geopolitics on migration (see column 4 in table 2 and the right panel of chart 6). This is what we would expect based on our hypothesis, as the associated costs of migrating weigh less when a higher "return" to migration is expected, which is the case if the destination is a high-GDP country. Again, we find that for destinations with the highest GDP per capita in the sample, the estimated coefficient turns insignificant.

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[11] The range of IPD in our sample varies between 0.0 and 4.8, but 90% of the country-pairs have an IPD of 2 or lower. For this reason, we did not address nonlinearities by including a square and/or cube of IPD in the regression as in that case the high-IPD-values would get an unduly high weight.

Chart 6

Average marginal effects of geopolitical distance (IPD) by GDP per capita

By log(GDP per capita at origin)

Marginal effect

log(GDP per capita at origin)

By log(GDP per capita at destination)
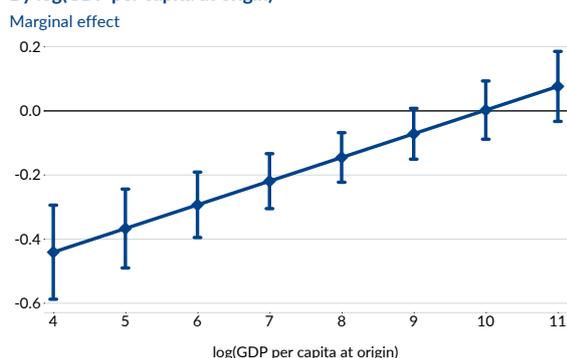
Marginal effect

log(GDP per capita at destination)
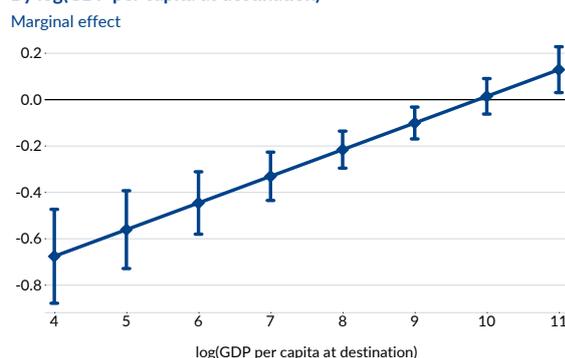
Note: Marginal effects by log(GDP per capita) at origin (left) and log(GDP per capita) at destination (right), according to specifications 3 and 4 in table 2. Spikes indicate 95% confidence intervals.
Source: Authors' calculations.

Chart 7

Average marginal effects of geopolitical distance (IPD) by GDP per capita

Marginal effect

log(GDP per capita at origin)

⊢━⊣ log(GDP per capita destination) = 5   ⊢━⊣ log(GDP per capita destination) = 7
⊢━⊣ log(GDP per capita destination) = 9   ⊢━⊣ log(GDP per capita destination) = 11
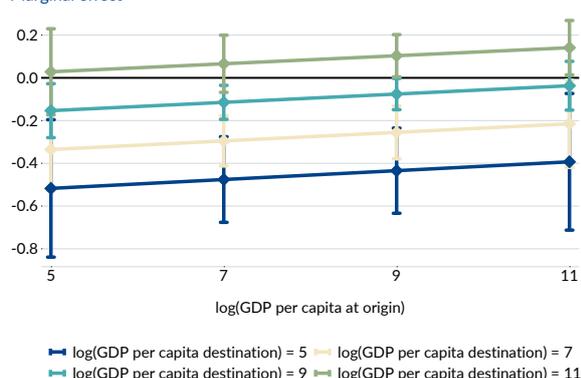
Note: Marginal effects of IPD by log(GDP per capita) at origin and by log(GDP per capita) at destination (triple interaction). Spikes indicate 95% confidence intervals.
Source: Authors' calculations.

When both GDP per capita at origin and at destination are interacted with the geopolitical distance measure (triple interaction, see chart 7 for a graphical illustration), our data suggest that the migration-reducing effect of geopolitical distance is strongest for low GDP origin–low GDP destination corridors. In other words, especially for movements between relatively poor countries, geopolitical distances appear to play an important role. With increasing GDP at either the origin or the destination or both, the negative impact of geopolitical distance on migration gets weaker or geopolitical distance is no longer statistically significant.

Third, we are interested in whether the results for the EU – either as a receiving or sending region of migrants – differ from the global average; this is shown in column 5 of table 2. We (triple-)interact the IPD variable with a dummy variable for an EU origin and a dummy variable for an EU destination. The results indicate that for within-EU migration, geopolitical distance does not seem to matter (is insignificant), but that geopolitical distance matters to a large extent for migration out of and into the EU. The coefficients for EU origin and non-EU destination as well as for EU destination and non-EU origin are more negative

than for the global average.[12]

Fourth, we analyze whether geopolitical distance might matter less for countries that are culturally close. We use a religion similarity index as a proxy for cultural proximity (Conte et al., 2022), and assume that this alternative form of proximity might weaken the impact of geopolitical distance. The estimations (see column 6 in table 2) confirm that the higher the religion similarity between two countries, the weaker (closer to zero) the estimated effect of an increase in geopolitical distance. We also test if using other proxies for cultural closeness – colonial ties and geographic distance between countries – lead to similar results. We can confirm that IPD appears to matter more for countries that are geographically distant and that do not have a common colonial history.

In order to address the issue of possible reverse causality – migration influencing geopolitical distance between countries – we present a version of table 2 with the *lag* of the IPD variable (see table A1 in the annex). While we find a somewhat lower estimate for the basic specification in column 1, the estimates remain statistically significant and relevant. In addition, the patterns found for coefficient heterogeneity hold: The higher the impact of IPD among geopolitical "friends," the higher the impact for relatively poor origin and destination countries, respectively, and the higher the impact for migration in and out of the EU. Merely the interaction with cultural similarity is no longer statistically significant.

Robustness

In order to assess the robustness of our results, we add further control variables and use panel fixed effects estimations instead of PPML. Table 3 shows the results, with column 1 setting out the basic specification we discussed above. In columns 2 and 3 we add the ratio of the log populations at origin to destination and the ratio of the log GDP per capita at origin to destination. The findings show that – not surprisingly – the larger the origin countries relative to the destinations, both in terms of population and GDP per capita, the lower the migration flows between the two countries. In other words, controlling for origin and destination country GDP per capita and population, larger gaps in population and GDP per capita in favor of the origins lead to lower migration. Adding both of those additional controls lowers the coefficient estimate of IPD, but it remains negative and statistically significant. In column 4, the log of the bilateral migrant stock is added to control for network effects. Network effects are accounted for by the dyadic fixed effects to the degree that they are constant, but dynamics over time are not captured. As bilateral migrant stock data is available only for a subset of observations, the sample reduces drastically – and there is no sound comparability. However, the estimates suggest a positive effect of networks on migration, and more interestingly, that even when controlling for (dynamic) network effects, IPD is estimated to remain negatively and significantly related to migration.

Columns 5 to 7 show coefficient estimates that are obtained by panel fixed effects estimators, i.e. by least squares estimations. While the magnitude of the estimates differs compared to PPML estimates, the coefficient estimate of IPD is negative and significant. This holds for the fixed effects estimations of the basic specification with the log of migration flows + 1 as dependent variable – to avoid losing observations due to zeros in the migration variable – (column 5), for the inclusion of additional controls (column 6) as well as for using the log of migration flows as dependent variable (column 7, where the number of observations is lowest due to the zeros in the migration variable).

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[12] The results are qualitatively similar when instead of EU origin and destinations we use euro area (EA) origins and destinations. The only difference is that for within EA migration, the coefficient of IPD turns positive and significant, indicating that within the EA, there is *more* migration among geopolitically distant countries. EA countries are all relatively similar geopolitically, however, so these results should not be over-interpreted in our view.

Table 3

Robustness: PPML estimations with additional control variables (1)-(4) and panel fixed effects estimations (FE) in (5)-(7)

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
IPD	-0.132***	-0.132***	-0.0852**	-0.0700*	-0.0549***	-0.0731***	-0.0484***
	(-3.26)	(-3.25)	(-2.29)	(-1.82)	(-6.06)	(-7.30)	(-2.77)
Log(population) ratio		-18.63**	-16.64**	-9.535		-2.011	5.697**
		(-2.39)	(-2.28)	(-1.27)		(-1.42)	(2.03)
Log(GDP pc) ratio			-5.941***	-4.003***		-1.503***	-2.083***
			(-7.42)	(-4.57)		(-8.44)	(-6.72)
Log(migrant stock)				0.219***			
				(10.49)			
N	169,477	169,477	155,519	53,401	212,644	194,346	139,159
Estimation	PPML	PPML	PPML	PPML	FE	FE	FE
Dependent variable	mig	mig	mig	mig	log(mig+1)	log(mig+1)	log(mig)

Note: All specifications include origin-destination, origin-year and destination-year fixed effects. Standard errors are clustered at the origin-destination-level. t statistics in parentheses. $^* p < 0.1, ^{**} p < 0.05, ^{***} p < 0.01$
Source: Authors' calculations.

5 Illustration of the magnitude of the estimates

In this section, we aim to obtain a better understanding of the magnitude of the estimated coefficients. We do so by looking at changes in predicted migration flows that our gravity estimations suggest in response to a change in IPD. As the estimated coefficients must not be interpreted as implying a causal effect, this is merely an exercise that simulates how migration flows could change in response to changes in geopolitical distance, under the strong assumption that the correlation in the future remains the same.

For the analysis, we rely on an allocation of countries into one of three geopolitical blocs, following Attinasi et al. (2025): a western (United States-centric) bloc, an eastern (China-centric) bloc and a neutral bloc of nonaligned countries.[13] We then consider two different scenarios, a mild and a severe fragmentation scenario. For the mild fragmentation scenario, we assume that our geopolitical distance measure IPD increases by one country-pair-specific standard deviation for country-pairs that do not belong to the same bloc (i.e. for eastern-western, western-neutral and eastern-neutral country-pairs). For country-pairs belonging to the same bloc, we assume no change in IPD. For the severe fragmentation scenario, we assume a stronger increase in IPD, namely by three country-pair-specific standard deviations.[14]

We apply these fragmentation scenarios to two different specifications in table 2, the basic specification in column 1 (referred to as *basic*) and the specification with EU-specific interaction terms in column 5 (referred to as *EU interactions*).

