OECD Science, Technology and Innovation Outlook 2016

Policy Profile

Financing public research

Rationale and objectives

Public research plays a key role in innovation systems and decision-making processes. It is the source of new knowledge, especially in areas of public interest, such as basic science or fields related to social and environmental challenges, which businesses are not always well equipped or motivated to invest in.

Funding arrangements between the central government, on the one hand, and universities and public research institutes (PRIs), on the other, are an important channel for delivering public research policy and a major driver of change in the public research landscape.

Major aspects and instruments

Most countries combine, in different proportions, discretionary institutional core funding ("block grants") and competitive R&D project grants. Institutional funding provides stable funding over the long term and a certain degree of research autonomy, which is essential for basic research (Table 1). While roadmaps and master plans help governments anticipate and plan the long-term development of research infrastructures, a longer-term view of research funding is also necessary to maintain research infrastructures at the institutional level. Block grants are granted on the basis of various criteria (e.g. formulae, performance indicators, budget negotiations). Competitive R&D project grants put more emphasis on research excellence and outcomes. Project funding is attributed to individuals or groups for specific projects over limited time periods (OECD, 2011). While institutional funding gives institutions more scope to shape their research agendas, project funding provides governments more scope to steer research towards certain fields or issues. Project funding may also allow governments to target the best research groups or support structural change (Lepori et al., 2007).

The results of performance-based research funding systems (PRFSs), which assess institutions' research output and outcomes, may be used to allocate a share of the block funding (OECD, 2010a). PRFS models vary across countries, as do the methodologies and metrics used (e.g. bibliometrics, external funding, number of graduates, patenting, summary indexes, university league tables, peer reviews). While the amounts involved may be small, the PRFSs can have strong incentive effects, in particular in terms of institutional prestige. However, universities and public agencies incur high application and evaluation costs, and such indicator-based systems also require maintaining a national documentation system and a statistical infrastructure. Aside from these costs, the diversity of research institutions and the heterogeneity of scholarly output – the propensity to publish varies widely among disciplines (e.g. life sciences versus social science and humanities) – mean that PRFSs may be less appropriate than other funding instruments for encouraging interaction with industry or capturing the economic benefits of research activities. PRFSs may also increase existing tensions between excellence and equity, notably by reinforcing leading institutions while reducing opportunities for others to improve. Concerns have been raised about the bias of certain PRFSs' criteria and evaluation modes against women, early career researchers or ethnic groups (OECD, 2010a).

Table 1. Financing public research: typology of policy instruments and some country examples

Financing instruments				Key features	Some country examples
Government budget appropriations	**Institutional core funding**	**Non performance-based "block" funding**		Traditional funding channel of public research and primary funding instrument in most countries. Basic funding guaranteed mid- to long term. Not dependent on applications. Various means of assigning budgets, including budget negotiations and agreements, formulae.	Most countries (General University Funds - GUF)
		Performance-based research funding systems (PRFSs)	Indicator-based (university)	Relies on quantitative formulas using bibliometrics, citations and a broad range of indicators (external research funding, completion rates, employment of graduates, faculty size, students population size, number of prizes and awards, university league tables, summary indexes etc.)	Austria, Denmark, Finland, Germany, Greece, Norway, Russian Federation (National Research University), Turkey (Entrepreneurial and Innovative University Index)
			Peer reviews (department/field /university)	Implemented at the university, department or field-in-university levels. May be informed by metrics, or summary indexes.	Australia (ERA), Denmark, Italy (VTR), Poland, Slovak Republic, United Kingdom (REF)
			Individual peer reviews	May affect researchers' remuneration or institutions' rating and the allocation of block funding.	
	Research Excellence Initiatives (REI)			Basic funding guaranteed mid- to long term. Organised in programmes. Time-bound. Application-based. Competitively organised. Outcome-oriented. Focus on exceptional research quality. System-level perspective (i.e. national science landscape). Frequent reference to socio-demographic issues.	Germany (Excellence Initiatives), France, Poland (Leading National Research Centre - KNOW)
	Project-based funding			Time-bound. Application-based. Competitively organised. Outcome-oriented. Public and private funding may also be combined and involve so-called “matching funds”.	Austria (Higher Education Area Structural Fund), France (ANR), Germany (Deutsche Forschungsgemeinschaft [DFG]), European Commission (ERA chairs)
	Towards full economic cost recovery (FCR)			Require pricing and amortising capital, infrastructures and overhead mobilised in research activities in a view to maintain financial sustainability and future capability.	Australia (Sustainable Research Excellence - SRE), Canada Foundation for Innovation (CFI), Estonia, Ireland, Norway, Slovenia, Switzerland (SNSF Overhead programme), Turkey

"Third part" funding	**Universities' and PRIs' own resources (*)**	May encompass a broad range of legal, administrative or regulatory reform to allow universities and PRIS increasing revenues from tuition fees, the provision of knowledge services or the commercialisation of research results. Could also include a revision of block funding mechanisms and universities' performance agreements.	Germany (Academic Freedom Act), France (France Brevets), Latvia (regulation on basic research funding mechanisms), Russian Fed. (licensing publicly-funded IPRs),
	Industry investment (*) (through research contracts, cooperative R&D, corporate patronage)	Encompass various policy instruments targeted to firms in support of collaborative R&D and industry-science linkages (including tax incentives for subcontracted R&D, innovation vouchers, public grants, loans and subsidies for business R&D involving public research partners etc.)	Czech Rep. (innovation vouchers), France (enhanced deductibility of R&D tax expenditure on subcontracted R&D), Italy (tax exemption on investments in joint programmes), Norway (higher ceiling on expenditure for subcontracted R&D), Portugal (innovation vouchers), South Africa (DST agreements with multinationals), Spain (CDTI direct aids), Turkey (reform initiative for research institutions)
	Science philanthropy (private foundations, charity, wealthy individuals)	Mainly tax-based incentives to attract private investments.	France (2011 Law on scientific patronage), Norway (govt reinforcement on private donations), Spain (Law on patronage and sponsorship)
	Crowdfunding (collective Internet fund-raising enabled by ICT and social networks that allow a small portion of the total funding being raised from a large audience of non specialists)	Encompass various policy instruments such as dedicated internet patforms, regulation for ensuring the protection and information of non-expert investors, tax incentives for participative funding or on crowdfunded capital gains, employment regulation including conflict of interest rules, national or institutional guidelines for responisble research.	Austria (regulation on alternative funding), Spain (Precipita platform)

(*) See related the policy profiles on "Tax incentives for R&D and innovation" (subcontracted R&D), "Government financing business R&D and innovation" (innovation vouchers), and "Commercialisation of public research" (collaborative R&D).

Note: This table draws upon recent analytical works on the innovation policy mix carried out for the OECD STI Outlook under the aegis of the OECD Committee for Scientific and Technological Policy. Country information is drawn from the EC/OECD International Science, Technology and Innovation Policy (STIP) Database, edition 2016, https://www.innovationpolicyplatform.org/topic-menu/sti-policy-database.

Source: Based on EC/OECD (2016) and Kergroach *et al.* (forthcoming-a).

Research excellence initiatives (REIs) offer an alternative to performance-based block funding. REIs are at the interface of institutional core funding and programme funding and share elements of both (OECD, 2014). Through REIs, governments award a limited number of very large, long-term block grants to universities and PRIs on the basis of competitive proposals. The aim of REIs is to concentrate exceptional researchers in a well-equipped working environment as a way to support research institutions that carry out ambitious, complex research agendas. Country-level evidence shows that REIs also fund doctoral and post-doctoral training (OECD, 2014). Unlike the PRFSs, REIs enhance interdisciplinary research by providing researchers with more opportunities to work across disciplines. They allow for greater flexibility, notably in terms of managing resources and hiring researchers. They can also help research institutions establish or strengthen ties with the private sector and the research excellence centres funded by REIs can engage in transferable skills training.

Full economic costing of research activities may have useful impact on research funding. It can help research institutions amortise assets and overhead and invest in infrastructures at a rate that allows for ensuring future capability (OECD, 2010b). The capital, infrastructure, maintenance and functioning costs associated with each piece of research are included in the final price. This represents a step towards internal and external market pricing of public research.

A number of governments also encourage universities and PRIs to increase their own revenues. