



The economic contribution of tech diffusion in the EU

An empirical perspective on
EU-US interdependence

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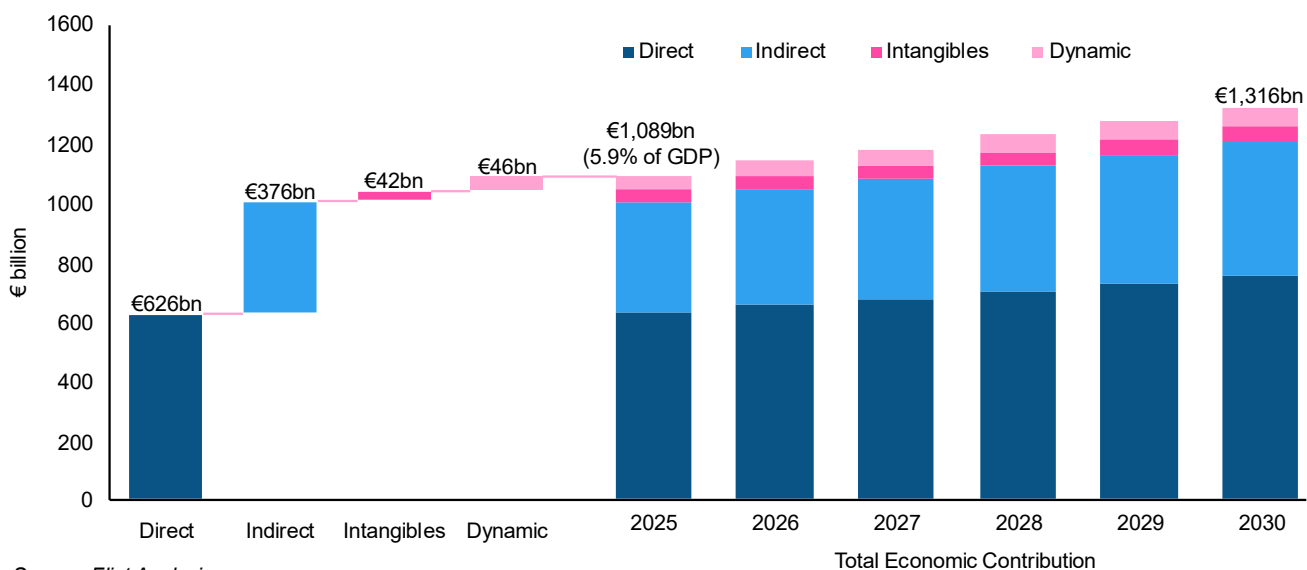
Executive Summary

The debate on how to revive Europe's declining economic competitiveness is increasingly framed through the lens of innovation and technology. The 2024 Draghi report identified a widening innovation gap as a key cause of the EU's economic struggles, and argued that accelerating the adoption and diffusion of advanced technologies will be essential to closing it.¹ At the same time, a rapidly growing discussion is focusing on how to improve the EU's 'technological sovereignty', in the face of the perceived political and economic risks of strategic dependencies on international supply chains and technology providers. As European policymakers try to reconcile their competitiveness and sovereignty objectives, it is crucial for them to base their decisions on a clear understanding of the costs and benefits of their policy decisions.

To this end, this report quantifies the economic value to the EU of continued access to the international diffusion of advanced technologies. The results show that interdependence with global technology providers, including those based in the US, already delivers large economic benefits to the EU and, if sustained, will increasingly do so in a context of accelerating innovation, largely driven by AI. Modelling the economic contribution of US-origin technologies focuses on three components (see Figure 1):

- The direct and indirect gross value added (GVA) of US technology companies operating in the EU and their supply chains contributes about €1.0tn in 2025 (5.4% of GDP).
- The role of intangible capital – non-physical assets such as software, data and organisational practices – adds a further €42bn by enabling adopting firms to increase productivity by reorganising and innovating more effectively.
- Dynamic productivity gains from the continued diffusion of advanced technologies are estimated to generate a permanent uplift of 0.25% in GDP, equivalent to €46bn in 2025 and €66bn by 2030.
- The overall contribution of US technology to the EU economy is projected to rise from today's footprint of €1.1tn (5.9% of GDP) to €1.3tn by 2030. This means forgoing just 15% of that future economic value over five years comes at an annual cost of €200bn (almost 1% of GDP) in 2030.

Figure 1: Contribution of US technology to the EU economy, 2025-2030



¹ Draghi (2024), [The future of European competitiveness](#).



The results put numbers on a simple but powerful intuition: the economic value of technology arises not just from invention, but also from how quickly it is adopted and how widely it is diffused. To put our results into context, McKinsey estimates that widespread AI adoption could raise European productivity by up to 3% per year through 2030, equivalent to a cumulative €4tn of additional EU GDP relative to baseline projections (or an annual average of around €800bn).² While that figure represents an upside scenario, it illustrates that potential impacts from technological change are of a similar order of magnitude to our results.

The report also shows that contrary to a common misconception, Europe itself is far from being merely a recipient of foreign technologies. Instead, it remains a leading exporter of digital services and home to important industrial and research capabilities, thanks to its international partnerships and participation in the global digital economy.

However, the conclusions of the Draghi report and the EU's performance against its own digital adoption targets make clear that openness to global technology by itself is not enough to close the competitiveness and innovation gap. As the European Commission's State of the Digital Decade 2025 report makes clear, this also requires complementary investment in skills, R&D and intangible assets, and institutions that encourage innovation, competition and adoption. Without these, the ability to both develop and adopt new technology is limited – in line with Draghi's identification of weak diffusion as a key reason for the EU's productivity gap.

The overall picture then is more nuanced than is sometimes portrayed. Europe's competitiveness challenge is rooted in its innovation gap. In a context of rapid technological innovation, the adoption and diffusion of advanced technology will remain central to plugging that gap, which requires maintaining a degree of openness to global technology flows. But that must be paired with investing in the domestic capabilities that allow firms and workers to develop and use technologies effectively. Interdependence has already delivered large benefits to the EU economy. With the right policies and investments, it can continue to do so, turning global innovation into European growth.

² McKinsey (2024), [Time to place our bets: Europe's AI opportunity](#).



1 Introduction

1. As the EU seeks to close the growing competitiveness and innovation gap identified in the 2024 Draghi report,³ an important economic and policy debate has emerged about the value of technology transfer and diffusion, where economics and geopolitics can push in different directions:
 - **Economic theory and empirical evidence points to the international diffusion of frontier technologies as a critical factor driving productivity growth.** In line with the Draghi report's recommendations, the European Commission's Competitiveness Compass of January 2025 notes that the root cause of why Europe has fallen behind the US in advanced technologies is a "*lack of innovation*" and a failure to "*integrate [new] technologies into its industrial base*". It further argues that "*digitalisation and diffusion of advanced technologies across the European economy are [a] necessary ingredient to lift Europe's productivity growth*", with 70% of new economic value created in the next decade digitally enabled.⁴
 - **Against this, in a context of rising geopolitical tensions, trade barriers and supply chain disruptions, attention has turned to the EU's 'innovation gap' with the US and China, as identified by Draghi, and to the associated risks for Europe's security and resilience.** Parallel to its efforts to boost its digital competitiveness, the EU is increasingly embarking on a tech and digital sovereignty agenda that partly seeks to reduce its exposure to international dependencies – especially in certain types of 'high risk' digital use cases.
2. While digital competitiveness and sovereignty can seem like opposing objectives, they are often two sides of the same coin. Indeed, as the European Commission recently pointed out in its *International Digital Strategy for the EU* that "*For the EU's competitiveness, economic security and defence capacity, it is crucial to closely cooperate with our partners and tech allies to enhance the ability of European tech companies to innovate and grow globally.*"⁵
3. As they attempt to reconcile these two objectives, it is crucial for EU policymakers to have a clear picture of the contribution of international technology diffusion to the EU economy, and the potential economic cost of higher barriers to diffusion. This report seeks to achieve that, with a focus on the diffusion of US-origin technologies, reflecting both the role of US firms in driving technological innovation over the past two decades and the role of US technology in the current EU policy debate.
4. Others have reached the same conclusion.⁶ A report from CERRE highlights "*an unwillingness to openly acknowledge and confront the complex relationship between competitiveness and digital sovereignty*". It calls for policymakers to "*quantify both the likelihood and consequences of [particular threats to sovereignty] materialising*" (i.e. the benefits of sovereignty policies) and "*the costs which will be borne by the private sector, for example where European companies face fewer choices of supplier or might be less willing to adopt new technologies*". This report seeks to fill a gap in quantifying the second of these – what CERRE describes as "*The direct costs and the long-term productivity costs*" that "*need to be understood*".
5. The analysis in the report is underpinned by an economic modelling framework that quantifies both the current footprint of US technologies in the EU economy and their longer-term benefits. We draw on research on tech spillovers and diffusion to estimate the productivity gains associated with the adoption of new technologies, applying an approach using a total factor productivity elasticity.

³ Draghi (2024), [The future of European competitiveness](#).

⁴ European Commission (2025), [A Competitiveness Compass for the EU](#).

⁵ European Commission (2025), [International Digital Strategy for the EU](#).

⁶ Meyers (2025), [Can the EU reconcile digital sovereignty and economic competitiveness?](#) CERRE; and Kantor and Irurzun (2025), [Friends with \(digital\) benefits: examining the EU's strategic tech ties](#), Politico.



6. The remainder of this report is structured as follows:

- Section 2 examines Europe's position in the global technology economy.
- Section 3 quantifies US technology's contribution to the EU economy, which is split into two components: a 'static' measure of its current economic footprint; and a 'dynamic' measure that factors in the longer-term productivity gains that arise from the benefits of tech diffusion.
- Section 4 concludes.

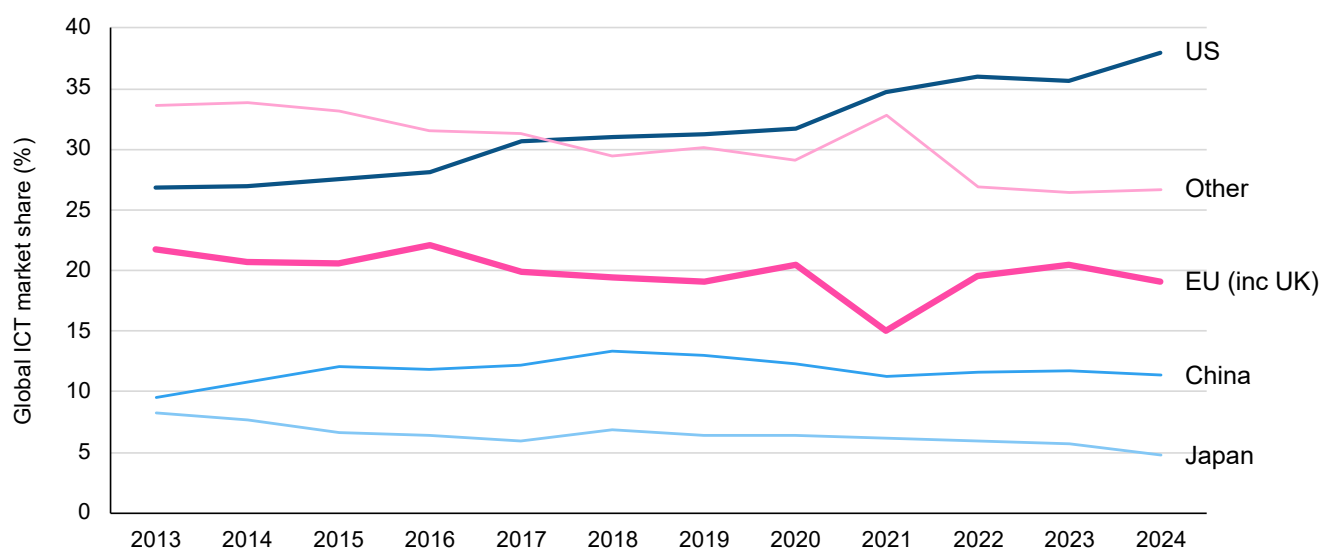
2 Assessing the EU's reliance on external technology

7. This section examines Europe's position in the global technology economy. It first reviews international trends in information and communication technology (ICT) markets and research investment. It then considers the EU's performance against its digital adoption targets, before turning to the role of transatlantic trade in digital services. Taken together, these perspectives provide a balanced view of the opportunities and challenges shaping Europe's digital competitiveness.