The findings show that the estimated coefficient implies an economically sizable effect: In the mild fragmentation scenario, immigration to the EU is estimated to drop by around 320,000 – or 2.6% – in a 5-year period. The simulated drop in immigration increases in size when considering the estimations that allow the impact of IPD to differ for EU (origin and destination) countries: In this case, even the mild fragmentation scenario could be associated with a drop in immigration to EU countries by over 500,000 over 5 years, i.e. by approximately 100,000 per year, on average. This means in relative terms that migration could be

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[13] See p. 17 in Attinasi et al. (2025) for a map that displays the country allocation.
[14] By using country-pair specific standard deviations instead of overall standard deviations calculated for the full sample we ensure that the shocks to IPD are not disproportionately large for some country-pairs, while being disproportionately small for others.

Chart 8

Estimated change in predicted migration due to geopolitical shocks

Basic specification

Change in predicted immigration
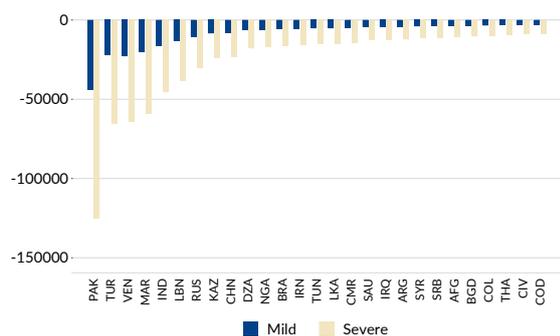
Basic specification
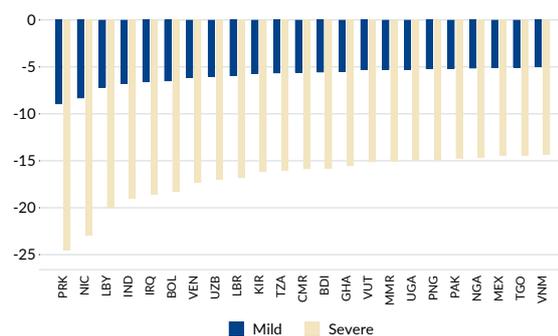
Change in predicted immigration (%)

Specification with EU interaction

Change in predicted immigration
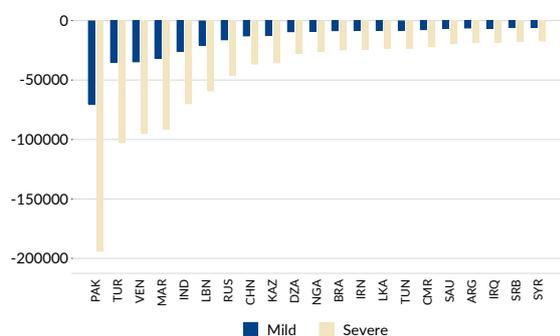
Specification with EU interaction

Change in predicted immigration (%)
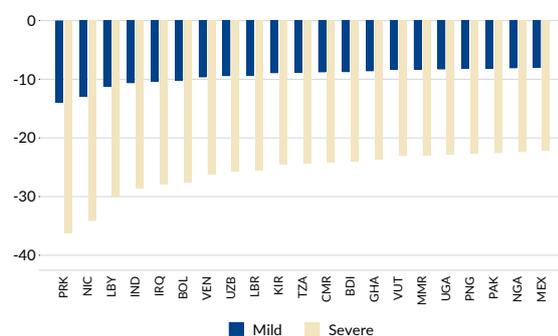
Note: The chart shows the change in predicted immigration to the EU by source country for the mild and severe fragmentation scenarios. **Top panels:** The assessment is based on the basic specification, column 1 in table 2. Top left panel shows changes in absolute values over a five-year period (as compared to predicted values for the period 2015–20) for changes smaller than –3,000 in the mild scenario. Top right panel shows relative changes in predicted immigration (change in expected immigration values expressed in percent of the predicted migration values for the period 2015–20) for changes smaller than –5% in the mild scenario. **Bottom panels:** The assessment is based on EU-specific interaction terms, column 5 in the same table: Absolute (bottom left panel) and relative changes (bottom right panel) in predicted migration flows. Panels display source countries with an estimated decline in migration by at least 6,000 (left) or 8% (right) in the mild scenario.
Source: Authors' calculations.

Table 4

Estimated change in predicted migration due to geopolitical shocks

	Basic specification				EU interactions specification			
	Mild		Severe		Mild		Severe	
	Absolute	Relative	Absolute	Relative	Absolute	Relative	Absolute	Relative
South Asia	-78,429	-4.8%	-223,355	-13.6%	-125,491	-7.5%	-346,749	-20.8%
Western Asia	-54,508	-2.4%	-158,634	-7.0%	-86,351	-3.8%	-246,932	-10.9%
Latin America & Carib.	-52,446	-4.2%	-149,705	-12.1%	-81,269	-6.7%	-225,478	-18.5%
Sub-Saharan Africa	-46,122	-3.5%	-132,789	-10.1%	-73,123	-5.6%	-205,548	-15.7%
North Africa	-36,952	-2.9%	-107,213	-8.4%	-58,697	-4.6%	-167,015	-13.1%
Eastern Europe	-13,802	-2.2%	-39,895	-6.2%	-21,601	-3.4%	-61,100	-9.6%
Southeast Asia	-12,495	-4.0%	-35,926	-11.4%	-19,823	-6.3%	-55,593	-17.7%
Central Asia	-12,004	-4.8%	-34,283	-13.8%	-18,065	-7.6%	-50,131	-21.1%
East Asia	-8,238	-3.8%	-23,560	-11.0%	-13,519	-6.1%	-37,601	-16.9%
Southern Europe	-3,874	-0.7%	-11,375	-2.1%	-6,137	-1.1%	-17,790	-3.2%
Melanesia	-35	-4.4%	-101	-12.6%	-56	-7.0%	-155	-19.4%
Micronesia	-8	-1.6%	-23	-4.6%	-13	-2.5%	-36	-7.0%
Polynesia	-4	-2.2%	-12	-6.4%	-6	-3.5%	-19	-10.1%
Total	-318,920	-2.6%	-916,872	-7.4%	-504,150	-4.1%	-1,414,148	-11.4%

Note: The table shows (absolute and relative) changes in predicted immigration to the EU over a five-year period, by region of origin. Results are for mild and severe fragmentation scenarios and for two different specifications: the basic specification (column 1 in table 2) and the EU interaction specification (column 5). No changes are predicted for Australia and New Zealand, North America, Western Europe and Northern Europe, as all countries in these regions belong to the western bloc and thus no shock in IPD is introduced for them relative to EU countries.
Source: Authors' calculations.

approximately 4% lower than in absence of the shock. In the severe fragmentation scenario, immigration to the EU could drop by 7.4% or more than 900,000 (basic specification) or by more than 11% or 1.4 million (EU-interaction specification) in a 5-year period.

Chart 8 and table 4 display the changes in expected immigration to the EU for shocks to geopolitical distance (IPD) by source countries and source regions. Expected relative changes are highest for source countries/regions that exhibit high standard deviations in IPD. According to the estimates, relative drops in migration would be strongest for Asian and Latin American origins.

6 Conclusion

Motivated by growing economic research on the impact of geopolitical fragmentation on international flows of goods and capital and the lack of studies that investigate the links between migration and such geopolitical shifts, we focus in this study on the relationship between global bilateral migration flows and changes in geopolitical fragmentation of countries. Do we see dynamics that are known as *friend-shoring* when trade or capital flows are concerned, i.e. higher flows among geopolitical friends than among geopolitical foes? Our hypothesis is that geopolitical fragmentation between two countries increases the cost of migrating between them – and thus that fragmentation is associated with lower migration. We bring this hypothesis to the data and estimate gravity models of migration with PPML estimators, using the most-conservative set of fixed effects, namely bilateral, origin-year and destination-year fixed effects.

While we need to interpret our findings with caution, as we cannot rule out reverse causality, we nevertheless find interesting patterns: Our results suggest that increases in the geopolitical distance between two countries are associated with lower migration between them. The estimated effect is nonlinear and higher for geopolitical friends than for geopolitical foes: Fragmentation among allies seems to reduce migration more than a (further) fragmentation among country-pairs that are already distant in terms of geopolitics. Furthermore, the estimated coefficient is higher when either the source or the destination

country has a comparably low GDP per capita. This is in line with our hypothesis, as the presumable increase in the cost of migration induced by higher geopolitical fragmentation matters more if the expected return to migration is low (as when migrating to a low-income country) or when the migrants faced low GDP per capita in their home countries (and thus a tighter budget).

As the geopolitical landscape is changing and migration is a topic featuring prominently on policy agendas worldwide, assessing the link between the two not only broadens knowledge on the implications of geopolitical changes in general, but also provides important information on expected changes in migration dynamics that can feed into policy considerations. This study suggests that migration is not merely driven by income and labor market opportunities of migrants, as is often argued, but also relates to shifts in geopolitical relations between countries.

We assess the economic relevance of the estimated coefficients by investigating the changes in expected migration flows associated with further geopolitical fragmentation. Focusing on the EU as an immigration region, we find that according to our estimates, immigration to the EU could drop significantly if geopolitical fragmentation intensifies. The estimates suggest that especially migration from Asian and Latin American origins could decline relative to baseline levels, with Asian origins playing a larger role in absolute terms.

