BRIEFING

European Parliament

Research and innovation in the EU

Evolution, achievements, challenges

SUMMARY

Research and innovation have become indispensable elements in many areas of our daily lives, including health and wellbeing (e.g. radiotherapy, vaccinations), the search for a sustainable environment (e.g. weather forecasts, solar energy), safety and security (e.g. tsunami alerts, biometric border control) and end-user products (e.g. smart phones, e-cars).

Despite the correlation between research, development, innovation and competitiveness, when it comes to international comparisons, most Member States lag behind the 'Barcelona target' to invest 3 % of national gross domestic product (GDP) in scientific research and innovation. Better coordination of transnational research activities and the completion of the European Research Area (ERA) could benefit the EU economy by an extra €16 billion per year.

The instruments, governance and scope of the framework programmes (FP) for research have changed dramatically over time. These changes include the development of public-public and public-private partnerships, the establishment of the European Research Council (ERC) and the European Institute for Innovation and Technology (EIT), and the introduction of specific instruments for small and medium-sized enterprises (SMEs), as well as individual mobility grants.

To date, the current FP, Horizon 2020, has supported over 18 000 projects with more than €31 billion in funding. Nevertheless, Horizon 2020 has shortcomings, including complex procedures, a high administrative burden, a lack of flexibility when it comes to reacting to unforeseen circumstances, and insufficient synergies with other EU funds and public interventions and/or private finance.

In this Briefing

EPRS | European Parliamentary Research Service

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PE 630.284 – November 2018

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Introduction: Why research and innovation matters

According to the Commission, investing in research and innovation is investing in Europe's future, helping it to compete globally and preserve its social model. About two-thirds of Europe's economic growth over recent decades has been driven by innovation.

This tallies with several (political) economy theories that suggest that businesses need to keep pace with the latest technological developments in order not to be wiped out of the market.[1] In this regard, businesses invest in research and development (R&D) because they want to remain competitive, keep their market share and grow with new innovative products. This can create jobs and increase tax revenues. However, one problem businesses often face is that of measuring the long-term impact and return on investment of individual R&D investments, since most expenses occur in the short term and might at first reduce commercial profit and shareholder value.

R&D and innovation also matters for policy-makers since they need to know about the path-dependency of political challenges. Causal effects can better be explained if the causal mechanisms are well understood. In this regard, policy-makers might need logic-based solutions that might derive from R&D and innovation in social and natural sciences.

Research, development and innovation are also used for political aims. Visionary projects can contribute to solidarity as well as to societal integration, one example being the prestigious space race between the US and the former Soviet Union. (Neo-)realist theorists and policy-makers would consider R&D and innovation to be a means to pursue national interests (e.g. security and trade) and shift the balance of power relative to other countries.[2] In this context, it is worth mentioning the development and use of nuclear energy in countries that are poor in natural resources, weapons of mass destruction, and cyber-attacks on critical infrastructure (e.g. airports, hospitals and electronic voting systems).

However, R&D and innovation experts can also advise policy-makers using objective scientific expertise and problem-solving solutions, since these, unlike democratically elected policy-makers, do not (usually) depend on public opinion and elections. On the other hand, policy-makers can put the blame on scientific boards if they want to conduct unpopular reforms.

Nonetheless, most people view research and innovation positively, as numerous inventions have become an indispensable part of daily life. Examples abound in areas such as health (e.g. radiotherapy, vaccinations), the search for a sustainable environment (e.g. solar energy, efficient water fixtures), transport (e.g. GPS navigation, e-cars), safety and security (e.g. tsunami alerts, biometric border controls) and everyday innovative market products (e.g. tablets, smart phones).