The evolving global technology landscape

8. In global ICT markets as a whole, the position of US companies is a relatively recent development (as Figure 2 shows). In 2013, the US lead over the EU was just a few percentage points but by 2024 the US market share was twice that of the EU, with an almost continuous divergence over the period. China has also expanded its presence in ICT markets over the past decade – though its rise has been more gradual compared with the sharp gains made by the US – while Japan's share has followed a similar downward trajectory to the EU.

Figure 2: Global market share for information, communication and technology, 2013-2024⁷



Source: Bitkom; IDC; EITO (via Statista)

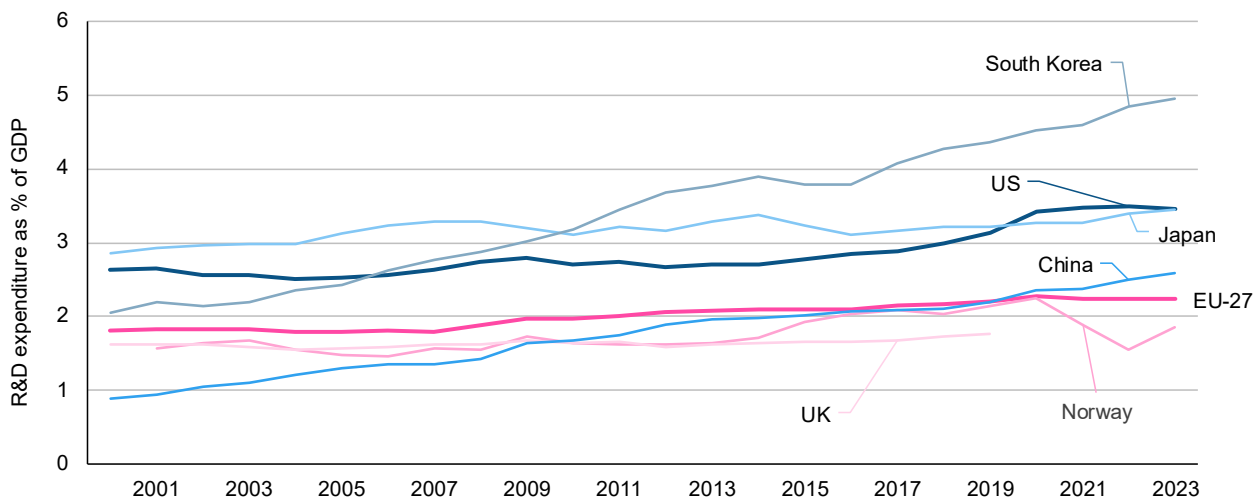
9. It is a similar story when comparing R&D expenditure as a share of respective economies (Figure 3). On this metric, it is the EU's relatively slow rate of increase compared to the US and others that drives

⁷ Figure 2 data sourced from Bitkom via [Statista](#).



the divergence, meaning the EU's share of the global R&D market is also declining. Once again, the EU-US gap has widened since 2013 after narrowing during the 2000s and early 2010s.

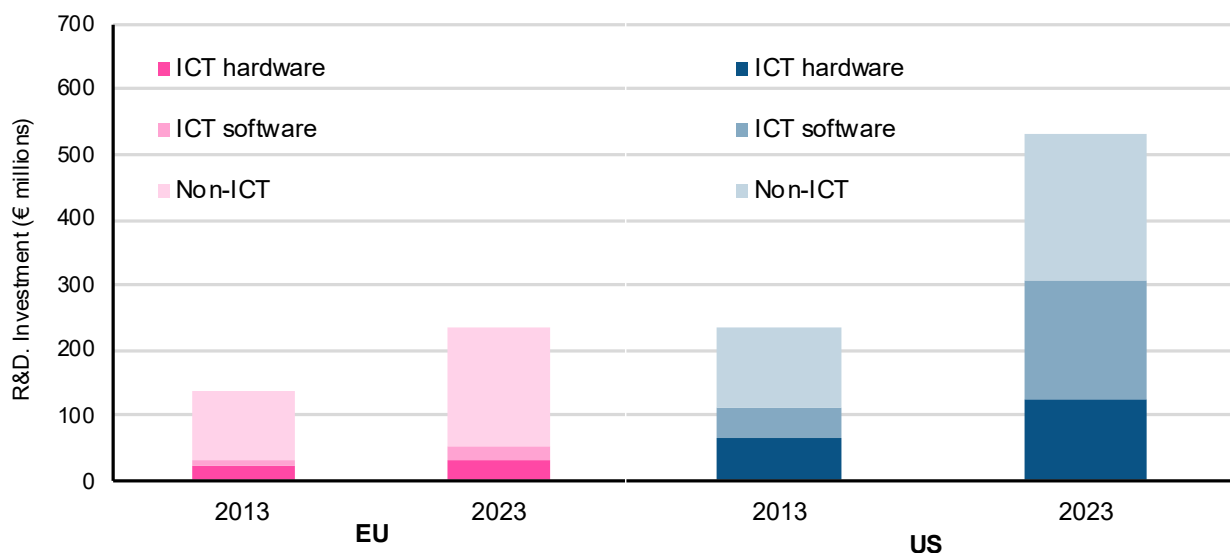
Figure 3: Gross domestic expenditure on R&D, 2000-2023⁸



Source: Eurostat

10. Figure 4 compares the EU and US levels of global R&D investment in ICT in 2013 and 2023.⁹ This confirms that R&D in the EU has grown by less than it has in the US but also that the growth of R&D in ICT has been particularly disappointing. In 2013, expenditure on R&D in ICT in the US was 3.7 times higher than it was in the EU, but by 2023 it was six times more. And the gap has widened two and a half times more in software than it has in hardware.

Figure 4: EU and US R&D investment in ICT, 2013 and 2023



Source: The 2024 EU Industrial R&D Investment Scoreboard. European Commission

11. Figure 5 illustrates the global importance of US technology in three key sectors. In public cloud, nine of the top ten vendors are US firms. In semiconductors, the US remains the most important source,

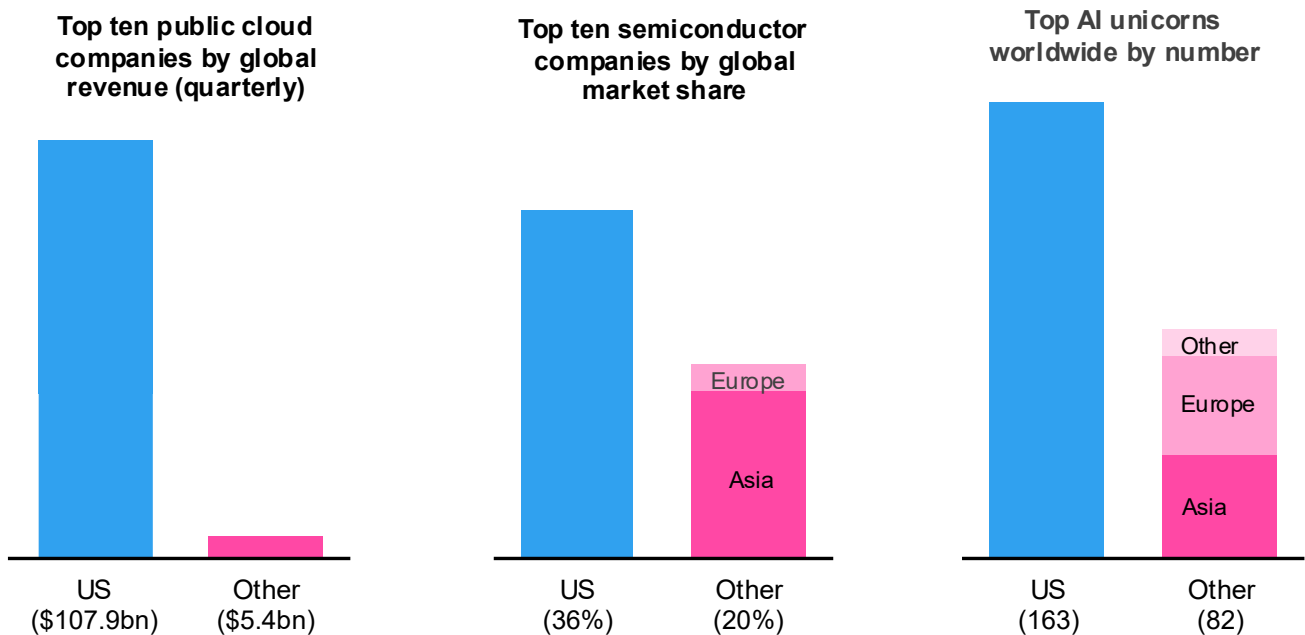
⁸ Figure 3 data sourced from [Eurostat](#).

⁹ Figure 4 data sourced from [European Commission](#).



with 7 out of the top 10 companies by global market share, with mostly Asian (as opposed to EU) alternatives.¹⁰ In AI unicorns, the US again leads, though the distribution is less skewed.¹¹

Figure 5: The importance of US companies in selected technology sectors



Source: Cloudwars, Gartner, CB Insights (via Statista)

The EU's technology innovation gap

12. Across cloud infrastructure, corporate R&D and venture scale-ups, the US remains the primary source of the digital technologies used in Europe: US-headquartered firms invest over twice as much in corporate R&D as EU peers,¹² and Europe still faces a pronounced late-stage financing gap.¹³ This highlights a component of the innovation gap in the EU, something implicitly acknowledged by several of the EU's 'competitiveness' key performance indicators (KPIs) that focus on accelerating technological adoption and digital transformation by the 2030 target date. More broadly, this digital gap forms part of the wider 'innovation deficit' highlighted in the Draghi report as a central cause of the EU's lagging competitiveness.¹⁴
13. Figure 6 shows that, based on the most recent data, which relates to 2023, meeting these technology-based KPIs appears very challenging.¹⁵ For example, adoption of data analytics, cloud computing and

¹⁰ Data sourced from Gartner via [Statista](#).

¹¹ A unicorn company is defined as a privately held startup valued at \$1 billion or more. It predominantly applies to the technology sector due to its potential for rapid scale-up. Data sourced from CB Insights via [Statista](#).

¹² The [European Commission's Industrial R&D Investment Scorecard](#) finds that US-headquartered companies invested €526.5bn in R&D in 2023, more than double the €219.2bn invested by EU-based firms (and double that for Chinese firms too). It also shows that US (and to a lesser extent Asian) tech companies invest particularly heavily in R&D.

¹³ A [report by the European Parliament Think Tank](#) highlights the persistent late-stage funding gap in Europe and notes that the US has around eight times as many unicorns as the EU (China has three times more), underscoring Europe's weaker scale-up pipeline.

¹⁴ Draghi (2024), [The future of European competitiveness](#).