This study is a first attempt to shed light on the under-researched but highly topical link between migration and geopolitical fragmentation. While our analysis does not allow causal interpretations, we find – controlling for a full set of fixed effects – correlations that are in line with our hypothesis and effects that indicate not only statistically significant relationships but also economically meaningful estimates in terms of magnitude. Given these results, we see merit for further research on the inter-linkages between global migration and geopolitical fragmentation.

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8 Annex

Table A1

PPML estimations with lagged IPD variable (L.IPD): IPD (1), nonlinearities in IPD (2) and IPD interactions (3)-(6)

	(1)	(2)	(3)	(4)	(5)	(6)
L.IPD	-0.0865** (-2.51)		-0.699*** (-5.45)	-1.098*** (-7.01)		-0.112*** (-2.77)
L.IPD 1st quintile		-0.515*** (-2.95)				
L.IPD 2nd quintile		-0.244*** (-2.96)				
L.IPD 3rd quintile		-0.121*** (-2.60)				
L.IPD 4th quintile		-0.0842** (-2.02)				
L.IPD 5th quintile		-0.127*** (-3.46)				
L.IPD x log(GDP ori)			0.0725*** (5.05)			
L.IPD x log(GDP dest)				0.115*** (6.62)		
L.IPD x Religion similarity						0.111 (0.92)
L.IPD x non-EU ori x EU dest					-0.0340 (-0.86)	
L.IPD x non-EU ori x EU dest					-0.230*** (-2.95)	
L.IPD x EU ori x non-EU dest					-0.251*** (-3.53)	
L.IPD x EU ori x EU dest					0.128 (0.47)	
Observations	137,350	137,350	133,113	132,810	137,350	129,440

Note: All specifications include origin-destination, origin-year and destination-year fixed effects. Standard errors are clustered at the origin-destination-level. t statistics are in parentheses. An x in the variable name indicates interactions. ori and $dest$ are abbreviations for origin and destination countries. $^{*}\ p < 0.1,\ ^{**}\ p < 0.05,\ ^{***}\ p < 0.01$.
Source: Authors' calculations.

Understanding central bank balance sheets

Drivers, determinants, and projections of the OeNB's profits and losses

This paper examines the OeNB's balance sheet and profit trends in light of Eurosystem losses from unconventional monetary policy during the low inflation period. Simulations show that future demand for central bank money is a key profit factor. Losses and negative capital do not necessarily prevent a central bank from ensuring price stability. Financial strength supports independence, but credibility depends on consistent policy performance.

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Central bank success defined

A central bank's success is measured by how well it fulfills its mandate, not by profits. Price stability, the ECB's mandate, anchors expectations and supports monetary policy transmission and the economy. Financial strength helps but cannot replace consistent and credible policy.

Determinants of a central bank's income

Central bank profits depend on various factors, many beyond its control. Net interest income mainly reflects monetary policy decisions, not a "business strategy". Profitability is not the goal, but a side effect of policy implementation.

Common policy, stronger central banks

Monetary unions can help central banks stay resilient during prolonged losses. A shared monetary policy, like in the Eurosystem, strengthens independence and shields central banks from national political pressure.

Abstract

This paper examines the evolution of the Oesterreichische Nationalbank's (OeNB) balance sheet and its profit and loss dynamics. Following a decade of unconventional monetary policy, Eurosystem central banks have experienced sustained financial losses in recent years. This study explores the drivers behind these losses. Using a simulation, the paper illustrates the OeNB's projected balance sheet and net interest income over a 15-year horizon across 32 scenarios, varying assumptions regarding demand for banknotes, excess reserves, and asset yields. The results highlight that the future usage of central bank money (whether in the form of banknotes or the digital euro) is the most influential factor for profitability. The analysis underscores that central bank losses and negative capital are not inherently problematic, provided the institution fulfils its price stability mandate and thereby maintains public trust. The paper concludes that financial strength can support central bank independence, but credibility ultimately hinges on consistent policy performance.

1 Introduction

Over the past decade, central banks worldwide have faced considerable challenges. A prolonged period of below-target inflation, followed by the COVID-19 pandemic and an inflation surge, necessitated decisive and forceful monetary policy action. As a result, the European Central Bank (ECB) and the Eurosystem first engaged in extensive expansionary monetary policy, before finally raising interest rates in 2022. These developments have led Eurosystem central banks, which have historically been profitable, to incur financial losses since 2023. This has not only sparked academic interest in the financial stability and sustainability of central banks but has also raised public awareness of central bank dividends as a source of government income.

This paper examines the factors driving the evolution of central bank balance sheets, using the Oesterreichische Nationalbank (OeNB)[1] as a case study. To this end, we first review the role of central bank balance sheets in general, with a particular focus on the last decade. We also explain the role of central bank profits, losses and capital in pursuing their respective mandates. Having provided this context, we simulate the balance sheet of a small- to medium-sized Eurosystem central bank (such as the OeNB) and project the resulting profits and losses over the coming 15 years, based on different assumptions regarding the development of bank liquidity, demand for banknotes, and interest rates. Our focus is on net interest income (NII) as the main determinant of central bank profits and losses. NII represents the difference between the income earned from interest-bearing assets and the expenses incurred from interest-bearing liabilities.

The paper is structured as follows: Section 1 provides an overview of the fundamentals of central bank balance sheets and their historical development. Section 2 discusses the significance of central bank profits and losses in evaluating their performance and financial sustainability. Section 3 presents a projection of possible future balance sheet developments and their impact on the profit/loss situation of a Eurosystem central bank, such as the OeNB. Section 4 concludes by discussing the policy implications.

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2 The bread and butter of central banks' balance sheets

A typical central bank's balance sheet includes assets – such as gold and foreign reserves. On the liabilities side, key items include banknotes in circulation and general government deposits (the latter of which are categorized under "other liabilities" in figure 1). These so-called "autonomous factors" may change with the gold price (e.g., gold) or fluctuate with exchange rates (e.g., foreign reserves). They may expand or shrink, but they are not purposely steered by the Eurosystem. Capital and reserves supplement the liabilities side. While the role of the former will be discussed in further detail in section 2, the latter provide financial buffers for e.g., exchange rate risks. These items are illustrated in light blue in figure 1.

Figure 1

Simplified central bank balance sheet

Assets	Liabilities
Gold and foreign reserves	Banknotes in circulation
Monetary policy operations (e.g. refinancing operations, asset purchases)	Commercial bank reserves (including minimum reserves)
	Other liabilities
Other assets	Capital and reserves

Source: Authors' compilation.

Major changes in the size of the Eurosystem's balance sheet are primarily caused by deliberate monetary policy operations, as can be seen in chart 1, which shows the main asset categories (positive) and liability categories (negative) corresponding to figure 1. Central banks typically use instruments such as refinancing operations and purchases of safe assets (which are shown in dark blue in figure 1). These tools are employed under normal conditions but can also be adapted and expanded during times of crisis.

When a central bank employs monetary policy tools, its balance sheet expands or contracts. Ceteris paribus, every euro the central bank spends on asset purchases or credit provision results in a corresponding credit to a commercial bank's account at the central bank. As a result, bank reserves increase on a one-to-one basis with the central bank's monetary policy tools (as illustrated by the white block in figure 1). In the end, the additional liquidity created in monetary policy operations can show up on the liability side of the central bank's balance sheet in three ways: (1) it remains a commercial bank reserve, (2) it is transformed into banknotes, or (3) it is recognized as other liabilities such as general government deposits.

Chart 1

Consolidated financial statement of the Eurosystem: assets vs. liabilities
EUR trillion
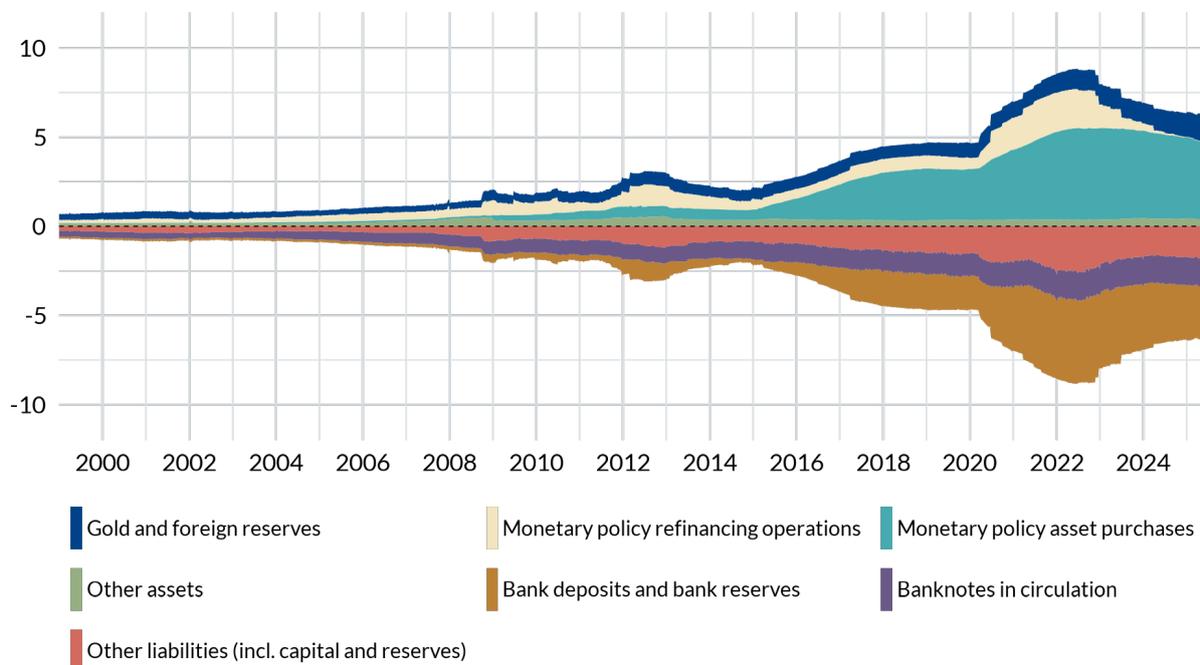
Note: Latest historical observation: July 31, 2025.
Source: ECB SDW (public).