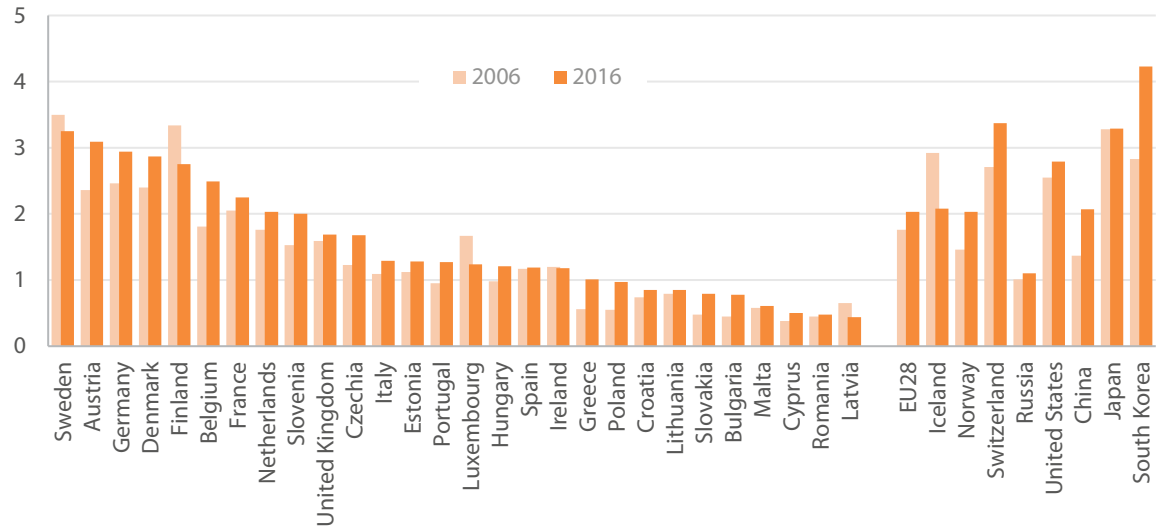
Facts and figures: Research, development and innovation in Member States and abroad

Many governments in the EU and across the world actively promote R&D and innovation, for instance through tax incentives and the introduction of good practices in administration, such as one-stop shops that are equally accessible to R&D businesses (e.g. start-ups) and investors, easy online application procedures, and short waiting times for decisions on funding eligibility.

At EU level, the Member States agreed in 2002 on the Barcelona target to increase investment in scientific R&D to 3 % of national GDP (with one third of funding provided by governments and two thirds by business). The aim was to catch up with high R&D expenditure countries such as South Korea, the US and Japan.[3] According to 2018 figures from Eurostat, most Member States' expenditure on scientific R&D had risen in 2016 compared with 2006 – in terms of percentage of national GDP. Member States are however lagging behind compared with South Korea, the US and Japan, while being on a par with China. The highest R&D intensities among the Member States were recorded in Sweden (3.25 %) and Austria (3.09 %). These were the only two Member States to report

levels of R&D intensity above the 'Barcelona target' of 3.00 %, followed by Germany (2.94 %), Denmark (2.87 %) and Finland 2.75 % (see Graph 1).

Graph 1 – Gross domestic expenditure on R&D, 2006 and 2016 (%, relative to GDP)

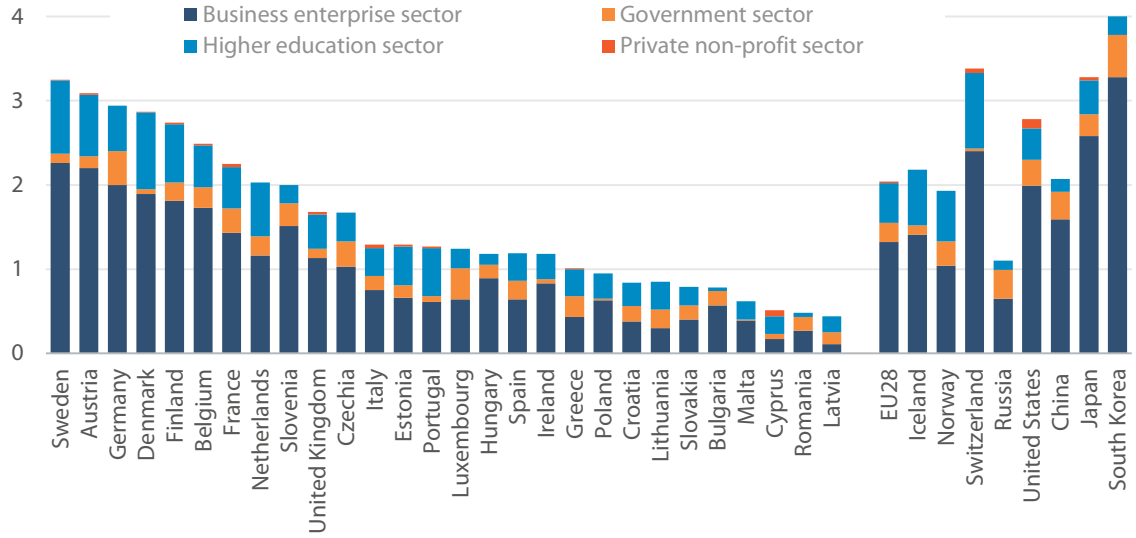


* China (not including Hong-Kong): 2008, 2015; Japan, Russia, South Korea and United States: 2006, 2015.

Source: Eurostat.

