European Commission

A comparative analysis of public R&I funding in the EU, US, and China

R&I PAPER SERIES
WORKING PAPER 2025/05

Research and Innovation

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Manuscript completed in April 2025

PDF	ISBN 978-92-68-6733-2	doi: 10.2777/3869663	KI-01-25-090-EN-N

Luxembourg: Publications Office of the European Union, 2025

EUROPEAN COMMISSION

A comparative analysis of public R&I funding in the EU, US, and China

Working Paper

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2025 Directorate-General for Research and Innovation

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ABSTRACT

Research and innovation (R&I) are essential for countries' competitiveness, prosperity, and societal resilience. Therefore, governments around the globe have established extensive R&I programmes to enhance R&I funding. This paper compares public R&I funding across the EU, US, and China - the world's largest R&I spenders – over recent years and identifies five key findings and their policy implications for the EU. First, all three economies have implemented strong R&I policies to boost investments in strategic areas, maintaining global leadership and safeguarding national interests, urging the EU to keep pursuing a strategic and balanced approach in line with 'promoting, protecting and partnering'. Second, China and the US have surpassed the EU in leveraging public R&D investments into private sector funding, suggesting the EU should reflect on its economic structure and focus more on disruptive innovations and advanced technologies. Third, EU public R&D funding is fragmented, indicating a need for better coordination, simplification, and potential consolidation. Fourth, despite relying more on public funding, the EU allocates less in absolute amounts to public R&D compared to the US, and EU's Framework Programme (EU FP) budgets lag behind those of the US and Chinese counterparts, emphasising the need for EU R&D budget prioritisation. Fifth, R&D funding distribution varies: the EU emphasises research efforts, while the US and China invest more on later R&D stages, prompting policy reflections on aligning means with objectives.

KEY MESSAGES

- In recent years, the EU, the US, and China have rolled out significant policy packages to advance research and innovation (R&I) investments in targeted science and technology (S&T) areas. These initiatives aim to enhance competitiveness, secure technological leadership, and safeguard sovereignty.
- The US leads the EU and China in terms of the absolute amount of public R&D funding, with China showing the largest growth in recent years. The US also outperforms all other major economies in total R&D funding, more than doubling the amounts spent by China and the EU, although recently China has outpaced both the US and EU in growth.
- Since 2000, when the EU's Lisbon Strategy formally set the 3% R&D target, the EU has seen a slight increase in total R&D intensity, from 1.8% to 2.2%. This increase is lower than that of China and the US which grew from 0.9% to 2.6% and 2.6% to 3.6%. Public R&D intensity of the EU (0.7%) and the US (0.7%) is slightly above that of China (0.5%).
- The EU is more dependent on public R&D funding compared to the US and China, whose economies attract more private R&D funding. Private R&D intensity in the EU is below the US and China, and lags behind in growth, representing the main cause of the EU's trailing total R&D intensity.
- The year 2010 marks a turning point in the composition of the US R&D funding mix, in line with the digital boom and the consequent increase in private R&D funding. The turning point marks a shift from a share similar to that of the EU (relatively high share of public R&D funding) towards a composition akin to China's (relatively low share of public R&D funding).
- Indirect R&D support (i.e., tax incentives) have gained relevance in the EU, US, and China over the last decade, with the US doubling this type of support and levelling slightly above the EU.
- In the EU, public R&D funding is predominately allocated to the higher education institutes sector (HEIs) in contrast to the US and China where the public sector is the main performer of public R&D funding. The EU's Framework Programme (FP) diverges from this general EU pattern, with a relatively higher share for the private sector at the expense of HEIs.
- The EU places greater emphasis on research efforts (both basic and applied), while the US and China focus more on the latter stages of R&D (experimental development). However, the US's emphasis on experimental development can largely be attributed to the R&D funding for defence.
- Public R&D spending in the EU is fragmented across Member States, in contrast to the US, where the vast majority of public R&D is financed through the federal budget. This fragmentation is reinforced by the variety of innovation funding programmes at Union level, in addition to the EU FP, which is the core programme to support R&I activities.
- The importance of EU-level financing to support R&I activities varies widely among EU Member States: for some Member States (MS) EU-level funding plays a major role, while some other MS can rely more on their national funding.
- Despite their differences, the EU, US and China share equivalent public R&I mechanisms, such as agencies dedicated to funding groundbreaking basic research and the use of public-private partnerships.
- Each economy has its own characteristic features. The EU FP stands out as a globally unique cooperative R&I initiative, providing funding to over 40 countries and encompassing a diverse array of instruments and support for various thematic areas. The US R&I landscape features agencies like DARPA that focus on developing disruptive innovations and new technologies, facilitating the rapid transformation of ideas into successful innovations. China has quickly strengthened its high-tech development, particularly in areas like AI and quantum technologies, by investing in 'Major S&T projects' that concentrate efforts and blend public and private resources.

1. Introduction

In today's world, knowledge and technological advancements are key for a country's competitive edge, sovereignty, and ability to tackle societal challenges. Research and innovation (R&I) play a vital role in driving socio-economic progress, enhancing competitiveness, and boosting productivity growth. It offers solutions to both current and future challenges, facilitating the creation of new knowledge and the enhancement of existing technologies. Additionally, R&I contributes to the formulation of informed policies and regulations, ensuring that societal needs are met with evidence-based solutions, and promotes skill development, preparing future generations to adapt and thrive in a rapidly evolving global landscape. Embracing R&I is, therefore, essential for building a resilient and prosperous society (Steeman et al., 2024).

Governments around the globe have established extensive R&I programmes to ensure that R&I efforts reach optimal levels and aligned with strategic goals and societal needs. Such public interventions are justified by various factors, including addressing 'market' and 'system' failures (Mitra et al., 2024). In the EU, Horizon Europe stands as the ninth European Framework Programme (EU FP) for research and innovation for 2021-2027, officially launched in February 2021 with a budget of 95.5 billion EUR. While Horizon Europe serves as the primary source of EU-level R&I funding, it is not the only one. Additional EU programmes such as the Recovery and Resilience Facility (RRF), InvestEU and European Defence Fund also contribute to funding R&I activities. Beyond EU-level funding, EU Member States implement their own R&I funding programmes and mechanisms, thereby creating dual layers of funding at both the Union and national levels.

However, it is important to note that private entities significantly shoulder public R&I investments, often boasting substantial annual R&I budgets. For instance, Alphabet allocated 39 billion EUR in 2023, and Meta spent 33 billion EUR the same year (European Commission, 2024). The objectives of private and public R&D funding are distinct; public funding primarily addresses market failures and broader societal interests, while private R&D funding focuses on achieving shareholder returns through sustained business growth and maintaining a competitive market edge. Both types of funding are crucial, each serving its unique purpose in driving innovation and economic progress.

The rapid advancements in artificial intelligence (AI) illustrate how countries and businesses are competing for technology leadership, fostering a policy landscape marked by both collaboration and competition. As this paper is written, uncertainty looms over the global directions of R&I policy. In the EU, the installation of a new EU College at the end of 2024, led by President Ursula von der Leyen, underscores a renewed focus on competitiveness (European Commission, 2025a). This in a response to an influential report by Mario Draghi (2024), potentially reshaping the EU's stance on international collaboration and other policy priorities. Meanwhile, the second Trump presidency in the United States signals a fundamental different policy approach to public R&I (Tollefson, 2025). The level of R&I collaboration is further troubled by restrictive policies on the trade of sensitive technologies, such as semiconductors and AI, which limit US and EU exports to China (Reuters, 2024). Despite these limitations, China's technological advancements remain rapid and noteworthy, as demonstrated by the launch of the AI tool DeepSeek (Conroy and Mallapaty, 2025). This dynamic landscape highlights the complex interplay of competitive and cooperative efforts shaping the coming years of R&I on the global stage.

In an uncertain policy landscape, gaining comparative insights is crucial to forming a robust evidence base for new policies and budget decisions. The EU's long-term budget is established through the Multiannual Financial Framework (MFF), which outlines strategic priorities, programmes, and budget allocations. In July 2025, the European Commission is anticipated to present the proposal for the next MFF, covering the period beyond 2027. This proposal will serve as a basis for negotiations between EU institutions and Member States, who will collaborate to finalise and approve the budget prior to its implementation (European Commission, 2025b).

Given these considerations, this paper seeks to provide comparative insights into how the EU and governments of major economies organise and allocate their R&I funding. What types of mechanisms are applied, and which priorities are chosen for funding? To address these questions, the paper conducts a benchmarking analysis of the scale, design, and main features of public R&I funding in major global economies. Specifically, it compares the current EU FP, Horizon Europe, with the R&I mechanisms of the US and China, two of the largest research and development (R&D)[1] spenders in the world, alongside the EU. To provide a more comprehensive view, some figures also highlight other R&D-intensive economies, such as Japan, South Korea, and the UK. Additionally, insights into the overall EU R&I landscape are discussed, given the EU's complex landscape of dual layers of funding.[2]

The analysis delivers five main findings. First, all three economies have put in place strong R&I policies to boost investments in strategic science and technology (S&T) areas, maintaining global leadership and safeguarding national interests, urging the EU to adopt a strategic and balanced international engagement strategy, through promoting innovation and cooperation while safeguarding its interests and sovereignty in a competitive global landscape. Second, the US and China have surpassed the EU in leveraging public R&D investments into private sector funding, suggesting the EU should reflect on its economic structure, focussing more on disruptive innovations and advanced technologies. Third, EU public R&D funding is fragmented, indicating a need for better coordination, simplification, and potentially consolidation of funding. Fourth, despite relying more on public funding, the EU allocates in absolute amounts less to public R&D compared to the US, and the EU FP budgets lag behind US and Chinese counterparts, emphasising the need for EU R&D budget prioritisation. Fifth, R&D funding distribution varies: the EU emphasises research efforts, while the US and China focus more on later R&D stages, inducing policy reflections on aligning means with objectives.

The remaining of this paper is structured as follows: In section 2, a comparison of general R&I investments and trends between the EU and other major global economies is presented. Section 3 presents the main funding mechanisms and priorities in public R&I support of the EU, US, and China. Section 4 introduces a selection of policy initiatives related to R&I. The paper concludes with section 5 providing a synthesis and the main outcomes.

2. Research and innovation expenditures and trends

This section begins with a comparative analysis of the magnitude and trends of (public) R&D funding in the EU and other major economies, specifically the US and China. Following this, the sectors of performance and type of R&D funded are explored. The section is completed with an assessment of the different layers of public R&D funding in the EU.

2.1. What is the size of EU public R&D funding compared to the US and China?

The US leads the EU and China in terms of the absolute amount of public R&D funding, with China showing the largest growth in recent years. The US's expenditures amount EUR 159 billion in 2022 and EUR 130 billion in 2021, while the EU reports EUR 106 billion in 2021 (no data for 2022) and China EUR 77 billion in 2022 and EUR 69 billion in 2021. Public R&D spending has

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[1] R&D and R&I are related wordings and often used interchangeable, though R&I is a broader concept compared to R&D. R&D is the scientific and technological foundation for innovation, where innovation also includes efforts to create value out of R&D. This paper uses R&D when discussing data for example of Eurostat or US statistic centre. R&I is used is for discussing policies and the full system.