2.1   Central bank losses are a by-product of crisis-fighting monetary policy …

In general, the expansion of a central bank's balance sheet is considered profitable ex ante: If a central bank provides a collateralized loan to a commercial bank and credits its central bank account accordingly, it receives the interest rate on the main refinancing operations (MRO rate) and pays the interest rate on the deposit facility (DF rate) for the reserves it created. As the MRO rate is strictly higher than the DF rate, this deal earns a positive NII and hence is profitable for the Eurosystem.[2] Under normal circumstances – characterized by an upward sloping yield curve, where short-term interest rates are lower than long-term interest rates – asset purchases are also an interest-earning transaction for the central bank.[3] If it buys e.g., a one-year sovereign bond, it will earn the yield of that bond and will pay the (overnight) DF rate for the reserves it created (see e.g. Cecchetti and Hilscher, 2024).

However, circumstances in the euro area (EA) have not been exactly normal in the past years. In 2015, when the Eurosystem started its first large-scale asset purchase programme (APP), short-term interest rates were below zero. Moreover, markets expected them to remain low for quite some time, resulting in a flat yield curve.[4] Expanding their balance sheets still earned the central banks in the Eurosystem a

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[2] In this discussion (sections 1.1 and 1.2), we refer to the Eurosystem as a whole rather than to individual national central banks. This approach allows us to abstract from the redistribution of monetary income between national central banks, which we introduce at a later stage.

[3] Looking at historical data, we observe that the spread between euro area government bonds (across all maturities) and the DF rate varied substantially. However, on average, it amounted to 2.76 percentage points between 1999 and 2016.

[4] This was the result of the expansionary monetary policy at that time, which was deliberately brought about to support the economy and bring inflation from below 2% back to target.

positive net interest margin in 2015: The Eurosystem bought low-yielding bonds, but the DF rate was even lower.

This only changed in January 2017, when the ECB Governing Council opened up to the possibility of purchasing securities "with a yield to maturity below the interest rate on the ECB's deposit facility […]" (ECB, 2016). In what followed, only a fraction of the bonds purchased featured yields below the DF rate. Consequently, the overall NII remained positive until 2022 (see, e.g., Belhocine et al., 2023; Cecchetti and Hilscher, 2024; El Joueidi et al., 2024).

2.2 … TLTROs III and the interest rate surge being the main contributors

In response to the economic consequences of the COVID-19 pandemic, the Eurosystem changed specific terms and conditions of the third series of its targeted longer-term refinancing operations (TLTROs III). TLTROs III were central bank loans to commercial banks with a three-year maturity. The maximum maturity remained unchanged even after COVID-19 hit. However, the maximum amount banks could borrow was increased and the interest rate charged was lowered. For taking up a TLTRO III loan between June 24, 2020, and June 23, 2022, banks paid the average DF rate over that period minus 50 basis points, i.e., −1% (ECB, 2019). A lending rate below the DF rate, however, proved costly for the Eurosystem: Under the TLTRO III framework, every euro borrowed by commercial banks – provided they met their lending benchmarks – incurred a cost of 0.5 cents for the Eurosystem.

The Eurosystem's NII came under additional pressure due to the increase in the DF rate from −0.5% in mid-2022 to 4% by September 2023, through a series of ten increases aimed at curbing surging inflation. While the interest income from the Eurosystem's long-term asset holdings remained unchanged, the interest expenses on the corresponding reserves rose by 450 basis points. This mismatch between the stable returns on assets and the rising costs on liabilities proved financially burdensome, especially in 2023 and 2024 (Belhocine et al., 2023; Cecchetti and Hilscher, 2024). When policy rates increase more quickly than anticipated at the time of asset purchases, interest rate risk materializes and leads to balance sheet losses (Donnery et al., 2017; Karadi et al., 2024). In the same vein, Del Negro and Sims (2015) conclude that the larger a central bank's balance sheet and the longer the duration of its nominal assets, the greater the likelihood of experiencing periods of negative net income.

Summing up, El Joueidi et al. (2024) show that the interest expense of the six largest Eurosystem central banks started to increase substantially from approximately EUR 20 billion in 2021, ballooning to nearly EUR 200 billion in 2023. According to their estimates, this led to a NII of EUR −50 billion and an overall accounting loss of EUR 6 billion in 2023. The annual reports of the six largest Eurosystem central banks suggest that their accounting loss increased to EUR 33.5 billion in 2024.

3 Profits and losses are poor measures of a central bank's success

A firm's success is usually measured by its profits. However, central banks serve different purposes than firms. They pursue national welfare, not profits. Consequently, Stella (2008) as well as Archer and Moser-Boehm (2013) argue that conventional measures of private enterprises' success – profitability and capital – can be very misleading when applied to central banks.[5] In this strand of literature, the term "capital" is not used in an accounting sense – which can vary across countries – but rather in a broader sense. It

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[5] Central banks pursue stability objectives. For example, the primary goal of the Eurosystem is to maintain price stability. Therefore, consumer price increases at 2% serve as the benchmark by which the Eurosystem's performance is to be assessed.

typically refers to shareholder equity (Wessels and Broeders, 2022) or conventional net worth (El Joueidi et al., 2024). In other words, capital is defined as the value of total assets minus the value of total liabilities. This form of capital is available to absorb losses and generally comprises statutory capital, retained earnings, and other provisions and reserves. We use the terms capital and capital base interchangeably.

For central banks, there may occasionally even be a trade-off between macroeconomic stability and profitability. The Eurosystem's experience in 2022–2023 can serve as an example in this respect: Gebauer et al. (2024) show that had the ECB adopted a loss-mitigating strategy, it would have needed to implement significantly lower policy rates – rather than raising them from –0.5% to 4%. This, however, would have resulted in considerably higher inflation rates, overshooting the inflation target for a longer period and to a larger extent.[6] Consequently, we argue that central bank losses are not a sign of weakness, but rather a sign that the central bank is carrying out its mandate uncompromisingly. Only a central bank that enjoys public trust – and according to Stella and Lönneberg (2008) therefore does not need to be concerned with its financial position – can operate independently and focus solely on fulfilling its stability mandate (Ehrmann, 2025). Accordingly, Gebauer et al. (2024) conclude that the ability to report losses is a precondition for successfully committing to a monetary policy that targets inflation.

3.1 Central bank losses: the OeNB as an example

Buiter (2008) argues that central banks typically have a relatively thin capital base. As a result, even modest losses can push them into net negative capital. This raises the question: If losses are not problematic (see above), is negative capital equally unproblematic?

Central banks are special by design. In contrast to commercial banks, no minimum capital requirements apply to them; they are not subject to the Basel prudential capital requirements and are protected from court-ordered bankruptcy. Hence, there are no constraints on the capital base from a legal perspective. Consequently, following Karadi et al. (2024), there is no reason why a central bank cannot operate with negative capital while maintaining control of inflation.

In 2022, the OeNB's financial statements reported a zero gain/loss. In 2023 and 2024, they reported a loss of EUR 2.06 billion and EUR 2.12 billion, respectively. Hence, the financial year 2024 closed with a loss of EUR 4.18 billion. The statutory capital of EUR 12 million remained untouched. On December 31, 2024, the OeNB recorded negative own funds for the first time, given that the loss for the year (including the loss carried forward from the previous year) exceeded its statutory capital and reserves. Hence, in 2022–2024, there was no profit distribution to the government.

Examining the OeNB's historical profit distributions, we find that it has traditionally allocated a significant portion of its profits to its sole owner, the Austrian federal government. Long and Fisher (2024) and Bunea et al. (2016) highlight that the OeNB's 90% profit distribution to the state is high by international standards. Furthermore, the OeNB did not establish a reserve buffer to cover risks arising from monetary policy – particularly interest rate risk. As a result, losses from monetary policy quickly translated into overall financial losses, ultimately leading to negative own funds (i.e., statutory capital and reserves). However, at the end of 2024, the OeNB's capital position (net equity), including funds earmarked for

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[6] Friedman and Schwartz (1963) even go so far as to argue that the US Federal Reserve's fear of losses was one factor that prevented it from pursuing its stability objective, i.e., an aggressive expansionary response to the emergence of the Great Depression.

specific purposes such as risk provision for market, liquidity and credit risks, as well as revaluation accounts, stood at EUR 24.3 billion and remained positive.

Central banks have various options for dealing with losses. Long and Fisher (2024) conclude that currently there is no single recognized model of best practice concerning negative capital and recapitalization arrangements. The OeNB, for example, accumulates its losses as a negative liability on its balance sheet. Once it returns to profitability and generates positive net income, this income is used to reduce the loss carried forward until it reaches zero. Only after this point will the OeNB resume profit distribution to the government.

What sets central banks apart is that they do not need to borrow from external investors to cover their losses. Instead, they can create money directly by crediting the current accounts of credit institutions held at the central bank (see Bindseil et al., 2004).

3.2 How other central banks in advanced economies deal with losses

The OeNB and the Eurosystem are not the only institutions to have incurred losses in recent years. The US Federal Reserve System (Fed) has also experienced negative NII since 2022. It records its losses as a deferred asset on its balance sheet. During periods of losses, the Fed suspends remittances to the US Treasury. In essence, this "deferred asset" reflects the future net earnings that the Federal Reserve Banks must generate before resuming payments to the Treasury. We refer to this mechanism as intertemporal smoothing of profits and losses. As of 2024, the Fed's deferred asset stood at USD 216 billion (Fed, 2025).

Similarly, the Swedish Riksbank has also experienced losses since 2022 (see Nordström and Vredin, 2022). However, the Swedes took another route for dealing with central bank losses. The Riksbank has a target equity level of SEK 60 billion for 2023.[7] If equity falls below one third of the target, the Riksbank requests a capital injection from the state as the Riksbank's owner. In 2023, the Riksbank's equity fell below the minimum level. Consequently, the Riksdag approved a capital injection of SEK 25 billion, bringing the Riksbank's equity to SEK 23 billion in 2024. Essentially, as long as the Riksbank's capital remains between SEK 20 billion and SEK 60 billion, its approach also serves as a form of intertemporal smoothing of profits and losses.