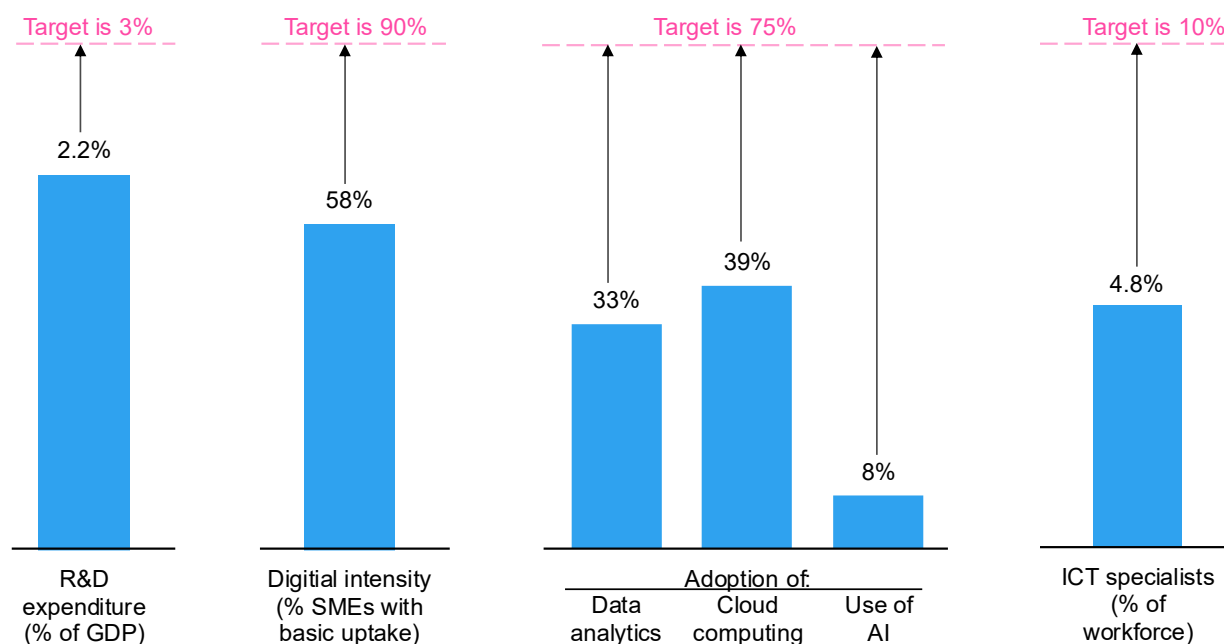
¹⁵ European Commission (2025), [Key Performance Indicators: Overview of Resilience Measure by Selected Global Players](#).



use of AI are well below the 75% target that was set in the Digital Decade 2030 programme¹⁶ – though they are trending upwards.¹⁷

14. Figure 7 looks in more detail at the digital intensity of SMEs, to give a sense of the scale of the challenge. Only in 3 of the Member States can the majority of SMEs be classed as having high or very high digital intensity – the EU-wide average is 27%. Even though the goal of the KPI in this area is less ambitious – focusing on SMEs achieving a ‘basic’ (as defined in the Digital Decade policy programme) rather than ‘high’ level of digital uptake – it currently stands at 58%, well short of the 90% target, though again, this is up from 55% in 2021.

Figure 6: Technology-based KPIs, 2023 data compared to Digital Decade 2030 targets



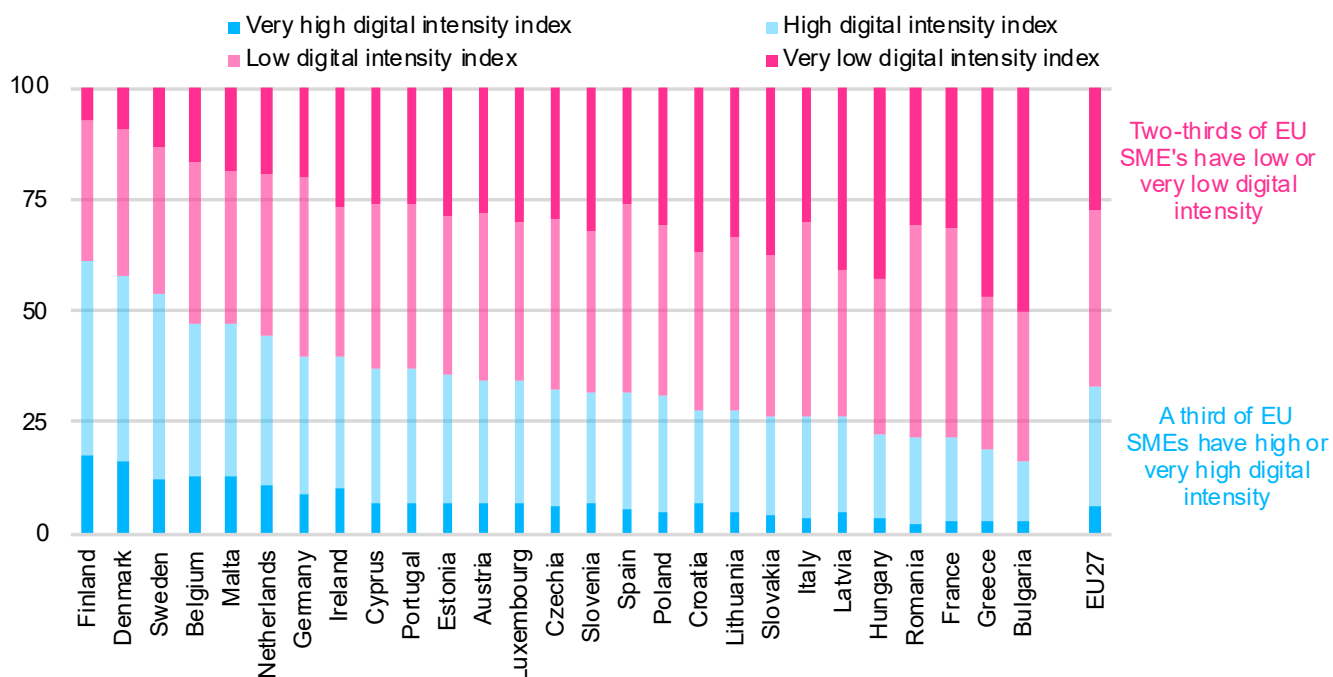
Source: European Commission, Key Performance Indicators, 2025

¹⁶ European Commission, [Europe's Digital Decade: digital targets for 2030](#).

¹⁷ The cloud KPI rose from 34.0% in 2021 to 38.9% in 2023, the data KPI from 14.2% in 2020 to 33.2% in 2023. The AI KPI has only marginally increased, from 7.6% in 2021 to 8.0% in 2023, though we might expect more recent data to show an upward trend given the pace of movement in this area.



Figure 7: Low digital intensity of EU SMEs



Source: Eurostat

Trade in digital services

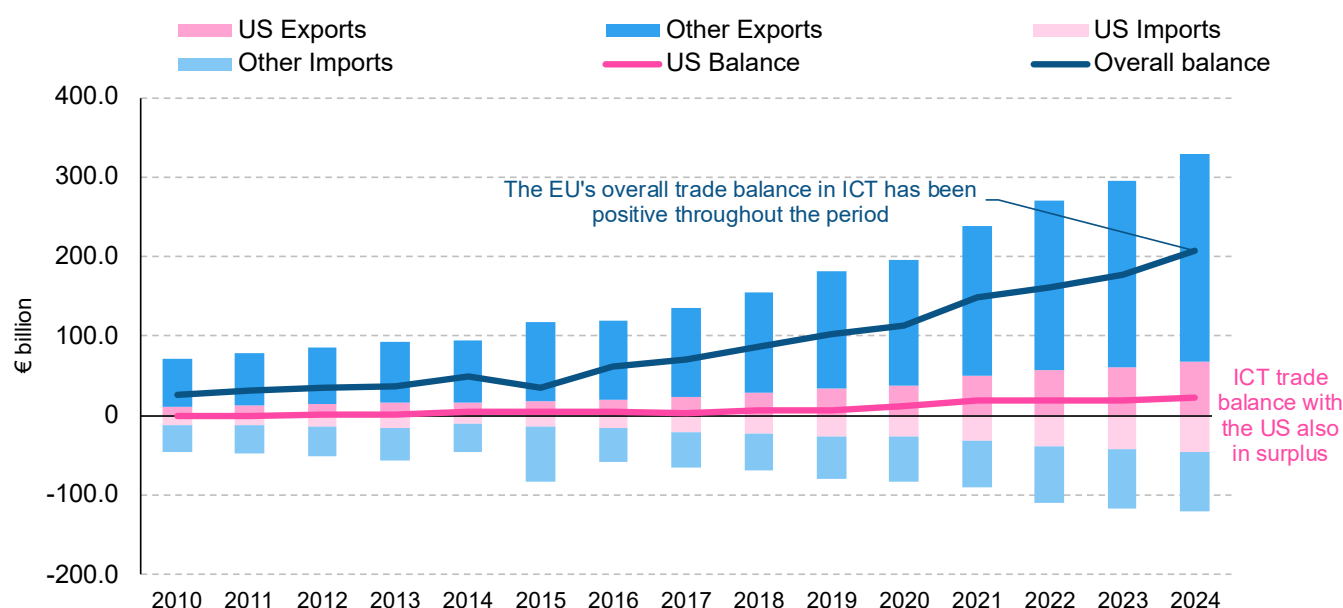
15. Debates on EU-US tech relations often emphasise competition and perceived imbalances, but the evidence shows that trade in digital services is both substantial and mutually beneficial. Contrary to a common misconception, the EU in fact records a consistent surplus in its ICT trade, including with the US. Trade data also indicate that the EU is a leading global exporter both of ICT services and of digitally delivered services more widely (Figure 8).¹⁸
16. Part of this measured surplus reflects the way multinational firms account for cross-border transactions, with revenues sometimes routed through European subsidiaries. This further emphasises the underlying reality that transatlantic digital trade is highly integrated, with supply chains and revenues flowing in both directions. The increasing value of ICT to the EU economy also reinforces the importance of openness to trade and investment. While the US records a surplus in overall services trade with the EU, the EU's surplus in ICT services points to areas of strength within Europe's digital economy, showing that the relationship is not wholly one-sided despite the broader digital innovation gap.¹⁹

¹⁸ 'Digitally delivered services' are a broader category than 'ICT services'. According to WTO and UNCTAD, ICT services comprise telecommunications, computer and information services. By contrast, digitally delivered services include *all* services supplied remotely over ICT networks – encompassing ICT services but also financial, professional, intellectual property and other services that can be transacted digitally.

¹⁹ See, for example, [Chapter 2](#) in AmCham EU (2025), [The Transatlantic Economy 2025](#), which reproduces data from the Bureau of Economic Analysis.



