

CHAPTER 2

INVESTING IN RESEARCH AND INNOVATION

CHAPTER 2.1

R&D INVESTMENT

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KEY QUESTIONS

- ▶ Why does research and innovation (R&I) policy matter and how has it evolved?
- ▶ How does the level and growth of research and development (R&D) investment in the EU compare with major global competitors?
- ▶ How do industrial composition and sectoral priorities influence EU private R&D performance, and how do these factors contribute to the gap with global peers?

HIGHLIGHTS

- ▶ The rationale for R&I policy has progressively broadened from correcting market failures toward supporting whole innovation systems and, increasingly, delivering on strategic objectives including competitiveness, technological sovereignty, and the green and digital transitions.
- ▶ Yet despite this growing policy ambition, the EU significantly underinvests in R&D relative to its main competitors. On current trends the 3% target would not be met until around 2057 and reaching it by 2030 would require roughly EUR 565 billion in additional investment.
- ▶ The investment gap is rooted in a structural imbalance. Private R&D in the EU remains concentrated in mid-tech manufacturing rather than the high-tech manufacturing and knowledge-intensive services that drive R&D intensity in the US and increasingly in China.
- ▶ Public R&D has partly compensated for weak private investment, but its relative weight is quietly shrinking. Although public R&D intensity has remained broadly stable as a share of GDP, the EU economy grows at roughly half the rate of the US and one-sixth the rate of China, meaning that stable shares translate into declining global weight in absolute terms.

POLICY INSIGHTS

- ▶ As R&I policy faces an expanding set of objectives, coherent priority-setting and well-designed policy mixes become more important than the overall level of spending alone.
- ▶ The private R&D gap with the US is driven more by industrial composition than by firm behaviour, suggesting that incentivising R&D spending alone is insufficient. Supporting the conditions that allow high-tech sectors to grow and scale in Europe has become equally important.
- ▶ Stable public R&D intensity as a share of GDP conceals a declining global footprint.
- ▶ The EU's public R&D model, heavily channelled through universities and towards undirected basic research, differs structurally from the more mission-directed, applied-research-focused models of the US, China, South Korea and Japan. Rebalancing this mix may deserve attention alongside increasing overall funding levels.

Innovation is a central driver of long-term productivity, economic growth and societal transformation. Governments play an important role in creating the conditions that support it, not only with direct research funding but through a much broader set of instruments including regulatory frameworks, standards, public procurement, skills development, technology transfer mechanisms and intellectual property regimes.

Investment in research and development (R&D) is arguably one of the most direct and measurable expressions of this broader commitment to innovation. R&D matters because it is one of the main drivers of long-run economic performance, enabling technological progress, innovation, productivity and growth (Romer, 1990; Aghion and Howitt, 1992). While recognising that R&D is not the only driver of innovation and productivity (for instance, Comin and Hobijn (2010) show how diffusion of innovation is at least as important as a driver of productivity), R&D generates substantial spillovers that operate at the local, regional and international level. Such spillovers are central to productivity at both the macro-economic level (Coe *et al.*, 2009) and firm level, with impacts going beyond the boundaries of the investing firms (Jones and Williams, 1998).

Given the non-rival and partially non-excludable nature of knowledge, private firms cannot fully appropriate the returns to R&D, leading to underinvestment relative to the social optimum (Arrow, 1962; Nelson, 1959). Public investment can then crowd in private investment, particularly for financially constrained firms, by stimulating their absorptive capacity (Cohen and Levinthal, 1990). These features make R&D a fundamental determinant of long-run growth and a primary justification for public investment.

While the importance of R&D is clear, the EU still underinvests compared to major global competitors. Total R&D spending in the EU has risen over the past two decades, but remains modest relative to countries such as the US, China, Japan and South Korea. At the same time, the EU's public R&D system is structured and governed differently from those of its main competitors and is characterised by widely varying national R&D intensity across Member States. Understanding the EU's R&D investment gap therefore requires not only looking at spending levels but also at the policy choices and governance structures that shape how investment is directed and how effectively it translates into innovation outcomes.

1. The evolution of R&I policy

Public intervention in R&I has traditionally been justified by market failures associated with knowledge production. Knowledge exhibits characteristics of a 'public good'. Once created, it can generate spillovers that enable others to benefit freely from the innovation. As this prevents firms from fully appropriating the returns on their investments, private investment often falls below socially optimal levels (Arrow, 1962; Nelson, 1959; Jaffe, 1986). Additional barriers, including financing constraints, uncer-

tainty and information asymmetries, further limit private investment, reinforcing the case for public support through instruments such as R&D subsidies, public research funding and fiscal incentives (Hall and Lerner, 2010).

Beyond these traditional market failures, innovation is increasingly understood as systemic and dependent on complex interactions between firms, research organisations, governments and institutions.

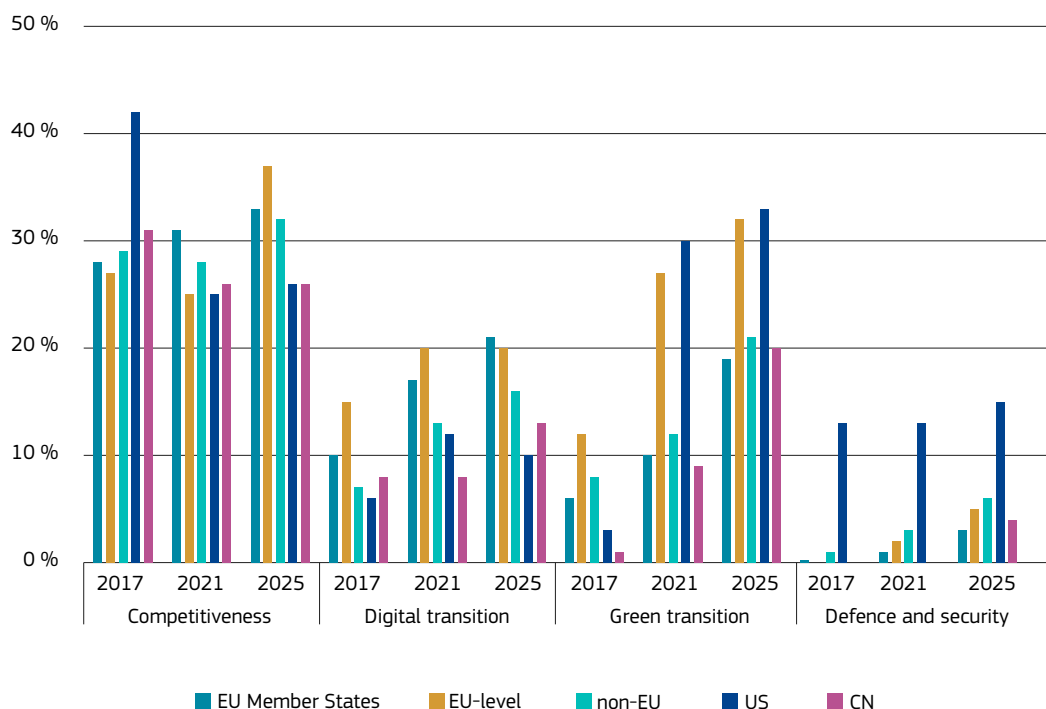
Failures in coordination, knowledge diffusion or institutional frameworks provide an additional rationale for policy intervention (Freeman, 1987). Rather than protecting specific firms or declining industries, public support for R&I aims to strengthen the broader innovation ecosystem by encouraging knowledge creation, diffusion and technological development. In this sense, R&I policy can be viewed as one of the least distortive forms of industrial policy, enabling creative destruction, firm entry and exit, and sustained productivity growth (Aghion and Boulanger, 2011) across the economy without picking winners.

This shift from correcting isolated market failures to supporting whole systems is increasingly important as R&I is asked to address wider economic, social and security goals. Geopolitical tensions and strategic competition have led countries to use economic instruments, including trade policies, investment controls and technological regulations to achieve broader political and security objectives – a dynamic often described through the concept of geoeconomics (Blackwill and Harris, 2016). In this context, critical technologies, resources and supply chains increasingly function as strategic assets, shaping a country's ability to compete economically while also influencing their geopolitical positioning and strategic autonomy (see chapters 4.1 and 4.4). The EU, the US and China have all introduced major policy packages to boost R&I investment in targeted science and technology areas, reflecting this broader shift (Steeman *et al.*, 2025).

These shifting priorities are visible in how Member States are orienting their policy instruments, though the degree of directionality varies across topics and time.

Over the last decade, competitiveness has become well established in EU Member State Science, Technology, and Innovation (STI) policy initiatives, with around 33 % of policies addressing competitiveness, a modest increase from 28 % in 2017 (Figure 2.1-1). Similar figures are observed for the EU-level STI policies, with 37 % in 2025, as well as for the US (26 %) and China (26 %), although the latter two countries show a decline over time. For the EU Member States, the share of policies addressing digital topics rose from 10 % to 21 %, while those focused on the green transition increased from 6 % to 19 % over the same period. Defence and security remain a smaller but growing topic area for EU Member States, rising from near zero in 2017 to around 3 % in 2025, with notable increases in France, Sweden, Czechia and Germany. A similar rise can be observed at the EU level, in China and the rest of the world, in contrast to the US, where this topic is already well established in STI policies. An increase between 2017 and 2025 in EU-level policies and in the US regarding the green transition is also apparent. Finally, some EU Member States, particularly in central and eastern Europe, show higher levels of directionality across all areas, while others, such as Luxembourg and the Netherlands, report lower overall levels. This variation shapes not only what gets funded, but also affects how national and EU-level investments align with one another – a theme taken up in chapter 2.2.

Figure 2.1-1 Strategic prioritisation of STI policies for the years 2017, 2021 and 2025



Source: DG Research and Innovation, Common R&I Strategy and Foresight Service, Chief Economist Unit based on OECD/European Commission STIP Compass.

Note: Policy initiatives were identified through keyword matching applied to the titles, descriptions and stated objectives of initiatives. EU Member States refers to national policies at Member State level; EU-level refers to supranational policies; non-EU refers to all other countries in the database that are not EU Member States. The list of keywords was defined by the authors and is available upon request.

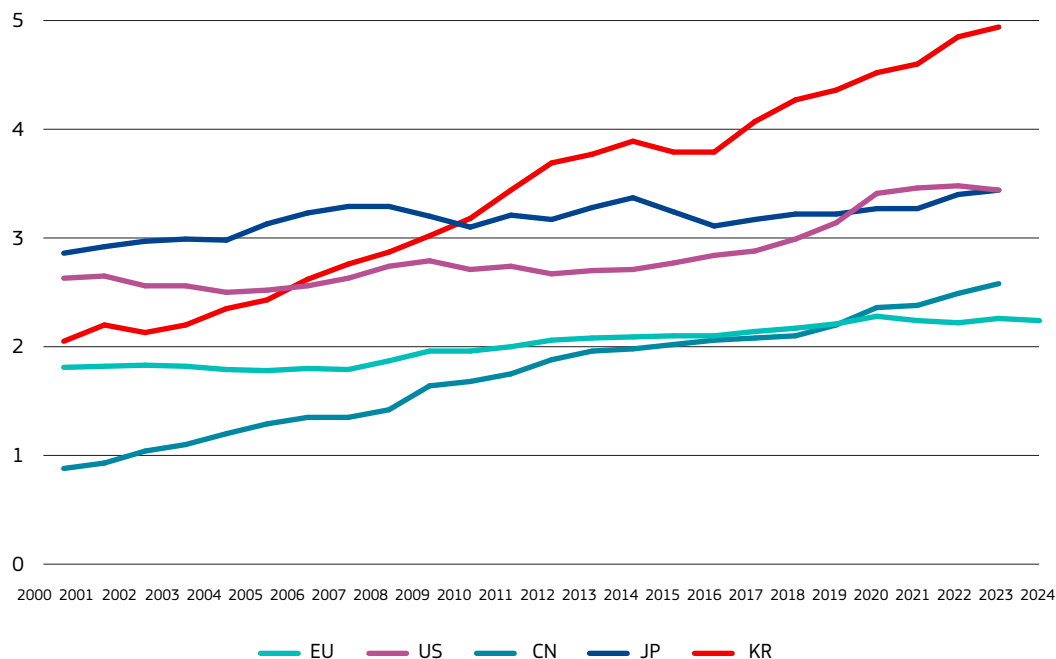
2. Where does the EU stand in terms of R&D investment?

Against the backdrop of an increasingly strategic and competitive global R&I environment, investment in R&D has become a central concern for policymakers.