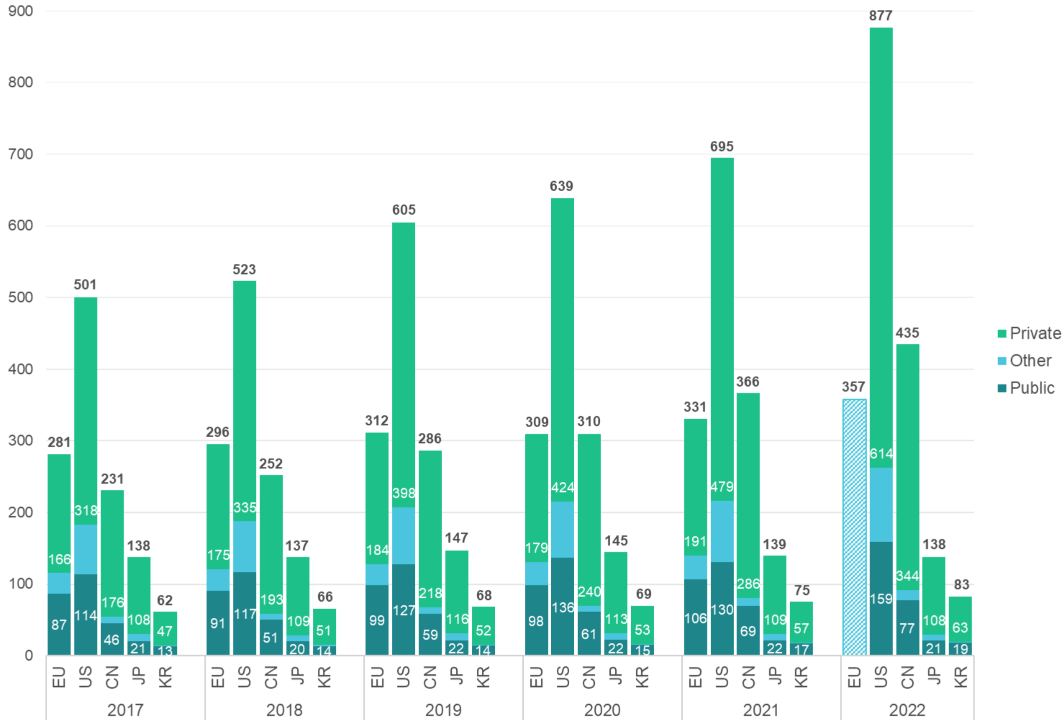
[2] The study is performed with data and information with a cut-off date of January 2025.

increased by 69% for China between 2017 and 2022, compared to 39% for the US in the same period, and 22% for the EU between 2017 and 2021 (Figure 1).

The US also outperforms all other major economies in total R&D funding, more than doubling the amounts spent by China and the EU, although China has outpaced both the US and EU in growth between 2017 and 2022. The US reports EUR 877 billion in R&D expenditures in 2022, followed by China with EUR 435 billion and the EU with EUR 357 billion. Since 2020, China has overtaken the second place at the expense of the EU and subsequently widened the gap. Between 2017 and 2022, China's total R&D expenditures have increased by 88%, compared to 75% for the US and 27% for the EU (Figure 1).

Figure 1: R&D expenditures

GERD in EUR billion by source of funding, all sectors of performance, years 2017-2022



Source: Authors elaborations based on Eurostat data.
Note: R&D expenditures labelled as 'private' is 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. The UK is not depicted as there is no data since 2019. For the EU no granular data is available for 2022. The numbers in the figure are rounded, yet growth rates are calculated with the original data.

For years, the EU has trailed behind the US in terms of total R&D spending as a percentage of GDP, also referred to as R&D intensity. Since 2020, it has also fallen behind China. In 2022, the R&D intensity of the EU stands at 2.2%, lagging behind China (2.6%), the US (3.6%), Japan (3.4%), and South Korea (4.9%) (Figure 2).

Since 2000 when the EU's Lisbon Strategy formally set the 3% R&D target[3], the EU has seen a slight increase of total R&D intensity, from 1.8% to 2.2% (representing a 22% growth). The EU's improvement is minor compared to that of China and South Korea, which managed to

[3] A brief overview of the history of the 3% target can be found here: https://ec.europa.eu/invest-in-research/action/history_en.htm

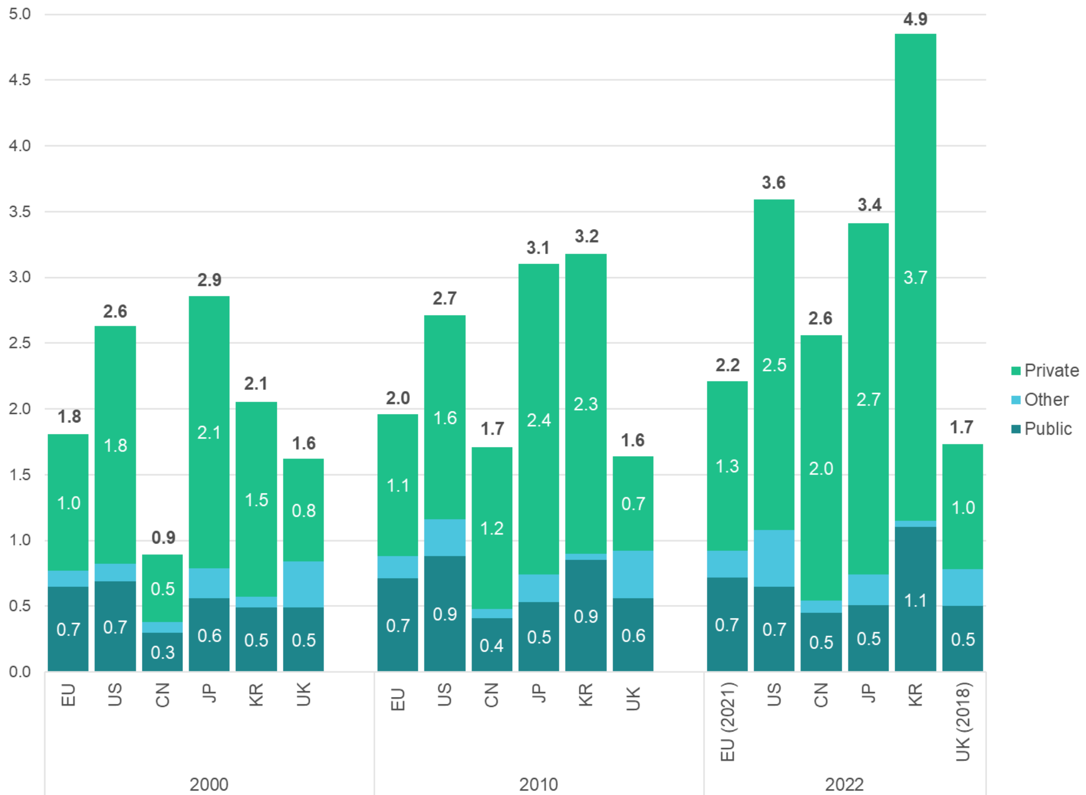
increase their R&D intensity from 0.9% to 2.6% (representing a 188% growth) and 2.1% to 4.9% (representing a 137% growth) respectively, and the US from 2.6% to 3.6% (representing a 37% growth) (Figure 2).

Public R&D intensity has been relative stable over the decades for the EU, in slight contrast to the trends in the US and China. The EU has maintained a public R&D intensity of around 0.7% over the last decades, remaining higher than the 0.5% reported by China, Japan and the UK. The US's public R&D intensity increased from 0.7% in 2000 to 0.9% in 2010 and subsequently decreased to 0.7% in 2022, while China reports an upwards trend from 0.3% in 2000 to 0.5% in 2022 (representing a 50% growth). South Korea differentiates itself from the other economies with a public R&D intensity of 1.1% in 2022, which is a notable increase from the 0.5% reported in 2000 (representing a 124% growth) (Figure 2).

Private R&D intensity in the EU is below and lags behind in growth compared to China and US, representing the main cause of the Union's trailing total R&D intensity. In 2022, EU's private R&D intensity stands at 1.3%, behind China (2.0%), the US (2.5%), Japan (2.7%), and South Korea (3.7%). For the EU, a total growth of 24% is reported over the two decades, in sharp contrast to China's growth of 296% over the same period. Notably, the US experienced a decrease in private R&D intensity between 2000-2010 but has seen a substantial increase from 1.6% in 2010 to 2.5% in 2022, representing a 62% growth over the 2010-2022 period, while public R&D intensity decreased during the same time (Figure 2).

Figure 2: R&D intensity

GERD as % of GDP, by source of funding, all sectors of performance, years 2000, 2010 and 2022 (or latest available)



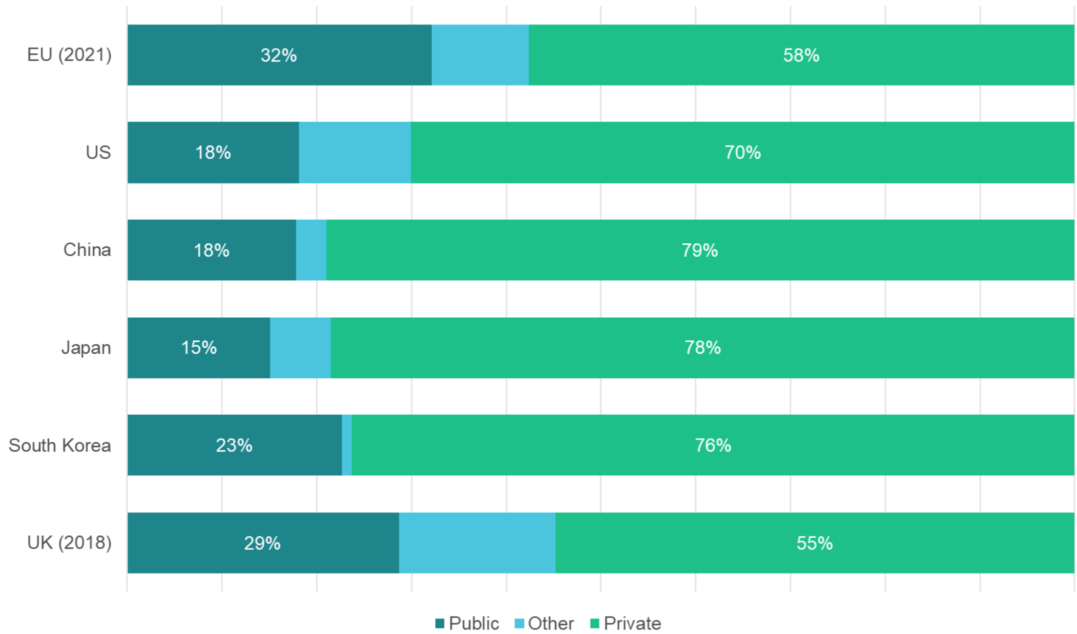
Source: Authors elaborations based on Eurostat data.

Note: R&D expenditures labelled as the 'private' is funded by the business enterprise sector; the label 'public' combines spending by the government sector and European Commission as part of the rest of the world; the label 'other' combines spending by the higher education, private non-profit and the remaining parts of the rest of the world sectors. The numbers in the figure are rounded on one decimal, yet growth rates are calculated with the original data.

The EU is more dependent on public R&D funding compared to the US and China, whose economies attract more private R&D funding. Within the EU, public R&D funding constitutes 32% of the total R&D funding mix. This contrasts sharply with other major economies including China and the US, both at 18%, and Japan at 15%. These figures are mirrored by the percentages of private R&D funding, with China, Japan, and South Korea ranging between 76% and 80% and the US at 70%. In the EU, private R&D funding amounts to 58% of the total, similar to the UK with 55% (Figure 3).

Figure 3: R&D expenditures by sector

GERD by source of funding, all sectors of performance, year 2022 (or latest available)



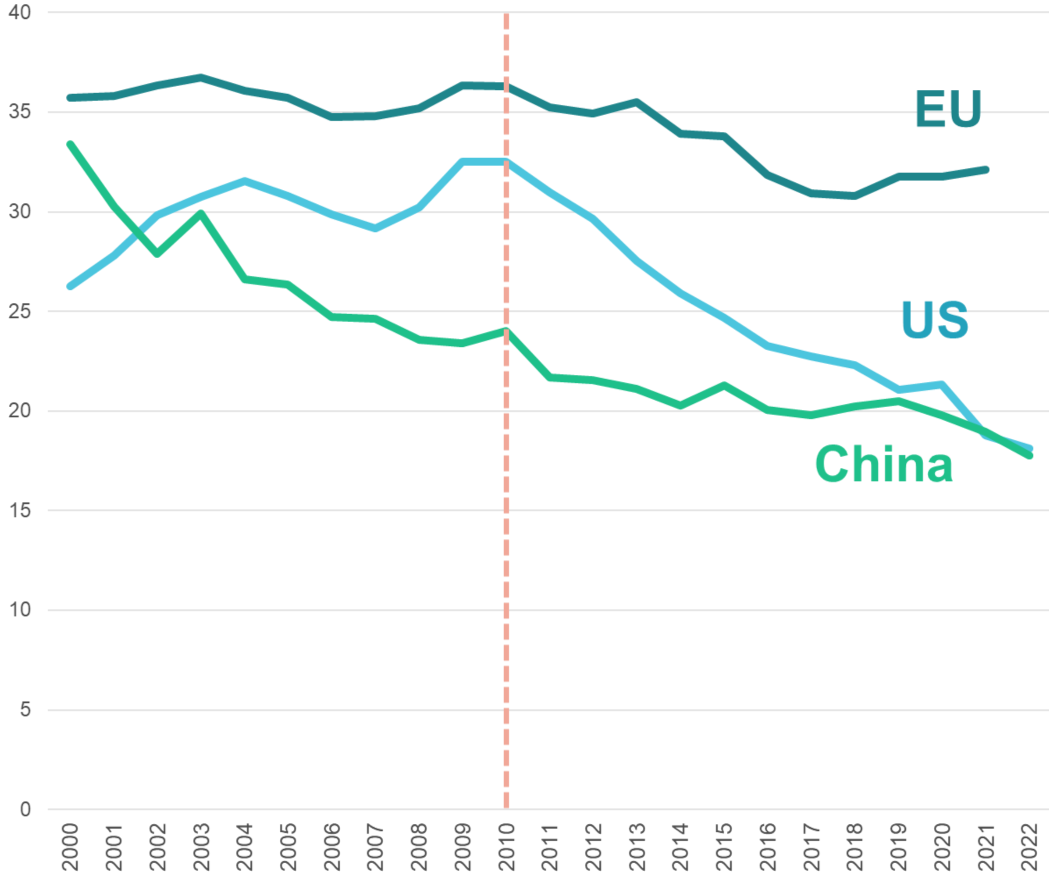
Source: Authors elaborations based on Eurostat data.

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

The year 2010 marks a turning point in the composition of the US R&D funding mix, as it shifted from a share similar to that of the EU (relatively high share of public R&D funding) towards a composition akin to China's (relatively low share of public R&D funding). In 2010, the share of R&D funded by the public sector was similar between the US at 33% and the EU at 36%. However, since 2010, aligning with the digital boom, the US has moved towards a lower share of public R&D funding aligning with China at 18% public R&D funding, which stands in sharp contrast to the current share of the EU at 32% (Figure 4). As illustrated by Figure 2, this change in composition is attributed to the increase in private R&D intensity, while public R&D intensity decreased during the same period.

Figure 4: Share of public R&D expenditures

Public R&D expenditures as % of total R&D expenditures, years 2000-2022

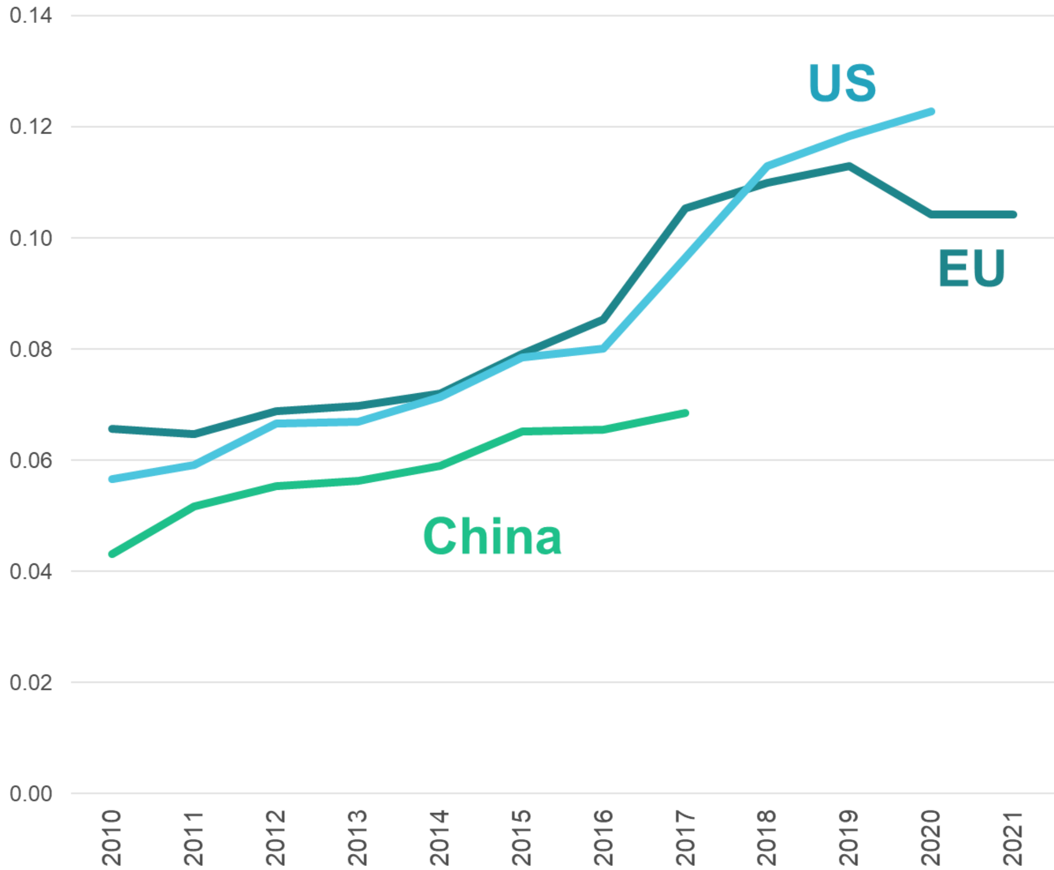


Source: Authors elaborations based on Eurostat data.
Note: Public R&D funding combines spending by the government sector and European Commission as part of the rest of the world.

Since 2010, tax incentives have gained relevance as a government R&D support measure in the US, EU, and China. As incentive, governments can provide tax relief for R&D expenditures, primary, though not exclusively, for businesses. An increase of this support measure would logically lead to an increase of private R&D spending. Over the past decade, this form of public support has risen, with the US more than doubling its support (from 0.06% of GDP to 0.12% GDP). The EU has also increased this type of support, but since 2017, a smaller growth and slight dip is observed, creating a potential divergence from the US. For China, no recent data is available; however, data up to 2017 shows a continuous upward trend, albeit with a level of support still below that of the US and EU (Figure 5).

Figure 5: Government R&D support through tax incentives

Indirect government support through R&D tax incentives (GTARD), percentage of GDP, 2010-2021 (or latest available)



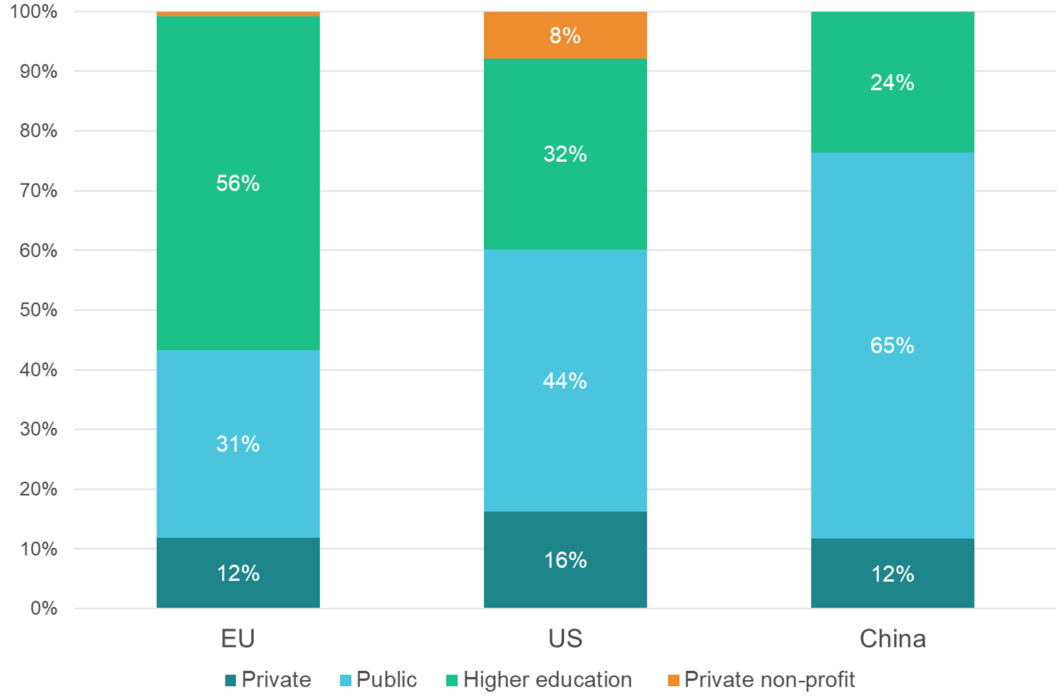
Source: Authors elaborations based on OECD Tax Incentives data

2.2. Who and what is funded?

In the EU, public R&D funding is predominately allocated to the higher education sector (HEIs), in contrast to the US and China where the public sector is the main performer of public R&D funding. The higher education sector is the primary recipient of EU's public R&D funding, receiving 56% of the total, followed by the public sector with 31%. In the US and China, most of the public R&D funding is allocated to the public sector, with respectively 44% and 65%, followed by the higher education sector with 32% and 24%. The public R&D funding allocated to the private sector is similar across the three economies, with EU and China both 12% and the US with 16% of the funding (Figure 6).

Figure 6: Sector of performance of public R&D funding

GERD by sector of performance, public R&D funding, as share of total, year 2021



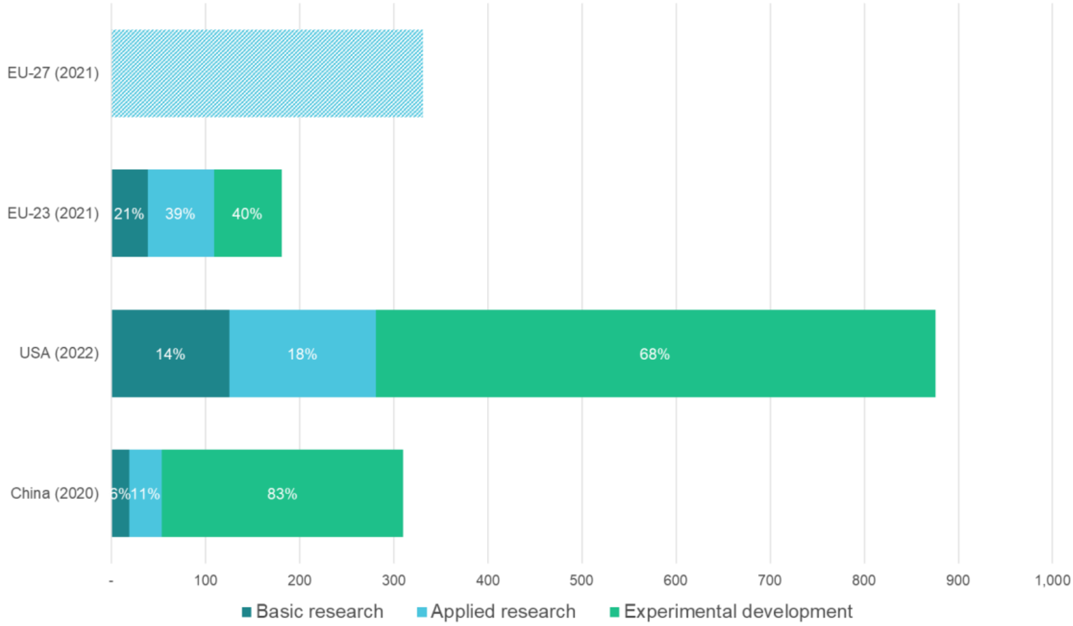
Source: Authors elaborations based on Eurostat data.
Note: The sector labelled as 'private' is the business enterprise sector, as 'public' is the government sector, as 'higher education' is the higher education sector and 'private non private' the private non private sector. Public R&D funding includes the funding by the government sector.