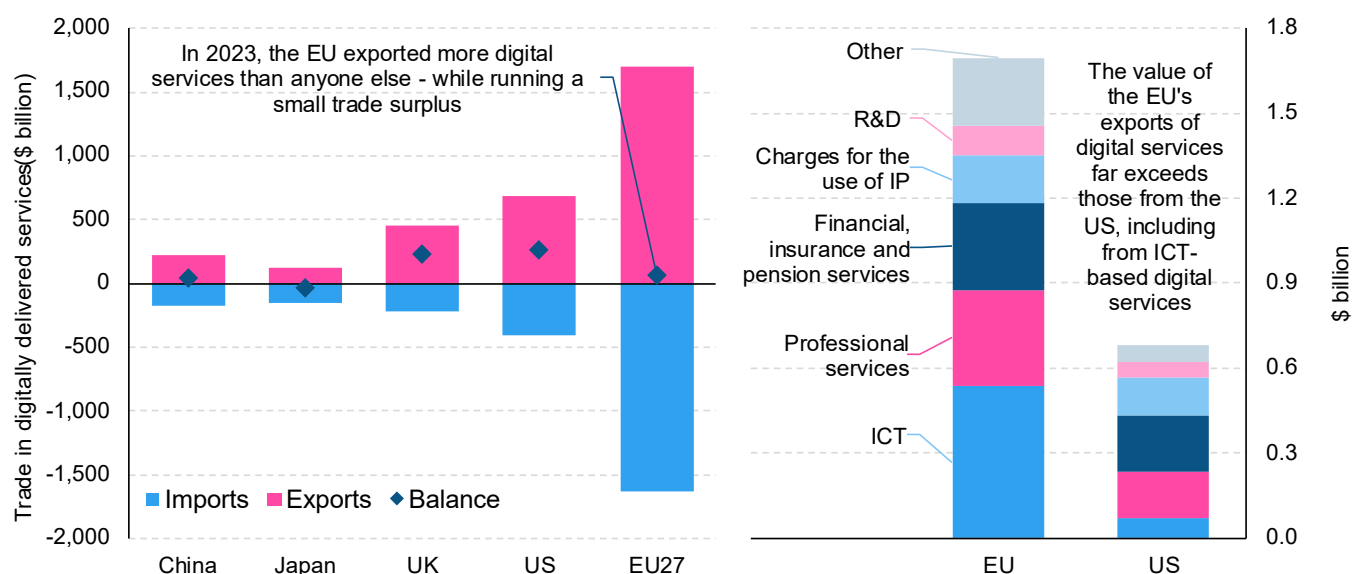
Figure 8: The EU's surplus in ICT trade



Source: Eurostat

17. The EU is not only competitive in transatlantic digital trade but also remains the world's largest exporter of digitally delivered services. Trade data show that European firms consistently lead global exports in telecommunications, computer and information services, ahead of both the US and Asia (Figure 9). This strength reflects a diverse set of digital champions, from enterprise software and industrial platforms (SAP, Siemens) to consumer-facing applications (Spotify, Nokia, Ericsson) and a strong base in financial and professional services, all of which are delivered digitally to markets worldwide.

Figure 9: Global comparison of trade in digitally delivered services



Source: UNCTAD

18. Europe's position in the digital economy reflects both strengths and challenges. International comparisons highlight the scale of global competition and the persistence of the EU's digital adoption gap, while trade data show that Europe is also a major exporter of digital services and benefits from



deep integration with the US. The picture that emerges is not one of one-sided dependence but of interdependence, in which openness to global technology flows has been a source of competitiveness for Europe. Recognising this balance is important: it underlines that policies which preserve openness and facilitate diffusion are likely to strengthen, rather than weaken, the EU's long-term digital performance.

3 How much does US technology contribute to the EU economy?

19. In economic theory, the case for openness in technology trade and adoption is clear. Access to frontier technologies allows firms to specialise, adopt best-in-class tools and benefit from knowledge spillovers that diffuse across the economy. These dynamics raise productivity and competitiveness, while restrictions or fragmentation risk higher costs and slower diffusion. This section develops this argument in more detail, drawing on economic theory and evidence to show how openness fosters diffusion and supports long-term growth, before quantifying the contribution that US technology makes to the EU economy.

3.1 Importance of technology and innovation in long-term prosperity

20. Technological progress has long been recognised as a central driver of economic growth. Classical models treated it as an exogenous source of higher output per capita, while endogenous growth theory placed innovation, knowledge accumulation and human capital at the core of growth dynamics. These models show that policy and investment choices can influence the pace of innovation and diffusion, and that economies may achieve increasing returns to scale from ideas. Annex A provides a literature review of the economics of technology transfer and economic growth.
21. Much of the impact of technology comes not from invention alone but from how quickly and widely new tools and practices are adopted – this is as true for highly advanced economies like the EU as it is for more developing ones. Productivity growth depends on firms' and workers' ability to integrate innovations into production, management and everyday activity. For Europe, the diffusion of advanced technologies – many originating in the US – has been an important source of competitiveness, helping to limit rather than widen the performance gap with the US.
22. Technology transfer occurs through multiple channels – trade in advanced goods, foreign direct investment, skilled migration, licensing and international research partnerships – but its benefits depend on absorptive capacity, skills and institutions. An enabling policy framework can accelerate diffusion, while fragmentation or weak regulation can slow it. Annex A develops these mechanisms in more detail, but the implication is clear: technological openness and investment in skills and R&D are essential for tech diffusion to continue to drive productivity growth, including for Europe.

3.2 How much does US technology contribute to today's EU economy?

23. To assess the economic contribution of US technology to the EU, we distinguish between several measurable impacts that form the basis of a backward-looking assessment of realised economic value. The next section builds on this by considering the longer-term, dynamic gains. The first two elements are the direct and indirect measures of gross value added (GVA), which reflect the contribution of US technology firms and their supply chains to output across the EU economy. The third relates to how US technologies enable the accumulation and use of 'intangible' capital, such as software, data systems, and organisational capabilities, which play a growing role in driving productivity.



Direct and indirect GVA

24. GVA is the value of goods and services produced in an economy, sector, or region, and is calculated by subtracting the cost of inputs from the value of total output. It is a key component of Gross Domestic Product (GDP), which can broadly be thought of as GVA plus government taxes less subsidies on products. Taking the two measures of GVA in turn:

- **The direct GVA from the US component of the ICT sector** is a good approximation of its current economic footprint and can be sourced from Eurostat statistics. Figure 10 (first column) shows that this element amounts to €0.6tn in 2025 (3.4% of EU GDP).
- **The indirect GVA from the US share of the EU's ICT sector** captures the economic ripple effect through its associated supply chains. This element can be derived from Eurostat input-output tables using what is known as a Type I multiplier.²⁰ Figure 10 (second column) shows that this adds a further €0.4tn in 2025 (2.0% of EU GDP).

25. Taking these direct and indirect sources of GVA together, the total contribution from ICT sector output and the supply chain comes to €1.0tn in 2025 (5.4% of GDP).

The role of intangible capital

26. Beyond the direct value-added contributions of ICT, one of the most powerful channels through which tech diffusion raises productivity is its interaction with intangible capital. **Investments in software, organisational know-how, data, design and brand equity complement ICT adoption, allowing firms to reorganise production, scale efficiently and capture knowledge spillovers.** In growth theory, this is consistent with models of increasing returns to scale from ideas, where intangible capital amplifies the benefits of technological innovation and diffusion.

27. Empirical studies of the EU economy confirm that intangible assets play a critical role in translating ICT investment into productivity gains. Corrado et al. (2014) estimate strong complementarities between ICT and intangibles, with interaction effects in the range of 0.11 to 0.15 – meaning that where intangible intensity is higher, a given ICT deepening delivers markedly larger productivity gains.²¹ They also find substantial intangible capital spillovers across firms, with elasticities around 0.25, with non-R&D components such as design, training and organisational capital especially important. These results imply that productivity effects are not just additive but multiplicative: ICT adoption is most effective when supported by complementary investments in organisational and human capital.

28. The wider literature reinforces these findings. Firm-level evidence from the US (Rincon et al, 2013) suggests inter-industry ICT spillovers in the 0.1 to 0.2 range.²² Studies of knowledge spillovers, building on the classic insights of Hall²³ and Lucas,²⁴ suggest externalities can be large. For example, Moretti (2004) finds education spillovers that imply higher elasticities, providing a useful benchmark for more optimistic scenarios.²⁵ R&D spillover elasticities tend to be lower – around 0.1 – as per Griliches²⁶ and

²⁰ This method is widely used by economists to measure how activity in one sector supports jobs and output in others. It uses official Eurostat data to trace the knock-on effects through supply chains – for example, how investment in ICT leads to more demand for equipment, services, and other inputs. The Type I multiplier is a standard way to estimate these indirect effects and is based on the best publicly available data for the EU economy.

²¹ Corrado, Haskel, Jona-Lasinio, Iommi (2014), [Knowledge spillovers, ICT and productivity growth](#), Oxford Bulletin of Economics and Statistics.

²² Rincón, Vecchi, Venturini (2013), [ICT as a general purpose technology: spillovers, absorptive capacity and productivity performance](#), NIESR Discussion Paper No. 416.

²³ Hall (1988), [The Relation between Price and Marginal Cost in U.S. Industry](#), Journal of Political Economy.

²⁴ Lucas (1988), [On the Mechanics of Economic Development](#), Journal of Monetary Economics.

²⁵ Moretti (2004) finds that a one-percentage-point increase in the share of college graduates in a city is associated with a 0.5-0.7% increase in plant productivity, implying relatively larger elasticities and providing a useful upper-bound benchmark for knowledge spillovers, even though the estimates are based on education rather than ICT per se. Moretti (2004), [Workers' Education, Spillovers, and Productivity: Evidence from Plant-Level Production Functions](#), American Economic Review.

²⁶ Griliches (1992), [The Search for R&D Spillovers](#), Scandinavian Journal of Economics.



successors, as summarised in Hall et al (2009),²⁷ but these nonetheless highlight the systemic importance of diffusion. Importantly, ICT spillovers also exhibit time dynamics: Rincon et al. show that intra-industry effects may take up to five years to turn positive, underlining the lag between investment and realised productivity gains.

29. A European Commission study notes that “*Econometric estimates confirm that... [a]... percentage point of additional growth of intangible capital tends to be associated with about 0.15-0.2 percentage points of additional TFP growth*”.²⁸ In practical terms, this means that when firms invest more in intangibles such as software, training or organisational capital, they are able to use their resources more efficiently, so that overall output rises faster than the growth of measured inputs – what economists call total factor productivity (TFP).
30. Applying the impact of intangible capital deepening adds a further €42bn to the estimate of how much US technology contributes to the EU economy today (third column of Figure 10).²⁹ These three static components sum to €1.0tn across the three components (5.6% of EU GDP).

Consumer welfare

31. Beyond the measured economy of GVA statistics, consumers also derive substantial non-monetary value from access to these technologies. These ‘consumer surplus’ effects, while not captured in GDP or productivity statistics, add materially to broader economic benefit. Many of the most widely used digital services – including search engines, messaging services, cloud storage and generative AI applications – are provided at low or zero monetary cost but deliver benefits that consumers value highly.
32. Research suggests that consumers derive annual surplus values that range, conservatively, from €100 to €300 per user for such services.³⁰ Applying the midpoint value to an estimated 300 million EU users yields an annual consumer surplus of €60bn. While this figure does not appear in GDP accounting, it does represent a substantial welfare gain that reinforces the broader economic rationale for maintaining open channels of digital and technological exchange. At the same time, estimates of consumer surplus are inherently uncertain: they depend on survey-based valuations and may not fully capture long-term substitution effects or dynamic market adjustments.³¹

²⁷ Hall, Mairesse, Mohnen (2009), [Measuring the returns to R&D](#).

²⁸ Nikolov et al (2024), [Mid-tech Europe? A sectoral account on total factor productivity growth from the latest vintage of the EU-KLEMS database](#), European Commission.

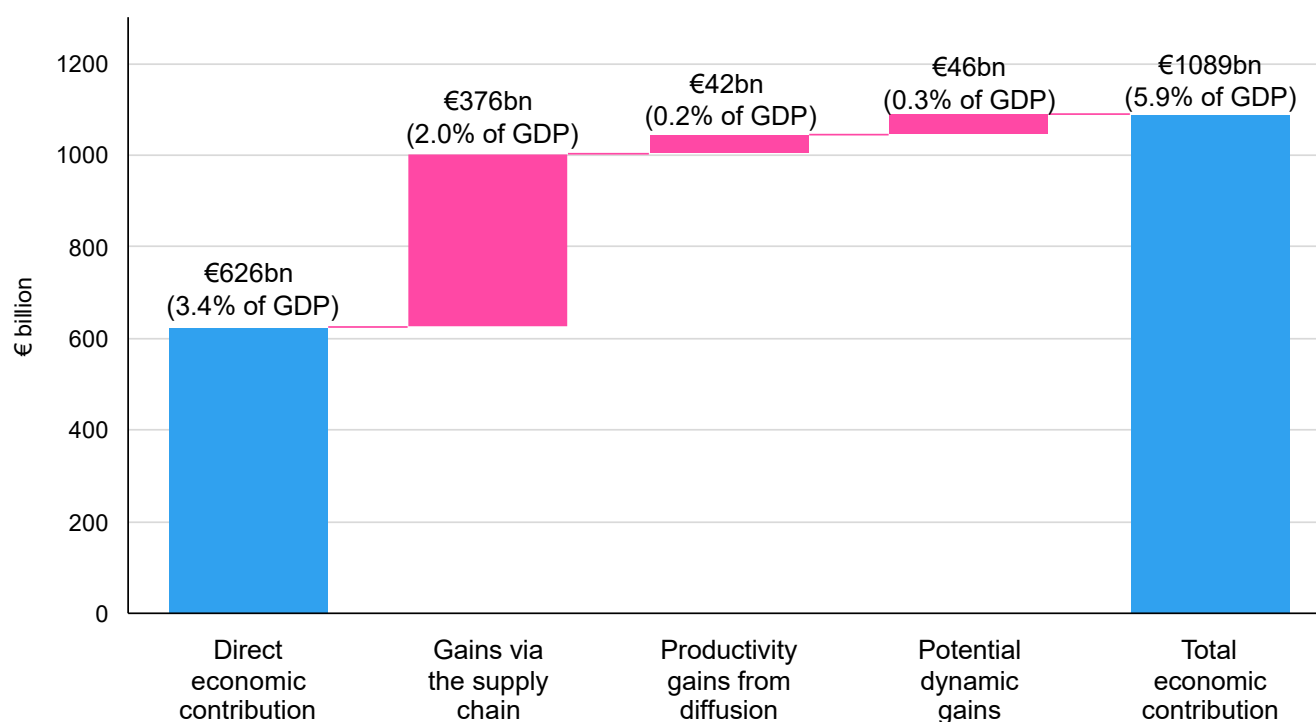
²⁹ The estimate follows a standard growth accounting approach, which attributes labour productivity growth to increased use of capital per worker (including intangible assets) and improvements in efficiency. By combining data on intangible capital growth with empirical estimates of how strongly it contributes to productivity, we calculate the share of output growth attributable to intangible investment. This method is widely used in academic and institutional studies, including Corrado et al. (2012), [Intangible capital and growth in advanced economies: measurement methods and comparative results](#), IZA Discussion Paper; and Corrado et al (2017), [Knowledge Spillovers, ICT and Productivity Growth](#), Oxford Bulletin of Economics and Statistics.

³⁰ Brynjolfsson et al (2018), [Using massive online choice experiments to measure changes in well-being](#), NBER Working Paper.

³¹ Brynjolfsson et al make this observation themselves. Coyle and Nguyen also note the limitations of willingness-to-pay survey methods (Coyle and Nguyen, 2023, [Free Digital Products and Aggregate Economic Measurement](#), *Economie et Statistique / Economics and Statistics*).



Figure 10: US technology's contribution to the EU economy in 2025



Source: Flint Analysis

3.3 How much might US technology contribute in the long term?

33. While the direct, indirect, and productivity-based effects offer a robust estimate of the realised economic contribution of US technology to the EU economy today, they represent *backward-looking* accounting – a snapshot of the observable gains that have already materialised. Similarly, consumer surplus (though a non-market measure) is also a measure of realised gains. But the impacts of the diffusion of technology is not static – continued access to and integration with advanced technologies also shape the EU's *future* growth trajectory, innovation potential, and structural transformation. These dynamic gains, while harder to measure, represent a further important channel through which US technology can influence the EU's long-run economic performance and resilience.

Dynamic gains in long-term productivity

34. The **long-term dynamic economic gains** of tech diffusion include strengthening the innovation ecosystem by raising the returns to R&D and enabling firms to move up the value chain more quickly. Over time, such dynamics contribute to higher growth potential by raising innovation, by making supply chains more resilient and by improving global competitiveness. Beyond direct productivity improvements, dynamic gains also arise from complementary channels. Advanced technologies increase the returns to domestic R&D, encourage reallocation of resources towards more productive firms, and accelerate knowledge spillovers through supply chains and labour mobility. These mechanisms amplify the long-term contribution of tech diffusion to innovation and growth (see Annex A).



35. Graetz and Michaels (2018) find that the adoption of industrial robots contributed around 0.36 percentage points to annual labour productivity growth across 17 advanced economies.³² McKinsey (2023) estimates that the diffusion of generative AI could raise labour productivity by 0.1% to 0.6% annually through to 2040.³³ Earlier waves of ICT adoption provide similar evidence: studies attribute 0.3 to 0.6 percentage points of US productivity growth in the late 1990s to ICT investment (Oliner & Sichel, 2000³⁴; Jorgenson et al., 2008³⁵), while broadband rollout has been linked to GDP per capita gains of up to 0.9 to 1.5 percentage points across OECD economies (Czernich et al., 2011³⁶).
36. Taken together, these findings suggest that a reasonable, if uncertain, estimate of the dynamic productivity benefits of continued access to and diffusion of US technologies in the EU could amount to a 0.25% rise in long-run productivity. This estimate is deliberately conservative relative to much of the empirical literature. Earlier breakthroughs such as broadband rollout or the first wave of ICT adoption generated very large gains that are less likely to be repeated at the same scale, while today's diffusion occurs in an economy where much of the digital infrastructure is already in place. EU-specific factors highlighted earlier, such as absorptive capacity constraints and slower diffusion across SMEs, are further reasons to expect future dynamic productivity gains to be lower than past ones.
37. Even so, a 0.25% increase translates into a permanent increase of €46bn in EU GDP (0.3% in 2025 terms, fourth column in Figure 10). This rises to €66bn in 2030 (Figure 11). The magnitude of such dynamic effects is inevitably uncertain, varying by sector, by complementary investment in intangibles, and over time, since spillovers often take several years to materialise. Taking a relatively conservative 0.25% assumption therefore provides a cautious but credible benchmark – and arguably leaves more upside than downside risk to the estimates.
38. Figure 11 uses the same methodology but applies it to all years from 2019 to 2030, assuming that the current level of openness to US tech is maintained. On this basis the total economic contribution is forecast to rise, in nominal terms, to €1.3tn by 2030 (5.9% of GDP), from €0.8tn in 2019 and €1.1tn in 2025. These projections highlight that the benefits of openness extend beyond today's measurable footprint: restrictions would not only reduce current output but also erode the future productivity gains that come from diffusion and innovation dynamics.

³² Graetz and Michaels (2018), [Robots at Work](#), The Review of Economics and Statistics.

³³ McKinsey (2023), [The economic potential of generative AI: The next productivity frontier](#).

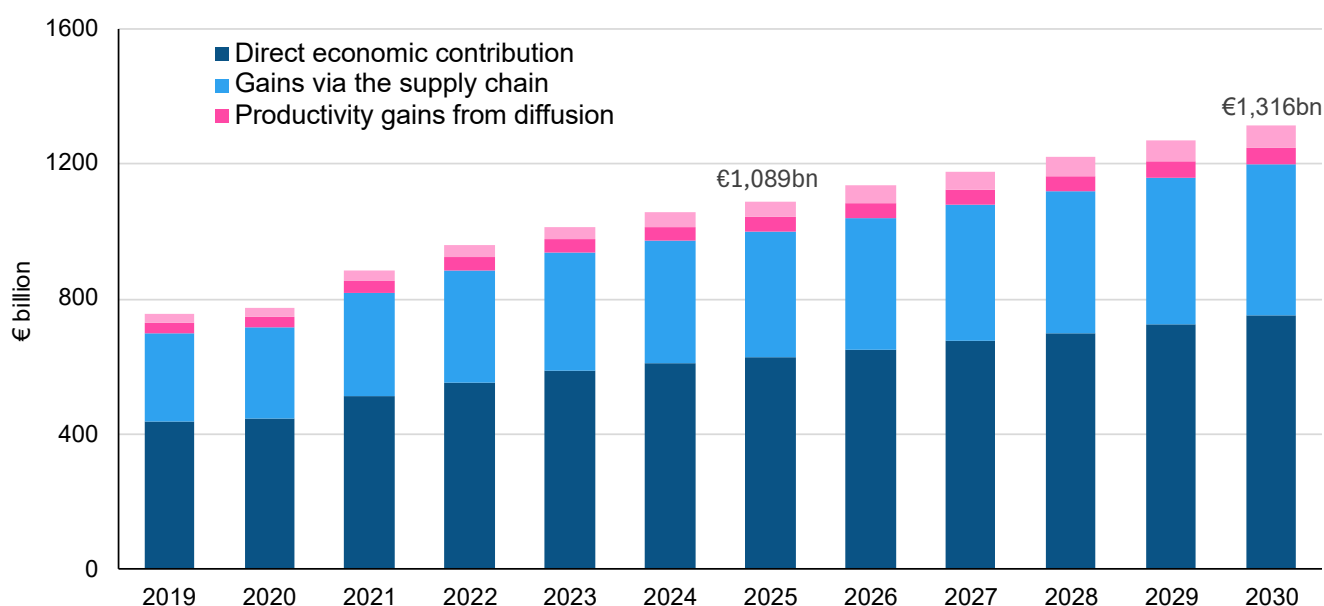
³⁴ Oliner and Sichel (2000), [The Resurgence of Growth in the Late 1990s: Is Information Technology the Story?](#) Journal of Economic Perspectives.

³⁵ Jorgensen, Ho and Stiroh (2008), [A Retrospective Look at the U.S. Productivity Growth Resurgence](#), Journal of Economic Perspectives.

³⁶ Czernich, Falck, Kretschmer and Woessmann (2011), [Broadband Infrastructure and Economic Growth](#), The Economic Journal.



Figure 11: US technology's contribution to the EU economy, 2019 to 2030



Source: Flint Analysis

3.4 The costs of scaling back the EU's use of US technology

39. As laid out above, tech diffusion drives important direct and indirect economic and productivity gains, whose realisation relies on an enabling policy and institutional framework. Trading off these benefits for greater digital sovereignty, if that results in reduced tech diffusion to the EU market, would therefore be likely to come at a cost in terms of benefits foregone.

40. There are currently no studies that quantify the amount of EU GVA that would be foregone as a result of prioritising sovereignty over retaining openness to international technology investment. In this section, we present two illustrative scenarios of the economic value that could be lost through foregone tech diffusion and the productivity it supports. To calibrate these scenarios, we draw on the following:

- Our estimate above that the economic contribution of US-origin technologies to the EU economy amounts to €1.1tn in 2025 rising to €1.3tn in 2030.
- A study by Jia et al, which estimates the impact of the EU's introduction of General Data Protection Regulation (GDPR) on venture investments, concluding that it led to a 17.6% reduction in the number of deals and a 39.6% reduction in the value-per-deal of those that remained – implying a combined loss across the 'extensive' and 'intensive' margins of 50%.³⁷
- Eurostat estimates of the depreciation rate of ICT capital – just above 25% a year – which imply that around 80% of the capital stock depreciates over five years (a guide to the value of replacement investment required to hold the net capital stock steady).³⁸
- We assume that a quarter of lost international investment can be substituted by EU investment within five years. This may be overly optimistic as it would require a sharp increase in the EU share of the ICT capital stock, as discussed above. CERRE argues that *“trying to eliminate all [Europe's]*

³⁷ Jia, Jian and Wagman (2018), [The Short-Run Effects of GDPR on Technology Venture Investment](#).