The EU has steadily expanded its R&D efforts over the past two decades, but this growth remains modest compared with other major economies. Total R&D spending rose from EUR 142 billion in 2000 to EUR 403 billion in 2024, while R&D intensity increased from 1.81% to 2.24% of GDP, indicating gradual but consistent progress (Figure 2.1-2). However, other major economies have expanded their R&D investment much faster. In 2023, the US remained the

world's largest R&D investor, spending EUR 884 billion, with an R&D intensity of 3.45%, roughly double the EU's expenditure and well above its intensity level. China, which overtook the EU in R&D spending in 2020, reached EUR 435 billion in 2023 and reported an R&D intensity of 2.58%, thereby continuing to widen the gap. Other international peers, notably South Korea and Japan, also outperform the EU in terms of R&D intensity, at 4.96% and 3.44% respectively.

Figure 2.1-2 Gross expenditure on R&D as % of GDP (R&D intensity), 2000–2024



Science, Research and Innovation Performance of the EU 2026

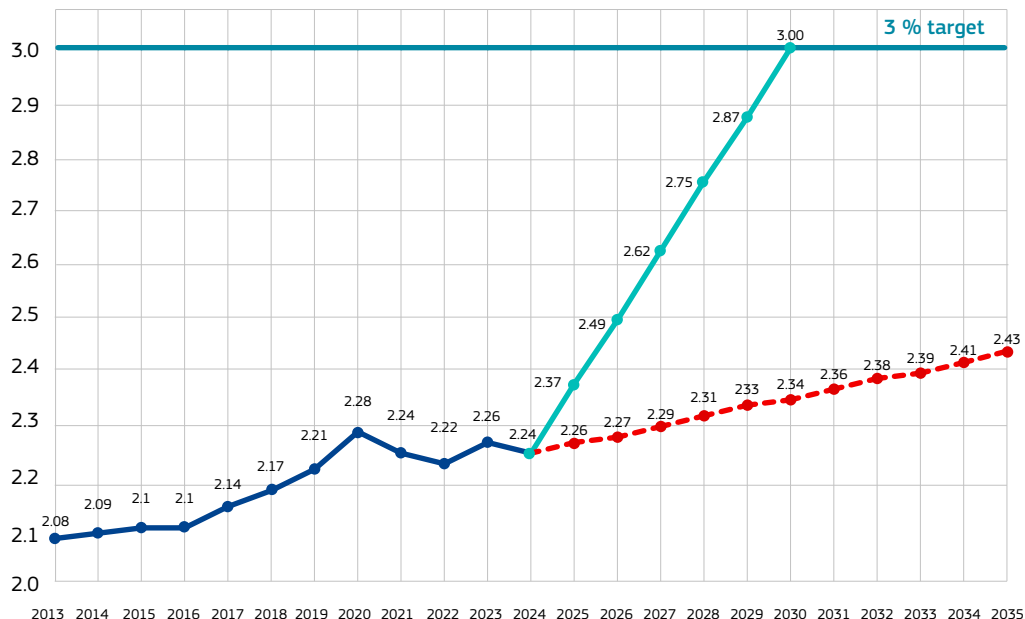
Source: DG Research and Innovation, Common R&I Strategy and Foresight Service, Chief Economist Unit based on Eurostat (DOI link: https://doi.org/10.2908/RD_E_GERDTOT).

Note: International comparison is limited to the largest R&D investors.

Despite this upward trend, the EU remains far from its long-standing goal of reaching 3% R&D intensity and closing the gap would require a significant acceleration of investment. The 3% R&D intensity target was formally set in 2000 under the *Lisbon Strategy*, inspired by Japan's leading R&D intensity at the time and intended to position the EU at the global frontier of innovation (Rakic *et al.*, 2021). Since then, R&D intensity has only increased gradually. If recent trends persist, the EU is projected to reach just 2.34% by 2030, with the 3% target not achieved until around 2057 (Figure 2.1-3). Reaching the target of 3%

of EU GDP for total investment in R&D by 2030 would imply an additional total investment of EUR 565 billion. Splitting this amount between the public and private sectors (assuming the relative shares remain the current ones), would mean about EUR 370 billion in additional investment from the private sector, with the remainder from the public sector. Hence, meeting the 3% would not require simply maintaining current efforts, but rather changing the trajectory of both public and private R&D investment.

Figure 2.1-3 The evolution of EU R&D intensity under various scenarios



Science, Research and Innovation Performance of the EU 2026

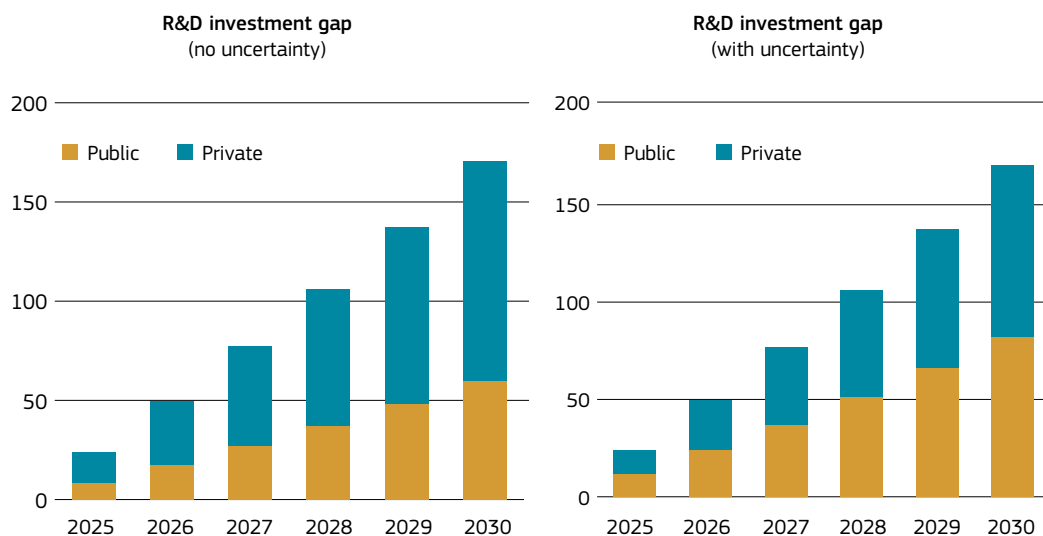
Source: DG Research and Innovation, Common R&I Strategy and Foresight Service, Chief Economist Unit based on Eurostat (DOI link: https://doi.org/10.2908/RD_E_GERDTOT).

Note: The current trend projection assumes that the trend over the last observed decade (between 2013 and 2022) would continue.

Meeting the 3% target becomes an even greater challenge in an environment of heightened uncertainty, as private R&D investment tends to contract precisely when uncertainty rises. In times of increasing uncertainty, private sector investment typically contracts as firms delay investment (Bloom, 2009), and this negative impact is even stronger in the case of R&D investment (Bansal *et al.*, 2019). This mechanism may even be reinforced if uncertainty affects demand expectations (Basu and Bundick, 2017) and in the case of financial frictions (Gilchrist

et al., 2014). Most estimates point to a 10% drop in private R&D investment following a macroeconomic shock, with that effect doubling in the case of large or prolonged ones (Barrero *et al.*, 2017; Handley and Li, 2020). Taking into account the unprecedented series of current geopolitical shocks, we design a scenario in which the share of private investment in R&D is 20% lower than the current level, as shown in Figure 2.1-4. In that case, additional public investment should cover almost half of the total need (about EUR 270 billion) to compensate for the missing private contribution.

Figure 2.1-4 The R&D investment gap to reach the 3 % target, billion EUR



Science, Research and Innovation Performance of the EU 2026

Source: DG Research and Innovation, Common R&I Strategy and Foresight Service, Chief Economist Unit based on European Commission AMECO and International Monetary Fund (IMF) data.

The requirement for such a large increase in private investment points to a deeper structural challenge, namely the EU's lower levels of private R&D investment.

Private R&D spending in the EU reached EUR 221 billion in 2023. While outspending Japan (EUR 104 billion) and South Korea (EUR 64 billion), the EU remains well below the levels recorded in China (EUR 345 billion) and the US (EUR 615 billion). However, when adjusting for economic size, the distance from global competitors grows further as shown in Figure 2.1-6. EU R&D intensity reached 1.28% in 2023, but lags behind that of China (2.04%), US (2.40%), Japan (2.68%) and South Korea (3.77%). The literature points to a range of structural factors behind this gap, including the EU's lower concentration of high-tech, scale-intensive industries and the conditions that shape firms' ability to grow and commercialise new technologies (see chapters 4.2 and 5.2).

While the EU's public R&D investment remains on par with other countries as a share of GDP, it may mask an important underlying vulnerability.

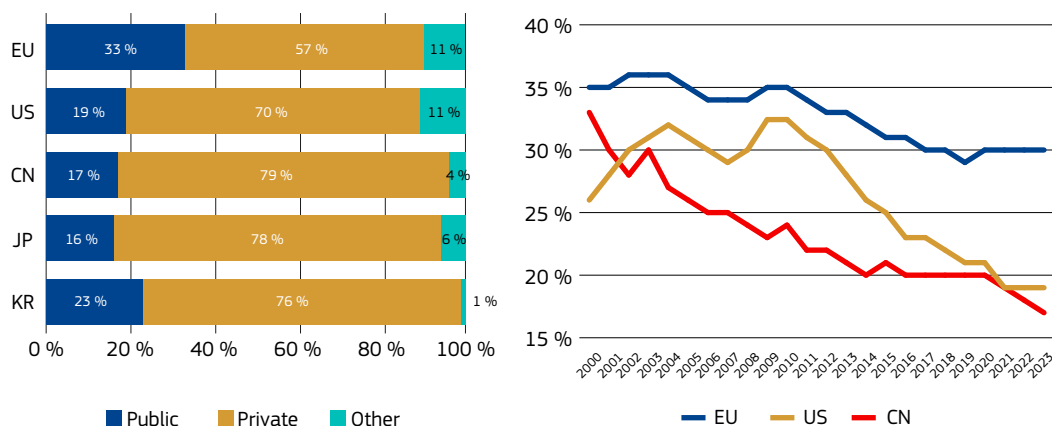
In absolute terms, EU public R&D investments reached EUR 127 billion in 2023, placing the EU among the world's largest public R&D funders. It spends more than China (EUR 74 billion), Japan (EUR 21 billion) and South Korea (EUR 19 billion), although it falls short of the US (EUR 167 billion). When accounting for economic size, EU public R&D intensity remained at 0.74% in 2023, which is higher than the levels recorded by China, the US, and Japan, all of which fall between 0.44% and 0.65%. Only South Korea surpasses the EU at 1.13% (Figure 2.1-6). However, this apparent strength conceals an underlying vulnerability. The EU economy grows at a much slower pace: roughly half the rate of the US (see chapter 5.1) and around one-sixth of China's GDP growth since

2010. Maintaining comparable R&D intensity therefore does not prevent the gap in absolute investment from widening over time. Even steady investment as a share of GDP can translate into declining global weight if the underlying economy grows more slowly. Over time, this dynamic can constrain the EU's capacity to generate innovation and productivity gains at scale.

The contrast between relatively high public investment and lower private investment points to a structural imbalance in how the EU R&D system is funded. Public sources account for approximately one-third of total R&D

financing in the EU, compared to around 17 to 19 % in both the US and China (Figure 2.1-5, left). This relatively high public share is in part a consequence of private investment not having kept pace. Since 2010, both the US and China have been shifting toward increasingly private-driven R&D systems, alongside the expansion of digital and scale-intensive sectors (Figure 2.1-5, right). This shift is reflected in the share of private funding with international counterparts reporting shares between 70% and 79%, while the EU stands at 57% of total R&D investment. Sustaining current levels of public investment alone may therefore not be sufficient to close the gap.

Figure 2.1-5 Gross domestic expenditure on R&D by source of funding, 2023 (left), share of public funding 2000-2023 (right)



Science, Research and Innovation Performance of the EU 2026

Source: DG Research and Innovation, Common R&I Strategy and Foresight Service, Chief Economist Unit based on Eurostat (DOI link: https://doi.org/10.2908/RD_E_GERDFUND).

Note: For the left side; R&D expenditures labelled as 'private' are funded by the business enterprise sector; the label 'public' combines funding by the government sector and European Commission as part of the rest of the world; and the label 'other' combines funding by the higher education, private non-profit and the remaining parts of the rest of the world. For the right side; the data represents only the government sector due to missing values (prior to 2015) for the European Commission as part of the rest of the world.