The EU places greater emphasis on research efforts (both basic and applied), while the US and China focus more on experimental development. Available data[4] indicates that R&D funding of the EU is concentrated on research efforts, with 21% of total R&D expenditures allocated to basic research, 39% to applied research, and 40% to experimental development. This contrasts with the US and China. The US allocates 14% to basic research, 18% to applied research, and 68% to experimental development. China's funding predominantly focuses on experimental development (83%), with minimal allocation to basic research (6%) and applied research (11%) (Figure 7). No granular comparative data is available to analyse the type of R&D funded by the public sector. Therefore, chapter 3 will analyse the available information for each economy independently.

[4] Concerning the composition of R&D across all sectors (GERD), aggregate data for the EU is incomplete, as it lacks information from four countries, including Germany and the Netherlands.

Figure 7: Type of R&D funded

GERD by type of R&D, all sectors of performance, in EUR billions and as % of total



Source: Authors elaborations based on Eurostat data

Note: Aggregate data for the EU is incomplete, as it lacks information from four countries, Denmark, Germany, The Netherlands and Sweden. The x-as represent the totals, while the shares are presented within the columns. No granular data is available by source of funding.

2.3. The different layers of public R&D funding within the EU

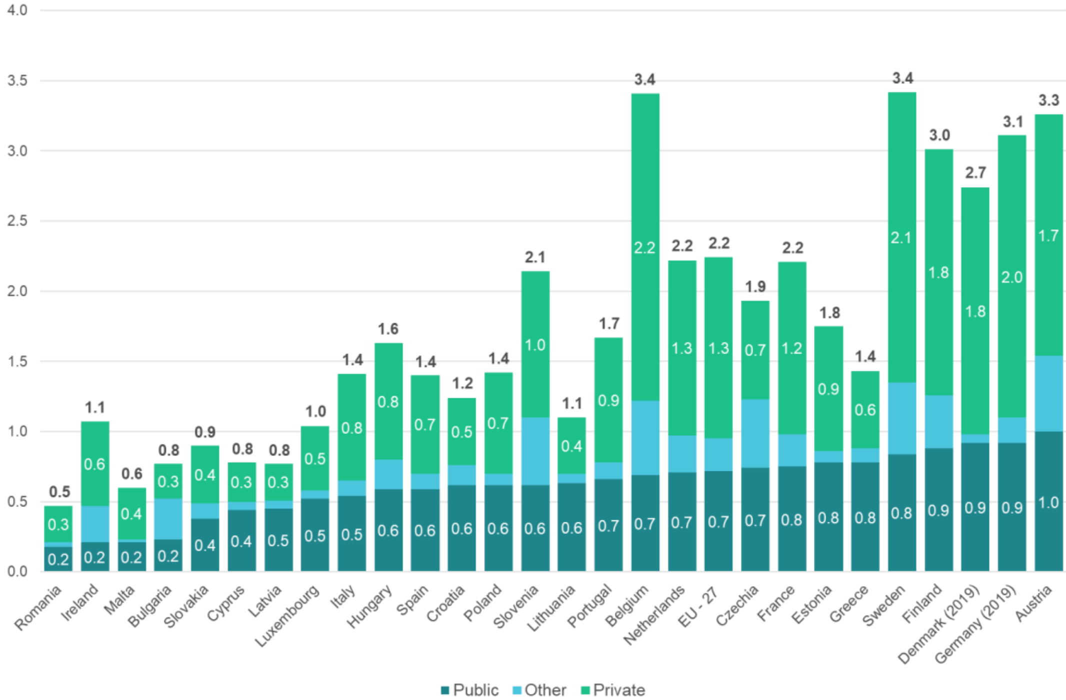
In the EU, public R&D intensity varies widely between Member States. The public R&D intensity ranges from a lower bound of 0.2% in Romania, Ireland, Malta, and Bulgaria to an upper bound of 1.0% in Austria (Figure 8).

Five out of twenty-seven Member States meet the 3% target. In terms of total R&D intensity, there is a wide variation. Five countries meet the 3% target: Sweden (3.4%), Belgium (3.4%), Austria (3.3%), Germany (3.1%) and Finland (3.0%), whereas six countries have an R&D intensity below 1%: Romania (0.5%), Malta (0.6%), Bulgaria (0.8%), Latvia (0.8%), Cyprus (0.8%) and Slovakia (0.9%) (Figure 8).

Remarkably, some EU Member States succeed in leveraging their public R&D spending substantially more than others, reaching a multiplier similar to the US and China. Notably Ireland and Belgium record a multiplier (total R&D intensity relative to the public R&D intensity) close to 5, while Sweden has a multiplier of more than 4, which are closer to the multipliers of other major economies such as the US and China (see Figure 2), contrary to Latvia, Lithuania, Cyprus and Greece with multipliers below the 2 (Figure 8).

Figure 8: R&D intensity per EU member state

GERD as % of GDP, by source of funding, all sectors of performance, year 2021 (or latest available)

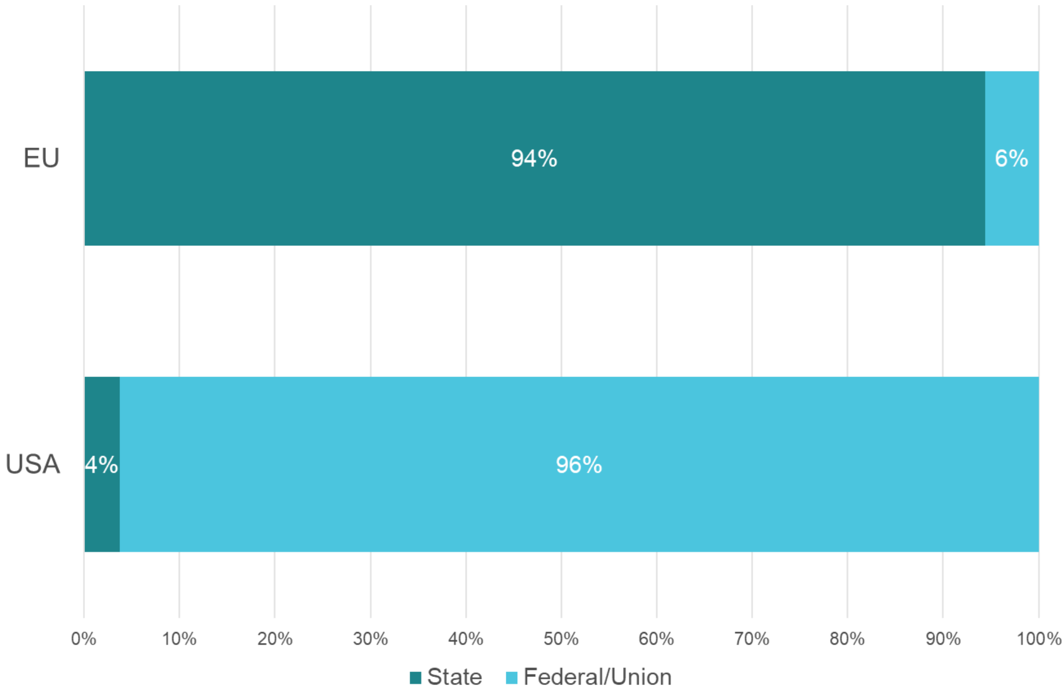


Source: Authors elaborations based on Eurostat data.

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

Public R&D spending in the EU is fragmented across Member States, in contrast to the US, where the vast majority of public R&D is financed through the federal budget. The US has a highly centralised public R&D funding system. Of the public R&D funding, 96% comes from the federal budget, with 4% of the public R&D funding coming from State (and local) resources. This stands in stark contrast to the situation of the EU. According to the available Eurostat data, public R&D funding predominately comes from the budgets of the 27 Member States (94%), complemented by a small portion of Union-level resources (6%) (Figure 9).

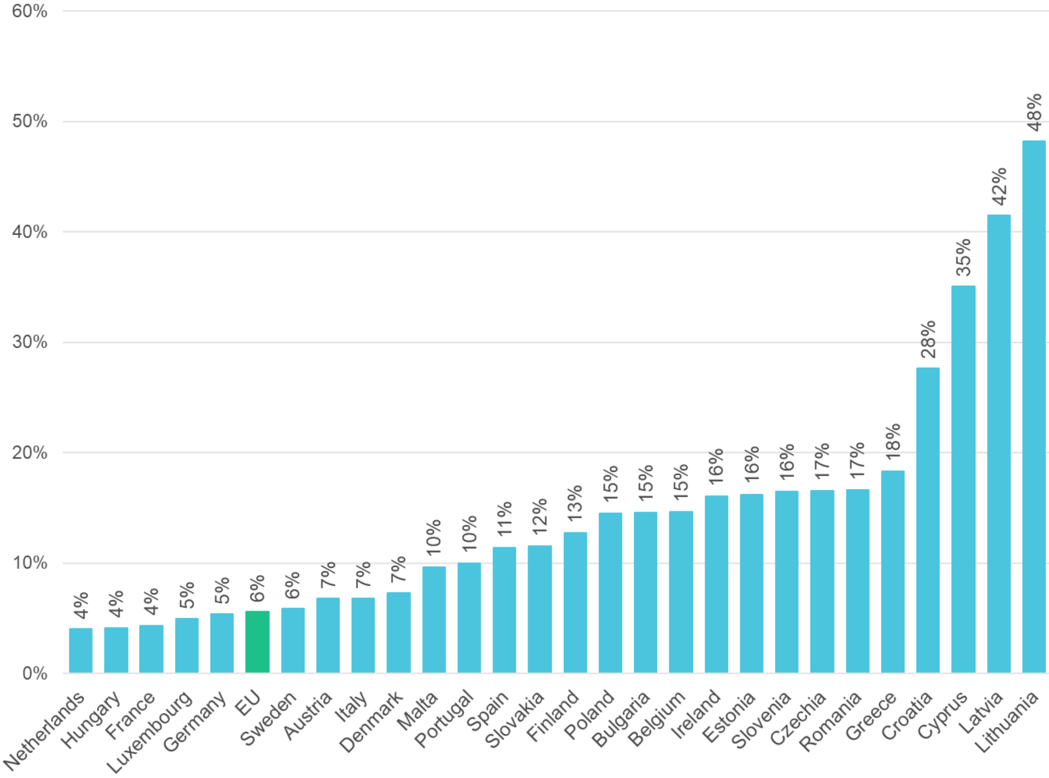
Figure 9: State versus federal R&D funding in EU and US
For the year 2021, as share (%) of the total governmental R&D funding



Source: Authors elaborations based on Eurostat data (EU) and National Center for Science and Engineering Statistics data (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 is funding by state and local governments. Depending on the data year used, the percentage of Union level funding may be higher, potentially close to 10%.

The importance of EU-level financing varies widely among EU Member States. The share of EU-level R&D funding as part of the total public R&D funding differs across Member States. In 2021, EU-level R&D funding, primarily funded through the EU FP for R&I, constituted circa 6% of total publicly funded R&D in Europe. However, this portion varies widely per country. For instance, EU funds accounted for 48% of public R&D spending in Lithuania, compared to just 4% in the Netherlands, Hungary and France (Figure 10). This finding suggests that for certain Member States, EU-level funding plays a major role in supporting R&I activities.

Figure 10: R&D expenditures financed by the EU as share of total public R&D funding
GERD, for the year 2021, or latest available



Source: Authors elaborations based on Eurostat data
Note: R&D expenditures by the governmental sector combines spending by the government sector and European Commission as part of the rest of the world. EU spending is European Commission as part of the rest of the world.

