

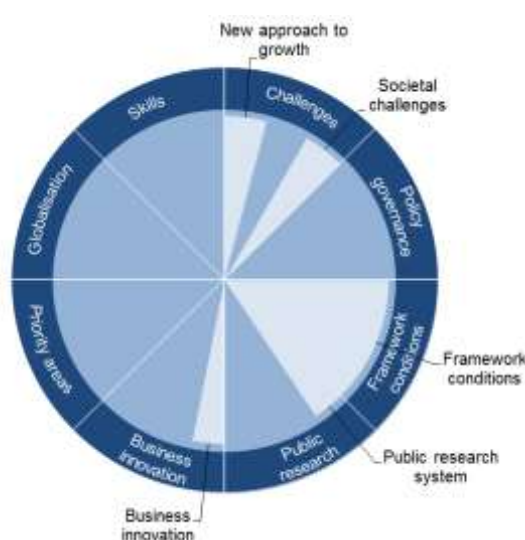
EUROPEAN UNION

The European Union's 28 member states account for less than 20% of world GDP and around 20% of world trade (excluding intra EU trade). The EU contributes to the world's R&D on a similar order of magnitude (23%). The Union's recent economic performance has been disappointing, with low economic growth and low labour productivity increases since 2009 (figure 2). The unemployment rate, especially for youth, remains high in many EU member states. **Weak economic and financial conditions are weighing on the EU's future growth prospects and on its ability to address societal challenges (e.g. ageing, security, migration, climate change, etc.).** EU member states are at different stages of development in their STI capabilities, and these cross-country differences have been increasing since 2009 (see chapter 4). Stagnating countries might fall further behind, while global innovation leaders might keep progressing. A widening gap between countries could hamper the EU's capacity to improve its overall innovation performance. As a result, EU Regional Policy has emphasised the importance of R&D to support sustained economic development and EU Research and Innovation Policy has been reinvigorated by focusing it on the three strategic priorities: Open Innovation, Open Science and Open to the World. The EU's Horizon 2020 (H2020) Framework Programme for Research and Innovation (2014-20) is the funding programme implementing the EU's research and innovation policy. With a budget of nearly USD 101 billion PPP (77 billion euros, not including Euratom), H2020 is one of the few programmes for which the EU has significantly increased financial efforts. H2020 increased the EU R&D budget by nearly 30% in real terms as compared to the previous programming period (2007-13). A special focus has been put on improving the capacity of the EU's STI system to address societal challenges.

Table 1. Gross domestic expenditure on R&D (GERD)

	EU28	OECD
GERD		
USD million PPP, 2014	365 775	1 181 495
As a % of total OECD, 2014	31.8	100
GERD intensity and growth		
As a % of GDP, 2014	2.03	2.38
(annual growth rate, 2009-14)	(+2.4)	(+2.3)
GERD publicly financed		
As a % of GDP, 2013	0.67	0.61
(annual growth rate, 2008-13)	(+1.1)	(+2.5)

Figure 1. Major STI policy priorities, 2016





Hot issues

Addressing societal challenges (including inclusiveness)

Although Europe has some of the most advanced national research programmes in the world, individually they are insufficient to tackle the major societal challenges the region has to face. The challenge-oriented H2020 provides EU level support to interdisciplinary approaches and covers different fields, technologies and disciplines, including the social sciences and humanities. The estimated amount of H2020 funding dedicated to Societal Challenges is USD 35.4 billion PPP (EUR 29.7 billion), or 38.5% of the total H2020 budget. Funding is distributed along dedicated strategies to address the following seven challenges: 1) health, demographic change and wellbeing; 2) food security, sustainable agriculture and forestry, marine, maritime and inland water research and the bioeconomy; 3) secure, clean and efficient energy; 4) smart, green and integrated transport systems; 5) climate action, the environment, and resource efficiency and raw materials; 6) inclusive, innovative and reflective societies; and 7) secure societies.. In addition, the EU's joint programming initiatives aim to pool national research efforts, on a voluntary basis and in a partnership approach, to agree on common visions and Strategic Research Agendas (SRA) to address major societal challenges. Looking at climate change mitigation in particular, the EU has improved its environmental productivity faster than OECD countries on average over the past decade, and it shows a marked comparative advantage in environment-related technologies (figures 3 and 6). The EU has initiated several programmes to further accelerate clean technology R&D and demonstration, for instance, in order to deliver mobility system solutions (e.g. European Green Vehicles Initiative 2014-20, Shift2Rail and Joint technology initiatives on Fuels Cells and Hydrogen and Clean Sky 2). The EU has also set several ambitious Action Plans for triggering system innovation that could lead to radical transformations, e.g. in energy systems (mostly through the Integrated Strategic Energy Technology (SET) Plan to accelerate the European Energy System Transformation and the forthcoming Energy Union Integrated Research, Innovation and Competitiveness Strategy), in cities or the economy as a whole. The European Initiative on Smart Cities supports cities and regions as pioneers and major channels for reducing GHG emissions through the sustainable use and production of energy. The EU Action Plan for the Circular Economy (2015 onwards) sets measurable targets for recycling municipal waste (65% by 2030) and packaging waste (75%) and sets ambitions to stimulate Europe's transition towards a circular economy that will boost global competitiveness, foster sustainable economic growth and generate new jobs.