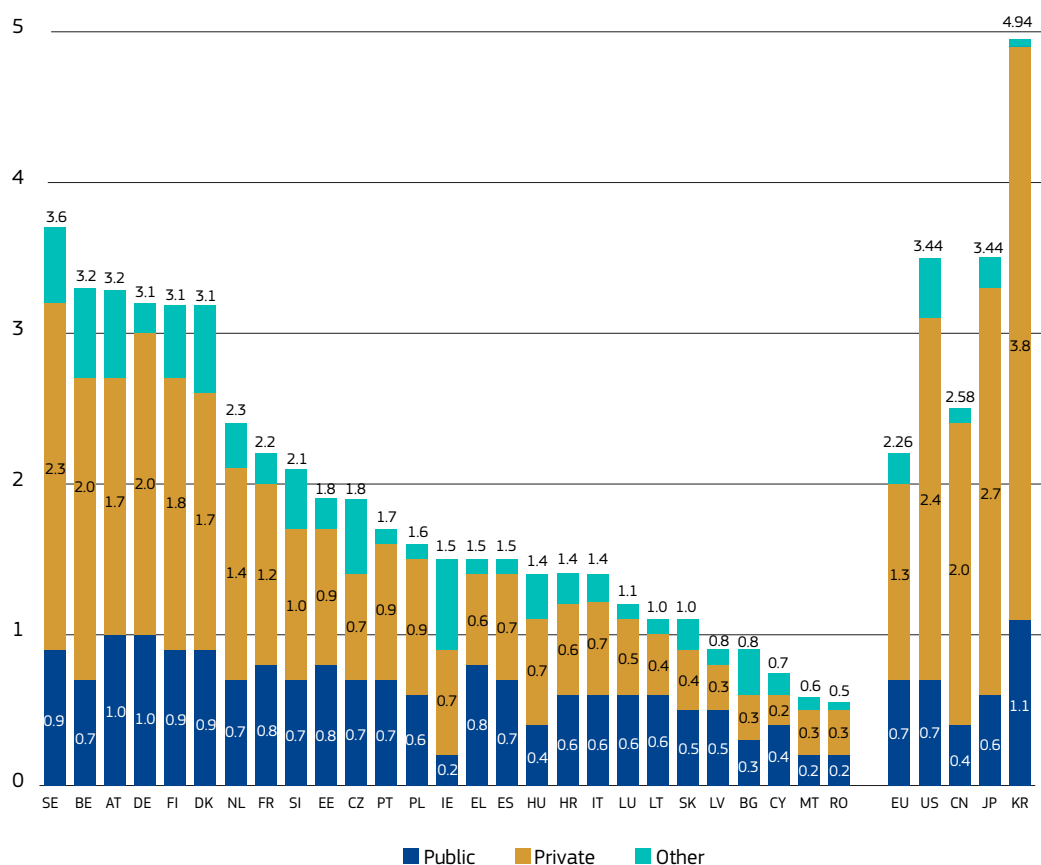
This structural imbalance plays out differently across Member States, with wide variation in both R&D intensity and the degree of public versus private investment. National R&D intensities range from 0.52% to 3.64% (Figure 2.1-6), reflecting differences in industrial specialisation and innovation system maturity, among other factors. Only six Member States currently exceed the EU's 3% benchmark, namely Sweden (3.64%),

Belgium (3.24%), Austria (3.22%), Germany (3.13%), Finland (3.09%) and Denmark (3.07%). Five countries remain below 1%, including Romania (0.52%), Malta (0.58%), Cyprus (0.66%), Bulgaria (0.79%) and Latvia (0.82%). In many countries with lower overall R&D intensity, public funding represents the largest share of total investment, whereas in high-intensity countries, private investment dominates the mix (Figure 2.1-6). This reflects a broader pattern in which

public R&D tends to step in where private investment capacity is more limited (Czarnitzki *et al.*, 2025). However, how public spending translates into broader research activity varies considerably. Measured as the ratio of total to public R&D intensity, some Member States perform at levels comparable to the US, China and Japan, i.e., Ireland (above 7), Belgium (around 5) and Sweden (above 4). Others such as Latvia,

Lithuania, Cyprus, Greece and Luxembourg report a ratio below 2. These differences partly reflect industrial structure and economic composition, but may also point to variation in the broader conditions that influence how effectively public investment is associated with private R&D activity (see for example chapter 3.2 on technology infrastructures).

Figure 2.1-6 R&D intensity, by source of funding for Member States, EU and other major economies, 2023



Science, Research and Innovation Performance of the EU 2026

Source: DG Research and Innovation, Common R&I Strategy and Foresight Service, Chief Economist Unit based on Eurostat (DOI link: https://doi.org/10.2908/RD_E_GERDFUND).

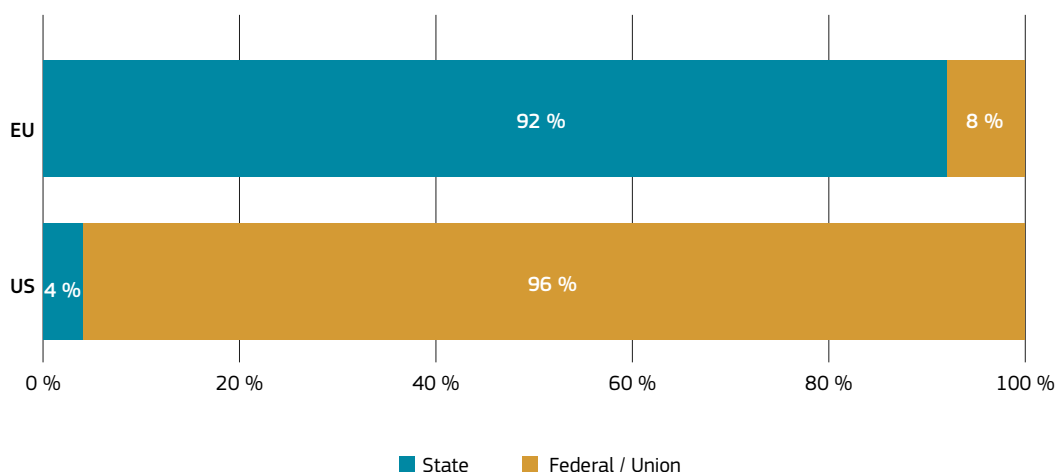
Note: R&D expenditures labelled as 'private' are funded by the business enterprise sector; the label 'public' combines funding by the government sector and European Commission as part of the rest of the world; the label 'other' combines funding by the higher education, private non-profit and the remaining parts of the rest of the world.

3. Public R&D investments: governance and funding priorities

Public R&D spending in the EU primarily relies on national resources, a fundamentally different system from the US approach of centralising funding at the federal level. In the EU, around 92% of public R&D funding originates from national governments (Figure 2.1-7). EU-level programmes, predominantly the Framework Programme for Research and Innovation and the R&I part of Cohesion Policy, account for roughly 8% of total public investments. By contrast, in the

US, 96% of public R&D funding comes from the federal budget, with only 4% from state and local sources. This difference is not only administrative. Existing research has shown that centralised systems tend to find it easier to coordinate research agendas and scale up investments around shared priorities, while more decentralised systems may better reflect diverse national needs but can make coordination across borders more challenging (Edler and Fagerberg, 2017).

Figure 2.1-7 State versus federal R&D funding in the EU and US as a share of total government R&D funding, 2023



Science, Research and Innovation Performance of the EU 2026

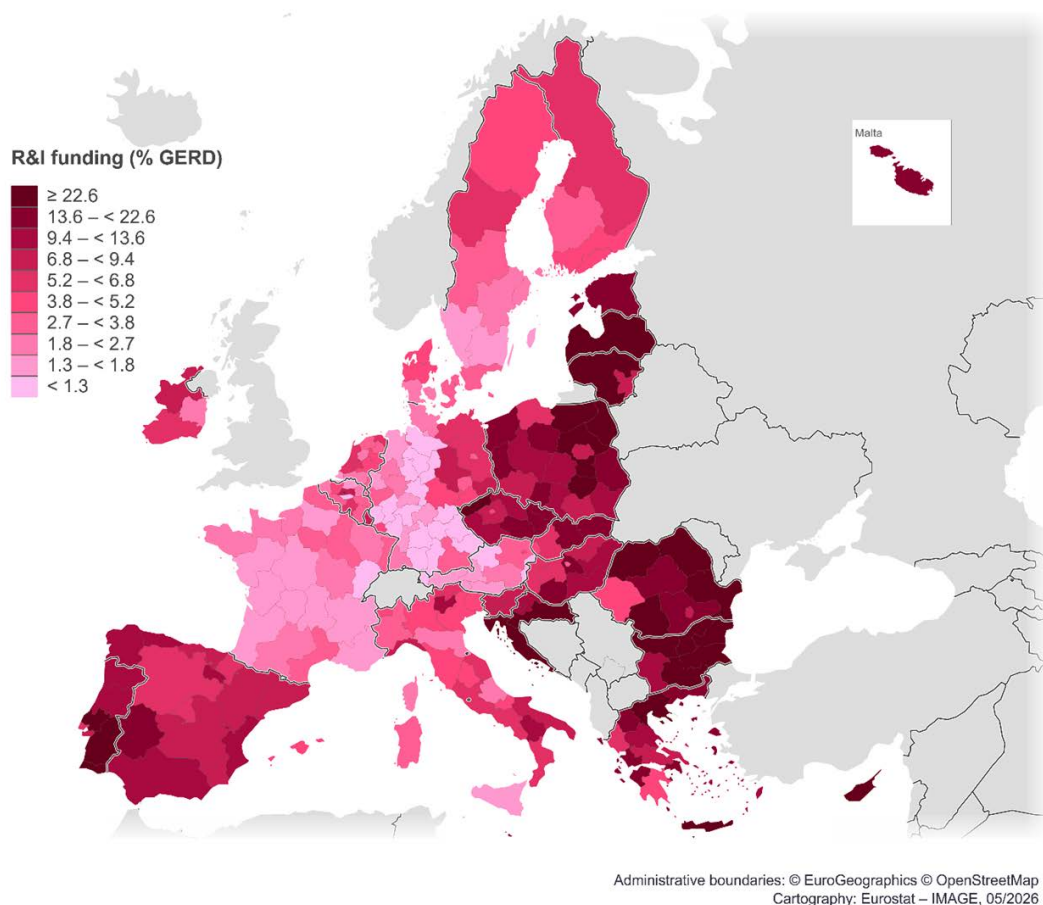
Source: DG Research and Innovation, Common R&I Strategy and Foresight Service, Chief Economist Unit based on Eurostat (DOI link: https://doi.org/10.2908/RD_E_GERDFUND) and National Centre for Science and Engineering Statistics (US).

Note: For the EU, Union funding is measured as funding by the European Commission as part of rest of the world. For the US, non-federal government funding is funding by state and local governments. Depending on the data year used, the percentage of EU Union level funding may be higher, potentially close to 10%.

Despite representing a smaller share of total public R&D spending, EU-level funding plays a strategic role that national programmes alone cannot easily replicate, particularly in enabling cross-border collaboration and tackling grand societal challenges. National funding allows countries to adapt research investments to their own regional needs, societal proprieties and industrial strengths. However, when each country funds research independently, it can lead to fragmentation, duplication of effort and a limited ability to bring together the scale of resources and expertise required to address major scientific and societal challenges (see chapter 6.2). EU programmes help address these limitations by pooling resources, coordinating research agendas and supporting collaborative initiatives that no individual Member State could easily sustain alone. In doing so, EU-level funding strengthens Europe's collective ability to address shared priorities such as climate change, health challenges and digital transformation (Mitra *et al.*, 2024). The extent to which this potential is realised, however, depends in part on the ability of national and regional research systems to engage with EU programmes and translate funding into outcomes (see chapter 6.1).

EU funding plays a very different role depending on the Member State, which means that the interaction with national funds also differs. In many central and eastern European countries such as Poland, Lithuania, Poland, and Romania, as well as parts of Southern Europe, including Croatia, Greece, and Portugal, EU funding represents a substantial share of total public R&D expenditure, often exceeding 22% in the period from 2021 to 2025 (Figure 2.1-8). In most western and northern European countries, EU funding typically accounts for less than 4% of R&D expenditure, with national and private investment remaining the dominant funders. These structural difference in funding composition may produce different incentives for policy alignment. Where EU funding constitutes a large share of the overall research budget, the incentives to align national strategies with EU priorities tend to be stronger. In contrast, where national systems are largely self-sufficient, alignment is more likely to be driven by strategic policy choice (Fagerberg *et al.*, 2009).

Figure 2.1-8 Average contribution of EU-level R&I funding to total public GERD: Horizon Europe and R&I Cohesion Policy, 2021–2025



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Source: Marques Santos and Conte (2026).

Note: Horizon Europe includes aggregated values of projects started by the end of 2025. R&I Cohesion Policy refers to estimates based on the EU share of operations decided by Operational Programmes by the end of 2025.