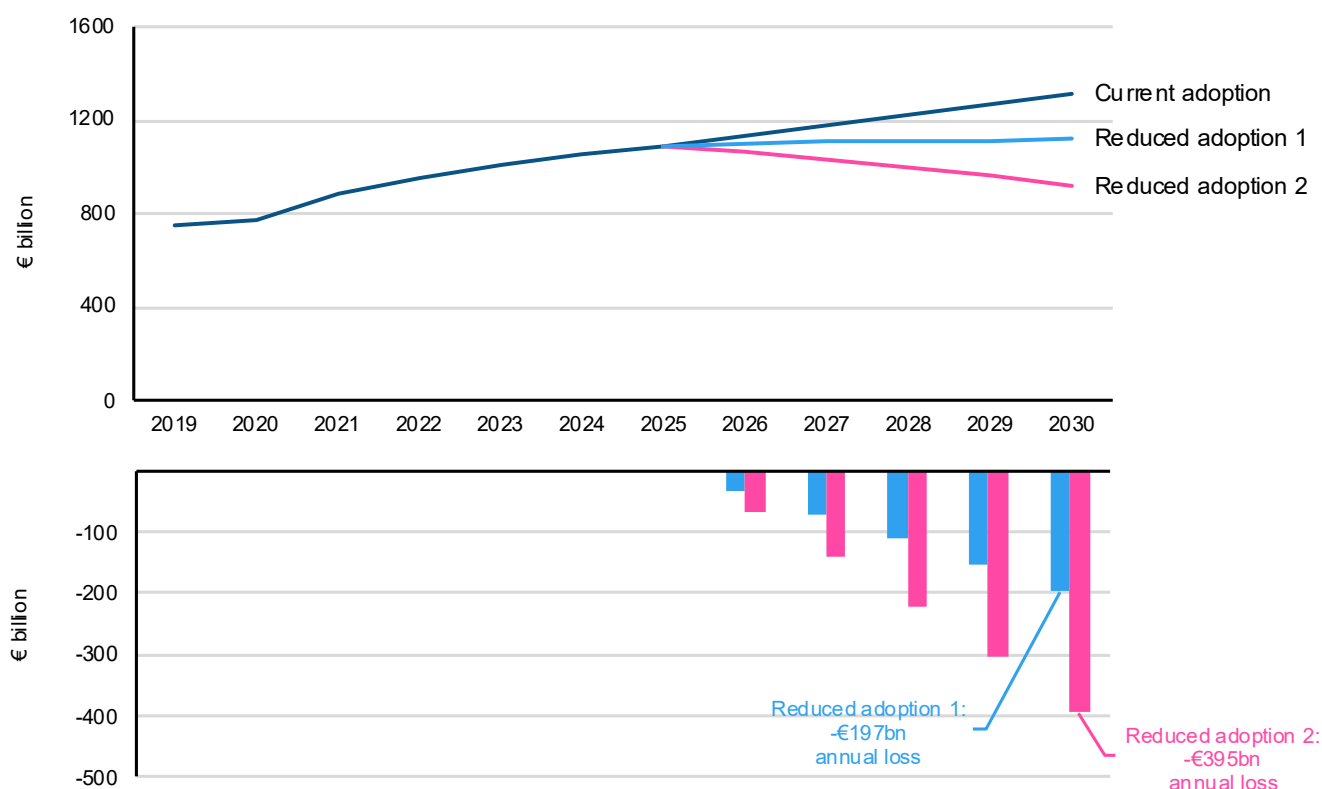
³⁸ According to the EU KLEMS industry-level dataset, depreciation rates are estimated at 31.5% for computer equipment and 11.5% for telecommunications equipment. Eurostat data on current replacement costs of capital stocks indicate that, in terms of weighting, the ratio of computer equipment to telecommunications equipment is approximately 4 to 1. Combined, these imply a weighted depreciation is 27%.



dependencies... will take years... and risks slowing tech take-up".³⁹ But we use this assumption so as not to overstate the *net* loss associated with a *gross* impact on investment from overseas.

41. On this basis, foregone US investment results in a roughly 40% gross loss in US tech-related GVA in 2030, which falls to a 30% net loss once we allow for substitute EU investment. This figure may be overly pessimistic given the focus on smaller venture capital investments in the GDPR study that informs the gross impact in the scenario, so a more conservative estimate of the potential benefits foregone would be to assume an impact half as large as in that study. This would imply a 20% gross loss in projected GVA before substitution, falling to a 15% net loss with substitution.
42. Figure 12 compares these scenario results to the baseline assumption that the current adoption rate of US tech is maintained. The scenarios lower EU GDP by amounts rising to an annual cost of €197bn in 2030 (0.9% of EU GDP) for the 15% net loss scenario and €395bn (1.8% of EU GDP) for the 30% net loss scenario.⁴⁰ For each 1% of US technology that is substituted by domestic investment (or not substituted), the costs to the EU economy reduce (increase) by €13bn. Box 1 compares the scale of these costs relative to other recent economic shocks and shows that it is of a comparable order of magnitude.⁴¹

Figure 12: Two scenarios comparing the costs of scaling back the use of US technology



Source: Flint Analysis

³⁹ Meyers (2025), [Can the EU reconcile digital sovereignty and economic competitiveness?](#) CERRE.

⁴⁰ For context, [Allianz](#) estimates that the temporary semiconductor shortage in 2021 and 2022 cost the EU €100bn in lost GDP.

⁴¹ While these scenarios are not forecasts, they are plausible risk bounds. For example, the 15% reduction corresponds to lower-bound parameter values for intangible deepening and dynamic gains, while the 30% reduction illustrates a deeper disengagement. For context, the estimated costs even in the 30% case remain within the lower bound of what the IMF estimates as potential gains from reducing internal barriers to the EU single market. They find that "in 2020 trade costs within Europe were equivalent to a sizable ad-valorem tariff of 44 percent for the average manufacturing sector... and as high as 110 percent in the case of services sectors" (IMF 2024, [Regional Economic Outlook: Europe](#)). These are equivalent, in GDP terms, to costs of over €1,000bn.



Box 1: Comparing the scale of potential losses from reduced US technology diffusion

Our central estimate suggests that scaling back US technology adoption by 15% would reduce EU GDP by around 1% in 2030 – equivalent to roughly €200bn annually. A 30% reduction equates to 2% of GDP. This is a persistent structural loss, not a temporary fluctuation, meaning the EU economy would operate on a lower long-run trajectory than under continued openness. Substitution with EU-based alternatives could mitigate some of the losses over time, but there is little evidence that this can be done rapidly or without higher costs to firms and consumers.

The impact is of a similar order of magnitude to some recent or potential economic shocks. For example:

- The UK Office for Budget Responsibility, based on an analysis of the literature and data, has judged that Brexit will reduce long-run UK productivity – and therefore GDP – by around 4% relative to the counterfactual of continued EU membership.⁴² In other words, Brexit is expected to leave the economy permanently smaller – by roughly 4% – than if the UK had remained in the EU. This estimate is uncertain, but it is close to those derived from so-called doppelgänger studies of the initial impacts of Brexit on UK GDP. For example, Springford estimates that by the second quarter of 2022 the UK's GDP was about 5.5% below what it would have been without Brexit.⁴³ In a more recent paper, the same author revisits the OBR's judgement and concludes that *"the broad consensus among economists on Brexit was broadly correct"*.⁴⁴
- The Covid-19 pandemic triggered a sharp but temporary contraction in GDP of more than 11% in the second quarter of 2020, with ECB estimates suggesting long-term scarring of about 0.8% of GDP, relative to a no-pandemic counterfactual.⁴⁵
- The energy price shock following Russia's invasion of Ukraine reduced GDP by around 1.5% in 2022–23; while the immediate impact is expected to ease as prices normalise, persistent competitiveness effects in energy-intensive sectors are likely.⁴⁶
- A global trade war would also carry significant costs: one study estimates long-term EU GDP losses of about 1.7%.⁴⁷

Taken together, these comparisons underline that the economic costs of scaling back the use of US technology are significant.

43. These results underline that the economic stakes of maintaining an enabling policy and institutional framework for tech diffusion are significant, with even partial disengagement carrying potentially material costs for growth and competitiveness.⁴⁸ If the CERRE report is right, then even the 30% net loss scenario might not be a lower bound. For example, there could be broader costs associated with substitution – CERRE argues that it *"will involve some cost, which might be borne by either the public or the private sector, and may impact tech dissemination, competition and productivity"*. It seems likely that substitution would raise costs or lower quality and choice for firms and consumers, particularly in the short to medium term.

44. Overall, these findings suggest that prioritising digital sovereignty over openness could entail non-trivial economic trade-offs. Policymakers therefore face a delicate balancing act between mitigating strategic

⁴² Office for Budget Responsibility (2020), [The effect on productivity of leaving the EU](#).

⁴³ Springford (2022), [The cost of Brexit to June 2022](#). The doppelgänger approach uses a synthetic control method to create a counterfactual 'twin' economy whose pre-treatment characteristics mirror those of the UK, allowing researchers to estimate the causal impact of Brexit by comparing actual and synthetic GDP paths after 2016.

⁴⁴ Springford (2025), [The economic impact of Brexit, nine years on: was the consensus right?](#).

⁴⁵ Bandera, Bodnár, Le Roux, Szörfi (2022), [The impact of the COVID-19 shock on euro area potential output: a sectoral approach](#), European Central Bank.

⁴⁶ Battistini, Bobasu, Gareis (2023), [Who foots the bill? The uneven impact of the recent energy price shock](#), European Central Bank.

⁴⁷ Dansk Industri (2024), [Full-blown trade wars weaken EU GDP by 2.5 percent](#).

⁴⁸ CERRE notes that *"The costs of excluding and removing 'high risk' equipment vendors from European telecommunications networks was made with little detailed analysis of its impacts on growth, security or resilience – and has reportedly cost approximately €45bn in productivity growth, and weighs heavily on the profitability of European telecommunications firms."* CERRE cites GSMA Intelligence, *Economic impact assessment of 5G supply chain restrictions in the EU*, April 2019.