Promoting structural adjustment and new approach to growth

The economic crisis has wiped out years of economic and social progress and exposed structural weaknesses in Europe's economy. As a result, the Europe 2020 strategy was set as a response to fuel the transition of the Union into a smart, sustainable and inclusive economy delivering high levels of employment, productivity and social cohesion. This strategy focuses on three mutually reinforcing priorities, namely smart growth (through the development of an economy based on knowledge and innovation), sustainable growth (by promoting a resource-efficient, green and competitive economy), and inclusive growth (with the goal of achieving high-employment and social and territorial cohesion). The European Semester process, the annual cycle of economic policy guidance and surveillance, also analyses the compliance of member states regarding the goals established for 2020.

In this context, research and innovation are key to building a prosperous future for the EU. They therefore figure prominently in the Europe 2020 strategy and the European Semester process and underpin progress towards the 10 priorities of the Juncker Commission, from providing a new boost to jobs, growth and investment, to developing the EU Digital Single Market and developing the Energy Union. The importance of R&I was also emphasised in the EC Communication on "Research and innovation as new sources of growth" (2014). With Horizon 2020, research and innovation are funded on an unprecedented scale as Europe's leaders and Members of the European Parliament agreed that research is an investment in our future and so it was put at the heart of the EU's blueprint for smart, sustainable and inclusive growth and jobs. By coupling research





and innovation, Horizon 2020 is helping to achieve this with its emphasis on excellent science, industrial leadership and tackling societal challenges. In what concerns the Excellent Science pillar, it aims to boost the excellence of the Union's science base and also to consolidate the European Research Area in order to make the Union's research and innovation system more competitive on a global scale. In this respect, this pillar includes grants for individual researchers from the European Research Council (ERC) and Marie Skłodowska-Curie fellowships. Additionally, part of the funding related to this pillar will be allocated to support breakthroughs in the area of Future Emerging Technologies (FETs) such as robotics and quantum technologies, and also to develop research infrastructures in Europe. The pillar of Industrial Leadership intends to accelerate the development of the technologies and innovations and help innovative European SMEs to grow into world-leading companies. It encompasses support for research, development and demonstration in enabling and industrial technologies such as ICT and biotechnology, as well as access to risk finance and SME-tailored support to research, development and innovation projects performed by SMEs. Finally, the pillar of societal challenges provides a challenge-based approach that brings together resources and knowledge across different fields, technologies and disciplines.

Improving the framework conditions for innovation

The Innovation Union flagship initiative was launched in 2010, as part of the Europe 2020 strategy, to tackle EU weaknesses in the framework conditions for innovation, including weak public education and innovation systems, the poor availability of finance, costly patenting, outdated regulations and procedures, slow standard-setting, a failure to use public procurement strategically, and fragmented efforts among the member countries and regions. As part of this initiative, the European Innovation Partnerships provide a framework for breaking down silos and bringing together all the relevant actors at EU, national and regional levels. The Better Regulation Agenda adopted in 2015 established that EU policy-making should be based on more transparency and consultation mechanisms, that there should be an assessment of existing laws (through the Regulatory Fitness and Performance Programme (REFIT)) as well as an approach to impact assessment and evaluations to improve the evidence base which underpins all legislative proposals, without prejudice to political decisions. In particular, the InnovREFIT targets the identification of regulatory barriers to investments in innovation. The areas to be considered include among others health, road vehicle automation, aircraft products certification, health technology assessment and eco-design for resource efficiency. To improve the regulatory environment for innovation-driven investment and as part of the Circular Economy initiative, the Innovation Deals, inspired by the Dutch Green Deals, are a non-legislative approach to addressing EU regulatory obstacles to innovation, in the form of voluntary cooperation between innovators, national, regional, and local authorities, and Commission services. Furthermore, the role of the Scientific Advice Mechanism (SAM) created in 2015 is to support the Commission with high quality, timely and independent scientific advice for its policy-making activities. This will contribute to the quality of EU legislation, in line with the Better Regulation agenda. Finally, through the Horizon 2020 Policy Support Facility (PSF), Member States and countries associated to Horizon 2020 can be given practical support to design, implement and evaluate reforms that enhance the quality of their R&I investments, policies and systems. Such reforms concern, for example, the stimulation of stronger and closer links between science and business or the introduction of performance-based funding of public research institutes.