Among the various approaches to recapitalization, the Reserve Bank of Australia's (RBA) strategy falls somewhere between the previously mentioned examples. Its target balance is not a mandatory minimum level of capital but rather a soft benchmark. As of June 30, 2024, the target was AUD 20.1 billion, compared with an actual total equity of AUD −20.4 billion (RBA, 2024). The RBA plans to restore its capital through all future retained profits. However, the Treasurer has responded by noting that, under the Reserve Bank Act 1959, the retention of earnings ultimately lies at the Treasurer's discretion.

Long and Fisher (2024) provide a survey of how central banks treat losses and arrange recapitalization across 70 jurisdictions and find nearly as many different approaches. Some authors (e.g. Buiter, 2008; Cecchetti and Hilscher, 2024) argue that the fiscal authority and the central bank should be viewed as a single consolidated government entity. Central bank losses lead to fiscal costs – either immediately through recapitalization, or later through suspended remittances to the government. Recapitalization through future retained profits (US Federal Reserve, OeNB) functions as a gradual, automatic mechanism. Aside from the legal framework underpinning this process, it involves no further political engagement.

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[7] The target level for the Riksbank's equity will be adjusted for inflation over time.

By contrast, direct recapitalization by the government (Swedish Riksbank) requires both governmental and parliamentary approval and may therefore be more susceptible to political influence. Hence, the issue of negative central bank capital and its subsequent recapitalization boils down to a matter of timing and political involvement.

3.3   When "printing" money turns problematic

Bell et al. (2024) studied whether low or negative capital levels are inflationary using data from 47 countries between 1950 and 2023. They found no statistically significant relationship between equity levels and subsequent inflation outcomes.

According to Reis (2015), "central banks may be able to print money, but they cannot conjure up free lunches." In other words, while central banks can create money to temporarily cover their losses, this strategy cannot be sustained indefinitely. If they were on a path of issuing an exploding volume of reserves (Hall and Reis, 2015), it would result in inflation. Historical examples – such as the role of central bank financing during 19th- and 20th-century wars (Ferguson et al., 2023; Jobst and Kernbauer, 2016), and the experience of Latin American emerging economies in the 1980s and early 1990s (Bell et al., 2024) – demonstrate that if monetary financing is used to accommodate unsustainable fiscal policies, it will ultimately erode price stability. Put differently, "printing" money is not inherently problematic. However, when fiscal policy begins to dominate and undermines the independence of monetary policy, price stability is put at risk.

Stella (2008) and Bell et al. (2024) argue that if central banks create domestic currency (both in physical and electronic form) without restraint, trust in the central bank deteriorates and the currency may eventually lose its status as money. Reis (2015) describes this scenario as "central bank insolvency" – a state in which reserves and currency become worthless. In such cases, people start resorting to alternatives, such as commodities, foreign currencies or stablecoins.

In summary, (1) a central bank's independence, (2) the ability to achieve its stability target, and related to that, (3) trust in its currency form the holy grail of monetary policy. All of this can be achieved with and without a large capital base. A strong capital position is neither a necessary nor a sufficient condition for achieving price stability and thus preserving trust in money.

Nevertheless, a range of authors (e.g. Bindseil et al., 2004; Ize, 2005; Archer and Moser-Boehm, 2013; Wessels and Broeders, 2022; Nordström and Vredin, 2022; Adrian et al., 2024a; Wessels, 2024; Claessens et al., 2025) argue that financial strength supports central bank credibility. Or, as Bell et al. (2023) and Adrian et al. (2024b) put it, achieving central bank independence has multiple dimensions, and financial independence is one of them: Capital is an interest-free liability that effectively expands the base from which interest income can be earned. Moreover, it enhances the central bank's financial independence and reduces the need for recapitalization. In turn, this lowers the risk of political interference, thereby bolstering confidence in the central bank's ability to meet its inflation target and ultimately strengthening trust in the domestic currency.

In principle, we agree with these points: A strong capital base can indeed have a stabilizing effect. Should central banks therefore go for a swift or a slow recapitalization? On the one hand, one-off government recapitalizations could, in the worst case, open the door to political interference (see e.g. Adrian et al., 2024a). In contrast, "stealth" recapitalizations, i.e. offsetting losses through retained earnings once the central bank returns to profitability, reduce this risk. Since no political approval is required and the recapitalization follows a transparent, rules-based process, there is less room for political influence.

Bindseil et al. (2004) conclude that "[a] fully automated and fully credible rule of re-capitalization by the government of the central bank in case of losses can be regarded as a substitute for positive capital." On the other hand, a central bank with negative capital – one that does not contribute to the national budget – may in general be more vulnerable to political pressure than one with a sound capital base. Since "stealth" recapitalizations often take many years, there is a prolonged risk of political influence. In contrast, immediate recapitalizations offer the advantage of a swift resolution. Once completed, the central bank regains financial independence and may be better shielded from political pressure.

Hall and Reis (2015) suggest that rather than formulating a concept of capital for central banks and raising red flags if capital is depleted, a better approach is to monitor how long it will take the central bank to pay off its deferred obligation. This is what we do in section 3.

4 Profit and loss projections of a euro area central bank such as the OeNB

We examine the development of NII for a small to medium-sized Eurosystem central bank, using the OeNB as an example. NII is determined by both balance sheet composition and the interest rates applied to assets and liabilities. To estimate the magnitude and duration of profits and losses, we first project the future evolution of the balance sheet, which then serves as the basis for our NII calculations.

Before proceeding, it is important to outline the institutional setup of the Eurosystem: Key aspects relevant for profits and losses – such as profit distribution and loss coverage – are not only governed by decisions of the ECB Governing Council but also by national legislation. While the policy rates are set collectively by the ECB Governing Council for the whole Eurosystem, monetary policy is implemented in a decentralized manner. In a monetary union comprising 20 national central banks, clear rules are therefore necessary to ensure fair distribution of NII. Monetary income refers to income and expenses from monetary policy operations on national central banks' balance sheets. This income is pooled and redistributed across the Eurosystem according to each central bank's share in the ECB's statutory capital. Therefore, the financial risk, costs and benefits of monetary policy are shared among all national central banks.

This setup motivates us to base our projections on the consolidated balance sheet of the entire Eurosystem.[8] We then approximate the OeNB's balance sheet – after the monetary income redistribution – by applying its proportional share of the Eurosystem balance sheet. However, not all monetary policy instruments are subject to profit and loss sharing. For example, government bond purchases under the expanded asset purchase programme (APP) and the pandemic emergency purchase programme (PEPP) were conducted by national central banks using domestic bonds only. Consequently, the associated risks and returns are not shared. This means that interest income from these portfolios has an idiosyncratic component – related to the risk premium of the government bond – specific to each national central bank.

Therefore, after simulating the consolidated Eurosystem balance sheet, we calculate the OeNB's NII separately. To this end, we make assumptions about the average interest rate earned on the OeNB's monetary policy portfolio. For confidentiality reasons, we do not use internal OeNB accounting data on the exact securities that are held. Therefore, we cannot replicate its exact financial situation.

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[8] The ECB is part of the consolidated balance sheet of the Eurosystem. However, it is not part of the monetary income redistribution among Eurosystem national central banks.

Nonetheless, our goal is to better understand the drivers of losses for central banks such as the OeNB. We do not aim to make precise forecasts about the OeNB's profits or losses over the medium to long term, nor do we extend our projections to other Eurosystem central banks. This is partly because losses vary across countries. For instance, because of higher credit spreads, central banks in Italy and Spain tend to earn higher average interest income from their government bond portfolios. Moreover, national regulations on financial provisions also influence the extent of losses.

Summarizing, our assumptions are based on market expectations at the time of writing regarding the future state of the economy. To assess the future profit and loss situation we make several assumptions about key parameters and analyze different scenarios. This allows us to evaluate the sensitivity of our projections and draw implications for central bank profitability. Assumptions related to demand for banknotes, excess liquidity, and policy interest rates apply to the entire EA, reflecting the shared nature of profits and losses within the Eurosystem. In contrast, assumptions about interest rate income from parts of the monetary policy portfolio are specific to the OeNB.

Finally, we emphasize that these assumptions are not intended as forecasts of the most likely outcomes. Rather, they serve to illustrate and discuss the impact of key parameters on the financial results of Eurosystem central banks.

4.1 Projection assumptions on balance sheet and interest rate developments

We use data from the ECB Data Portal, including data on the consolidated Eurosystem balance sheet, required reserves, and total banking assets. Our primary focus is on the impact of monetary policy on the profits and losses of EA central banks. Accordingly, we concentrate on NII and its drivers.

Interest expenses are largely determined by the DF rate, which is paid on commercial bank reserves held at the central bank in excess of minimum reserve requirements. Interest income, on the other hand, stems from two main sources: interest paid by commercial banks in refinancing operations, and returns on assets held in the monetary policy portfolio. To estimate profits and losses, we must therefore make assumptions about the evolution of both central bank assets and liabilities, as well as the future path of interest rates.

4.1.1 Balance sheet assumptions

We begin by outlining our assumptions for key items of the Eurosystem balance sheet. Regarding liabilities, our first assumption concerns the future circulation of banknotes in the EA. The future of cash is currently uncertain due to the proceeding digitalization of the payment system. To account for this and to evaluate the sensitivity of central bank profitability to different future paths of physical money, we suggest four scenarios: The first scenario assumes that the quantity of banknotes in circulation will grow at the same rate as long-run nominal EA GDP (i.e., 3.2% per year) an assumption discussed in Bindseil et al. (2004).[9] The second scenario assumes that the number of banknotes in circulation will not grow. The third scenario assumes a growth rate of −2.98% per year, which corresponds to a decrease in banknotes in circulation by about 25% by the end of 2033.[10] Lastly, we extrapolate the growth in banknotes in the EA from 1999 to 2025 as a fourth scenario. This results in a higher growth rate than

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[9] For this long-run nominal GDP growth rate, we use the median expectation of the ECB Survey of Monetary Analysts (SMA), June 2025, about long-run real growth rates (1.2%), plus the ECB's inflation target of 2%.