According to Eurostat, gross domestic expenditure on R&D stood at €303 billion in the EU-28 in 2016, and was 40 % higher than in 2006. Compared with third countries, aggregated EU-28 R&D expenditure was equivalent to two thirds of that of the US and was 48.5 % higher than that of China, more than double that of Japan, and more than five times as high as that of South Korea.

Graph 2 – Gross domestic expenditure on R&D by sector, 2016 (%, relative to GDP)



* China (not including Hong-Kong), Japan, Russia, South Korea and United States: all 2015.

Source: Eurostat.

Eurostat's analysis of R&D expenditure by source of funds shows that more than half (55.3 %) of total expenditure within the EU-28 in 2015 was provided by business, while almost one third (31.3 %) was funded by governments, and a further 10.8 % stemmed from foreign funds. Throughout this period, the bulk of R&D expenditure was in the business enterprise sector, with the sector's R&D spending rising from 1.12 % of GDP in 2006 to 1.32 % by 2016. The second largest sector was higher education.

Member States with relatively high ratios of business enterprise expenditure were Sweden (2.26 %), Austria (2.20 %) and Germany (2.00 %). In South Korea, R&D business enterprise expenditure reached 3.28 %, in Japan it was 2.58 %, in Switzerland 2.40 % and in the United States 1.99 % (see Graph 2).

According to the 2017 edition of the EU Industrial R&D Investment Scoreboard, R&D growth in the EU was driven by information and communication technology (ICT) producers (+14.4 %), ICT services (+12.7 %), the health industries (+7.9 %) and the automobile sector (+6.7 %). However, companies from a few sectors traditionally important for the EU economy decreased their R&D spending, in particular the aerospace and defence sectors (-5.4 %) and to a lesser extent the chemicals sector (-0.8 %).

Relevance of the European Research Area (ERA) and the cost of non-Europe

In 2000, the European Union decided to establish the European Research Area (ERA) in 2002. Its main objectives are to promote the free circulation of researchers, scientific knowledge and technology, to improve the coordination of research activitites on national and European level, to increase the worldwide attractiveness of European research, and to boost Europe's competitiveness.

However, the ERA has not yet been completed. On the basis of a distance-to-target calculation, the 2017 EPRS Cost of non-Europe report states that the remaining implementation gap of ERA completion corresponds to a loss of €3 billion in additional GDP per year.

According to estimations made by the European Commission, completion of the ERA and transnationally coordinated funding could benefit the EU's economy by €16 billion per year (deriving from 0.25 % additional GDP growth on top of the 0.92 % additional growth expected from the Horizon 2020 programme). In addition, improved coordination of transnational funding would create 323 000 additional jobs. The impact would be even greater if the 'Barcelona target' (3 % of national GDP dedicated to R&D) were to be reached by 2020.[4]

The evolution of the EU framework programmes: Horizon 2020 and its synergies

With the deepening of European integration in the 1980s, research became a shared competence between the Union and the Member States. In this regard, the EU runs a number of programmes to finance research activities in various sectors. These programmes provide a total estimated budget of more than €120 billion to support research, development and innovation activities in the current multiannual financial framework period, i.e. the 2014-2020 period.

While the first research and innovation projects (outside the coal and nuclear sectors) began back in the 1970s, the first framework programme (FP1) was only adopted in 1983. As the FPs have evolved, their instruments, governance and scope have changed. These changes include, inter alia, the development of public-public and public-private partnerships, the establishment of the European Research Council (ERC) and the European Institute for Innovation and Technology (EIT), and the introduction of specific instruments for SMEs as well as individual mobility grants.

Today, the FPs for research are seen as the most important instrument for the implementation of the ERA. The current framework programme for research, Horizon 2020 or FP8, was adopted in 2013. The programme's current budget is €74.8 billion, making it the fourth highest budget heading (after agriculture, regional development and external action) in the current multiannual financial framework (MFF).

Horizon 2020 is based on three main pillars: Excellent Science (32 % of the Horizon 2020 budget), Industrial Leadership (22 %), and Societal Challenges (39 %). Horizon 2020 provides grants for individual researchers and their mobility, funds cooperative research projects, supports and funds public-public and public-private partnerships, and provides specific instruments supporting

research and innovation in SMEs. In its press release on the proposed Horizon 2020 successor programme, Horizon Europe, the European Commission provided updated figures on projects funded. As of May 2018, Horizon 2020 had supported over 18 000 projects with over €31 billion awarded.