The characteristics of Member State R&D investments

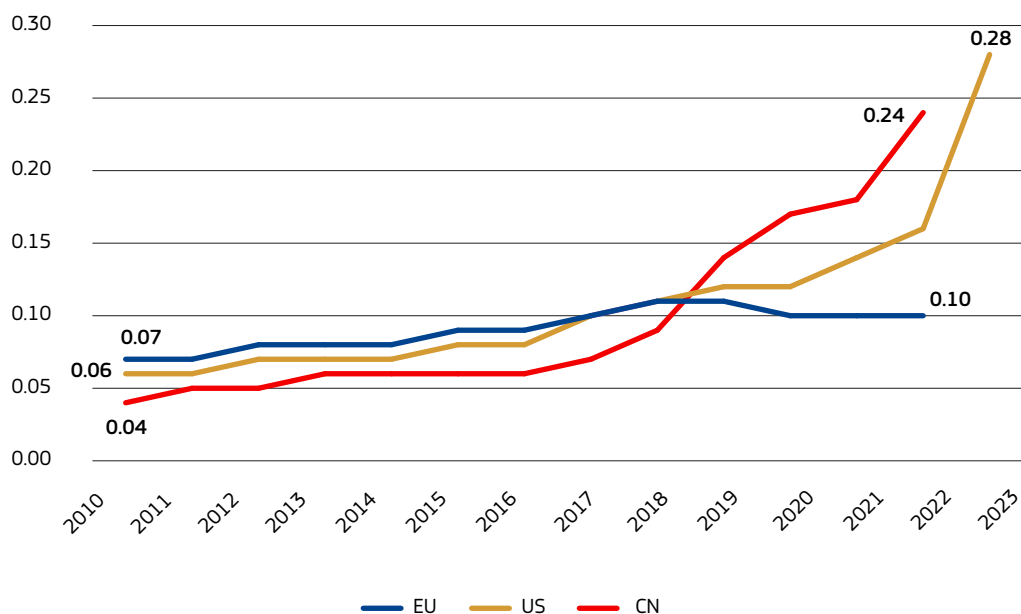
Member States channel their public R&D support through two broad types of instruments, namely direct institutional support and tax incentives. Direct instruments, such as grants, subsidies, public procurement and the establishment of public research institutions, allow governments to focus funding on specific priorities and sectors. Indirect instruments,

including tax incentives, credits, and favourable regulatory adjustments, encourage private-sector innovation by lowering the cost of R&D without directly funding specific projects. Research indicates that both tax incentives and direct funding are similarly effective, with one extra unit of R&D tax or direct support translating into 1.4 extra units of R&D (OECD, 2023), yet they support different stages and needs in the R&D process.

Since 2010, the use of tax incentives has increased significantly in the US and China, while the EU's use of this instrument has stagnated. As shown in Figure 2.1-9, over the past decade, tax incentives as a public support measure have risen sharply, with China increasing its support by sixfold (from 0.04 % of GDP in 2010 to 0.24 % of GDP in 2023) and the US by more than fourfold (from 0.06 % of GDP to 0.28 % of GDP over the same period).

The EU has also increased this type of support, but since 2019, a stagnation and slight decrease is observed, creating a diverging path compared to the US and China. In 2022, this resulted in a difference between the US and China on the one hand and the EU on the other, whereas in 2010, the difference between the major blocks was small, pointing to diverging approaches between the economies.

Figure 2.1-9 Indirect government tax relief for R&D expenditure (GTARD), EU, US and China, 2010–2023



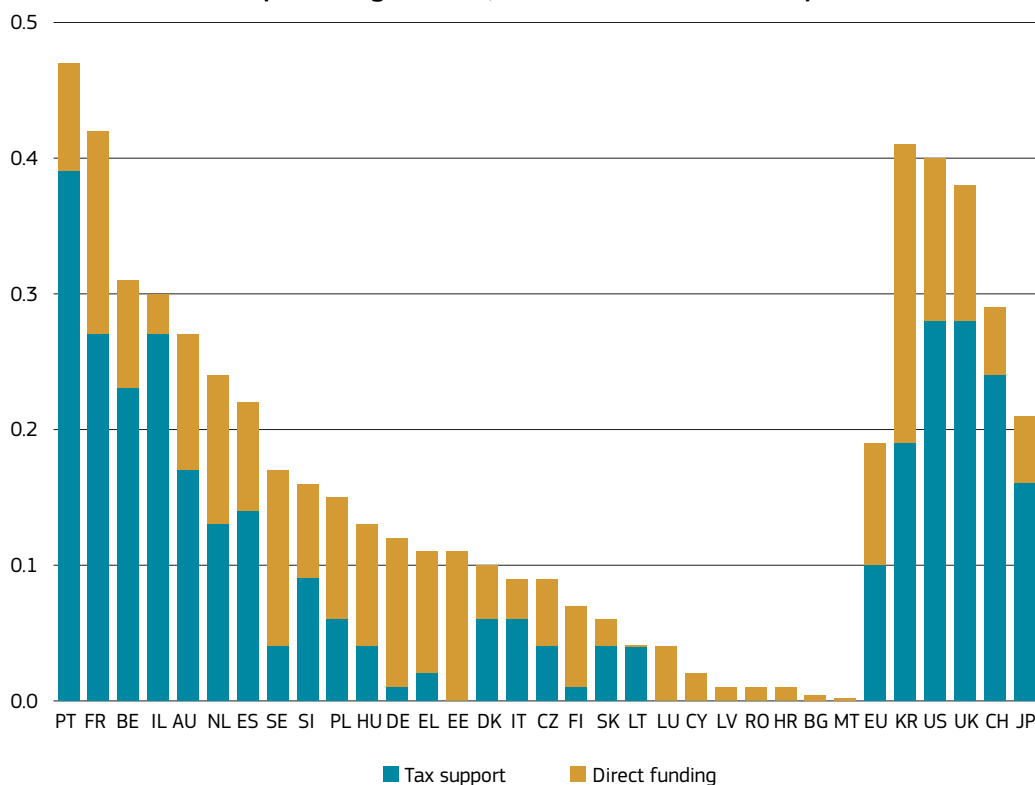
Science, Research and Innovation Performance of the EU 2026

Source: DG Research and Innovation, Common R&I Strategy and Foresight Service, Chief Economist Unit based on OECD R&D Tax Incentives database.

The use of tax incentives also varies considerably across Member States, with higher-intensity research economies tending to make greater use of indirect support. In 2023, indirect support by Member States in the form of tax incentives accounted for about 53 % of the total support to business R&D, while direct support accounted for 47 %. Member States such as Portugal, France, Belgium and Ireland, and to a lesser extent Austria, the Netherlands

and Spain, are among those offering the most generous R&D tax relief as a percentage of GDP (Figure 2.1-10). These figures are somewhat similar to international peers such as the US, UK and China. In contrast, most other EU Member States – and especially several central and eastern EU countries – rely comparatively more on direct funding than tax incentives at much lower overall levels of support.

Figure 2.1-10 Direct government funding and tax support for business R&D as a percentage of GDP, 2023 or latest available year



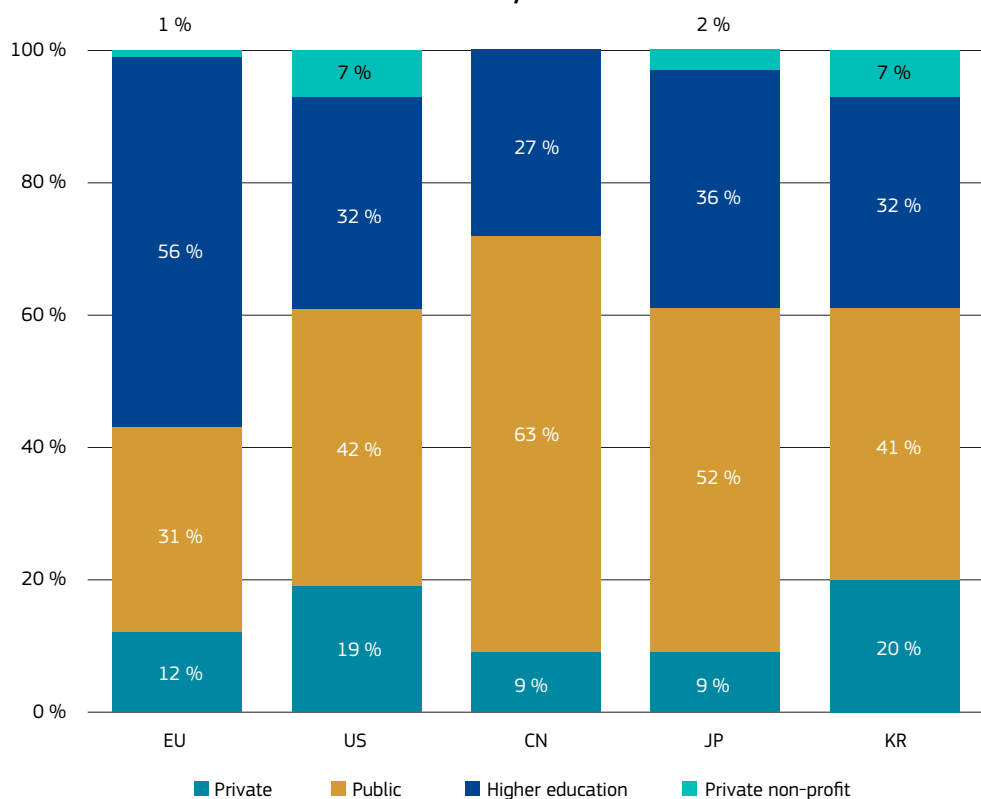
Source: DG Research and Innovation, Common R&I Strategy and Foresight Service, Chief Economist Unit based on OECD R&D Tax Incentives database.

Note: Tax support is measured as indirect government support through R&D tax incentives (GTARD) and direct funding as government-financed BERD. For additional information on the availability, design and implementation of R&D tax incentives in the EU and OECD area, see the OECD INNOTAX Portal.

Turning to where public R&D funding flows, national public R&D funding within the EU flows predominantly into the higher education sector, contrary to other major economies where governmental R&D organisations are the main recipients. Within the EU, the higher education sector receives 56 % of national government R&D funding, followed by the government sector at 32 % (Figure 2.1-11). This university-centred model reflects a long-standing feature of European research governance, in which universities have historically served as the primary an-

chors of the public research system (Lepori *et al.*, 2007). This model has been associated with the generation of knowledge that spills over into the broader economy, stimulating private innovation and productivity growth (Cohen *et al.*, 2002; Pavitt, 2001; Jaffe, 1989). However, the extent to which this happens depends on the strength of links between universities and the private sector and on the broader institutional environment in which knowledge transfer takes place (Etzkowicz and Leydesdorff, 2000; Breschi and Lissoni, 2001).

Figure 2.1-11 Sector of performance of public R&D funding, as a share of total, 2023 or latest year available



Source: DG Research and Innovation, Common R&I Strategy and Foresight Service, Chief Economist Unit based on Eurostat (DOI link: https://doi.org/10.2908/RD_E_GERDFUND).

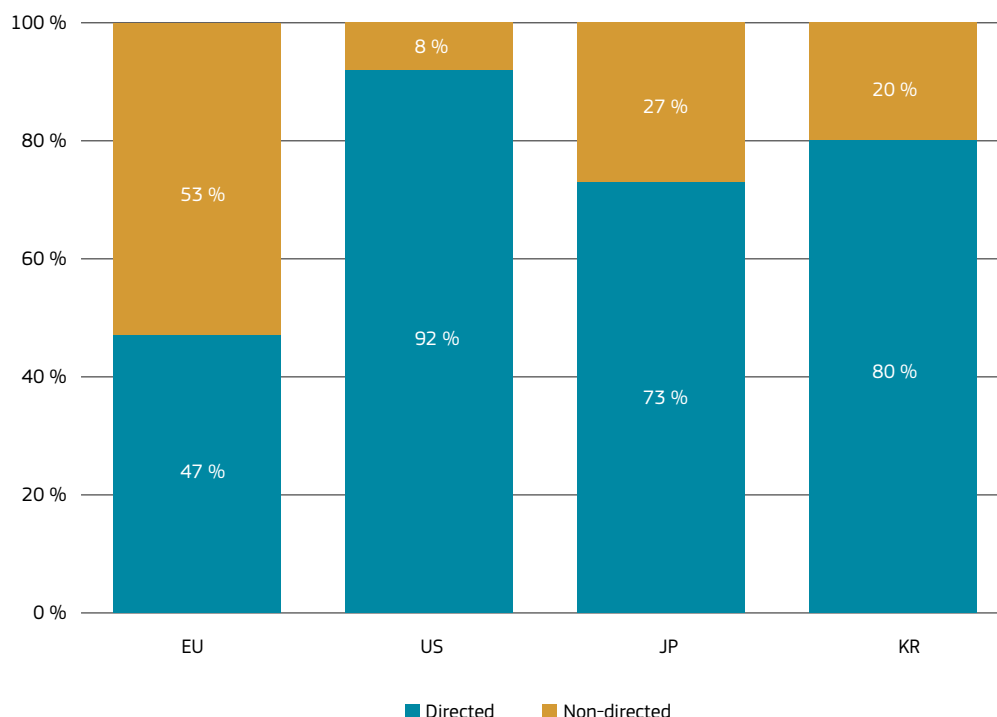
Note: For the EU, the latest full year available is 2020; for the other countries, 2023 is used. The sector labelled as 'private' is the business enterprise sector, as 'public' is the government sector, as 'higher education' is the higher education sector, and 'private non-profit' is the private non-profit sector.