3. Research and innovation funding mechanisms and priorities

Based on the levels and trends in (public) R&I funding presented in Section 2., section 3 will further analyse the mechanisms, approaches and priorities in public R&I support of the EU (focussing on the EU FP, Horizon Europe), the US, and China. This analysis will be conducted through case studies for each economy.

3.1. European Union

In the EU, Member State organise their public R&I funding independently, which fragments the R&I landscape across the Union. As shown in Figure 9, public R&D funding in the EU is fragmented, with only small portion funded on EU-level. Member States adopt their individual mechanisms, approaches and strategic priorities to fund R&I activities. This is primarily done through annual budget allocations to national agencies or dedicated R&I programmes and funds. Noteworthy examples of multiyear R&I funding programmes of EU Member States are the 'National

Growth Fund' (EUR 11 billion) of the Netherlands and the 'France 2030 programme' in France (EUR 54 billion).[5]

The current EU FP, Horizon Europe, is the primary tool for funding R&I activities at the Union level, with an annual budget of approximately 14 billion EUR. EU FP-funding is granted competitively based on the criteria of excellence and impact. Other sources of EU-level R&I funding include the Recovery and Resilience Facility, InvestEU and the European Defence Fund (8 billion EUR of initial R&D budget, 1.1 billion EUR per year). The EU FP was established in 1984 as an initial 5-year programme with a budget of 3.3 billion EUR, and its budget has gradually increased to an (initial) 95.5 billion EUR (13.6 billion EUR per year) for the 2021-2027 period (Horizon Europe programme) (Cavicchi et al., 2023). Centralising R&I funding at Union level has added value by pooling resources - ideas, capital and talent - potentially creating spillover effects, reducing duplication, strengthening the competition base, and increasing administrative efficiency (Mitra et al., 2024).

The EU FP is a cooperative R&I programme that offers equal R&I funding opportunities to entities from over 40 countries, enabling global R&I cooperation. Association to Horizon Europe represents the closest form of cooperation with non-EU countries, allowing them to participate on equal terms to (parts of) the programme, although restrictions may be applied when necessary. In addition to neighbouring countries including Ukraine, Türkiye and Norway, global R&I actors such as Canada, New Zealand and the UK have also been associated in recent years.[6]

Horizon Europe supports a wide range of technology readiness levels (TRLs 1-9)[7], with a budgetary emphasis on applied research. The programme incorporates multiple instruments aimed at various objectives (see Box 1). The majority of the budget is allocated through Pillar 2 (56%, 53.5 billion EUR, 7.6 billion EUR per year) which focuses on applied research efforts. A quarter of Horizon Europe's 7-year budget (26%, 25 billion EUR, 3.6 billion EUR per year) is directed through Pillar 1, which concentrates on fundamental research, including the European Research Council (ERC) that funds the world's most prestige researchers. Most of the remaining budget (14%, 13.6 billion EUR, 1.9 billion EUR per year) is allocated through Pillar 3, which primarily supports experimental development efforts, including start-up and scaleup funding through the European Innovation Council (EIC), one of Europe's largest deep tech investors. A small portion is dedicated to EU member state capacity building (4%, 3.4 billion EUR, 0.5 billion per year) (Figure 11).

Horizon Europe demonstrates a thematic focus on digital, industry, space, health, and the green areas, including clean tech, when analysing the budget of Pillar 2 and European Innovation Council funding. Of the total 7-year Pillar 2 budget available for the thematic clusters, the funding is directed primarily towards the clusters 'Digital, Industry and Space' (30%, 15.3 billion EUR, 2.2 billion EUR per year) and 'Climate, Energy and Mobility' (29%, 15.1 billion EUR, 2.2 billion EUR per year), followed by 'Food, Bioeconomy, Natural Resources, Agriculture, and Environment' (17%, EUR 9 billion, 1.3 billion EUR per year) and 'Health' (16%, 8.3 billion EUR, 1.2 billion EUR per year) (Figure 11). The EIC Impact Report 2025 reveals that EIC's current investment portfolio is in 'health' (41%) and 'digital, industry, and space' (31%), and 'clean tech/other' (28%) (European Commission, 2025c).

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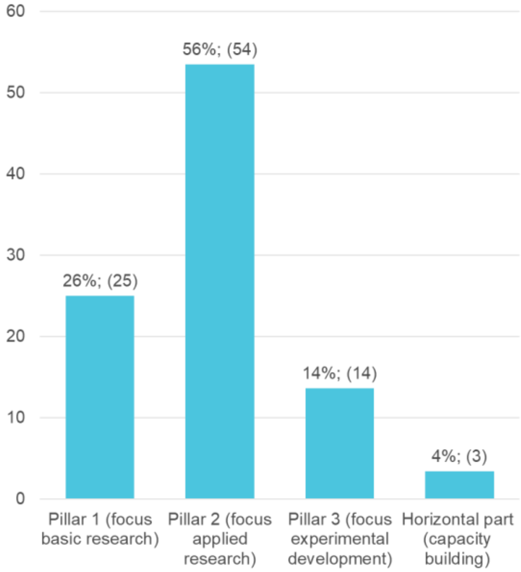
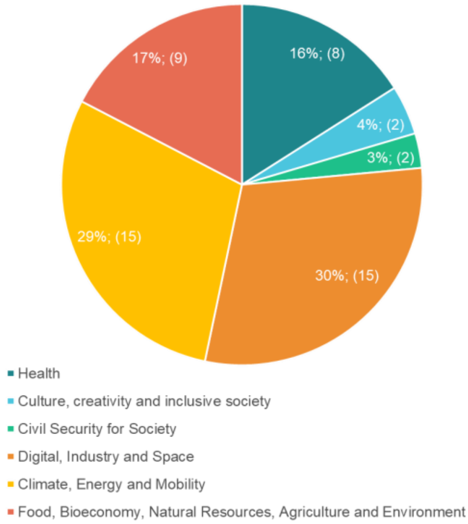
[5] See for more information on the 'France 2030 programme': https://www.economie.gouv.fr/france-2030#; and the 'National Growth Fund': https://www.nationaalgroeifonds.nl/

[6] The full list of countries associated to Horizon Europe can be found here: https://research-and-innovation.ec.europa.eu/strategy/strategy-research-and-innovation/europe-world/international-cooperation/association-horizon-europe_en#countries-associated-to-horizon-europe

[7] TRL is a measurement system to assess the maturity level of a particular technology, or stage of R&I more generally. There are nine technology readiness levels. TRL 1 is the lowest (basic principles observed) and TRL 9 is the highest (actual system proven in operational environment). See also: https://ec.europa.eu/research/participants/data/ref/h2020/wp/2014_2015/annexes/h2020-wp1415-annex-g-trl_en.pdf.

Figure 11: Horizon Europe initial budgets by Pillar and Pillar 2 thematic clusters
Breakdown per Pillar (left), and Pillar 2 thematic clusters (right), initial budgets 7-year period, % of total and billions EUR





Source: Authors elaborations based on DG Research and Innovation data
Note: Numbers in parentheses represent absolute values in billions EUR

Box 1: Horizon Europe main features

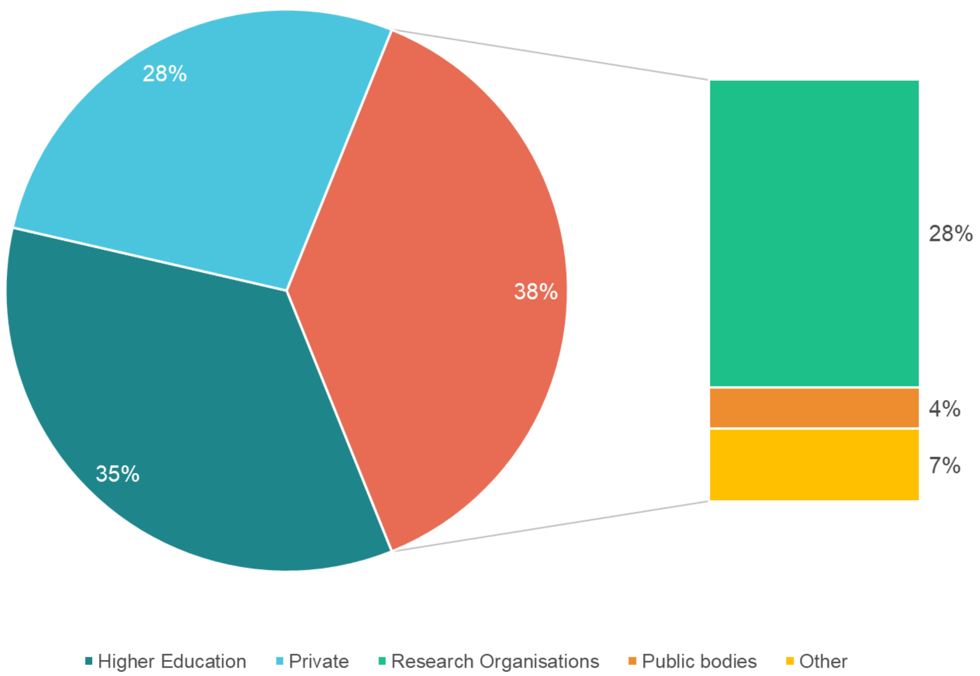
Horizon Europe (EUR 95.5 billion, 2021-2027)

- **Pillar 1:** 'Excellent Science' (EUR 25 billion, EUR 3.6 billion per year) has a focus on basic research and the lower TRLs (fundamental research, 1-3), including the European Research Council (EUR 16 billion, EUR 2.3 billion per year) to fund "bottom-up" research, Marie-Sklodowska Curie Actions (EUR 6.6 billion, EUR 0.9 billion per year) to foster researcher mobility, and Research Infrastructures (EUR 2.4 billion, EUR 0.3 billion per year) to fund facilities.
- **Pillar 2:** 'Global Challenges and European Industrial Competitiveness' (EUR 53.5 billion, 7.6 billion EUR per year) is established through six thematic clusters funding typically projects in the mid-range TRLs (applied research, 3-6), and supporting collaborative research and innovation activities between scientists, industry, public and research bodies, including through the EU Partnerships. The pillar also includes five Missions that target key societal challenges.
- **Pillar 3:** 'Innovative Europe' (EUR 13.6 billion, EUR 1.9 billion per year), focuses efforts on the higher TRLs (applied research and experimental development 3-9), emphasising breakthrough innovations, start-up funding, scaling-up, and strengthening ecosystems, though the European Innovation Council (EUR 10.1 billion, EUR 1.4 billion per year), the European Institute of Technology (EUR 3 billion) and the European Innovative Ecosystems (EUR 0.5 billion, EUR 0.1 billion per year).
- **Horizontal part:** 'Widening participation and strengthening the European Research Area (ERA)' (EUR 3.4 billion, EUR 0.5 billion per year) contributes to strengthening the R&I capacity of EU members states lagging behind on R&I performance, in line with the policy objectives of the ERA.

EU FP funding is fairly evenly distributed among organisation types, although the relative high share for private entities stands out. A substantial portion of the Horizon Europe funding has been allocated to governmental organisations, including research organisations (28%)[8], while higher education organisations are the primary beneficiaries of the EU FP funding (35%). Nonetheless, the share dedicated to the private entities is notable (28%), especially when considering the results shown in Figure 6 (Figure 12).

Figure 12: Horizon Europe contribution by organisation type

Net contribution per organisational type, % of total, cut-off date 06/01/2025



Source: Authors elaborations based on Eurostat data.

Note: Horizon Europe net contribution. The labels stand for Higher or Secondary Education entities (HES), Private for-profit entities (PRC), Research Organisations (REC), Public bodies (PUB) and other entities (OTH). Total signed HE grants by 6/1/2025 stands at EUR 43.2 billion.