While Horizon 2020 is the largest EU programme specifically supporting R&D and innovation activities, there are other funds for research and innovation, such as sectoral programmes (e.g. nuclear energy, coal and steel) and the European structural and investment funds (such as the European Regional Development Fund and the European Social Fund), that are implemented at regional level. Five other programmes are connected to, or impact on, research and innovation activities: the COSME programme to support small and medium-sized enterprises, the Erasmus+ programme to support education, the Health programme, the LIFE programme for environment and climate action and the Connecting Europe Facility to support investments in energy, transport and digital infrastructure.

The European Commission aims to interlink most research activities horizontally and to create synergies with other EU instruments and programmes, such as InvestEU, the European space programme (Galileo, EGNOS, Copernicus, Govsatcom) and the European Defence Fund.

EP research conference: Promoting health, sustainable environment, innovation and security

The 27 November 2018 European Parliament high-level conference on EU research and innovation in our daily lives, to which this paper is targeted, is organised around four panels: health and wellbeing, sustainable environment, putting innovation on the market, safe and secure society. The following section gives a brief overview of what the EU is doing (within and beyond the Horizon 2020 framework) on these four topics:

Health and wellbeing

The European Union actively supports research in the health sector to improve citizens' quality of life. With a budget of €449.4 million (2014-2020 period), the Health programme is the main instrument financing projects that improve human health and help EU countries develop innovative and sustainable health systems. Areas of research include antimicrobial drug resistance, cancer, cardiovascular diseases, diabetes, Ebola, HIV/AIDS and tuberculosis. Success stories include smarter toxicity tests for novel nanomaterials, a way to make vaccines immune to heat and the use of smartphones to tackle teenage depression.

Sustainable environment

Within the Horizon 2020 framework, climate, environment and energy fall under the Societal Challenges pillar. The LIFE programme, however, is the only EU fund entirely dedicated to environmental and climate objectives. The general objective of LIFE is to contribute to the implementation, updating and development of EU environmental and climate policy and legislation, by co-financing projects. For the 2014-2020 period, the budget allocation set aside for LIFE is approximately €3.4 billion. To date, it has co-financed, mainly through grants, over 4 500 projects with a total EU contribution amounting to about €5.9 billion. Businesses, in particular SMEs, public authorities, and private non-commercial organisations are beneficiaries of these projects. According to a recent study, the LIFE programme generated 74 500 jobs between 2009 and 2015. Recent successful EU-funded research projects include, for instance, energy-efficient carbon fibre reinforced polymer (CFRP) remanufacture from regenerated carbon fibres; new soil improvement products for reducing the pollution of soils and waters and revitalising the soil system; and petrol-based glue and energy consumption reduction in nappy production processes.

Innovation and market launch

In order to promote innovation and market launch, the European Commission, launched the Fast Track to Innovation (FTI) instrument as part of the Horizon 2020 work programme for 2018 to 2020. The FTI provides a one-stop shop for funding of innovators/innovations in the EU and is part of the European Innovation Council (EIC) pilot. The FTI is a fully bottom-up innovation-support programme promoting close-to-the-market innovation activities open to industry-driven consortia. It can help partners to co-create and test breakthrough products, services or business processes that have the potential to revolutionise existing or create entirely new markets.

Furthermore, the European Commission has announced that the EIC will support 38 high-risk innovative projects located in new future and emerging technologies (FET) to support radically new, breakthrough products and services that might open up new markets. The projects will receive €124 million in total. Current beneficiaries include the projects listed in the table below.

Project name	Description	EU contribution	Participants	Countries involved
BoostCrop	Boosting Crop Growth using Natural Product and Synthesis Enabled Solar Harvesting	€4 940 403	University of Warwick; University of Bristol; Universiteit van Amsterdam; Stichting Katholieke Universiteit; Institut des sciences et industries du vivant et de l'environnement – AgroParisTech; Université d'Aix-Marseille; Bundesinstitut für Risikobewertung; PlantResponse Biotech S.L.	UK, NL, FR, DE, ES
CANCER SCAN	A Body Scan for Cancer Detection using Quantum Technology	€3 934 743	Ben-Gurion University of the Negev; Medizinische Universität Wien; Technische Universität München; Università degli Studi di Roma La Sapienza	IL, AT, DE IT
IQubits	Integrated Qubits Towards Future High-Temperature Silicon Quantum Computing Hardware Technologies	€2 688 375	Aarhus Universitet; Consiglio Nazionale delle Ricerche; Governing Council of the University of Toronto	DK, IT, CA

Source: European Commission.