[10] This may seem like an extreme assumption at first, but it is only a fraction of the reduction of cash in usage in Sweden observed over the last 15 years: In the beginning of 2010, banknotes and coins in circulation in Sweden stood at around SEK 105,000 million, whereas in the beginning of 2025, this amount had reduced to about SEK 56,000 million.

what we assume in the first scenario (about 6.54% per year). We believe that these four scenarios provide reasonable upper and lower bounds for the future development of this balance sheet item.

Next, we assume that the minimum reserve requirement in the EA (as a proportion of specific liabilities on banks' balance sheets) will grow at the long-run nominal GDP growth rate of 3.2% per annum. The remaining commercial bank reserves, i.e., excess reserves, are initially determined by the run-off of the monetary policy portfolio. In our projections, we assume that – depending on banks' demand – excess liquidity will be reduced to a certain percentage of total banking assets in the EA. Again, we propose four scenarios, which reflect different levels of liquidity in the Eurosystem. The first scenario assumes a reduction to 2%, the second to 2.5%, the third to 3%, and the fourth to 3.5% of total banking assets. Once this minimum amount has been reached, we assume that excess liquidity will grow at the same rate as long-run nominal GDP. Other liabilities, as well as capital and reserves (abstracting from the accounting treatment of incurred losses), are assumed to remain constant after the data cut-off date (July 31, 2025).[11]

We now turn to our assumptions about the development of the asset side. Carpenter et al. (2015) conduct a similar analysis to ours for the Federal Reserve and Kjellberg and Åhl (2022) for the Sveriges Riksbank. While Carpenter et al. (2015) explore various scenarios for the way the Fed's balance sheet is reduced through the asset side, the Eurosystem's path for reducing its monetary policy portfolio is clearly defined. Currently, the consolidated balance sheet of the Eurosystem (see chart 1) shows close to EUR 4 trillion in legacy bond holdings from earlier asset purchase programmes, namely the APP and the PEPP. Reinvestments ended in June 2023 for the APP and in June 2024 for the PEPP. Since then, the legacy portfolios have decreased in line with their maturity distributions. No asset sales are foreseen. The ECB publishes the expected redemption amounts for the APP and PEPP until July and December 2026, respectively. Consequently, the contraction of the asset side that drives the balance sheet volume is transparent and publicly available. From 2027 to 2033, we assume that bond holdings under APP and PEPP will develop in line with median expectation from the ECB Survey of Monetary Analysts (SMA, June 2025).

In 2024, the Eurosystem completed a review of its operational framework for implementing monetary policy, outlining the key features of its balance sheet development (ECB, 2024). An important decision made during this review – besides the passive shrinkage of the asset portfolio – is that the amount of liquidity provided by the Eurosystem will be determined by banks' demand for reserves. Currently, it is the asset side that drives the size of the balance sheet, as the legacy bond holdings provide more reserves than the banks demand. These legacy assets will shrink until the supply of reserves equals their demand. From that point onward, it will be banks' demand for reserves that determines the size of the balance sheet, as long as no further unconventional monetary policy measures are used in the future. The ECB Governing Council has announced that new structural longer-term refinancing operations and a structural portfolio of securities will be introduced at a later stage. "These operations will make a substantial contribution to covering the banking sector's structural liquidity needs […]" (ECB, 2024). This announcement, however, only provides a vague indication of how the structure of the Eurosystem's asset

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[11] Assuming that the future volumes of all other assets and liabilities remain constant (see chart 3) is a simplifying assumption. This assumption primarily serves to highlight the impact that developments of monetary policy-related balance sheet items (including banknotes) have on the profit and loss position of a medium-sized central bank in the euro area. Given our focus on the impact of monetary policy on net interest income, we disregard other income and expenses incurred by central banks, such as income from other assets or operating expenses. We assume that, on average, these revenues and expenses cancel each other out and are therefore revenue neutral. Our aim is to avoid obscuring this analysis with additional assumptions concerning balance sheet items that are not related to monetary policy.

side will evolve. We therefore make a few assumptions here, too. For simplicity, we assume that the entire amount of excess reserves will be provided by main and longer-term refinancing operations, while structural operations will provide the remainder, i.e., the structural liquidity needs arising from autonomous factors and from minimum reserve requirements. As with liabilities, we make the simplifying assumption that other assets, gold, and foreign reserves will remain constant after our data cut-off date.

4.1.2   Interest rate path and portfolio yield assumptions

Having completed our projection of the future Eurosystem balance sheet, we also need assumptions about future interest rates (i.e., rates paid on the deposit facility and those to be received for refinancing operations) and the average interest income from the monetary policy portfolio. For the future development of the MRO and the DF rate, we again rely on median SMA expectations from June 2025.[12] As mentioned before, unlike the MRO and the DF rate, which are common for all EA central banks, interest earned on assets in the legacy monetary policy portfolio is in part based on the national government bond yields. Therefore, our assumptions on interest rate income from the monetary policy portfolio rely on the situation of the OeNB, which purchased most bonds in its portfolio during a period of low or negative interest rates (OeNB, 2024).

Specifically, we assume two different scenarios in which the assets purchased during the low-interest-rate period earn an average of either 0% or 0.5%. For future assets, that the Eurosystem might purchase as part of its structural portfolio, we assume that the interest earned will be the MRO rate plus a markup of 1.76 percentage points.[13]

Table 1

Projection results

Scenario	Legacy asset yield	Banknotes demand	Excess reserves	Max. losses (EUR billion)	Max. losses date	Break-even date
1	0.00%	3.20%	2.00%	10.76	July 2030	Feb. 2039
2	0.00%	3.20%	2.50%	10.74	June 2030	Jan. 2039
4	0.00%	3.20%	3.50%	10.69	May 2030	Nov. 2038
5	0.00%	0.00%	2.00%	11.25	Mar. 2031	> Dec. 2040
8	0.00%	0.00%	3.50%	11.16	Feb. 2031	> Dec. 2040
9	0.00%	-2.98%	2.00%	11.81	Jan. 2032	> Dec. 2040
12	0.00%	-2.98%	3.50%	11.71	Nov. 2031	> Dec. 2040
13	0.00%	6.54%	2.00%	10.35	Nov. 2029	Apr. 2037
16	0.00%	6.54%	3.50%	10.29	Oct. 2029	Feb. 2037
17	0.50%	3.20%	2.00%	7.15	July 2029	Sep. 2036
20	0.50%	3.20%	3.50%	7.11	May 2029	July 2036
21	0.50%	0.00%	2.00%	7.46	Mar. 2030	June 2038
24	0.50%	0.00%	3.50%	7.40	Jan. 2030	Mar. 2038
25	0.50%	-2.98%	2.00%	7.83	Jan. 2031	Oct. 2040
28	0.50%	-2.98%	3.50%	7.77	Nov. 2030	May 2040
29	0.50%	6.54%	2.00%	6.91	Dec. 2028	May 2035

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[12] This assumption implies that our results will be sensitive to changes in the expected path of interest rates.

[13] This markup is in line with the historical markup of euro area bonds over the MRO rate between January 1999 and February 2016.

| 32 | 0.50% | 6.54% | 3.50% | 6.87 | Nov. 2028 | Apr. 2035 |

Source: Author's calculations.

4.1.3 Integrating balance sheet and interest rate assumptions to estimate NII

To calculate NII, we compare interest income from monetary policy operations with interest expenses on the deposit facility. While our balance sheet projection covers the entire Eurosystem, we calculate the NII for a central bank representing 2.96% of the ECB's statutory capital – corresponding to the OeNB's capital key.
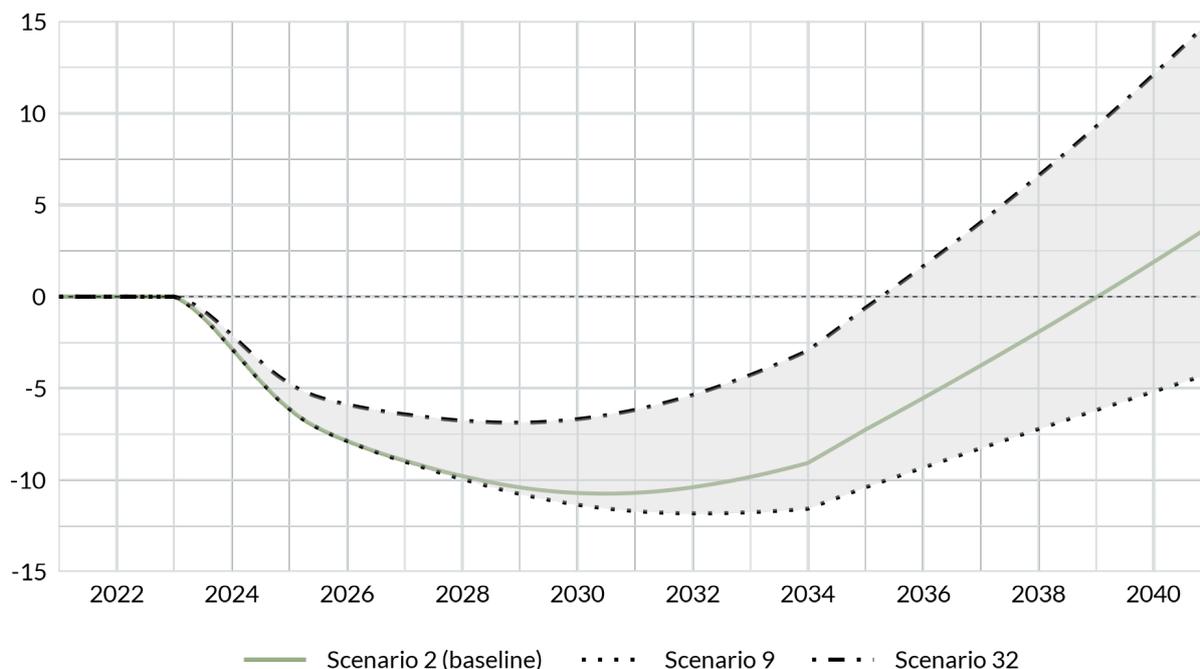
4.2 Projection results

In the following section, we discuss the resulting projections of future profits and losses under 32 different scenarios.