Strengthening the public research system

EU public R&D expenditure accounted for 0.7 % of GDP in 2014, which places it on par with the OECD median (figure 5^a). The EU as a whole ranks in similar terms on world-class universities and top scientific publications (figure 5^{b,c}), although there are still significant differences between Member States. The European Research Area (ERA) gives priority to more effective national research systems through greater investment in research, optimal transnational co-operation and competition, an open labour market for researchers, gender equality and gender mainstreaming in research, and an optimal circulation, access and transfer of scientific knowledge. The ERA Roadmap (2015-20) has been developed as a living document and identifies the key priorities for implementation that are likely to have the biggest impact on Europe's STI systems. H2020 includes a 60% increase in the budget allocated to the European Research Council (ERC), the first pan European funding agency for cutting-edge research. The ERC budget for 2014-20 is USD 15.8 billion





PPP (EUR 13.1 billion), i.e. 17% of the overall H2020 budget. The European Strategy Forum on Research Infrastructures (ESFRI) Roadmap was updated in 2016. Increased attention is being given to open science (OS). The EU Amsterdam call for action on Open Science proposes 12 concrete actions that can be taken immediately to accelerate the transition towards open science, e.g. full Open Access to scientific publications by 2020. An Open Science Policy Platform was launched to co-design a future Open Science agenda. The European Open Science Cloud initiative was launched to set up a virtual environment for storing, sharing and re using data across disciplines and borders. It aims to integrate existing networks, data and high-performance computing systems and e-infrastructure services across scientific fields, within a framework of shared policies, standards and investments. Similarly, the Open Research Data Pilot was launched under H2020 in 2016 to improve and maximise access to and the reuse of data generated by research projects.

Encouraging business innovation and innovative entrepreneurship

The EU business and entrepreneurial environment has been weakened during the financial crisis. Equity investments fell sharply during the downturn, and have still not recovered. The situation is especially lacklustre at earlier developmental stages. STI policy efforts are currently being undertaken to simplify access and to fill gaps within and between existing innovation support measures, including through the potential European Innovation Council that aims to stimulate European innovative start-ups and SMEs to grow into world-beating businesses by providing innovators with support for developing and deploying ground-breaking, disruptive innovations that can create new markets.. The EU has introduced several measures to transform start-ups into internationally competitive businesses. One feature of H2020 is strengthened support for the close-to-market stage of innovation compared to the previous Framework Programme. H2020 funding has been made available for all STI activities, from research to market commercialisation, but with a renewed focus on innovation-related activities, such as piloting, demonstration and test-beds, together with support for public procurement and market uptake. Particular emphasis is being given to direct funding, through competitive grants, equity funding and public procurement (figure 9). The EC has deployed new financial instruments that also intend to leverage private investments. First, a debt facility provides loans, guarantees and other forms of debt finance to all firms and second, an equity facility provides finance for early- and growth-stage investments, with a particular focus on early-stage SMEs with high growth potential. Overall, USD 3.43 billion PPP (EUR 2.84 billion) is budgeted for these two funding facilities, with a view of achieving a 1:5 leverage ratio with private investment. A minimum of one-third of this amount is expected to be absorbed by SMEs. These two facilities will be operated in conjunction with the COSME programme, which allocates USD 1.66 billion PPP (EUR 1.38 billion) for debt and equity financing for SMEs. An additional USD 3.6 billion PPP (EUR 3 billion) programme is dedicated to small companies to support innovative activities from the stage of business idea conception and planning to business plan execution and demonstration to commercialisation. The EU also introduced in 2013 a Regulation on European Venture Capital Funds setting out a European venture capital fund label and associated measures to allow venture capitalists to grow across the EU area, under a single set of rules. VC funds operating under this label will dedicate 70% of their capital to young and innovative companies. In addition, the Entrepreneurship Action Plan 2020 that was presented in 2012 proposes to reignite the culture of entrepreneurship, increase training opportunities for entrepreneurs, and remove existing administrative barriers in crucial phases of the business lifecycle. Moreover, the SME Instrument helps high-potential SMEs to develop ground-breaking innovative ideas for products, services or processes that are ready to face global market competition. It includes business innovation grants for feasibility assessment purposes, innovation development and demonstration purposes, business coaching and facilitated access to risk finance. The Eurostars Joint Programme (2014-20) undertaken by several Member States and Associated countries in the framework of Eureka, with the participation of the Union, promotes market-oriented transnational research activities of R&D-performing SME in any field. The European Commission recently launched a proposal for a Common Consolidated Corporate Tax Base, which includes specific provisions to stimulate private R&D investment through a super-deduction for R&D costs, with specific incentives for young, innovative companies.