Safe and secure society

Covered by Horizon 2020, under the Societal Challenges pillar, the sub-programme Secure Societies has set aside some €1.6 billion with the aim of enhancing resilience against natural and man-made disasters; developing novel solutions for the protection of critical infrastructure; fighting crime and terrorism; improving border security; and providing enhanced cybersecurity. In this context, examples of research projects include the Civil Cyber Range Platform for a novel approach to cybersecurity threats simulation and professional training, an advanced surveillance system for the protection of soft urban targets and critical urban infrastructure, and the use of artificial intelligence for monitoring seismic activity.

Addressing the challenges of Horizon 2020: Stakeholder and European Parliament positions

In the 2017 interim evaluation of Horizon 2020, stakeholders criticised, among other things, the uneven distribution of funding across the EU. They also requested greater interlinkage of shared,

multi-level governance between the EU, the Member States and the regions. Finally, the complex funding landscape was deemed to require streamlining.

Between January and March 2018, the European Commission ran a public consultation on future EU funds in the area of investment, research and innovation, SMEs, and the single market. According to most stakeholders, the main obstacles preventing the current programme from achieving its objectives are the excessively complex procedures; high administrative burden; lack of flexibility to react to unforeseen circumstances; insufficient synergies between EU programmes and funds; and the difficulty of combining EU action with other public interventions and private finance. On the other hand, most stakeholders expressed their satisfaction with the existing three-pillar structure of Horizon 2020 and asked for minor refinements, such as better linkage between pillars for better coverage of the whole knowledge chain. There were also suggestions to reinforce the role of social sciences and humanities as they offer strong value for tackling societal challenges and achieving goals.

The subject of R&D and innovation attracts a lot of attention in the European Parliament. In an 18 May 2000 resolution, Parliament supported the implementation of a European Research Area and called for an enhanced European research policy able to react rapidly to changing circumstances and emerging research priorities.

In its 13 June 2017 resolution on the assessment of Horizon 2020's implementation, Parliament criticised, inter alia, the under-performing synergies between Horizon 2020 and EU cohesion policy and the semi-transparency and lack of openness of public-private partnerships. In addition, Parliament pointed to the latent potential of the budget earmarked for non-fossil fuel energy research, and criticised the low participation rate of women in R&D.

Outlook

The European Union and the Member States currently face a broad range of challenges, such as a possible return of the economic and financial crisis, tax avoidance, terrorism, social inequalities, industrial (r)evolution, digitalisation, an ageing population, illegal migration, climate change, pollution, the increased assertiveness of China, the increasing unilateral US approach under President Trump to international trade, disinformation campaigns and the rise of populism. The Member States cannot tackle these challenges alone. In order to address shared major societal challenges and strengthen EU industrial leadership, a number of obstacles still need to be overcome and national research efforts and resources need to be pooled at European level.

In this regard, the evolution of the research framework programmes should address the lack of clarity regarding the EU innovation policy that the FP is expected to implement, as well as tackle the balance between the various aspects of the innovation process supported by the FP. It could also be useful to assess the existing instruments and their efficiency at EU level in order to rationalise the EU funding landscape and limit its fragmentation. In order to reduce the innovation gap between countries and between regions, more cohesion measures might be needed.

In this context, the European Parliament, in its 13 June 2017 resolution, considered the strengthening of the European Research Area as 'a collective European duty' and encouraged Member States to contribute properly to meeting the target of 3 % of EU GDP for R&D. Parliament also called for a higher budget allocation for Horizon 2020's successor programme, and argued that reporting obligations should be kept to a minimum – in order to prevent red tape from curbing innovation, and to strengthen SME participation in collaborative projects and innovation.

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ENDNOTES

1 For an overview of the correlation between economic growth and innovation, see Jerry Courvisanos and Stuart Mackenzie, 'Innovation economics and the role of the innovative entrepreneur in economic theory', *Journal of Innovation Economics & Management*, 2014/2 (No 14), pp. 41-61; and Philippe Aghion et al., Competition and Innovation: An Inverted U Relationship, Institute for Fiscal Studies (IFS), WP 02/04, February 2002.

2 See the benchmark work of Kenneth N. Waltz, *Theory of International Politics*, Long Grove: Waveland Press, 2010. For a fresh view and analysis on the concept of realist and neo-realist theories, see the upcoming (already available as e-book) edited volume of Roberto Belloni et al. (eds.), *Fear and Uncertainty in Europe – The Return to Realism?*, London: Palgrave Macmillan, 2019.

3 For more information, see Christian Salm, EU Research Policy: Tackling the major challenges facing European society, EPRS, European Parliament, March 2017, p. 4.

4 See the European Commission impact assessment accompanying the communication on A Reinforced European Research Area Partnership for Excellence and Growth, SWD(2012) 212, pp. 29-30.

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