Chart 2

Simulated cumulative profits/losses - scenario analysis
EUR billion

Note: Latest historical observation: July 31, 2025.
Source: ECB SDW (public), author's projections.

Table 1 summarizes the key parameters of each scenario, the resulting central bank losses, and the projected recovery timelines.[14] Depending on the scenario, cumulative losses of an illustrative central bank could range from approximately EUR 6.87 billion to EUR 11.81 billion. The time required to recover these losses varies accordingly – from around ten years (until mid-2035) to more than 15 years, extending beyond 2040. Chart 2 visualizes the range of our results by plotting the most optimistic scenario (scenario 32) and the most pessimistic scenario (scenario 9). The gray shaded area captures the full range of projections, while the green line represents our baseline scenario, which we discuss in more detail below.

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[14] We show only a subset of results in the main part of this paper to increase readability and because the assumptions about excess liquidity levels have limited impact on our results. The full table is in the annex.

The wide range of possible paths of central bank losses shown in chart 2 clearly demonstrates the difficulty in assessing the future of central banks' profits and losses. Demand for banknotes, as well as commercial banks' demand for excess reserves, are taken as a given by monetary policymakers, not to mention the possibility that large exogenous shocks make it necessary to change the monetary policy stance again in the future. Nevertheless, we want to use this range of results to illustrate how different parameters of monetary policy and ingredients of the operational framework influence the profits and losses of a central bank such as the OeNB.

We first highlight the importance of our assumptions about the growth in demand for banknotes for our projections, as illustrated by the results in table 1 (and table 2 in the annex). The development of future banknotes in circulation is by far the most influential assumption in our projections. Holding all other parameters constant, the difference between our most optimistic scenario in terms of future demand for banknotes (extrapolating the historical growth rate from 1999 to the present) and the most pessimistic scenario (a negative growth rate) translates into a three-year difference in the duration of losses, and at least five and a half years in the time to fully recover them.

In contrast, variations in excess reserve levels (ranging from 2% to 3.5% of total banking assets) have a much smaller effect, shifting recovery timelines by only a few weeks (holding all other assumptions constant). While excess liquidity is important for monetary policy transmission, it plays a relatively minor role in profitability. We conjecture that both quantity and price effects are responsible for this result. For one, our banknote scenarios (ranging from −2.98% to 6.54%) provide a much larger variety in future balance sheet sizes than the relatively small variations in possible excess reserves. In addition, the interest rate differential between banknotes (which are by definition unremunerated) and interest-earning assets will be larger than that between excess reserves (which are remunerated) and interest-earning assets.

Finally, assuming a higher remuneration of the monetary policy portfolio results in lower cumulative losses and a shorter recovery period. However, since these returns are largely locked in by past purchases made during periods of low interest rates, there is limited flexibility. If future monetary policy again requires large-scale asset purchases in a low-rate environment, central banks may need to accept low returns and losses. In this context, demand for banknotes can significantly offset the impact of low asset yields.

Having discussed the general implications of our assumptions and the resulting range of projections, we now turn to what we consider our baseline projection (scenario 2 in table 1) and discuss it in further detail. We chose this specification to balance both pessimism and optimism about future developments. Specifically, we assume that banknotes in circulation will grow with the growth rate of nominal GDP, and we are less optimistic about the actual remuneration of the legacy monetary policy portfolio, assuming a 0% interest rate. In terms of the level of excess reserves in the system, we choose a level of 2.5% of total EA banking assets, although we would like to emphasize that this assumption has limited impact on the results.

Chart 3 shows the projected development of the asset side of the Eurosystem balance sheet. While the chart depicts the entire consolidated Eurosystem balance sheet, we reiterate that we calculate profit and losses on the basis of about 2.96% of this total to make our projection more comparable to the situation of the OeNB. Chart 3 depicts the consolidated asset side, highlighting the expansion of the monetary policy portfolio from 2015 onward (pale yellow) and the spikes in refinancing operations (brown) during 2008–2009, 2012 and 2020. The latter has declined significantly since the repayment of TLTRO III in 2024. These two balance sheet items have historically been the main drivers of NII.

Chart 3

Eurosystem: asset side, historical and projected (baseline scenario)
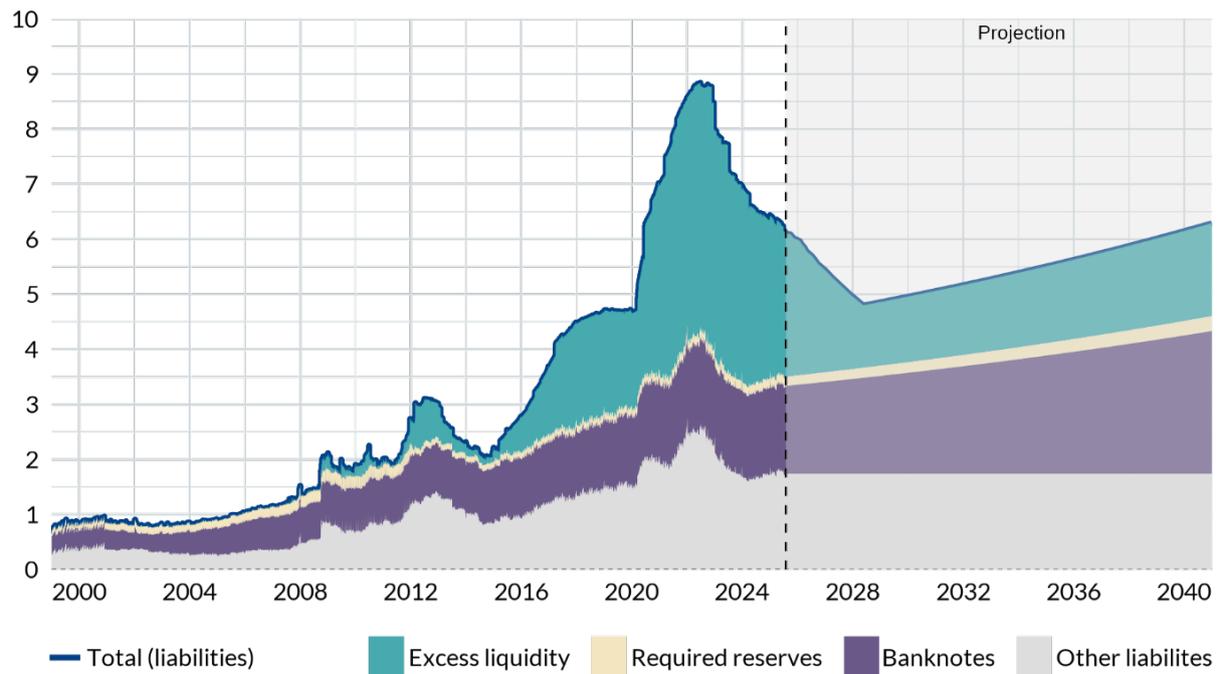EUR trillion
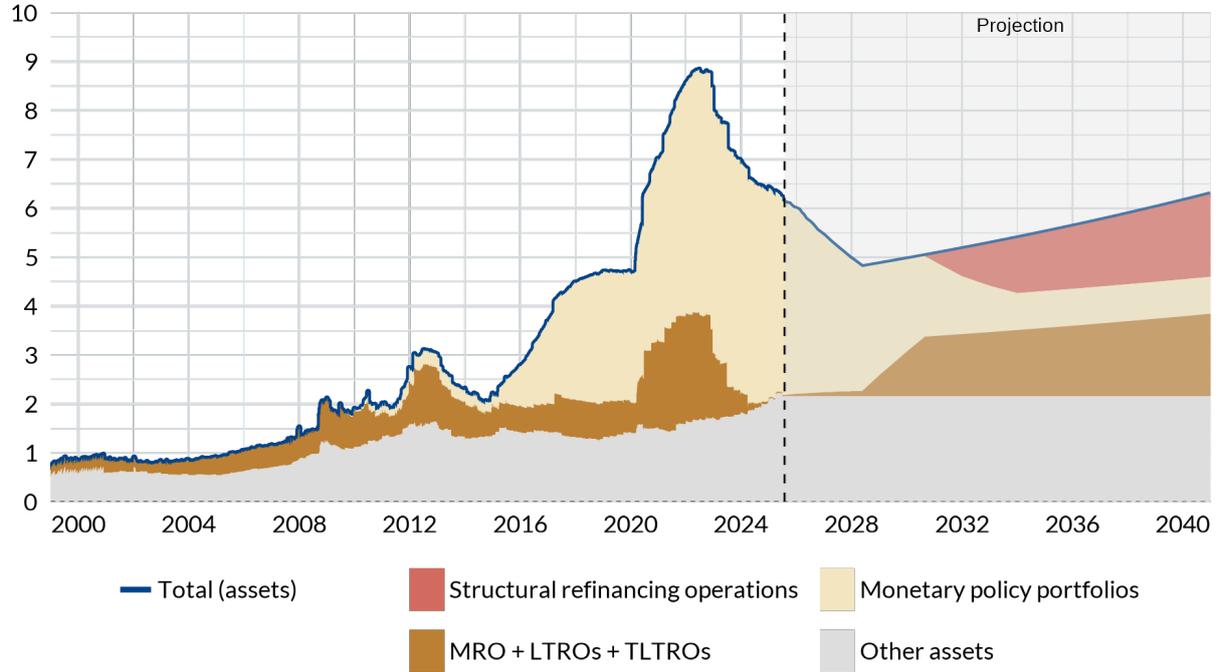
Note: Latest historical observation: July 31, 2025.
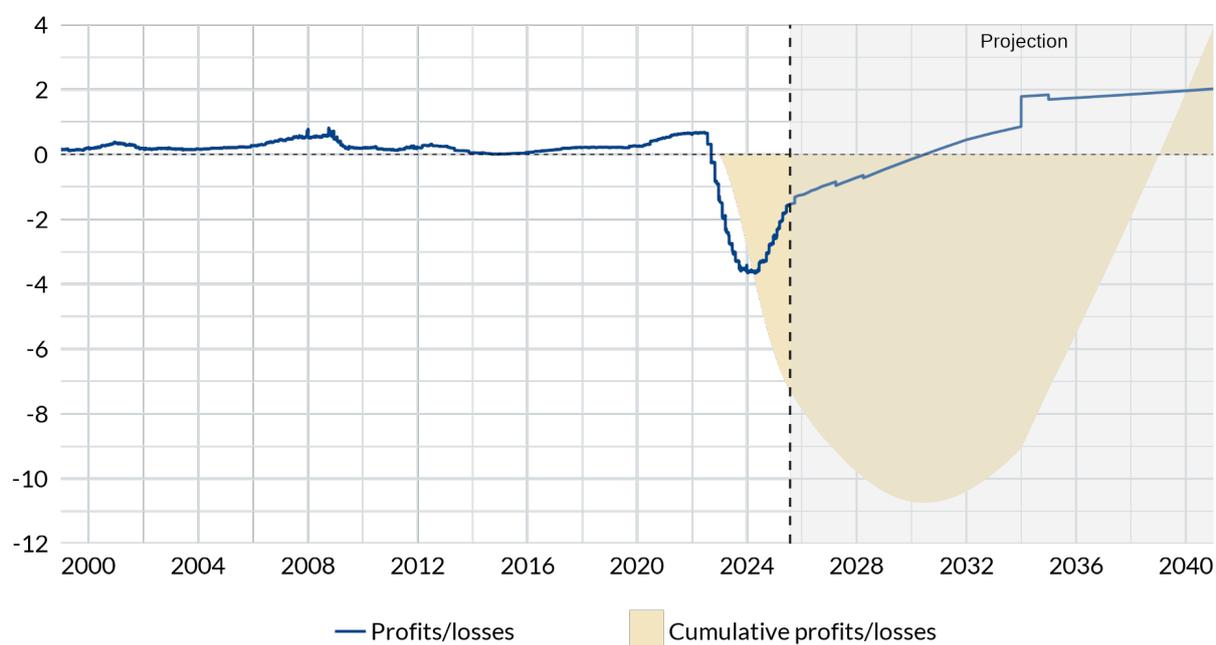Source: ECB SDW (public), author's projections.