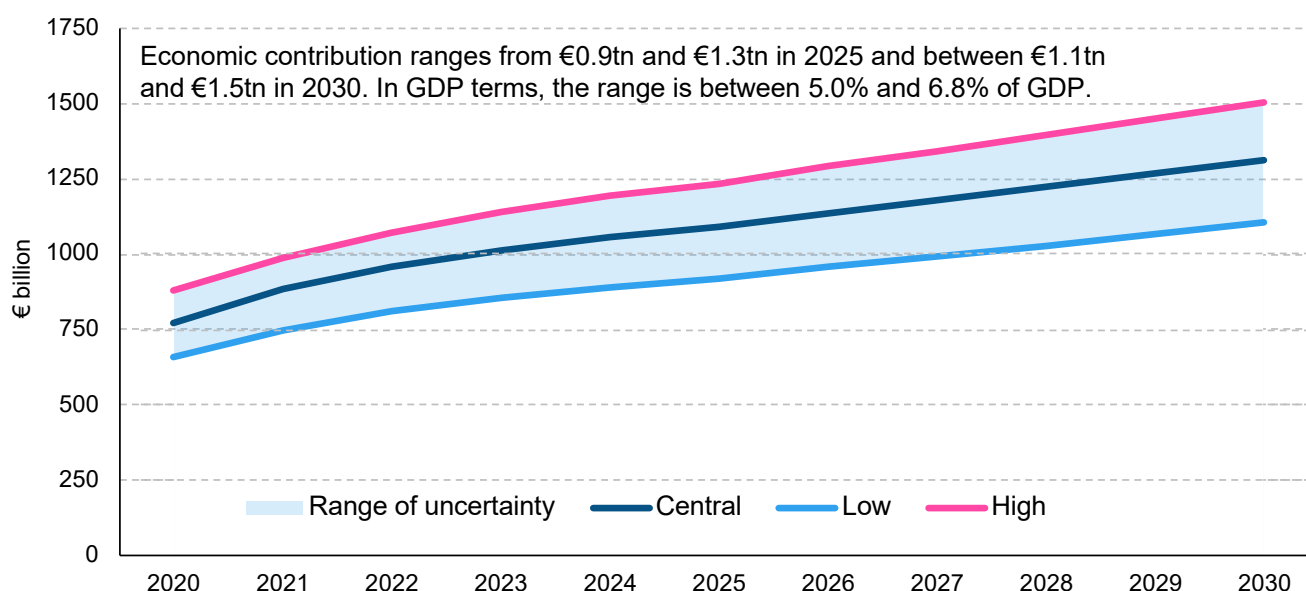


dependencies and preserving the productivity and growth benefits that arise from international technology diffusion.

3.5 Sensitivity analysis

45. Our estimate of the economic contribution of US technology to the EU economy is mostly composed of the direct GVA impact, which is based on the size of the ICT sector in Eurostat accounts and the share attributable to US firms. Because this largest component relies on official sources, the main result is not overly sensitive to modelling assumptions.
46. Figure 13 presents results using plausible 'high' and 'low' values, drawn from the literature, for three assumptions: (i) the multiplier capturing supply-chain effects; (ii) the elasticity for intangible capital deepening; and (iii) the productivity boost from dynamic technology diffusion. The high and low variants amount to €1.5tn and €1.1tn in 2030, respectively, compared with the central estimate of €1.3tn. This range confirms the robustness of the central result that the economic contribution remains substantial.

Figure 13: Sensitivity analysis showing low and high scenarios



Source: Flint analysis.



4 Conclusions

47. Europe's competitiveness challenge is increasingly understood through the lens of its innovation gap. As the Draghi report emphasised, Europe has not kept pace with the US and other peers in translating research and ideas into breakthrough firms and productivity growth, and weak diffusion of digital technologies has been a central cause. Closing this gap requires not only invention, but also faster adoption and wider diffusion of advanced technologies across the economy.
48. Our analysis has shown that *interdependence* with global technology providers, including those based in the US, already delivers substantial economic benefits to Europe. In 2025, the direct and indirect GVA of US technology companies operating in the EU and their supply chains amounts to around €1.0tn (5.4% of GDP), with intangible capital deepening adding a further €42bn. Continued diffusion contributes an additional uplift of 0.25% of GDP, worth €46bn in 2025 and €66bn by 2030. Taken together, the overall contribution of US technology is projected to rise to €1.3tn (5.9% of GDP) by 2030. The message is straightforward: openness to international technology flows is a source of economic strength for the EU.
49. At the same time, openness alone will not close the innovation gap. As both Draghi and the Digital Decade reports underline, the benefits of technology depend on Europe's absorptive capacity – on its skills, its investment in R&D and intangibles, and on having institutions that encourage competition, adaptation and diffusion. Without these complementary conditions, barriers remain, and the gains from interdependence and technology diffusion cannot be fully realised.
50. The conclusion, then, is more nuanced than a simple call either for sovereignty or for openness. Competitiveness and sovereignty are sometimes framed in tension, but Europe's experience shows that interdependence can reinforce competitiveness without diminishing the value of sovereignty. With the right policies and investments – remaining open to global technology while investing in the domestic capabilities that allow firms and workers to use it effectively – the EU can turn global innovation into sustained European growth.



Annex A: Technology transfer and economic growth: a literature review

51. Technological progress is a fundamental determinant of long-run economic growth, consistently pushing the boundaries of production possibilities and enhancing overall productivity. This Annex reviews the economic literature on how such progress is generated and the implications for policy. It highlights three main channels through which growth can be achieved: **innovation and R&D, human capital accumulation, and the adoption and diffusion of technology across firms and countries.**
52. Each of these mechanisms has been shown to play a central role in sustaining growth, and each is shaped by the institutional and policy environment. In the remainder of this Annex we:
- summarise the main growth theories; then
 - examine the evidence on international technology transfer and the barriers that can impede it; before
 - drawing out the key policy implications.

Exogenous growth theory

53. The Solow (1956) model is a cornerstone of economic growth theory. It posits that long-run economic growth is driven by capital accumulation, labour force growth, and, crucially, an *exogenous* rate of technological progress.⁴⁹ In this framework, economies converge to a steady state where per capita income growth is solely attributable to this unexplained technological advancement, often referred to as the 'Solow residual'. The model implies that while capital accumulation and population growth can affect the *level* of income per capita, they do not affect *long-run* growth rates.
54. A critical conceptual limitation of the Solow model was its inability to explain the origin or drivers of long-run technological progress. The 'Solow residual' represented the portion of output growth not explained by changes in measured capital and labour inputs. By defining technology as an exogenous residual, the model implicitly acknowledged its inability to account for the *sources* of this progress. This theoretical void became a primary motivation for subsequent research, particularly the development of endogenous growth theory, which sought to bring the determinants of technological change *inside* the economic model, thereby transforming technology from an unexplained residual into an outcome that could be influenced by economic decisions and policy. The residual, therefore, was not just a measurement, but a conceptual placeholder that revealed a profound theoretical gap in understanding the fundamental drivers of sustained improvements in prosperity.

Endogenous growth theory

55. Endogenous growth theory emerged to overcome the limitations of classical models by internalising technological progress within the economic system. This theoretical framework states that economic growth is primarily the result of endogenous forces, driven by deliberate investments in human capital, innovation, and knowledge. A distinctive feature of these models is the presence of *increasing returns to scale* associated with knowledge and innovation: because ideas are non-rival and only partially excludable, their use by one firm does not diminish their usefulness to others. As a result, aggregate

⁴⁹ Solow (1956), [A Contribution to the Theory of Economic Growth](#). The Quarterly Journal of Economics.



production can exhibit constant or even increasing returns, allowing growth to be self-sustaining rather than subject to diminishing returns as in the Solow framework.

56. Building on this insight, two main strands of endogenous growth theory developed to explain how these increasing returns are realised. Romer (1986, 1990)⁵⁰ emphasises the role of innovation and R&D in generating new ideas that drive growth. Lucas (1988)⁵¹ highlights the accumulation of human capital and the spillovers from education and learning that sustain growth. Together, these approaches transformed technological progress from an unexplained residual into an outcome of purposeful economic decisions.⁵²

The role of innovation and R&D

57. Romer (1986, 1990) formalised the idea that the production of new ideas is the key driver of long-run growth. In his framework, knowledge is non-rival and only partially excludable, so investment in R&D generates positive spillovers that benefit the whole economy. By showing how innovation can yield increasing returns at the aggregate level, Romer provided the foundation for the modern innovation-driven view of endogenous growth.
58. Aghion and Howitt (1992)⁵³ built on Schumpeter's notion of creative destruction, where each innovation creates new technological knowledge while simultaneously rendering existing knowledge, skills, and capital obsolete. This underscores that technological progress is not uniformly beneficial: it generates both efficiency gains and distributive conflicts. Consequently, a society's long-run growth trajectory depends not only on its capacity to foster innovation but also on its institutional ability to manage the frictions and redistributive tensions that innovation inevitably produces.
59. Jones (1995)⁵⁴ addressed the criticism that early endogenous growth models implied implausibly strong scale effects. The models predict that larger populations of researchers should, in principle, generate ever-accelerating growth. Jones's theory of semi-endogenous growth introduced diminishing returns to new ideas at the aggregate level. In this framework, long-run growth requires ongoing investment in R&D, but its rate is ultimately constrained by population growth, rather than being boundless. This reconciled endogenous growth theory with empirical observations, while preserving the central link between innovation and growth.

The role of human capital

60. Lucas (1988) placed human capital at the centre of endogenous growth, arguing that education and skill accumulation not only raise individual productivity but also generate externalities through learning spillovers, making growth self-sustaining. In his framework, investment in human capital fuels both innovation and the economy's overall capacity to learn and adapt, providing a parallel channel to Romer's focus on ideas and R&D. Subsequent research extended this insight by examining more precisely how human capital supports growth – both through its role in technology adoption and through the quality of education itself.

⁵⁰ Romer (1986), [Increasing Returns and Long-Run Growth](#), Journal of Political Economy; Romer (1990), [Endogenous Technological Change](#), Journal of Political Economy.

⁵¹ Lucas (1988), [On the Mechanics of Economic Development](#), Journal of Monetary Economics.

⁵² Early contributions included Rebelo's 'AK model', which abstracted from diminishing returns by assuming a linear relationship between capital and output. This stripped-down formulation demonstrated that if capital broadly defined – including physical, human, and knowledge capital – accumulates without diminishing returns, economies can sustain growth purely through investment. While stylised, it provided a foundational intuition for later, richer endogenous growth models. Rebelo (1991), [Long-Run Policy Analysis and Long-Run Growth](#), Journal of Political Economy.

⁵³ Aghion and Howitt (1992), [A model of growth through creative destruction](#), Econometrica.

⁵⁴ Jones (1995), [R&D-Based Models of Economic Growth](#), Journal of Political Economy.



61. Benhabib and Spiegel (1994)⁵⁵ showed that human capital matters not only as a direct input to production but also as a driver of technology adoption and catch-up, giving economies the absorptive capacity to benefit from the latest innovations. Hanushek and Woessmann (2008, 2012)⁵⁶ further refined the argument, demonstrating that education quality, measured by cognitive skills, is far more important for long-run growth than years of schooling alone. Together, these contributions extend the Lucas framework by highlighting both the external role of human capital in diffusion and the internal dimension of education quality.

The empirical evidence

62. The empirical evidence broadly supports the central role of innovation and human capital, and the value of purposeful investments in knowledge, skills, and ideas as key to driving long-run growth.

63. Griliches (1992)⁵⁷ showed that R&D produces significant knowledge spillovers, with firms not only benefiting from their own research but also that of others. These spillovers provided empirical grounding for the central claim of endogenous growth theory: that ideas are non-rival and can generate increasing returns at the aggregate level. By linking innovation to measurable productivity gains, his work bridged theoretical models and observed technological diffusion, underscoring R&D's pivotal role in sustaining long-run growth.

64. Later research expanded the mechanisms through which innovation and productivity shape long-run growth while grounding the theories in empirical evidence. Kortum (1997)⁵⁸ advanced the empirical foundations of R&D-based growth by linking research activity to patenting and technological change, addressing how ideas translate into measurable innovation. Acemoglu (2002)⁵⁹ argued that innovation tends to follow economic incentives and technology, developing in ways that favour the resources that are most valuable. For example, when skilled labour is abundant, firms are more likely to invest in software or tools that make skilled workers more productive.