In other major economies, public R&D funding is organised differently, dedicating a greater share to government research organisations and to the business sector. In China, Japan, the US and South Korea, governmental research organisations receive 63%, 52%, 42% and 41% of public R&D funding respectively (Figure 2.1-11). Government support directed at businesses stands at 20% in South Korea and 19% in the US, compared to 12% in the EU. This reflects a model in which public funding is more directly connected to applied research and commercial development.

Consistent with this university-centred model, the EU also allocates a considerably higher share of its public R&D budget to

open-ended, undirected research than other major economies. EU Member States channel around 53% of their R&D budgets into undirected support for the general advancement of scientific knowledge, compared to only 8% in the US, 20% in South Korea and 27% in Japan (Figure 2.1-12). This approach gives researchers freedom to pursue ideas that may not necessarily align with immediate policy needs or predefined priorities and has often been associated with an increase in breakthrough discoveries (e.g., Aghion *et al.*, 2009). The remaining 47% is directed towards specific socio-economic objectives, which is considerably lower than the shares reported for the US (92%), South Korea (80%) and Japan (73%).

Figure 2.1-12 Budget allocations for R&D by socio-economic objective, 2024



Source: DG Research and Innovation, Common R&I Strategy and Foresight Service, Chief Economist Unit based on Eurostat (DOI link: https://doi.org/10.2908/GBA_NABSF1N07).

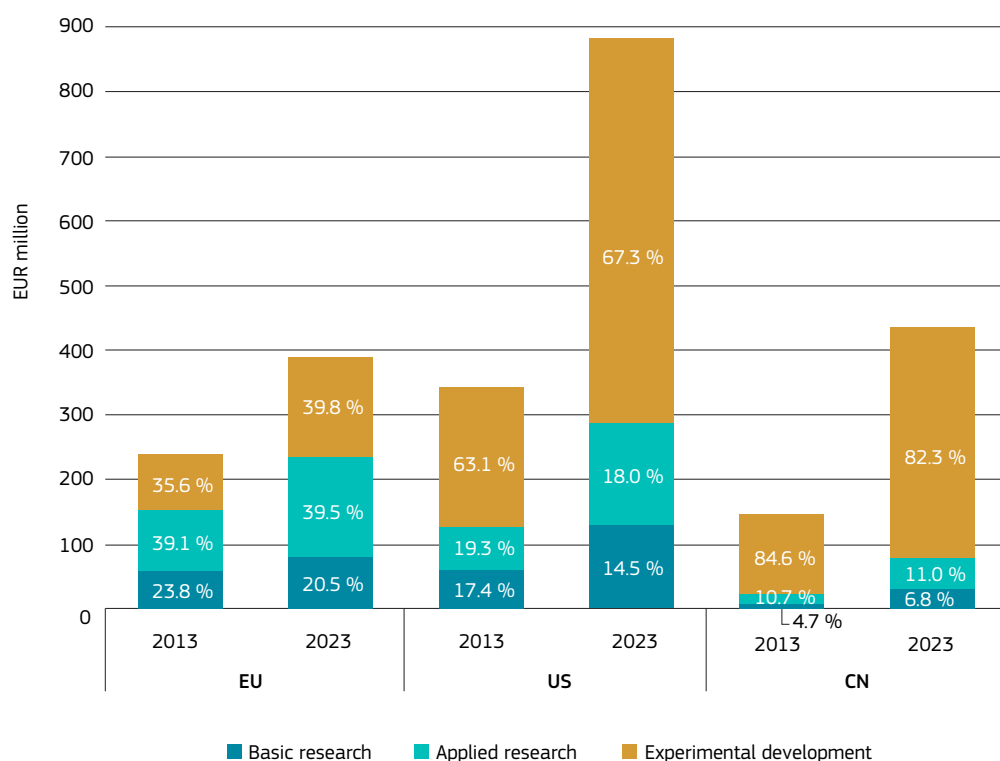
Note: NABS12 (general advancement of knowledge: R&D financed from General University Funds (GUF)) covers the estimated R&D content of 'block grants' paid by the government to the higher education sector. NABS13 (general advancement of knowledge: R&D financed from sources other than GUF) covers all budget allocations earmarked for basic research, but which cannot be attributed to a specific objective and are financed by sources other than GUF. Both NABS12 and NABS13 are categories that represent non-directed government appropriations. Data for China is no longer available.

These characteristics of EU's public research system (the concentration of funding in universities and the high share of open-ended research) are reflected in the type of R&D activity performed. R&D can be broken down into three stages, each taking knowledge a step closer to practical use. Basic research is the most exploratory stage as it generates new scientific knowledge without a specific application in mind. Applied research takes that knowledge and uses it to address questions or problems, while experimental development converts this existing knowledge into concrete outputs, processes or products.

The EU invests relatively more in the earlier stages of research with 20% of total R&D expenditure allocated to basic research, 39% to applied research and 41% to experimental development (Figure 2.1-13). In contrast, China and the US, allocate 82%, and 67% to experimental development respectively, i.e., the stage where knowledge is most directly converted into commercial outputs. These higher shares are reflected in substantially larger real amounts compared to the EU. Over the last decade, a small shift is observed for the three economies, with the EU (+6 percentage points (pp)) and the US (+4 pp) putting relatively more emphasis on

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Figure 2.1-13 GERD by type of R&D funded, EUR billion and % of total, 2013 and 2023



Science, Research and Innovation Performance of the EU 2026

Source: DG Research and Innovation, Common R&I Strategy and Foresight Service, Chief Economist Unit based on Eurostat (DOI link: https://doi.org/10.2908/RD_E_GERDACT).

Note: The EU figures are calculated using a sample of EU Member States that have available data for the years 2013 and 2023 and multiplying the shares for the total of the EU. Missing countries for the year 2013: Germany, Luxembourg, the Netherlands, Sweden and Finland; and for the year 2023: Germany, the Netherlands and Finland. The y-axis represents the totals, while the shares are presented within the columns. Percentages do not round to 100 due to non-specified data.

experimental development in 2023 compared to 2013, opposed to basic research, (-4 pp) and (-3 pp) respectively, while China has seen a relative decrease of the share of experimental development (-2 pp), in favour of more basic research (+2 pp) over the same period.

At the business sector level, where the link between research and commercial outcomes is most direct, the EU similarly shows a lower share of experimental development than its main competitors. More granular data for 2023, by sector of perform-

ance further indicates that the EU has a relatively low share of experimental development performed by the business sector (37% of GERD), compared to the US (62%) and China (75%). Conversely, the EU shows relatively higher shares of applied research performed by the business sector (25% of GERD), compared to the US (11%) and China (2%). This suggests that European businesses are active in research, but more at an earlier stage of the R&D cycle. Part of this difference reflects the composition of the European industry, which will be explained in section 4 of this chapter.

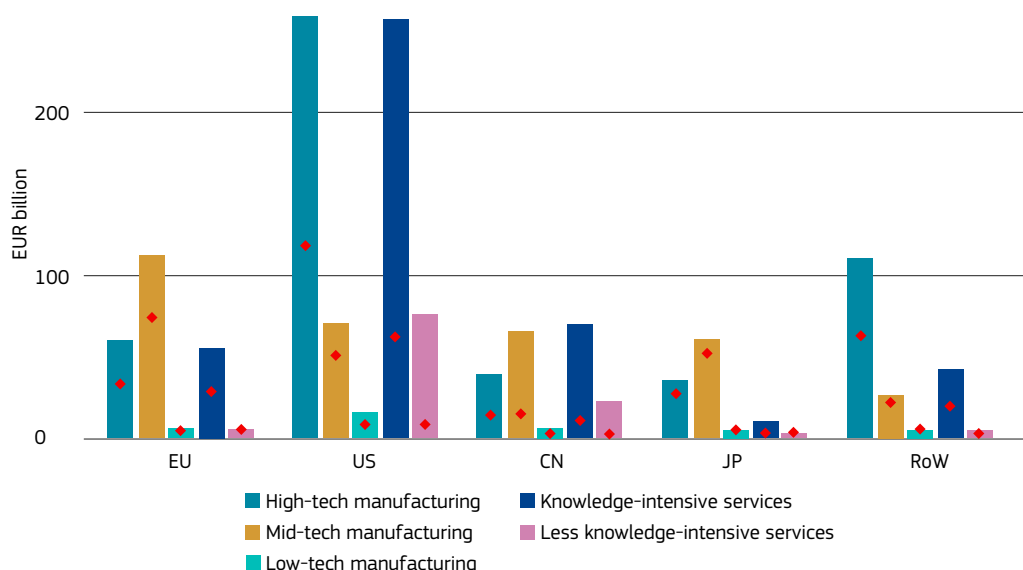
4. Structural and sectorial features of EU private R&D investment

Business expenditure on R&D (BERD) in the EU is relatively stable, but comparatively modest. Reaching approximately 1.50 % of GDP in 2023, the overall EU's BERD remains substantially lower than in other major economies, such as the US and Japan (both about 2.70 %) and South Korea (3.93 %) and slightly below China (2.00 %). Beyond this aggregate gap, the composition of private R&D spending also differs significantly from that of the EU's peers.

EU private R&D investments are largely directed towards mid-tech industries. Based on the top 2 000 R&D investors in the world, EU firms commit large shares of their R&D budgets to mid-tech manufacturing (EUR 112 billion), while high-tech manufacturing (EUR 60 billion) and knowledge-intensive services (EUR 56 billion) receive considerably less (Figure 2.1-14).

The focus of R&D investments underlines a structural gap between the EU and its peers, with potential implications for EU's long-term competitiveness. In 2024, the US deployed EUR 680 billion in total business R&D, with high-tech manufacturing (EUR 259 billion) and knowledge-intensive services (EUR 257 billion) accounting for over three quarters of total investment. China's total business R&D grew nearly fivefold from EUR 43 billion in 2014 to EUR 204 billion in 2024 and its knowledge-intensive services (EUR 71 billion) now slightly exceed mid-tech manufacturing (EUR 65 billion). Japan, similar to the EU, remains concentrated in mid-tech manufacturing, with knowledge-intensive services accounting for just EUR 10 billion.

Figure 2.1-14 Private R&D investment by region and NACE sector type, 2024



Science, Research and Innovation Performance of the EU 2026

Source: DG Research and Innovation, Common R&I Strategy and Foresight Service, Chief Economist Unit based on the EU Industrial R&D investment Scoreboard 2025.

Note: This figure is based on R&D investment of companies that belong to the top 2 000 companies of the EU Industrial R&D Investment Scoreboard 2025. Further categorisation of NACE (the statistical classification of economic activities in the European Community) sectors by type of sector was made using the Eurostat HTEC classification.

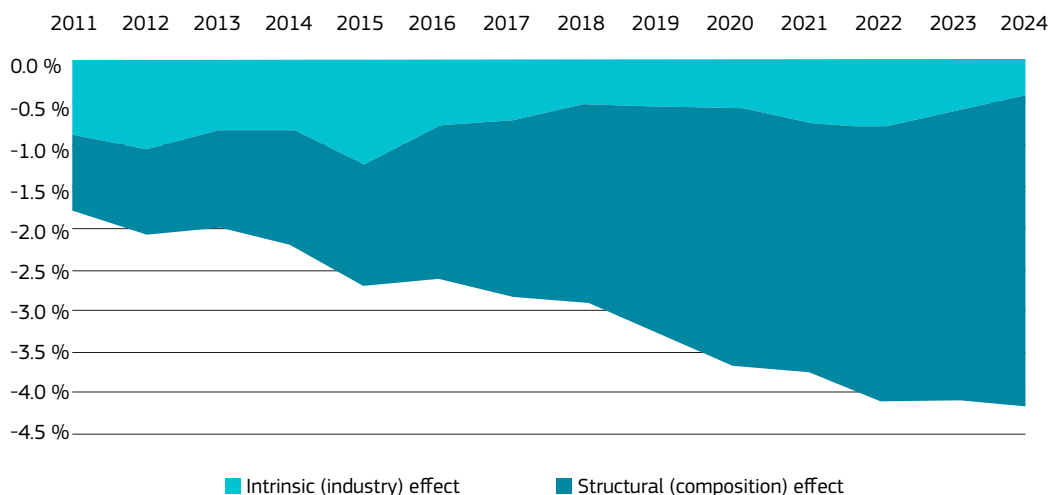
The differences in R&D spending can be explained through both structural composition and intrinsic effects.