Some key STI performance indicators

Figure 2. Economic performance

Labour productivity, GDP per hour worked,
index 2005=100

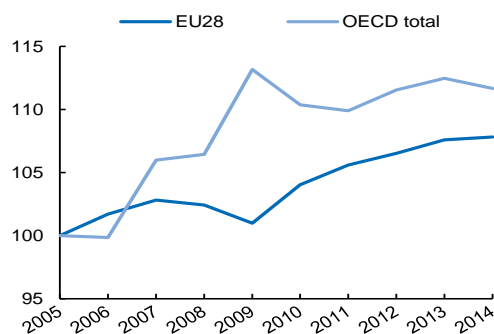


Figure 3. Environmental performance

Green productivity, GDP per unit of CO₂
emitted, index 2005=100

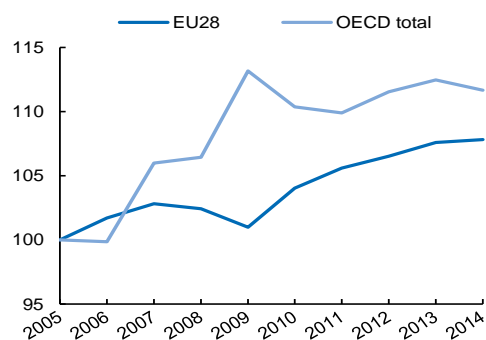
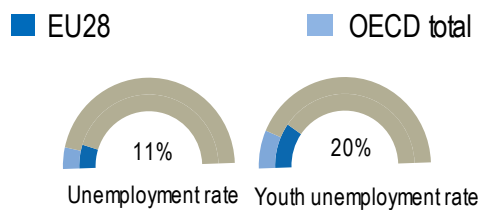