3.2. United States

US public R&D funding is concentrated among a handful of public agencies, highlighting a strong thematic focus on defence and security, health, energy, and aeronautics and space. Data on US R&D reveals that most of the US federal budget, totalling USD 197 billion in 2022 (EUR 187 billion[9]), is allocated to five federal agencies. These are the Department of Health and Human Services (HHS) with USD 74 billion (38% of federal R&D budget, EUR 71 billion), which encompasses the R&D funding agency National Institutes of Health (NIH, with a budget of approximately USD 45 billion in 2022, EUR 43 billion); the Department of Defence (DoD) with USD 73 billion (37%, EUR 69 billion); the Department of Energy (DoE) with USD 18 billion (9%, EUR

[8] The organisational types used to label EU funding, differs from the organisational types used by Eurostat. The main difference is for labelling 'research organisations' which are primarily labelled as government entity in Eurostat, though for some a minor extent also as private non-profit.

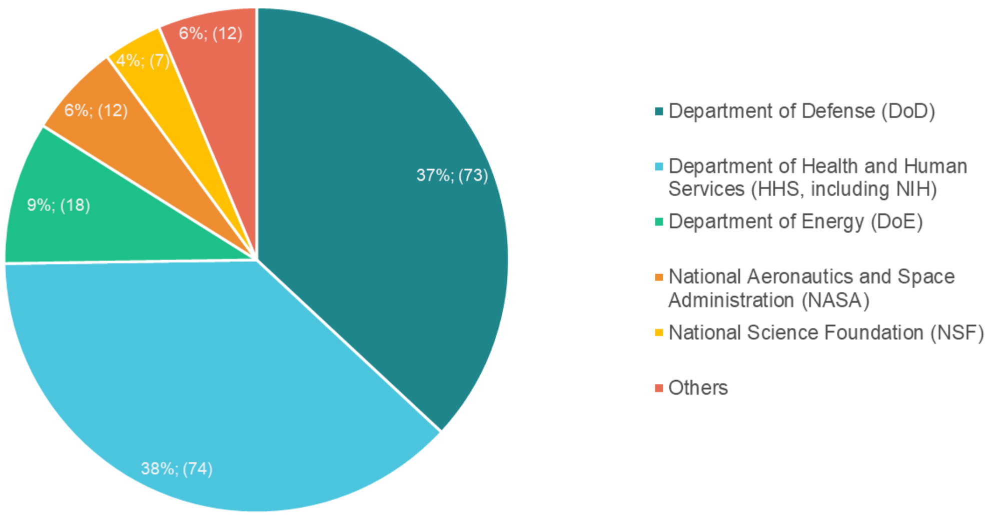
[9] For the conversion to EUR, the OECD conversion rate for EUR/USD of 2022 is used (0.949624)

17 billion); the National Aeronautics and Space Administration (NASA) with USD 12 billion (6%, EUR 11 billion); and the National Science Foundation (NSF) with USD 7 billion (4%, EUR 7 billion) (Figure 13).

Nearly half of the US federal R&D budget is allocated to in-house R&D performers, including funding for Federally Funded Research and Development Centres (FFRDCs), while the remaining is distributed to out-house performers, such as universities and businesses. In 2022, 46% of the federal budget was directed towards in-house (governmental) performers, such as FFRDCs. These centres are public-private partnerships that conduct R&D on behalf of the US government and are overseen by one of the US federal agencies.[10] The remaining 54% of the budget in 2022 was allocated to out-house (external) performers. This support, primarily R&D conducted by businesses and universities, is typically provided through competitive grants, contracts, or cooperative agreements, depending on the US agency. The distribution between in-house and out-house performers varies widely among US agencies. For instance, 94% of the NSF's R&D budget and 66% of NASA's R&D budget go to out-house organisations, while 73% of the DoE R&D funding is allocated to in-house performers (NCSES, 2024).

Figure 13: US federal R&D funding

Budget obligations per agency, % of total and billions USD



Source: Authors elaborations based on National Center for Science and Engineering Statistics data.
Note: Numbers in parentheses denote the budget in USD billions.

A vital part of the US R&I system includes R&D funding agencies that concentrate efforts on specific areas, exemplified by the NIH for health, NASA for space and aeronautics, and the NSF for basic and applied research. The NIH, the R&D funding agency of the Department of HHS, comprises 27 institutes and centres specialising in medical research. Most of its budget is awarded through competitive grants for extramural research, with the remaining funds used for in-house research at the NIH campus laboratories. NASA funds R&I related to space and aeronautics and consists of 20 centres and facilities across the US and a laboratory in space. The NSF funds basic and applied research across all fields except health, awarding most of its research funding through competitive grants. It is responsible for approximately a quarter of all federally supported basic research conducted by US colleges and universities. These agencies offer opportunities for

[10] National Center for Science and Engineering Statistics, List of Federally Funded R&D Centers: https://ncses.nsf.gov/resource/master-gov-lists-ffrdc

international cooperation, although they are typically targeted towards specific countries, organisations, and/or specific calls.[11]

Uniquely, the US R&I system includes several agencies dedicated to focusing on disruptive innovations and technology development, with DARPA being the best-known example. These agencies have a mission to safeguard US national security and technological sovereignty by concentrating on disruptive innovations. Although they have relatively limited R&D resources compared to the overall federal R&D budgets, these agencies have successfully developed innovative technologies. This success can be partly attributed to their setup, which is non-hierarchical, ecosystem-based, and challenge-driven, as well as their ability to scale up innovations, including through procurement, via their parent agencies such as the DoD and DoE (Box 2).

Box 2. DARPA and alike US agencies. [12]

- **Objective:** R&D agencies focussing on developing emerging technologies and disruptive innovations to safeguard the US national security and technological sovereignty.
- **Approach:** These agencies employ an R&I ecosystem approach, integrating knowledge and capacities from various sources, including academia, businesses, and public bodies. Key characteristics include a non-hierarchical structure with empowered programme managers, a willingness to take risks (high-risk, high-reward), challenge-based methods, and technology adoption through public procurement.
- **Areas:** The first and most well-known is the Defense Advanced Research Projects Agency (DARPA), founded in 1958 as part of the DoD. While DARPA focuses on military technology applications, many of its innovations have dual-use benefits, impacting civil society and integrated into daily life, such as unmanned aerial vehicles (drones) and the Global Positioning System (GPS). In recent decades, similar US federal agencies have been established, modelled after DARPA. These include the Intelligence Advanced Research Projects Activity (IARPA), focusing on AI, quantum computing, machine learning, high-performance computing, and synthetic biology, and the Advanced Research Projects Agency-Energy (ARPA-E), part of the DoE, concentrating on solar, batteries, transportation, radiation, grid, and energy conversion. Additionally, the Homeland Security Advanced Research Projects Agency (HSARPA) works on R&I and technology development related to border, maritime, and cybersecurity, as well as chemical and biochemical defence. The Advanced Research Projects Agency for Health (ARPA-H), part of the National Institutes of Health (NIH) and launched in 2022, focuses on biomedical breakthroughs.
- **Budgets:** Annual budgets range from USD 0.5 billion for ARPA-E to approximately USD 4 billion for DARPA.

In the US, half of public R&D funding is directed towards experimental development, with the remaining funds evenly split between basic and applied research, highlighting a focus on the later stages of R&D. Specifically, in 2022, the US federal government, encompassing all agencies, allocated 51% (USD 97 billion, EUR 92 billion) of its total R&D funding to experimental development, in contrast to the 24% (USD 45 billion, EUR 43 billion) for basic research and 25% (USD 48 billion, EUR 46 billion) for applied research (Figure 14).

The US emphasis on experimental development can largely be attributed to the funding by the Department of Defence, which allocated USD 62 billion (EUR 59 billion) to experimental development in 2022, representing 86% of its total R&D budget. The type of R&D funded varies considerably across US agencies. The DoD prioritizes experimental development, while the HHS maintains an even distribution across all three R&D types, and the NSF primarily focuses on basic research activities, dedicating approximately USD 6 billion, or 85% of its R&D budget, to this area.

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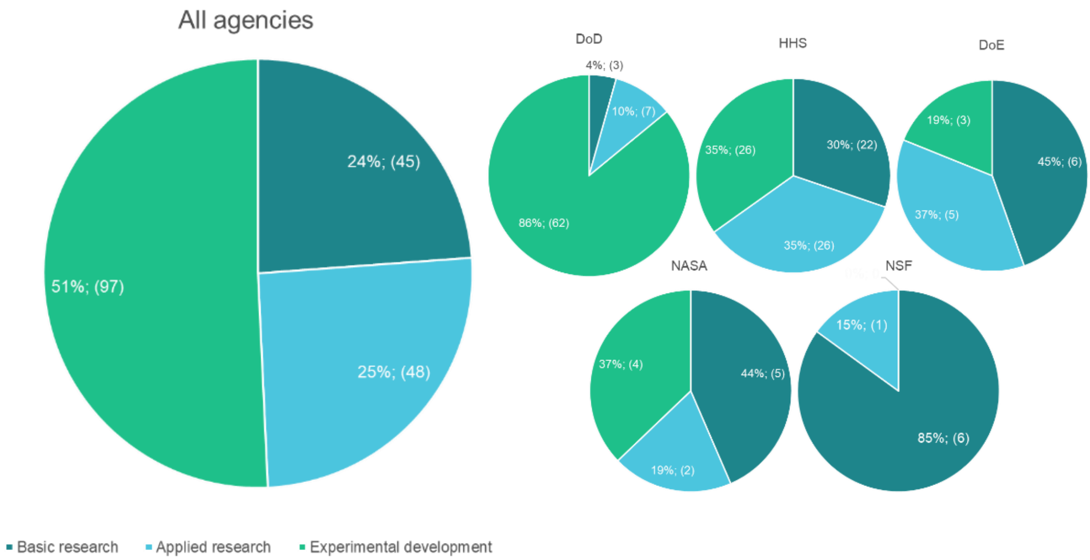
[11] For more information, see on the NIH: https://www.nih.gov/; NASA: https://www.nasa.gov/ NSF: https://new.nsf.gov/about.

[12] For more information on DARPA and the model applied see Bonvillian et al. (2019)

Notably, more than half (51%, USD 48 billion) of the total federal research funding (combining basic and applied research) is allocated to the HHS (Figure 14).

Figure 14: US federal R&D budgets per type of R&D
R&D budget obligations, percentage of total and in USD billion, year 2022



Source: Authors elaborations based on National Center for Science and Engineering Statistics data.
Note: Numbers in parentheses denote the budget in USD billions.

3.3. China

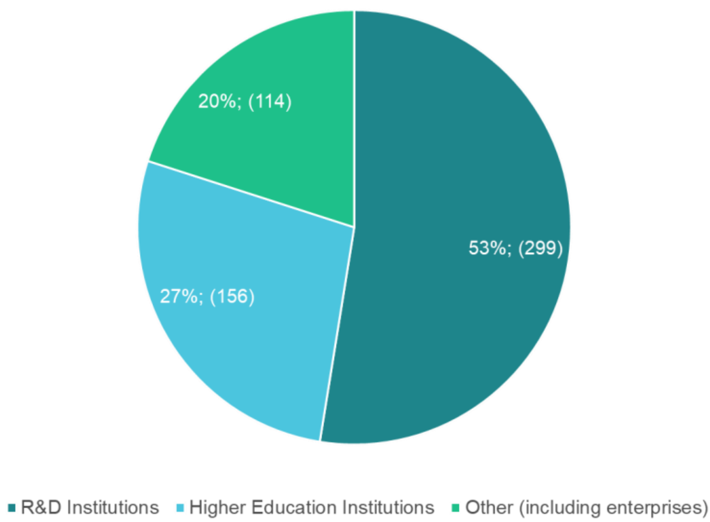
Government-affiliated R&D institutions receive more than half of the R&D funding from the Chinese government, highlighting their significance in the Chinese R&I system. Data from 2023 indicates that 53% of the Chinese government's budget (RMB 299 billion, approximately 42 billion EUR[13]) is allocated to these institutions. This is followed by higher education institutions (HEIs) with 27%, and other organisations, including enterprises, receiving 20% (Figure 15). China hosts numerous government-affiliated R&D institutions, totalling 2890 in 2023. Most of these are affiliated at the local level (2139) as opposed to the national level (751). However, recent data shows a trend towards centralisation, with a decrease of about 350 institutions at the local level and an increase of 25 institutions at the national level (Figure 16).

Although Chinese R&D institutions are primarily funded by the government, a substantial portion of their funds supports the later stages of innovation. These institutions receive 94% of their budget from the government. Of this funding, 44% (RMB 169 billion, approximately EUR 24 billion) is allocated to experimental development, 35% (RMB 137 billion, approximately EUR 19 billion) goes to applied research, and 21% (RMB 80 billion, approximately EUR 11 billion) is dedicated to basic research activities (Figure 16).

[13] For the conversion to EUR, the OECD conversion rates of the latest year available, 2022, for RMB/USD (6.737158) and EUR/USD (0.949624) are used.

Figure 15: China government R&D funding

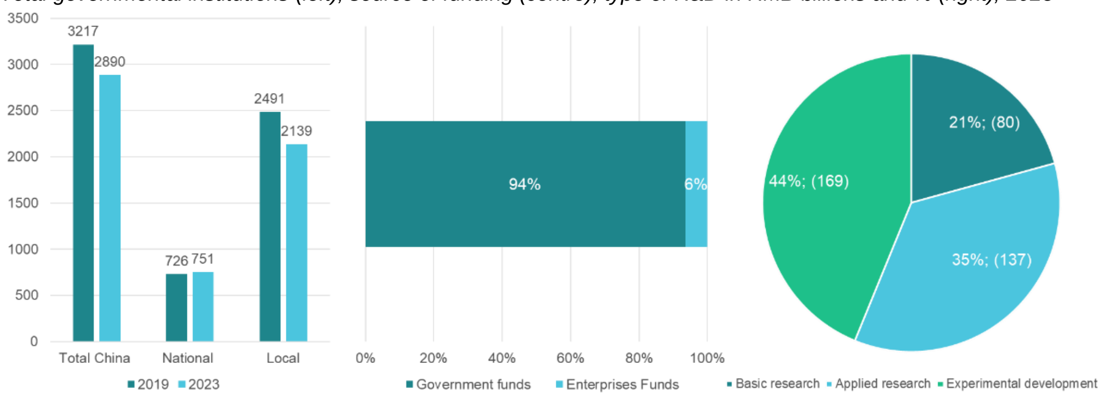
China R&D funding, by performer, % of total and RMB billions, 2023



Source: Authors elaborations based on National Bureau of Statistics of China, Yearbook 2024.
Note: Numbers in parentheses denote the budget in RMB billions.

Figure 16: China government R&D institutions

Total governmental institutions (left), source of funding (centre), type of R&D in RMB billions and % (right), 2023

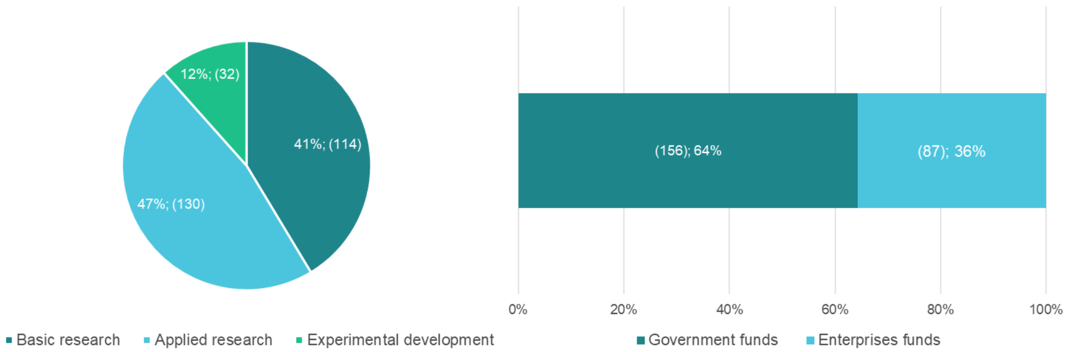


Source: Authors elaborations based on National Bureau of Statistics of China data, Yearbook 2024.
Note: Numbers in parentheses denote the budget in billions RMB.

China's HEIs allocate nearly half of their R&D funding to applied research. In 2023, Chinese HEIs spent 47% of their budget (RMB 130 billion, approximately EUR 18 billion) on applied research activities. This was followed by 41% (RMB 114 billion, approximately EUR 16 billion) allocated to basic research and 12% (RMB 32 billion, approximately EUR 5 billion) directed towards experimental development. Notably, over one-third (36%) of the R&D resources for HEIs come from enterprises, which may explain the substantial portion of funding dedicated to the later stages of research and innovation by these institutions (Figure 17).

Figure 17: China Higher Education Institutions

Type of R&D (left), source of funding in RMB billions and % (right), 2023



Source: Authors elaborations based on National Bureau of Statistics of China data, Yearbook 2024.

China's governmental R&D is predominantly funded through five key mechanisms, including the National Natural Science Fund (NNSF) which focuses on basic research, and the 'Major S&T Projects' which support strategic technology areas. With a budget of approximately RMB 42 billion for 2022 (EUR 6 billion), the NNSF stands as China's largest fund supporting basic research and scientific frontier exploration in natural sciences (CSET, 2022a). The Key R&D Programmes (NKPs) emphasise the transformation and commercialization of scientific research through public-private partnerships, integrating basic, applied, and experimental development in several critical areas such as new energy vehicles and cloud computing. The Major S&T Projects are ambitious large-scale initiatives that address strategic science and technology challenges and aim to support China's innovation capabilities. Some of these projects have a (partly) military focus, such as those related to earth observation and the manufacture of large aircraft (see also Box 3). Beyond these mechanisms, the Technology Innovation Guidance Funds provide financial support, including loans and equity, to invest in innovative start-ups and SMEs within priority and strategic areas. Additionally, the Bases and Talents Programme supports research infrastructure and talent development. While these programmes sometimes offer opportunities for international organisations, participation does not appear to be straightforward or easily accessible (Development Solutions Europe, 2018).

Box 3. China's Major S&T Projects ("Mega Projects") [14]

- **Objective**: These initiatives are geared towards large and ambitious R&I challenges pivotal for China's mid- and long-term development. The projects focus on key products, engineering tasks, and technologies of strategic importance.
- **Approach**: The projects utilise public-private S&T cooperation, effectively leveraging both public and private resources.
- **Funding**: While exact figures on public funding are not available, studies suggest approximately USD 75 billion has been allocated for the initial set of sixteen national megaprojects alone.
- **Projects**: In 2006, sixteen projects were launched, including three with partial military applications and three with fully military applications that are not publicly disclosed. In 2021, seven new priority areas were identified through the 14th Five-Year Plan.

[14] For more information, see Bazavan (2024), Poo (2021) and Sun and Cao (2021).

	Initial Major S&T Projects (2006-2020)	Latest Major S&T Projects (2021 - ?)
1	Core electronic components, high-end generic chips, and basic software	**new generation AI;**
2	Extra large-scale integrated circuit manufacturing and technique	**Quantum information;**
3	New-generation broadband wireless mobile telecommunications	**Integrated circuit;**
4	Advanced numeric-controlled machinery and basic manufacturing tech	**Brain science and brain-inspired research;**
5	Large-scale oil and gas exploration	**Genetics and biotechnology;**
6	Large advanced nuclear reactors	**Clinical medicine and health**
7	Water pollution control and treatment	**Deep-earth and deep-sea research**
8	Genetically modified new-organism variety breeding	**Space technology and polar exploration**
9	Drug innovation and development	
10	Control and treatment of AIDS, hepatitis, and other major diseases	
11	Large aircraft	
12	High-definition Earth observation systems	
13	Manned aerospace and Moon exploration	

Source: Authors elaborations

4. Selection of policy actions related to research and innovation

In recent years, the EU, the US, and China have rolled out significant policy packages to boost R&I investments in targeted science and technology (S&T) areas. These initiatives aim to enhance competitiveness, secure technological leadership, and safeguard sovereignty (see Table 1).

In the wake of the COVID-19 pandemic and the war in Ukraine, the EU has introduced several legislative measures to advance R&I developments and reduce dependencies that undermine its competitiveness. Notably, the Recovery and Resilience Facility, with a budget of EUR 650 billion, offers loans and grants to support EU Member States through reforms and investments. This initiative drives economic recovery from the pandemic and promotes green and digital transitions, dedicating at least 37% of the budget to green actions and 20% to digital actions (European Commission, 2020).[15] Additional key EU initiatives include the RePowerEU Plan, which addresses the energy crisis by reducing reliance on Russian energy and stimulating breakthrough innovations in renewable and low-carbon hydrogen (European Commission, 2022). The EU Chips Act further directs R&D efforts into semiconductor technologies and applications, amplifying production capacity and investments (European Commission, 2023). At the start of 2025, the EU published the Competitiveness Compass, building on Draghi's report on the future of European competitiveness. This roadmap aims to boost EU competitiveness for the upcoming Commission period, closing the innovation gap with the US and China (European Commission, 2025). Besides the RRF, the other initiatives are financed, regarding public contributions at the Union level, through prioritisation of the existing Multiannual Financial Framework budget for the period 2021-2027.

Since 2021, the US has enhanced policy interventions to stimulate R&I efforts in strategic technologies and to foster domestic manufacturing and supply through a variety of instruments, including tax incentives and grants. Through the Inflation Reduction Act (2022, USD 400 billion), the US employs investments and tax benefits to address climate change, boost the clean energy supply, and strengthen US competitiveness, innovation performance, and industrial productivity (McKinsey, 2022a). Meanwhile, the US Chips and Science Act (2022, USD

[15] See for current information on the RRF also https://commission.europa.eu/business-economy-euro/economic-recovery/recovery-and-resilience-facility_en.

280 billion) aims to address global semiconductor shortages, enhance US technological leadership, and ensure economic security through increased domestic production and capacity building, as well as R&D and skill investments (McKinsey, 2022b). With the Infrastructure Investment and Jobs Act (2021, USD 1.2 trillion), the US aims to revitalise and modernise critical infrastructure across the country. R&D resources have been freed to boost infrastructures, including rail, energy, air, and water (McKinsey, 2021). Before this, in 2021, to ensure continued US leadership in AI developments, the US government put forward the National Artificial Intelligence Initiative Act to prioritise and boost AI R&D, infrastructure, and skills training (US Congress, 2020). These strategies and investment packages exemplify the assertive industrial policy currently seen in the US, though a change in presidency could lead to a shift in the type of public interventions, moving from direct public investments to an increased focus on deregulation and tax benefits.

China has launched ambitious strategies and increased its international presence to establish itself as a leading country in R&D, focusing on investments and building capacities in key and strategic technological and scientific areas. A decade ago, China introduced the Made in China (MIC) 2025 strategy to become a leading global technological superpower by 2049. The MIC 2025 strategy outlines ten priority sectors, including aerospace and aeronautics, biopharmaceuticals and high-end medical equipment, next-generation IT, energy-efficient and new energy automobiles, and new and advanced materials (CSET, 2022b). China's 14th Five-Year Plan for National Economic and Social Development and Long-Range Objectives for 2035, launched in 2021, reinforces these initiatives through the establishment of several national laboratories in strategic S&T areas, including quantum information, photonics, micro- and nano-electronics, network communications, AI, biotech and pharmaceuticals, and modern energy systems. Additionally, new Major S&T Projects have been initiated in key industries, as set-out in Box 3 (CSET, 2021). Aligned with these strategies is the more recent initiative to foster the domestic market and reduce reliance on exports, known as the Dual Circulation Plan. This plan aims to shift the country’s economic growth model toward more sustainable and self-sufficient industries by stimulating national consumption and investments in R&I as a driver for growth (CSET, 2022c). Another significant Chinese strategy is the Belt and Road Initiative, launched in 2013, which promotes infrastructure development and strengthens cooperation in Asia, Africa, Latin America, and Europe through Chinese lending and supply (Hirakawa, 2024).