Structural composition effects relate to the size and weight of each sector within the economy. Regions with a larger share of R&D intensive industries, such as ICT software and health, naturally show higher overall R&D intensity. Intrinsic effects capture what individual firms within a given sector choose to invest. These decisions depend on firm-level factors, including company strategies, capabilities, access to resources and knowledge, and broader innovation cultures. As a result, firms operating in the same sector can still display very different levels of R&D investment across regions (Mathieu and van Pottelsberghe de la Potterie, 2010; Becker and Hall, 2013).

The main driver behind the gap between the EU and the US is sectoral specialisation in high R&D intensity.

Historically, EU companies have trailed their US counterparts in terms of R&D intensity, invested at similar levels to Japanese firms, and outperformed most other regions. However, in recent years, the R&D intensity gap has widened causing both US and Chinese firms to outpace EU firms. For the US, this widening between 2011 and 2024 was mainly caused by the structural composition effect as US companies have expanded their presence in highly R&D-intensive sectors. In this case, the intrinsic effect played a smaller and diminishing role (Figure 2.1-15).

Figure 2.1-15 EU-US private R&D intensity gap



Science, Research and Innovation Performance of the EU 2026

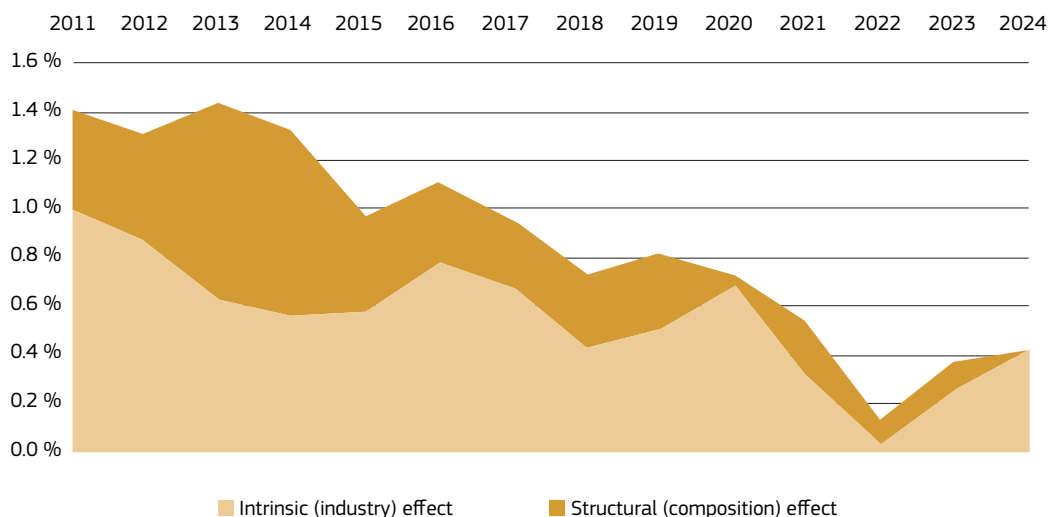
Source: Joint Research Centre, Industrial Strategy, Skills and Technology Transfer Unit based on EU Industrial R&D Investment Scoreboard 2025.

Note: R&D intensity is calculated as R&D expenditure divided by net sales (current euros), based on the top 2 000 global R&D investors each year. The aggregate difference in R&D intensity between two economies is the sum of the differences in output shares of net sales, weighted by their average R&D intensities (structural effect), plus the sum of differences in R&D intensity for all sectors, weighted by their average share of net sales (intrinsic effect).

The EU-China R&D intensity gap is narrowing, driven by both China's changing industrial structure and reductions in within-sector differences. Among the world's top 2 000 R&D investing companies, the EU historically maintained a lead over China, unlike when considering the economy as a whole. This lead was largely due to EU firms' stronger R&D performance in sectors such as health and automotive. However, this gap has narrowed substantially over time. By 2024, the EU's structural advantage had fully disappeared, marking the first year in which the EU registered a slightly negative structural

R&D intensity gap (-0.02%) compared to a positive 0.40% in 2011 (Figure 2.1-16). This reflects China's growing specialisation in R&D-intensive sectors, particularly ICT services and ICT hardware, fuelled by the rise of major innovators such as Huawei, ZTE, Lenovo, Tencent, Alibaba and Baidu. Although the EU still maintains higher firm-level R&D intensity in key sectors like health and automotive, the overall structural advantage has vanished, with the remaining gap only reflecting differences within sectors.

Figure 2.1-16 EU-China private R&D intensity gap



Science, Research and Innovation Performance of the EU 2026

Source: Joint Research Centre, Industrial Strategy, Skills and Technology Transfer Unit based on EU Industrial R&D Investment Scoreboard 2025.

Note: R&D intensity is calculated as R&D expenditure divided by net sales (current euros) based on the top 2 000 global R&D investors each year. The aggregate difference in R&D intensity between two economies is the sum of the differences in output shares of net sales, weighted by their average R&D intensities (structural effect), plus the sum of differences in R&D intensity for all sectors, weighted by their average share of net sales (intrinsic effect).

The difference in public versus private R&D can lead to variations in broader economic impact. A growing body of empirical research suggests that public and private R&D are not equivalent in this respect (e.g., chapter 8). Public R&D tends to generate larger spillovers across the economy, as the produced knowledge can be acquired by many firms and sectors. By contrast, private R&D is more closely tied to commercial objectives and typically produces more targeted, appropriate returns. Recent estimates indicate that the long-term productivity gains associated with public R&D are significantly higher than those from private investment, largely due to these wider diffusion effects (e.g., Dyèvre, 2024; Gazzani *et al.*, 2025).

At the same time, the two forms of R&D are not substitutes, but fulfil distinct and complementary roles. Public investment provides the scientific foundations, while private R&D plays a central role in translating knowledge into marketable products and services (Antolín-Díaz and Surico, 2025). Evidence also suggests that government-funded research, while accounting for a smaller share of total innovation outputs, contributes disproportionately to medium-term productivity dynamics (e.g., Dyèvre, 2024; Fieldhouse and Mertens, 2024). This reinforces the importance of maintaining a balanced R&D system, where strong public research capacity supports and interacts with private sector innovation.

With R&I investments at the core of economies' long-term objectives, such as economic growth and societal returns, attention has increasingly shifted towards an optimal R&I policy design.

Beyond the overall scale of funding, recent contributions emphasise the importance of directionality and strategic prioritisation in shaping innovation outcomes (Edler and Fagerberg, 2017; Mazzucato and Semieniuk, 2018). In this context, governments face persistent trade-offs in allocating limited budgetary resources to enhance societal returns. This has led to a growing focus on policy mixes that combine

direct funding instruments, such as grants, tax-based incentives, and supply as well as demand-side instruments, in order to influence both the intensity and composition of R&I investment (Edler and Fagerberg, 2017). At the same time, these policy approaches must adapt to evolving economic and technological landscapes, with shifting geopolitical and industrial priorities. As a result, R&I policy is not only concerned with increasing investment levels, but also with directing resources in ways that enhance complementarities between public and private actors and maximise long-term innovation performance.

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CHAPTER 2.2

VERTICAL COHERENCE OF R&I INVESTMENT IN THE EU*

*Andrea Conte, Paolo Pasimeni, Silvia Rocchetta**

KEY QUESTIONS

- ▶ How is research and innovation (R&I) investment deployed in a multi-level governance system such as the EU?
- ▶ How do we track R&I investment across the full spectrum of EU funding programmes (supranational, national and regional) and governance levels?
- ▶ Do EU-level funds crowd-in or -out national investment in R&I? Are there positive spillovers between funding streams?

HIGHLIGHTS

- ▶ Public R&I funding is unevenly distributed across Member States and across the main instruments (EU's Framework Programmes, the R&I specific strand of Cohesion Policy, and national research and development [R&D] budgets). This heterogeneity shapes the degree to which additional EU resources can be absorbed and turned into productive outcomes.
- ▶ The analysis indicates consistent crowding-in between funding streams. An additional EUR 1 000 of national R&D budget is associated with, on average, EUR 58 of extra Horizon Europe funding two years later (pass through 5.8 %)
- ▶ R&I cohesion is a strong lever. The R&I-specific component of Cohesion Policy exhibits the largest pass through rate: every EUR 1 000 of R&I Cohesion Policy outlay is associated with roughly EUR 385 of extra Horizon Europe funding in the following year (+38.5%). This channel therefore represents a powerful source of vertical coherence, reinforcing the capacity of Member States to benefit from EU wide research grants.

POLICY INSIGHTS

- ▶ Ensure that funding coordination across governance tiers (supranational, national, regional) is matched by cross policy alignment (thematic priorities) to enhance overall policy effectiveness.
- ▶ Use the sector specific results to align work programme calls, co financing rules and monitoring indicators across different instruments. This will enable the EU to target capacity building investments where absorptive capacity is weakest, and to channel complementary funding efficiently.
- ▶ Align the R&I component under direct management and maintain the broader complementarity with R&I programmes under shared management. This joint approach strengthens vertical coherence across EU, national and regional levels while optimising the use of public resources.

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Public investment in research and innovation (R&I) in the EU flows through a complex multi-level governance system. Understanding how public investment is deployed through this multi-level governance system and assessing the vertical coherence of such efforts across the EU remain key to ensuring an effective use of public money. This calls for evidence

assessing the extent to which EU-level funds crowd-in or -out national investment, shedding light on whether each additional unit of funding allocated to one programme generates positive spillovers that stimulate further investment in the other streams, or whether it displaces (or replaces) investment from them, reflecting a negative substitution effect.

1. Coherence in funding architecture is essential for an efficient R&I system

The allocation of fiscal responsibilities within multi-level governance systems remains a central question in economic and political theory. The question of how fiscal responsibilities should be allocated across different levels of government is particularly relevant for the EU's system of multi-level governance (Wyplosz, 2016; D'Apice and Pasimeni, 2020; Conte and Marques Santos, 2023). A large body of economic literature is devoted to the issue of the optimal assignment of expenditure responsibilities across government layers¹. Since the pioneering work of Musgrave (1959), which distinguished among the allocation, distribution and stabilisation functions of the public sector, scholars have argued that public spending should be administered by the level of government best able to deploy efficiently, while accounting for differences in citizens' preferences and geographic externalities.

The articulation of such functions is crucial. This is particularly important in the EU, where competences are shared among supra-national, national and local authorities. In this context, the design of investment policies is not merely an administrative issue but a fun-

damental determinant of policy effectiveness, democratic accountability and economic efficiency². The existence of cross-border spillovers, integrated markets and common policy objectives may justify the centralisation of certain competences, whereas the diversity of economic, social and territorial conditions across Member States supports decentralisation in other areas (D'Apice and Pasimeni, 2020).

The EU's budgetary constraints call for an optimisation of coherence across different layers of government. The debate about the EU multiannual financial framework has always focused on the best ways to cope with emerging priorities, while having a comparatively more rigid structure and a much smaller size with respect to national budgets (Tarschys, 2011; Benedetto and Milio, 2012; Monti *et al.*, 2016; Becker *et al.*, 2017; Heinemann *et al.*, 2017; Fuest and Pisani-Ferri, 2019; Busse *et al.*, 2025; Buti *et al.*, 2026). Consequently, determining an appropriate attribution of functions and expenditures across the various layers of government is essential for ensuring that public resources are employed efficiently. Moreover, policy responsibilities must be exer-

1 A comprehensive review of the literature can be found in Oates W.E., (1999, 2005) and, within an EU context, in Oates (2002) and Begg (2009).

2 For an in-depth analysis of the so-called 'decentralisation theorem', see Oates (1972).

cised at the level where they can generate the greatest value, consistent with the EU principle of subsidiarity.

The EU R&D system operates through a layered architecture of public funding, including EU directly managed programmes, such as Horizon Europe, the shared management instruments of Cohesion Policy, and the national R&D budgets (as reported in the Eurostat's Government Budget Allocations for R&D [GBARD] series). Most public investment in R&D in the EU is deployed at the national level (see chapter 2.1); therefore, synergies between EU-level instruments and national budgets are crucial, as the EU budget is only able to finance a small fraction of overall public expenditure in these areas. Although these streams are designed to be mutually reinforcing, empirical evidence of their interaction has been limited.