65. Empirical work has also examined the growth effects of human capital. Barro (1991)⁶⁰ and Barro and Sala-i-Martin (1995)⁶¹ found that higher levels of schooling are positively associated with long-run growth, providing early cross-country support for the Lucas framework. Later studies refined these findings by stressing that it is not just the quantity but the quality of education that matters, echoing the results of Hanushek and Woessmann.

Technology transfer, adoption and diffusion

Technology transfer

66. Technology transfer is one of the important ways that technological progress can be achieved, through its effect on innovation and productivity. Nelson and Phelps (1966)⁶² first stressed that advances at the technological frontier can spill over to followers, provided they have the human capital to absorb them. Mansfield (1985)⁶³ and Jaffe, Trajtenberg, and Henderson (1993)⁶⁴ showed empirically that such spillovers are a powerful source of productivity gains beyond the originators of innovation. Technology

⁵⁵ Benhabib and Spiegel (1994), [The Role of Human Capital in Economic Development: Evidence from Aggregate Cross-Country and Regional U.S. Data](#), Journal of Monetary Economics.

⁵⁶ Hanushek and Woessmann (2008), [Education Quality and Economic Growth](#), World Bank Working Paper; Hanushek and Woessmann (2012), [Do Better Schools Lead to More Growth? Cognitive Skills, Economic Outcomes, and Causation](#), Journal of Economic Growth.

⁵⁷ Griliches (1992), [The Search for R&D Spillovers](#), Scandinavian Journal of Economics.

⁵⁸ Kortum (1997), [Research, Patenting, and Technological Change](#), Econometrica.

⁵⁹ Acemoglu (2002), [Directed Technical Change](#), Review of Economic Studies.

⁶⁰ Barro (1991), [Economic Growth in a Cross-Section of Countries](#), Quarterly Journal of Economics.

⁶¹ Barro and Sala-i-Martin (1995), [Economic Growth](#), McGraw-Hill.

⁶² Mansfield (1985), [How Rapidly Does New Industrial Technology Leak Out?](#), Journal of Industrial Economics.

⁶³ Nelson and Phelps (1966), [Investment in Humans, Technological Diffusion, and Economic Growth](#), American Economic Review.

⁶⁴ Jaffe, Trajtenberg and Henderson (1993), [Geographic Localization of Knowledge Spillovers as Evidenced by Patent Citations](#), Quarterly Journal of Economics.



transfer thus complements domestic R&D and human capital accumulation by broadening access to new ideas and accelerating convergence. Building on this foundation, a large literature has examined the specific mechanisms of international technology transfer, recognising that cross-border flows of trade, investment, and knowledge are critical enablers for countries to share in global technological progress.

67. Earlier work tended to focus on tangible assets like machinery, but more recent evidence highlights the increasing importance of disembodied technology (e.g., licenses, royalties) and especially the tacit knowledge embedded in human capital (Miric, 2021)⁶⁵. These distinctions matter, but in practice embodied and disembodied forms often operate together within broader transfer channels.

International technology transfer

68. International technology transfer occurs through a diverse array of mechanisms that represent concrete pathways through which the theoretical spillovers identified by Nelson & Phelps and others operate across national borders. Grossman and Helpman (1991)⁶⁶ formalised this link in their trade-and-growth models, showing how openness to international markets not only reallocates resources but also facilitates the cross-border diffusion of ideas and technologies.

69. We can, broadly speaking, place the mechanisms into two groups – traditional channels and newer/emerging channels. Within each channel, technology may flow in embodied forms (such as machinery, equipment, and production processes) or in disembodied forms (such as software, designs, or managerial know-how).

70. Traditional channels include:

- **Trade in goods and services:** Technology can be embodied in imported machinery, equipment, and intermediate inputs, which can be a source of learning for domestic firms (Coe and Helpman, 1995)⁶⁷. Keller (2004)⁶⁸ emphasises that international technology diffusion occurs not only through formal channels like trade and FDI but also through imitation and reverse engineering, which have historically been central to catch-up growth.
- **Foreign direct investment (FDI):** Multinational corporations are one of the primary conduits for transferring not only physical capital and production processes (embodied technology) but also managerial expertise, R&D know-how, and organisational practices (disembodied technology) to their foreign affiliates (UNCTAD, 1997)⁶⁹.
- **Licensing and intellectual property (IP) agreements:** Formal agreements, such as licensing and patent agreements, allow recipient entities to use patented technologies or proprietary know-how for a fee (Teece, 1977)⁷⁰. These provide access to proven technologies without the need for extensive domestic R&D and are underpinned by predictable IP systems.

71. The newer channels include:

- **Human capital mobility and collaborative arrangements:** The movement of skilled labour, including scientists, engineers, and managers, facilitates the transfer of tacit knowledge and expertise between countries (Miric and Ozalp, 2021). Collaborative research agreements, joint

⁶⁵ Miric and Ozalp (2021), [Standardized Tools and the Generalizability of Human Capital: The Impact of Standardized Technologies on Employee Mobility](#), working paper, University of Southern California.

⁶⁶ Grossman and Helpman (1991), [Innovation and Growth in the Global Economy](#), MIT Press.

⁶⁷ Coe and Helpman (1995), [International R&D Spillovers](#), European Economic Review.

⁶⁸ Keller (2004), [International Technology Diffusion](#), Journal of Economic Literature.

⁶⁹ UNCTAD (1997), [World Investment Report](#), United Nations.

⁷⁰ Teece (1977), [Technology Transfer by Multinational Firms: The Resource Cost of Transferring Technological Know-How](#), Economic Journal.



ventures, and R&D consortia also foster knowledge exchange and technology transfer through direct collaboration (Teece, 1977).

- **Global value chains (GVCs):** Participation in international production networks enables firms to access embedded know-how, management practices and process innovations, with Baldwin (2016)⁷¹ highlighting GVCs as a major conduit for technology diffusion and catch-up.
- **ICT and digital diffusion:** Openness to overseas digital technologies is an increasingly powerful conduit for knowledge transfer, lowering barriers to collaboration and accelerating adoption of global best practices. The World Bank (2016)⁷² emphasises that when supported by complementary skills and institutions, access to these technologies can significantly enhance productivity and growth.

72. These different mechanisms demonstrate that technology transfer is far more nuanced than a simple exchange of goods. It involves both embodied elements, such as machinery and equipment, and disembodied elements, such as software, data, and managerial know-how, often operating together within the same channel. This complexity means that policy must go beyond simple openness, addressing issues such as cross-border data flows, intellectual property rights, and skilled labour mobility. At the same time, some near-universal truths remain: economies that are open to technology flows and that invest in R&D and human capital are better placed to reap the benefits of diffusion.

73. Yet the existence of these channels does not guarantee smooth or effective diffusion; a range of barriers can impede the adoption and spread of technologies, which we turn to next.

Barriers to diffusion

74. Despite the clear benefits of tech diffusion, barriers and frictions can impede its smooth and efficient spread across countries and sectors. Some of the main impediments include:

- **Capabilities:** Technology adoption depends heavily on the absorptive capacity of firms and economies: the ability to recognise, assimilate, and apply external knowledge. This is shaped by human capital, R&D investment, and the existing knowledge base (Nelson & Phelps, 1966). Tacit knowledge also matters: much advanced technology requires hands-on experience, training, and organisational flexibility, which can be costly and time-consuming (Miric, 2021). Weak managerial skills, rigid practices, and resistance to change often limit how effectively new technologies are integrated.
- **Institutions and rules:** The institutional environment strongly influences diffusion. Intellectual property protection can encourage technology transfer by supporting licensing and innovation, but excessive or poorly enforced regimes deter firms from sharing knowledge. Coe and Helpman (1995) showed how international R&D spillovers rely on trade and open institutions, while Keller (2004) emphasised that weak or fragmented regulatory frameworks can sharply constrain diffusion – for example in fast-moving digital sectors, which can create uncertainty and uneven playing fields that discourage investment and scaling.
- **Resources:** Adoption and diffusion often require significant upfront investment in equipment, training, and complementary infrastructure. These costs can be prohibitive, particularly for smaller firms or economies with limited access to finance. Comin and Nanda (2014) show that deeper financial markets accelerate the diffusion of capital-intensive technologies in their early stages,

⁷¹ Baldwin (2016), [The Great Convergence: Information Technology and the New Globalization](#), Harvard University Press.

⁷² World Bank (2016), [World Development Report 2016: Digital Dividends](#), World Bank.



underscoring the role of financial constraints in limiting technology adoption when experimentation and initial commercialisation are most needed.⁷³

75. These barriers show that policy must address not just the channels of technology transfer, but also the barriers that limit its diffusion and economic impact.

Policy implications and the role of institutions

76. Endogenous growth theory provides a strong theoretical justification for active government intervention, elevating the importance of policy from merely optimising resource allocation to lifting the growth trajectory of an economy.
77. If technological progress is an outcome of domestic investment in R&D and human capital, then government policies that incentivise these investments (e.g. R&D subsidies, education spending and robust but balanced intellectual property rights) can directly influence the rate of technological progress and, consequently, the long-run growth rate of the economy.
78. Technological progress can also be ‘sourced’ internationally, as the process of technology transfer, diffusion and adoption similarly generates innovation and productivity gains that translate into higher growth rates. The flip side of this is that impediments to diffusion can slow or prevent adoption, at best limiting the potential gains. This suggests a role for many of the same investments in R&D and human capital but also for maintaining an open and competitive economy.
79. Acemoglu, Johnson, and Robinson (2001, 2005)⁷⁴ further emphasised the key role that institutions play in shaping long-run growth, arguing that secure property rights, effective constraints on elites, and inclusive political systems are essential for innovation and technological adoption to thrive. Their work showed that without supportive institutional frameworks, even access to frontier technologies may fail to generate sustained growth, as the incentives to invest, innovate, and diffuse knowledge are undermined. This perspective shifted the focus beyond pure accumulation of capital and R&D toward the broader political and institutional environment in which economic decisions are made.
80. To take a real-world example – the EU’s Industrial Strategy and innovation policies illustrate the logic: they emphasise coordination across Member States to support the twin green and digital transitions while strengthening strategic autonomy and competitiveness, backed by substantial R&D investment through initiatives such as Horizon Europe. This is applying the core insight of endogenous growth theory: that long-run prosperity stems not from external shocks but from deliberate policy choices that treat innovation as an engine of growth in its own right, shaping the conditions under which knowledge and new capabilities can continuously expand the economy’s productive potential.
81. At the same time, endogenous growth models rooted in Schumpeter’s notion of creative destruction highlight that innovation is inherently disruptive: each technological advance can render existing skills, capital, and industries obsolete. Effective policy must therefore not only provide incentives for innovation but also include mechanisms to manage its social costs. The EU’s emphasis on measures such as the Just Transition Mechanism reflects this balancing act, aiming to ensure that the gains from innovation-driven growth are broadly shared, while cushioning the adjustment costs for workers and regions most affected by structural change.

⁷³ Comon and Nanda (2019), [Financial Development and Technology Diffusion](#), IMF Economic Review.

⁷⁴ Acemoglu, Johnson and Robinson (2001), [The Colonial Origins of Comparative Development](#), American Economic Review; Acemoglu, Johnson and Robinson (2005), [Institutions as the Fundamental Cause of Long-Run Growth](#), Handbook of Economic Growth.



Summary

82. This review highlights three central drivers of long-run economic growth: innovation and R&D, human capital, and the adoption and diffusion of technology. Each contributes to sustained productivity gains, and each is shaped by the wider institutional and policy environment. The evidence shows that while openness to trade, investment, and international technology remains critical, it is not sufficient on its own. Policies that build human capital, support R&D, and strengthen institutions are essential to ensure that new technologies are effectively absorbed, widely diffused, and translated into long-term prosperity.





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