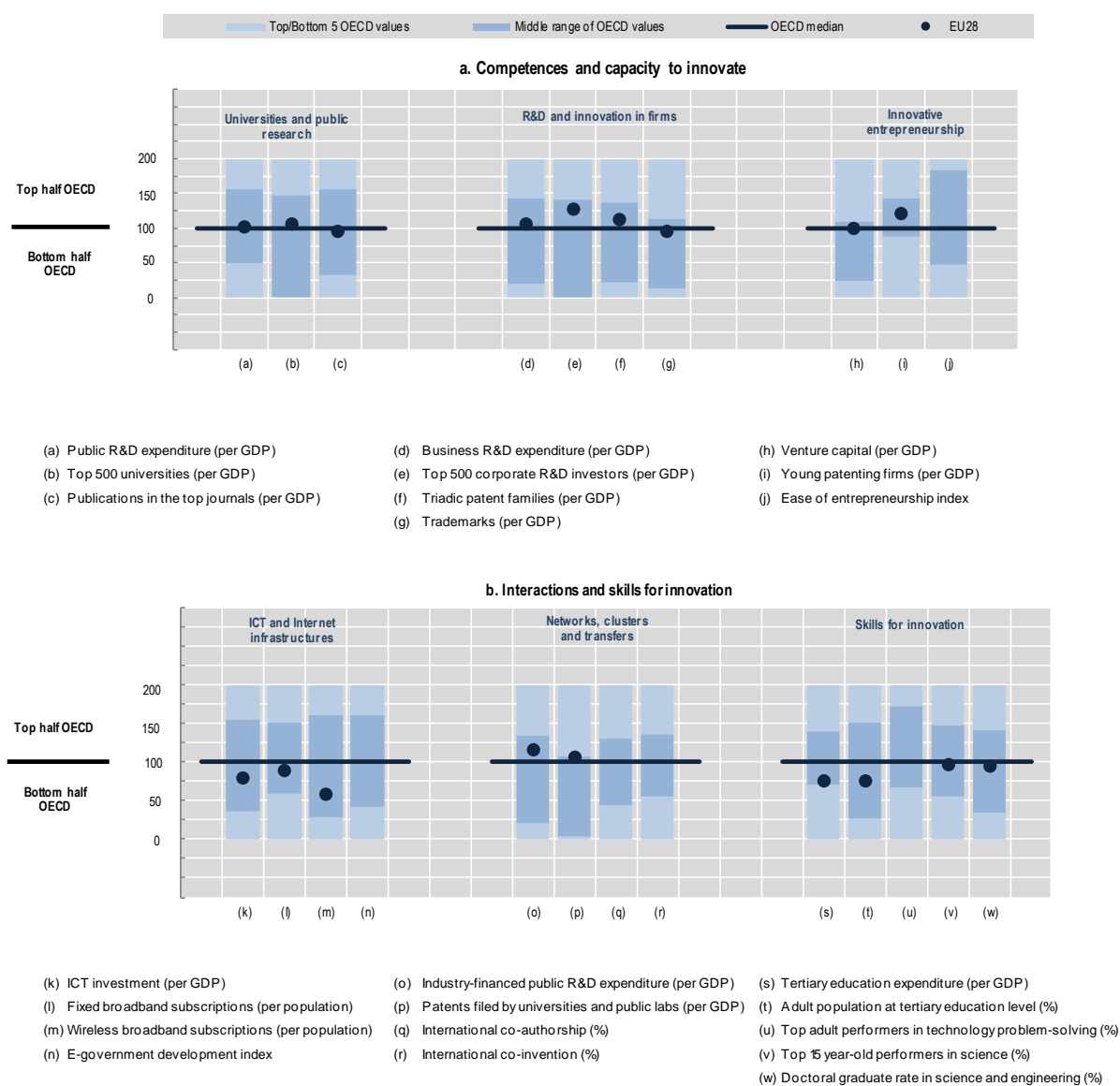
Figure 4. Unemployment

2015 or latest year available, percentages



Benchmarking national STI systems

Figure 5. Science and Innovation in the European Union
Comparative performance of national science and innovation systems, 2016



Note: Normalised index of performance relative to the median values in the OECD area (Index median=100).



Highlights of the EU STI system

STI policy governance

The EU is placing an emphasis on policy evaluation. The European Commission introduced the European Semester mechanism so as to analyse Member States' **policy** and reform efforts, including in the research and innovation (R&I) policy domain, assess progress towards the Europe 2020 R&I goals and, where appropriate, issue Country Specific Recommendations. Through ERAC- European Research Area and Innovation Committee- Member States are also asked to contribute with advice on EU STI policies. Since March 2015, the Policy Support Facility (PSF) provides Member States with practical support to identify, implement and evaluate reforms of R&I policies. The PSF also supports peer reviews by independent experts and government officials from other countries and provides access to independent expertise and analysis. It also organizes Mutual Learning Exercises (MLEs) on specific R&I policy challenges of interest to various countries around project-based exchange of good practice, for instance on public research funding systems based on performance. The H2020 legal framework stipulates compulsory reporting on Key Performance Indicators in all research areas. To reduce red tape, since 2014 all H2020 evaluation functions have been centralised. A mid-term evaluation to be carried out in 2016/2017 will help improve H2020 implementation by providing evidence for designing future initiatives, and it will also help prepare the future Framework Programme (starting in 2017). The Research, Innovation and Science Policy Experts (RISE) Group gives direct strategic support to the European Commissioner for research, innovation, and science and to the European Commission. It focuses on how to best use EU research, innovation, and science policy to address the European growth model and to create the conditions for a different type of growth, a growth that is smart, sustainable, and socially inclusive for the EU and associated countries within a globalized world. In its new setup, RISE is structured along the three policy priorities of EU Research and Innovation – Open Innovation, Open Science and Open to the World - with additional reflection on economic impact building on Open Knowledge Markets. Recently, greater use has been also made of foresight as a priority-setting support tool, and a dedicated internal unit responsible for policy development and co-ordination has been created. In addition, a Scientific Advice Mechanism was introduced in 2015, drawing on the expertise of a High-Level Group of independent scientific experts so as to support the Commission with high quality, timely and independent scientific advice for policy making.