Chart 4

Eurosystem: liabilities side, historical and projected (baseline scenario)
EUR trillion

Note: Latest historical observation: July 31, 2025.
Source: ECB SDW (public), author's projections.

Looking ahead, the monetary policy portfolio will continue to shrink. By mid-2028, excess liquidity is projected to reach 2.5% of total banking assets (turquoise in chart 4). From that point, additional liquidity will be provided through refinancing operations, which will begin to rise again. Around two years later, as the monetary policy portfolio shrinks further, structural operations will be phased in to meet remaining liquidity needs.

On the liability side of the Eurosystem balance sheet depicted in chart 4, once excess liquidity stabilizes, the size of the balance sheet will be determined by banks' demand for reserves. This, in turn, dictates the required size of the asset side to meet liquidity needs.

Chart 5

Simulated cumulative profits/losses (baseline scenario)
EUR billion

Note: Cumulative profits/losses before January 01, 2023 are assumed to be zero, based on the premise that existing reserves were used to cover previous losses. Latest historical observation: July 31, 2025.
Source: ECB SDW (public), author's projections.

Based on these balance sheet developments, chart 5 presents the projected NII and cumulative losses over time. In our baseline scenario, NII remains positive until the end of 2022. After that, losses start to accumulate, peaking around Q2 24. NII turns positive in Q2 30, allowing for a gradual recovery. Full recovery of accumulated losses is projected by Q1 39, approximately ten years after the turning point.

5   Conclusion

Central bank losses or negative capital are not inherently problematic, especially when they arise as a result of the central bank fulfilling its mandate. Unlike commercial banks, central banks can operate effectively with negative capital due to their exemption from capital requirements and their unique ability to create money. Therefore, conventional indicators of private sector success – such as profitability and capital – are not suitable measures of a central bank's performance and can be misleading.

The success of a central bank should be judged primarily by its ability to fulfill its mandate. For the Eurosystem, this means maintaining price stability – specifically an inflation rate of 2% over the medium

term. After the inflation surge in 2021/2022, the Eurosystem successfully managed to bring inflation back to target. Delivering price stability is central to the functioning of the monetary union, as it anchors expectations and enhances the transmission of policy measures. While some academic literature suggests that financial strength supports central bank independence and thus credibility, consistent policy performance remains the most critical factor in ensuring effectiveness. A positive capital base can support credibility, especially when institutional independence is fragile, but it cannot replace sustained policy execution.

Profitability is not among central banks' objectives, and the pursuit of price stability and macroeconomic welfare outweighs concerns about short- or medium-term financial performance. However, there are a few lessons to be learned from the current episode of central bank losses in advanced economies:

First, intertemporal smoothing mechanisms, such as deferred assets and automatic recapitalization through retained earnings, are effective in helping to manage central bank losses and to reduce the likelihood of political influence. However, while these tools may limit interference, they do not eliminate it entirely. If capital-weak central banks are easier targets for political pressure, then prolonging such weakness (through "stealth" recapitalizations instead of one-off recapitalizations) could itself become a source of vulnerability.

Second, demand for banknotes is a key driver of central bank profits. Therefore, future cash usage is a critical variable in long-term financial planning. Generalizing this insight also points to the importance of future use of central bank money by the public, be it via banknotes or a digital currency.

Third, excess liquidity has a limited impact on central banks' profitability. While it is important for a smooth monetary transmission, variations in excess reserves have a smaller influence on profit and losses in our projections, as we have shown in our simulation.

Fourth, asset yield assumptions significantly influence the recovery timelines in our projections. Higher yields on monetary policy portfolios can shorten the duration of losses and accelerate financial recovery, underscoring the importance of asset composition. When designing a structural monetary policy portfolio in the future, the Eurosystem will need to carefully balance the costs and benefits of high-yielding (long-term) versus low-yielding (short-term) assets, i.e., improving the financial recovery time versus a smaller risk of asset-liability mismatches in the future.

Lastly, monetary unions can offer resilience during episodes of longer sustained central bank losses. As also argued by Cardoso da Costa (2022), shared monetary policy across member states enhances independence and offers protection against idiosyncratic national pressures on central banks.

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7 Annex

Table 2

Projection results

Scenario	Legacy asset yield	Banknotes demand	Excess reserves	Max. losses (EUR billion)	Max. losses Date	Break-even Date
1	0.00%	3.20%	2.00%	10.76	July 2030	Feb. 2039
2	0.00%	3.20%	2.50%	10.74	June 2030	Jan. 2039
3	0.00%	3.20%	3.00%	10.71	June 2030	Dec. 2038
4	0.00%	3.20%	3.50%	10.69	May 2030	Nov. 2038
5	0.00%	0.00%	2.00%	11.25	Mar. 2031	> Dec. 2040
6	0.00%	0.00%	2.50%	11.23	Mar. 2031	> Dec. 2040
7	0.00%	0.00%	3.00%	11.20	Feb. 2031	> Dec. 2040
8	0.00%	0.00%	3.50%	11.16	Feb. 2031	> Dec. 2040
9	0.00%	-2.98%	2.00%	11.81	Jan. 2032	> Dec. 2040
10	0.00%	-2.98%	2.50%	11.78	Jan. 2032	> Dec. 2040
11	0.00%	-2.98%	3.00%	11.75	Dec. 2031	> Dec. 2040
12	0.00%	-2.98%	3.50%	11.71	Nov. 2031	> Dec. 2040
13	0.00%	6.54%	2.00%	10.35	Nov. 2029	Apr. 2037
14	0.00%	6.54%	2.50%	10.33	Nov. 2029	Mar. 2037
15	0.00%	6.54%	3.00%	10.31	Nov. 2029	Feb. 2037
16	0.00%	6.54%	3.50%	10.29	Oct. 2029	Feb. 2037
17	0.50%	3.20%	2.00%	7.15	July 2029	Sep. 2036
18	0.50%	3.20%	2.50%	7.14	June 2029	Sep. 2036
19	0.50%	3.20%	3.00%	7.12	June 2029	Aug. 2036
20	0.50%	3.20%	3.50%	7.11	May 2029	July 2036
21	0.50%	0.00%	2.00%	7.46	Mar. 2030	June 2038
22	0.50%	0.00%	2.50%	7.44	Mar. 2030	May 2038
23	0.50%	0.00%	3.00%	7.42	Feb. 2030	Apr. 2038
24	0.50%	0.00%	3.50%	7.40	Jan. 2030	Mar. 2038
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26	0.50%	-2.98%	2.50%	7.82	Dec. 2030	Sep. 2040
27	0.50%	-2.98%	3.00%	7.79	Nov. 2030	July 2040
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30	0.50%	6.54%	2.50%	6.90	Dec. 2028	May 2035
31	0.50%	6.54%	3.00%	6.89	Dec. 2028	Apr. 2035
32	0.50%	6.54%	3.50%	6.87	Nov. 2028	Apr. 2035

Source: Author's calculations.