Coherence in the architecture of R&I funding can be seen as the condition for turning Europe's diversity into collective capacity. In the specific case of the EU R&I system, vertical coherence refers to the alignment of supranational R&I funding (e.g., the EU's Framework Programmes [FP] for R&I), both national (government budget appropriations for R&D) and regional (the R&I strand of Cohesion Policy). When policies at each tier are designed and implemented so that they reinforce one another, they generate synergies: the combined effect of the instruments exceeds the sum of their isolated impacts (Magro and Wilson, 2013; Flanagan *et al.*, 2011).

When this alignment is weak, fragmentation or contradictory policy signals can dilute the overall return on investment. When it is strong, resources are more likely to be used effectively. The more coherent, the more the policies at different tiers of governance strengthen one another by reducing conflicts between objectives and instruments, both in design and implementation (Platjouw

et al., 2025). Such coherence can be seen as the condition for turning Europe's diversity into collective capacity. The qualifier 'vertical' distinguishes this from 'horizontal' coherence, which concerns coordination across policy domains at the same level of governance. Examples of horizontal coherence include the alignment of research funding with climate action, digitalisation, health or industrial policy programmes. Horizontal coherence is achieved when these policy streams are organised so that they create synergies. For instance, a climate-focused research call that simultaneously advances digital innovation could be seen to deliver dual benefits without duplicating effort or resources.

Both forms of coherence are essential for an efficient EU R&I system. Vertical coherence ensures that funding flows from the EU, national and regional tiers complement each other, strengthening overall investment capacity. Horizontal coherence guarantees that the same funds contribute to multiple policy objectives, maximising the return on public spending through inter-policy synergies. Together, they help the EU achieve a more integrated, resilient and innovative knowledge economy.

Public R&I financing in EU operates through three distinct institutional logics. Analysing their interaction is a prerequisite for a credible assessment of vertical coherence. These three different sources of public investment for R&I are managed in different ways.

- ▶ **Direct EU management:** the European Commission designs competitive calls and awards grants directly to beneficiaries; national authorities have no gate-keeping role. This channel rewards research excellence, generates knowledge spillovers and follows a short-term, grant-by-grant timetable.

- ▶ **Shared EU management:** Cohesion Policy R&I funding is co-financed by the Commission and the Member State. Allocation envelopes are fixed ex-ante and disbursement depends on national co-financing and absorption rates. The instrument pursues territorial convergence by upgrading regional R&I systems and operates on a longer implementation horizon.
- ▶ **National management:** Member States allocate R&D spending through their own budgetary procedures (GBARD). These allocations reflect national strategic priorities, are subject to domestic fiscal cycles, and embody strategic public-investment decisions.
- ▶ **Horizon Europe** creates knowledge spillovers and innovation externalities; its competitive nature encourages efficiency and productivity gains.
- ▶ **Cohesion Policy R&I** enhances regional absorptive capacity, a pre-condition for realising the spillovers from supranational programmes; it also contributes to convergence externalities.
- ▶ **National R&D budgets (GBARD)** represent strategic public-investment decisions that can generate multiplier effects and shape the domestic innovation system; they are, in general, more flexible in their allocation.

The distinction between direct and shared management is central to any assessment of vertical coherence. Because Horizon Europe, Cohesion Policy and national R&I funds are governed by different institutional logics, eligibility criteria and disbursement schedules, treating them as a homogeneous EU funding block would mask genuine complementarities (crowding-in) or substitution (crowding-out) effects. From an economic perspective, the three channels generate distinct externalities:

The relative importance of each channel varies markedly across Member States. In economies with limited national R&D capacity, EU-level instruments constitute a substantial share of total R&I spending, whereas in larger, richer economies they account for a modest proportion. This territorial heterogeneity influences the scope for vertical synergy. Similar dynamics are observed at the sectoral level, where differences in sectoral composition, technological intensity and global-value-chain position modulate the magnitude of spillovers.

2. Investment is highly decentralised

There is a pronounced territorial heterogeneity in the funding allocation across Member States³. Although national R&D budgets dominate in absolute terms, the relative weight of the EU instruments varies greatly across the EU (Table 2.2-1). In some countries R&I Cohesion Policy outlays occasionally exceed national GBARD, whereas in the more research-inten-

sive economies, the combined Horizon Europe and Cohesion Policy contribution represents less than 10% of total R&I effort. These differences largely mirror variations in absorptive capacity, i.e. the ability of a region to transform external resources into productive outcomes (Becker *et al.*, 2013). Regions with limited human-capital endowments or weaker institutional settings

³ The analysis covers the period of 2016 to 2023. This time window matches the implementation phase of the 2014 to 2020 European Structural and Investment Funds (ESIF) programming cycle, for which observed spending under Thematic Objective 01 ('Strengthening research, technological development and innovation') is available. 2016 is the first year for which ESIF spending is recorded, while 2023 is the most recent year available. Both the descriptive figures in Table 2.2-1 and the causal estimates discussed in the next section rely on this same reference period.

tend to rely more heavily on EU-level funding, which in turn creates stronger scope for vertical synergies. Conversely, well-funded national systems exhibit lower marginal effects from additional EU resources, because the incremen-

tal knowledge spillovers are partially offset by existing domestic capacity.

EU instruments are designed for different purposes and therefore interact

Table 2.2-1 Average annual public R&I funding by instrument, 2016–2023
(constant 2015 EUR million)

Member State	GBARD (million EUR)	Horizon (million EUR)	R&I-Cohesion (million EUR)	Horizon / GBARD	R&I-Coh. / GBARD	R&I-Coh. / Horizon
Austria	2 948.9	192.1	23.4	6.5 %	0.8 %	12.2 %
Belgium	3 016.6	318.6	35.6	10.6 %	1.2 %	11.2 %
Bulgaria	112.8	15.3	29.2	13.6 %	25.9 %	190.8 %
Croatia	370.7	13.4	70.1	3.6 %	18.9 %	523.1 %
Cyprus	88.5	34.4	13.9	38.9 %	15.7 %	40.4 %
Czechia	1 115.6	46.7	235.4	4.2 %	21.1 %	504.1 %
Denmark	2 684.9	175.7	11.9	6.5 %	0.4 %	6.8 %
Estonia	166.5	24.3	62.6	14.6 %	37.6 %	257.6 %
Finland	1 971.4	155.0	35.3	7.9 %	1.8 %	22.8 %
France	15 196.2	723.5	195.5	4.8 %	1.3 %	27.0 %
Germany	32 632.7	943.3	466.0	2.9 %	1.4 %	49.4 %
Greece	1 228.4	183.9	48.7	15.0 %	4.0 %	26.5 %
Hungary	470.8	34.8	208.2	7.4 %	44.2 %	598.3 %
Ireland	804.9	119.7	24.4	14.9 %	3.0 %	20.4 %
Italy	9 970.8	557.3	385.8	5.6 %	3.9 %	69.2 %
Latvia	65.8	11.0	53.0	16.7 %	80.5 %	481.8 %
Lithuania	141.7	9.4	72.8	6.6 %	51.4 %	774.5 %
Luxembourg	394.9	20.3	1.1	5.1 %	0.3 %	5.4 %
Malta	27.5	3.8	5.4	13.8 %	19.6 %	142.1 %
Netherlands	5 592.1	521.5	52.7	9.3 %	0.9 %	10.1 %
Poland	2 102.9	76.5	890.0	3.6 %	42.3 %	1163.4 %
Portugal	687.0	110.2	404.0	16.0 %	58.8 %	366.6 %
Romania	348.4	27.9	74.5	8.0 %	21.4 %	267.0 %
Slovakia	336.2	14.3	87.3	4.3 %	26.0 %	610.5 %
Slovenia	229.9	35.9	85.0	15.6 %	37.0 %	236.8 %
Spain	6 538.7	640.3	578.0	9.8 %	8.8 %	90.3 %
Sweden	3 728.0	238.2	27.9	6.4 %	0.7 %	11.7 %

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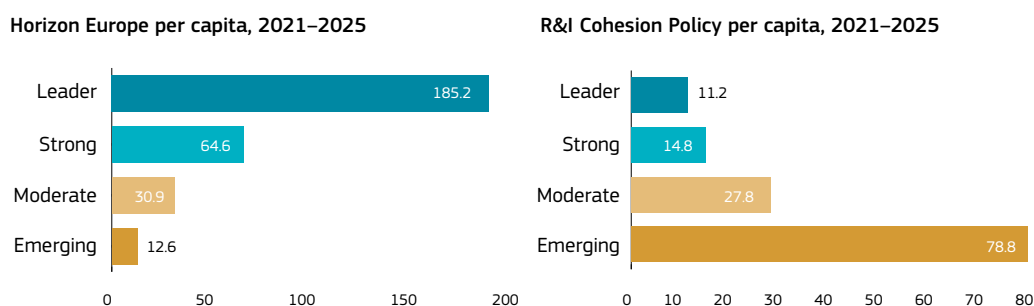
Source: Joint Research Centre based on Eurostat (DOI link: https://doi.org/10.2908/GBA_NABSFIN07), DG Research and Innovation (framework programme allocations) and DG Regional and Urban Policy (ESIF Thematic Objective 01).

Note: Country-level annual averages over the period of 2016 to 2023, in million EUR at 2015 constant prices, deflated with the country-year GDP deflator; ratios computed on unrounded values. The Horizon column is restricted to Horizon 2020. EU, net of the territorial cooperation envelope and of the UK.

with national systems in fundamentally different ways. Funding from Horizon Europe is strongly concentrated in Europe's most advanced innovation ecosystems. Innovation leaders receive roughly 15 times more Horizon funding per capita compared to emerging innovators (Figure 2.2-1, left). R&I funding under Cohesion Policy flows is primarily directed towards regions with lower levels of innovation performance, as emerging in-

novators receive roughly seven times more R&I Cohesion Policy support than innovation leaders (Figure 2.2-1, right). This pattern suggests that the Horizon Europe instrument primarily supports the best performing innovation ecosystems, while the R&I funding from Cohesion Policy helps ensure that less innovative regions are not left behind.

Figure 2.2-1 R&I funding intensity per instrument (EUR per capita) by Regional Innovation Scoreboard (RIS) 2025 classification, 2021–2025



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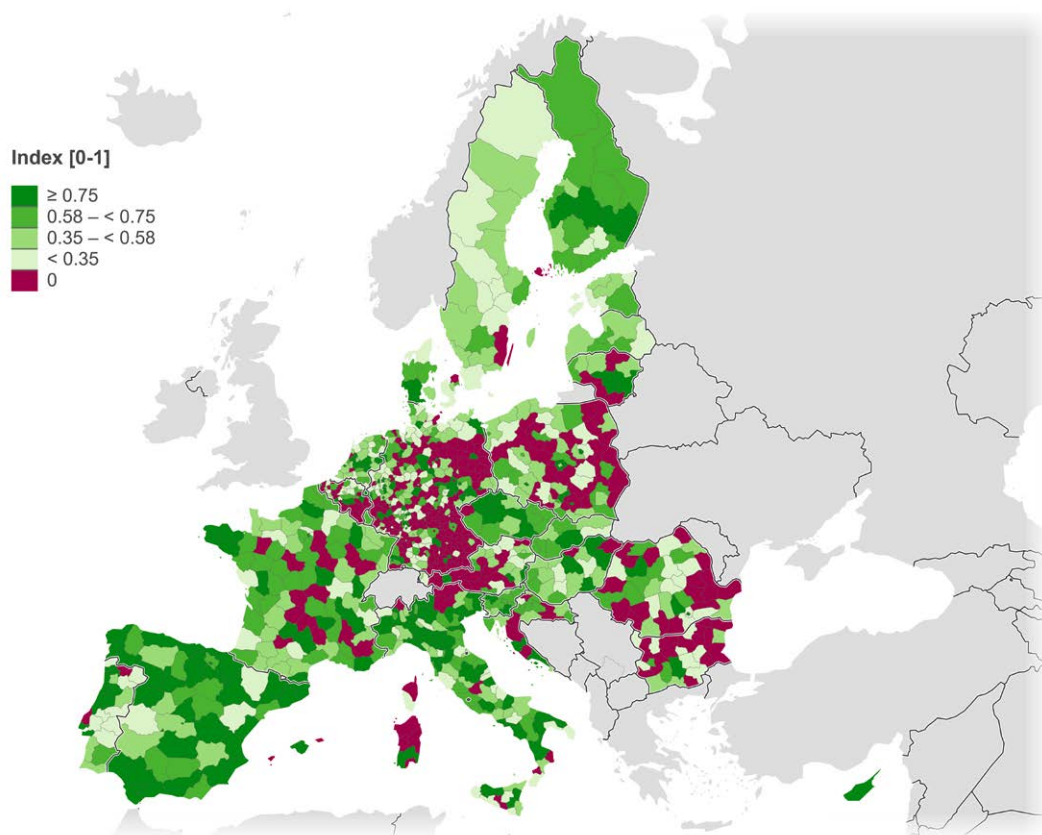
Source: Santos and Conte (2026).