ICT and Internet infrastructures

ICT investment in Europe is still low as per OECD standards, and fixed and mobile broadband networks are unevenly deployed (figure 5^{k,l,m}). In early 2016, the EC released its Digital Agenda, which sets objectives for the growth of the EU by 2020 and aims to achieve a Digital Single Market (DSM) based on interoperability, security, fast access for all, digital literacy, ICT R&D and ICT-enabled benefits. ICT are included in all H2020 activities, either through specific calls or as part of a broader set of contributing technologies. Particular focus is given to reduce the fragmentation of efforts across the EU area. The EU Open Science Cloud Initiative aims to make it easier for researchers, businesses and public services to move, share and re use research data across borders, institutions and research disciplines. The European Data Infrastructure will support the European Open Science Cloud, by deploying the high bandwidth networks, the large-scale storage facilities and the super-computer capacity necessary to effectively access and process large datasets stored in the cloud. By making research data openly available, the initiative also aims to boost Europe's competitiveness, especially for start-ups, SMEs and companies that can use data as a basis for R&D and innovation. In addition, the Excellent Science H2020 pillar will finance advanced research to develop open research infrastructures for ICT and FET.

Technology transfer and commercialisation

Industry-science linkages are fairly developed in the EU, as reflected by the patents filed by universities and PRIs and the share of public research financed by industry (figure 5^{op}). The EU intends to further research cooperation between academia and industry, taking into account the 2016 Bratislava Declaration of Young



Researchers. There are examples of academia-industry partnerships in doctoral training, such as the European Industrial Doctorates programme. To this end, the EU designed the Industrial Talents Programme and launched a feasibility study to evaluate the need for increased inter-sectoral mobility between academia and industry for young researchers. As part of the Erasmus+ Programme, new Knowledge Alliances have been developed to stimulate the flow and exchange of knowledge between higher education and enterprises. These are transnational, structured and result-driven projects that are open to any discipline or sector and to cross-sectoral cooperation. The Knowledge Alliances may also help support the mobility activities of students, researchers and staff. Very importantly, through **partnerships**, **Horizon 2020 pools Europe's** resources to tackle the biggest challenges, support competitiveness of sectors that deliver high quality jobs, develop closer synergies with national and regional programmes, and encourage greater private investment in research and innovation. Most of the funding goes to Joint Technology Initiatives (JTIs). These are run as Joint Undertakings that organise their own research agenda and award funding for projects on the basis of open calls. Some examples of JTIs include the Innovative Medicines 2 (IMI2) and the Clean Sky 2.

Clusters and regional policies

Within the EU's Cohesion Policy, investments in research and innovation and the Digital Agenda require focusing on smart specialisation. The European Structural and Investment Funds (ESIF) provide support for regional innovation, with USD 96.4 130 billion PPP (EUR 80 100 billion). The EU DG Research and Innovation works closely with the DG for Regional and Urban Policy to ensure that smart specialisation strategies are incorporated in operational programmes and partnership agreements, and that they underpin ESIF investment in R&I. The EC launched several thematic Smart Specialisation Platforms (energy, agri food, industrial modernisation) in 2015 and 2016 to drive interregional cooperation. Furthermore, the Seal of Excellence scheme introduced in 2015 aims to help regions to identify research proposals that have gone through selection processes successfully but could not be funded under H2020, for potential funding by the regions.

Globalisation

The ERA aims to strengthen Member States' **research and competitiveness and their capacity to address** grand challenges collectively by enabling researchers, PRIs and businesses to collaborate freely across borders. However, the recent Brexit decision raises new concerns about future intra EU mobility. Under the Open to the World priority, the European Commission encourages further engagement in science diplomacy, global scientific collaboration and the internationalisation of funding programmes. As part of the RISE Group, an **"Open to the World" advisory group has been set up to contribute to deepening the international dimension across R&I policies.** The ultimate aim is to develop a Global Research Area focusing on researcher mobility and addressing common challenges through collaborative projects and mutual access to infrastructure. The international mobility of researchers has been addressed through EURAXESS which since 2015 also includes support for refugee scientists and researchers to find suitable jobs and pursue research careers in Europe (Science4Refugees initiative). A new EU directive 2016/801 allows third-country students and researchers to stay in Europe nine months after the finalisation of their studies or research in order to look for work or set up a business. Additionally, as mentioned before, the Eurostars Joint Programme promotes market-oriented transnational research activities of SMEs in any field, in the framework of Eureka, and involves several Member States and Associated countries. As of April 2016, there were 15 countries associated with H2020, namely Iceland, Norway, Albania, Bosnia and Herzegovina, the former Yugoslav Republic of Macedonia, Montenegro, Serbia, Turkey, Israel, Moldova, Switzerland (partial association), Faroe Islands, Ukraine, Tunisia and Georgia. These are third countries that are parties to an international agreement with the European Union with regards to this specific framework programme.