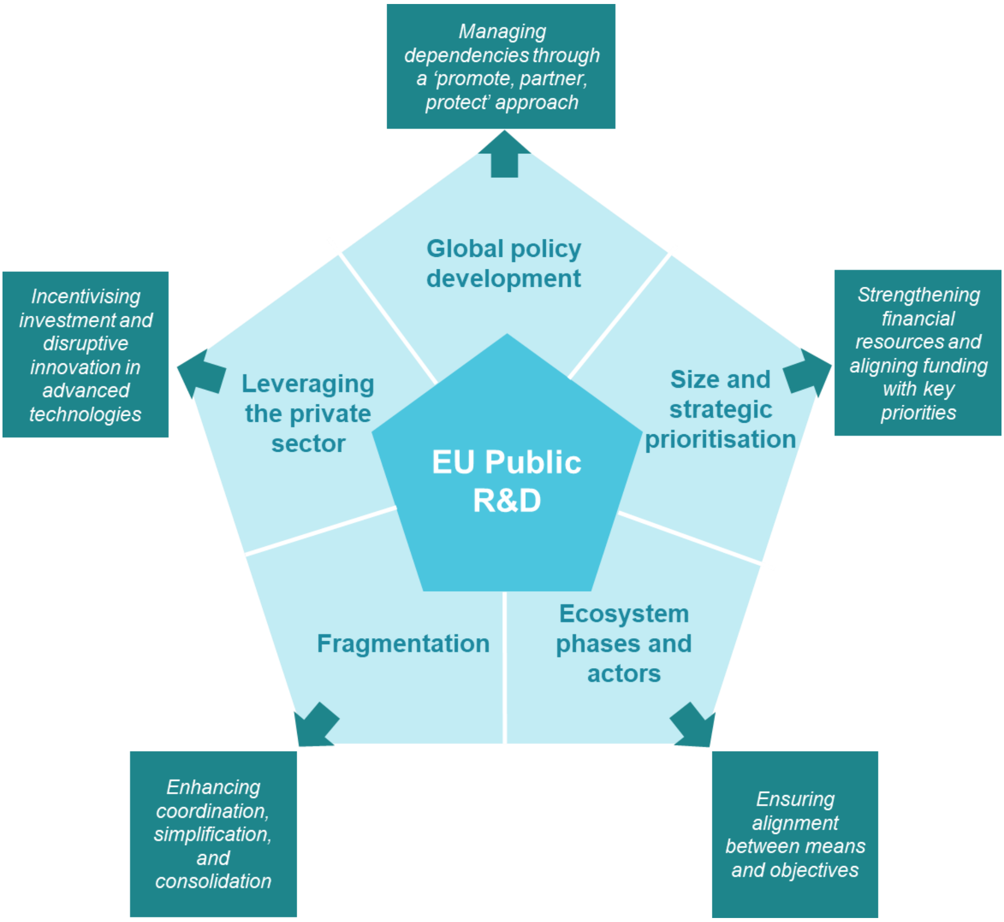
Table 1: Overview of selected R&I policies in the EU, US, China

EU	US	China
Competitiveness Compass (2025) *Guiding and enhancing the EU's competitiveness in the context of rapidly evolving tech landscape and geopolitical shifts, including through closing the innovation gap with the USA and China*	**Inflation Reduction Act** (2022, USD 400 billion) *Address climate change, strengthening US competitiveness and support clean energy initiatives, through tax incentives and investments for renewable energy projects*	**China's 14th Five-Year plan** (2021) *Strengthen the Chinese national economy between 2021 and 2025, emphasizes high-tech innovation, including by prioritising strategic S&T areas including digital and health tech*
Recovery and Resilience Facility (2021, EUR 650 billion) *Foster a stronger and more resilient recovery of the EU from the COVID-19 crisis via support (reforms and investments) to EU member states that drive economic recovery and promote the green and digital transitions*	**US Chips and Science Act** (2022, USD 280 billion) *Strengthen US semiconductor sector, by addressing shortages and technological leadership through increased domestic production and capacity building, and R&D and skill investments*	**Dual Circulation Plan** (2022) *Shift China's economic growth model towards sustainable and self-sufficient, reducing export reliance, including by stimulating national consumption and R&I investments*
RePowerEU Plan (2023) *Reduce EU's energy dependency and socio-economic needs caused by Russians invasion of Ukraine, by accelerating the transition to a clean energy system and diversification*	**Infrastructure Investment and Jobs Act** (2021, USD 1.2 trillion) *Revitalising and modernising critical infrastructure across the US. R&D investments to boost infrastructures including rail, energy, air, and water*	**Made in China Strategy** (2015) *Make China a leading global technological superpower by 2049, through priority investments in several key S&T areas to boost national capabilities and industries*
EU Chips Act (2023) *Boost Europe's competitiveness and resilience in semiconductor technologies and applications, by boosting production capacity and (R&I) investments*	**Artificial Intelligence Initiative Act** (2021) *Ensuring continued US leadership in AI, including through prioritize AI R&D, infrastructure, and skills training*	**Belt and Road Initiative** (2013) *Promote infrastructure development and strengthen cooperation in Asia, Africa, Latin America and Europe through Chinese lending and supply*

Source: Authors elaborations.
Note: This table provides a selection of policies on EU-level, while EU Member States in parallel also have introduced relevant policy.

5. Conclusion

Figure 18: Key dimensions and considerations



In recent decades, the EU, US, and China have each developed robust R&I policies aimed at boosting investments and prioritising strategic science and technology areas to maintain global leadership and safeguard national interests. This paper emphasises that all three economies have implemented over recent years strategies to enhance industrial competitiveness in key sectors. Notable examples include initiatives to advance the semiconductor industry and the development of renewable energy resources and clean technologies, which are central to the global quest for leadership and managing of dependencies. The fragile and rapidly developing global political landscape calls for the EU to continue to respond appropriately, through a balanced and strategic approach, to international engagement. This can allow EU's economy to thrive through innovation and cooperation while safeguarding its interests and sovereignty in a competitive global landscape through a 'promoting, protecting and partnering' approach (European Commission, 2023b).

In the past decade, China and the US have outpaced the EU in leveraging public R&D investments into robust private sector funding. Our analysis reveals that since 2010, these countries have seen significant growth in private R&D funding, aligning with the digital boom and the rise of enterprises—primarily from the US and China—in the digital (IT) sector that heavily invest in R&D. In contrast, the EU boasts a different economic structure, characterized by greater diversity but a concentration in medium high-tech industries. This explains partly the disparities in private R&D funding (European Commission, 2024). Given that digital technologies are notably complex and may contribute to lagging productivity and unwanted dependencies for the EU (Di Girolamo et al., 2023) and considering that the EU's target of 3% for R&D investments remains elusive due to insufficient private investment, reflecting on the EU's economic structure could be justified. This could include a stronger emphasis on disruptive innovations and advanced technologies (Draghi, 2024). Policies play an important role in incentivise enterprises and ensuring an innovation-friendly environment. Encouragingly, some EU Member States have successfully leveraged public R&D funding to private investments, offering valuable insights and pathways for best practices. Additionally, the balance between direct and indirect R&D support should be considered in these reflections, as indirect support (through tax incentives) gained importance in recent years. Currently, the US exceeds the level of indirect support as seen in China and the EU, pointing to potential strategies for enhancing private investment.

With private R&D funding trailing behind that of other major economies, the EU finds itself increasingly reliant on public funding. This dependency underscores the importance of ensuring the efficiency of the EU's currently fragmented public funding system. Given the constraints on public resources, optimising their allocation is vital. This paper shows that EU public R&D funding is fragmented across multiple governmental layers, among Member States and between EU and Member State levels, as well as programmes. Only a fraction of R&D funding is funded on Union level. This fragmentation stresses the relevance of a comprehensive assessment of the current structures of public EU R&D funding. Strengthening coordination can help allocate funding more effectively, by creating economies of scale and minimising potential duplications. Additionally, exploring the benefits of more consolidated budgets for EU-wide needs, while respecting the subsidiarity principle as well simplification efforts, can improve accessibility and impact.

Size matters. Although the EU relies more on public funding, the actual amounts allocated to public R&D fall short compared to the US, and EU FPs' annual budgets are below those of their US and Chinese counterparts. To effectively compete on the global stage for talent and knowledge, it is crucial to allocate sufficient R&D funding to strategic priorities. This paper illustrates that, in concrete terms, EU's public R&D funding is outmatched by that of the US. This disparity extends to the budgets of key EU FP instruments: for instance, the ERC operates with fewer resources than both the NSF and the NNSF, while the EIC remains comparatively small even in relation to DARPA alone. Moreover, the combined R&D funding at US federal level for the NIH, NASA, and NSF alone is more than four times the annual budget of the entire EU FP. These insights are particularly relevant when examining thematic areas, as EU FP funding is only a fraction of what the US government dedicates to similar fields. This highlights the importance of better coordination and prioritisation of EU R&D budgets to areas with the highest EU added value.

Policy reflections should touch upon the distribution of EU public R&D funding, including the actors and the stages of R&D supported, to assess the alignment between means and objectives. This paper shows that the EU, US and China have different mechanisms and allocations regarding the organisations and type of R&D funded. Two aspects stand out. First, the US and Chinese governments channel more public R&D funding through public sector organisations, while EU public R&D funds are primarily directed towards higher education institutes. Interestingly, the EU FP diverges from this general EU pattern, with a relative lower level of funding to universities, while the share for the private sector is noticeably higher. This could reflect the gap in private sector funding (in particular related to riskier innovation activities) that the EU FP tries to fill, for example through the EIC. Second, the EU seems to place greater emphasis on research efforts, while the US and China focus more on the later stages of R&D. Interpreting these results need care. For example, US defence R&D funding skews the public funding to the later stages. Also, the type of sector performing R&D can influence the stages of R&D funding, as, for example, universities are by nature more established in research efforts. Though, reflections can help in optimising the current EU funding design, assessing if the current means are suited for EU's objectives, including to lead new innovation waves. One aspect that could be touched upon is whether the later stages of R&I are sufficiently supported to ensure that research can be translated into market-ready and scalable innovations, including ensuring an adequate innovation ecosystem.

Overall, the EU, China, and the US each have distinct as well as similar mechanisms for advancing their R&I capabilities. The EU FP stands out as a globally unique cooperative R&I initiative, providing funding to over 40 countries and encompassing a diverse array of instruments and support for various thematic areas. This comprehensive and integrated approach makes it a strategic tool for enhancing international collaboration and fostering key thematic areas. The US R&I landscape features agencies like DARPA that focus on developing disruptive innovations and new technologies, facilitating the rapid transformation of ideas into successful innovations. This model has inspired other economies to establish similar agencies.[16] Meanwhile, China has quickly strengthened its high-tech development, particularly in areas like AI and quantum technologies, by investing in 'Major S&T projects' that concentrate efforts and blend public and private resources. Despite their differences, the three economies also share equivalent mechanisms, such as agencies dedicated to funding groundbreaking basic research and the use of public-private partnerships.

[16] For example, the Advanced Research and Invention Agency (ARIA) in the UK and the Federal Agency for Disruptive Innovation (SPRIND) in Germany are inspired by the principles of DARPA.

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This paper provides comparative insights into how the EU and governments of major economies organise and allocate their R&I funding. The paper conducts a benchmarking analysis of the scale, design, and main features of public R&I funding in major global economies. Specifically, it compares the current EU FP, Horizon Europe, with the R&I mechanisms of the US and China, two of the largest research and development (R&D) spenders in the world, alongside the EU. The paper identifies five key findings on public R&I funding and their policy implications for the EU, in regard to global policy developments, the size of and strategic prioritisation, ecosystem phases and actors, fragmentation and leveraging the private sector.

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