Note: Horizon Europe includes aggregated values of projects started by the end of 2025. R&I Cohesion Policy refers to estimates based on the amount of the EU share of operations decided by operational programmes by the end of 2025.

EU programmes such as Horizon Europe and R&I Cohesion Policy increasingly focus on common societal challenges, including health, climate change, sustainable energy security and transport. However, the degree of alignment varies considerably (Figure 2.2-2). Stronger alignment between the thematic focus of Horizon funding and R&I Cohesion

Policy investments is observed in some regions (indicated in darker green), suggesting that both instruments often reinforce similar research priorities. By contrast, other regions in central and eastern Europe (indicated in lighter shades and purple) display weaker alignment, where the two funding streams tend to support a more diverse set of thematic areas.

Figure 2.2-2 Thematic alignment of EU R&I funding across regions:
R&I funding synergy index



Source: Bachtrögler-Unger, Gabelberger, Marques Santos and Doussineau (2025). JRC141964.

Administrative boundaries: © EuroGeographics © OpenStreetMap
Cartography: Eurostat – IMAGE, 07/2026

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Source: Bachtrögler-Unger *et al.* (2025).

Note: Figure 2.2-2 reports the cosine similarity index, which measures how closely R&I Cohesion Policy and Horizon 2020 funding are distributed across thematic areas (Societal Challenges) within each NUTS3 region (under the programming period of 2014 to 2020). Values range from 0 (no thematic overlap) to 1 (identical distribution across themes). Greek, Irish and Maltese regions are excluded due to missing NUTS3 project data.

This thematic coherence at the EU level is increasingly mirrored by national research strategies. Evidence suggests that Member States have progressively oriented their national R&D investments towards similar priorities as those promoted in EU programmes, particularly

around strategic objectives such as the green and digital transitions, health innovation and industrial competitiveness (European Commission, 2023a; Palmero *et al.*, 2025), although differences may persist in scale and specialisation.

3. Distinct investment programmes reinforce each other

Public R&I investment is organised through a multi-level architecture that is intended to be complementary, yet the joint operation of its channels has rarely been examined in causal terms. The persistent EU territorial R&I divide raises the core empirical question of how other funding streams respond when one stream expands in a given

Member State, with three possible scenarios: crowding-in, neutrality and crowding-out (Table 2.2-2). The issue is especially salient given the forthcoming Multiannual Financial Framework 2028-2034 is expected to reshape the EU R&I support around the European Competitiveness Fund (across four policy windows), operating alongside a separate Horizon Europe envelope.

Table 2.2-2 Funding interaction scenarios and policy implications

Scenario	Expected dynamics	Policy implication
Crowding-in	An increase in one EU stream is followed by a parallel rise in national R&D budgets or receipts from the other EU instrument.	Justifies coordinated programming and the design of additionality safeguards that reinforce synergies.
Neutrality	The shock to one channel leaves the others unchanged.	Allows each instrument to be designed and administered independently.
Crowding-out	EU funding substitutes for national R&I investment (or vice-versa), reducing complementary spending.	Calls for built-in additionality safeguards to prevent substitution.

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Source: Authors' own elaboration.

Most recent evaluations have focused on the relationship between public R&D subsidies and private R&D at the firm level, yielding mixed results across countries and programs. For example, the European Parliament's Stairway to Excellence (S2E) project (JRC, 2018) showed that Cohesion Policy investments in research infrastructure and human capital facilitate participation in framework programmes, particularly in the EU 13 countries. More recently,

Hegerty *et al.* (2023) demonstrated that different forms of additionality (input, behavioural, output) among users of EU research infrastructures reinforce one another, suggesting the need for joint assessment. It is therefore important to study how distinct streams of public investment influence each other.

Recent evidence on the response of an R&I investment when another R&I funding stream expands

The empirical analysis suggests that EU funds do not crowd out national funds for R&I; instead, they reinforce each other. Table 2.2-3 and Figure 2.2-3 present the Local Projections instrumental variable (LP-IV) estimates⁴ obtained from the observed investment flows⁵. The R&I-specific strand of Cohesion Policy generates the strongest vertical synergy: a EUR 1 000 increase in R&I Cohesion Policy spending in a Member State is associated with an additional EUR 385 of Horizon funding in the following year (coefficient +0.385, $p < 0.01$) and EUR 388 two years later (+0.388, $p < 0.10$).⁶ Then, an additional EUR 1 000 of national R&D budget is followed by roughly EUR 58 of extra Horizon funding after two years (Table 2.2-3), showing the important complementarity between EU and national funds for R&D.

These results suggest that vertical coherence in the EU R&I system is characterised by selective crowding in. The three main sources of public investment in R&I reinforce one another rather than competing for the same fiscal envelope. The remaining channel pair estimates (notably the response of national R&D budgets [GBARD] to shocks in the framework programme, and several symmetric specifications with ERDF as the outcome) are not statistically different from zero, providing strong evidence that EU instruments do not crowd out national investment⁷. The findings together describe the interaction of these distinct streams of public investment in the EU R&I system. In particular, R&I under Cohesion Policy builds the institutional and infrastructural absorptive capacity that allows Member States to compete more effectively for Horizon Europe resources, while stronger national R&D budgets are themselves associated with higher Horizon receipts. Taken together, the estimates point to a single mechanism: domestic capacity, whether built through Cohesion Policy or funded from national budgets, translates into a greater ability to attract EU-wide competitive funding.

4 A central concern in the design of the estimator is the macroeconomic cycle. The three funding streams may co-move with the business cycle for reasons unrelated to programme design: during recessions, national discretionary R&D budgets tend to be cut, whereas EU funds follow pre-set schedules under the seven-year budget cycle. Ignoring this co-movement would create the illusion of crowding-out. To mitigate the bias, each specification includes three macro controls: the change in GDP captures the immediate business cycle effect; the change in the trade balance reflects external constraints on domestic investment; and the change in gross fixed capital formation absorbs broader public investment cycles. With these controls, the residual variation that identifies the LP-IV coefficients is plausibly orthogonal to macroeconomic fluctuations, allowing the estimator to capture the structural response of one funding channel to an exogenous shock in another.

5 For the specific purpose of this exercise, we use a panel covering 28 EU Member States from 2002 to 2023, except for 2009, which is excluded because the financial crisis shock to all three channels generates outlier observations that would dominate identification. The outcome at horizon h is the cumulative change in funding at year $t+h$ relative to year t , expressed in constant 2015 euro. In order to reduce potential additional biases, the 'leave one out' instrumental variable (IV) approach adopted is chosen.

6 The result is robust to weak instrument diagnostics (Anderson Rubin 95 % CI [+0.221, +0.550]).

7 Few caveats are worth mentioning: (1) the headline R&I Cohesion Policy → Horizon estimate is derived from a short panel ($T = 7$); consequently, confidence intervals widen at medium horizons. (2) Results capture relative gains within the fixed Horizon Europe envelope, not absolute growth in EU R&I resources. (3) While the evidence is robust for the three identified crowd in channels, further research could extend the framework to sectoral and technology readiness level dimensions to verify whether similar synergies hold across different parts of the economy.

Table 2.2-3 LP-IV and impulse responses for R&I-Cohesion Policy, observed ESIF panel 2016–2023

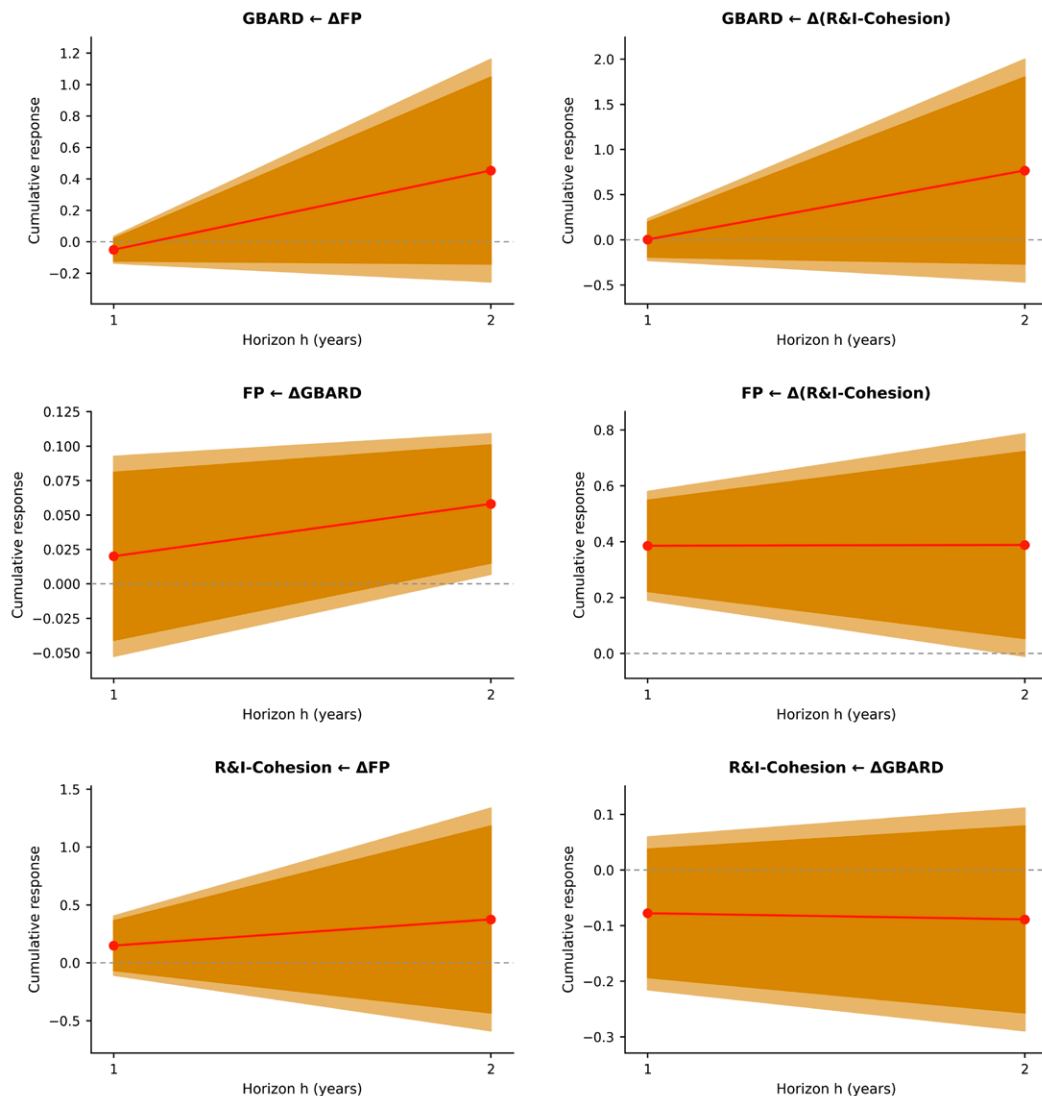
Specification	h = 1	h = 2
Panel A – GBARD (national R&D budget)		
GBARD $\leftarrow$ Δ FP shock	–0.051	+0.453
	(0.043)	(0.361)
GBARD $\leftarrow$ Δ (R&I-Cohesion Policy) shock	+0.003	+0.767
	(0.117)	(0.628)
Panel B – EU framework programmes (FP)		
FP $\leftarrow$ Δ GBARD shock	+0.020	+0.058**
	(0.037)	(0.026)
FP $\leftarrow$ Δ (R&I-Cohesion Policy) shock	+0.385***	+0.388*
	(0.099)	(0.203)
Panel C – R&I-Cohesion Policy (observed ESIF T001)		
R&I Cohesion Policy $\leftarrow$ Δ FP shock	+0.149	+0.375
	(0.130)	(0.490)
R&I Cohesion Policy $\leftarrow$ Δ GBARD shock	–0.078	–0.089
	(0.070)	(0.102)

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Source: Joint Research Centre based on Eurostat (DOI link: https://doi.org/10.2908/GBA_NABSFIN07), DG Research and Innovation (framework programme allocations) and DG Regional and Urban Policy (ESIF Thematic Objective 01).

Note: Coefficients with standard errors in parentheses. Short panel 2016–2023 (T=7), 27 EU Member States. Similar results hold for a longer time period covering three waves of FP/Horizon funding (21 years) and GBARD. Macro controls included. Standard errors clustered by country. The headline result is the FP $\leftarrow$ Δ (R&I Cohesion Policy) shock at h=1 (highlighted). *** p<0.01; ** p<0.05; * p<0.10.

Figure 2.2-3 Vertical coherence of R&I investment in the EU, impulse responses, 2016–2023



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Source: Joint Research Centre based on TEDAM LP-IV estimates.

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