Skills for innovation

The EU's performance on skills remains on par with the OECD median (figure 5^{t.v.w.v}). The EU considers, however, that human resources are key to future competitiveness. The New Skills Agenda for Europe introduced in 2016 a number of actions to ensure that the right training, skills and support is available and



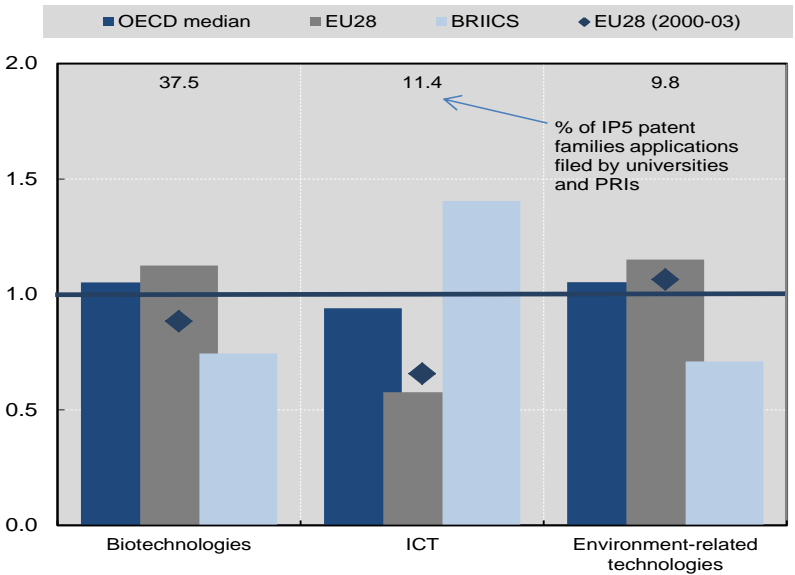


visible to people throughout the European Union. The European Commission is launching a multi-stakeholder partnership, the Digital Skills and Jobs Coalition, to tackle the lack of digital skills in Europe and the thousands of unfilled ICT-related vacancies across all industry sectors. Member States are invited to develop comprehensive national digital skills strategies by mid-2017 on the basis of targets set by end-2016. This includes, in particular, establishing national digital skills coalitions connecting public authorities, business, education, training and labour market stakeholders, and developing concrete measures to bring digital skills and competences to all levels of education and training, supporting teachers and educators and promoting active involvement of business and other organisations. Under H2020, the Marie Skłodowska-Curie actions support researchers at all stages of their careers in all disciplines to combine academic research with work in companies, as well as with other innovative training that helps enhance employability and career development. Furthermore, ensuring a gender balance in science and research careers is at the top of the EU research agenda. A number of H2020 EU funding programmes allow for the promotion of gender equality and gender mainstreaming, in particular, through: i) gender balance in advisory groups (50% target) and evaluation panels (40%); ii) the selection of grant beneficiaries and research teams; and iii) a gender dimension in research content (i.e. taking account of women's and men's biological characteristics and social/cultural factors). The joint H2020 Gender-NET programme promotes gender equality in science and research policies and co funds and monitors strategic transnational actions for that purpose. The EC recently published a Staff Working Document on Strategic engagement for gender equality 2016-19.

Structural aspects and specialisation

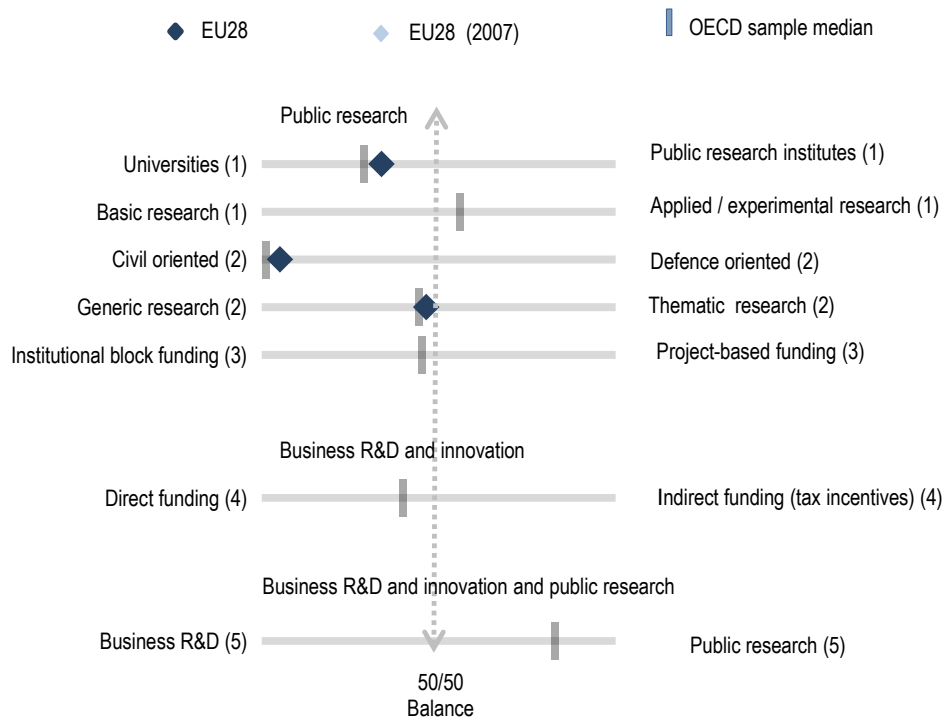
Figure 6. Revealed technology advantage in selected fields, 2011-13

Index based on IP5 patent families applications



STI policy mix

Figure 8. Allocation of public funds to R&D, 2014 or latest year available
By sector, type of R&D and mode of funding



(1). Balance as a share of both higher education (HERD) and government (GOVERD) R&D expenditure.

(2). Balance as a share of total government budget appropriations and outlays for R&D (GBAORD).

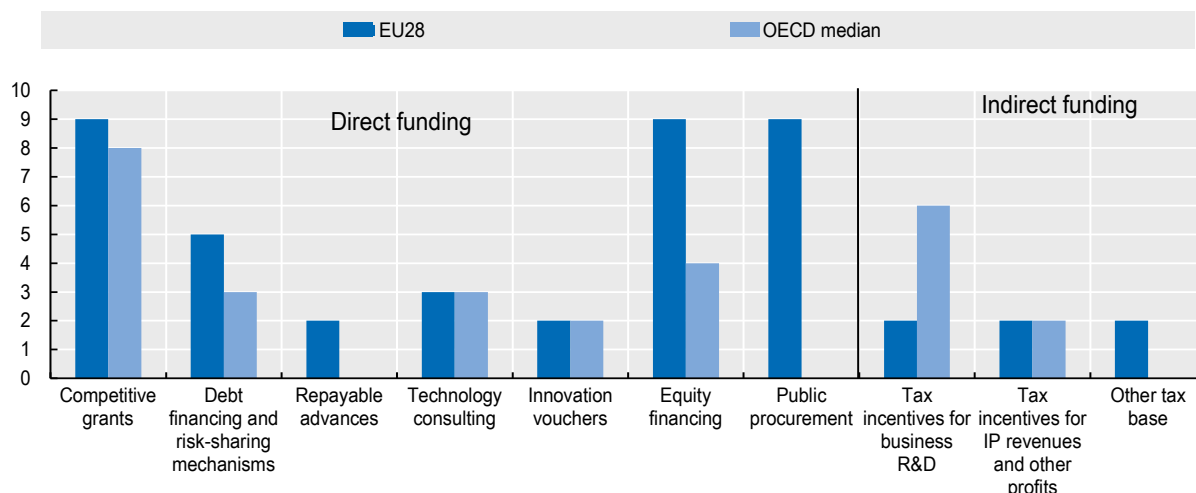
(3). Balance as a share of total funding to national performers.

(4). Balance as a share of both indirect funding (through R&D tax incentives) and direct funding (through grants, procurement, loans, etc.).

(5). Balance as a share of publicly-funded HERD and GOVERD and components of (4).

Figure 9. Most relevant policy instruments of funding for business R&D, 2016

Country self-assessment, index (9 = high and increasing relevance to 0 = not used)



Note: Policy information comes from country responses to the *OECD STI Outlook* policy questionnaires 2016 and 2014. European Union's responses are available in the EC/OECD STI Policy Database, edition 2016 at http://qdd.oecd.org/DATA/STIPSurvey/EU28...STIO_2016.

Source: See the reader's guide and methodological annex.

StatLink <http://dx.doi.org/10.1787/888933434145>

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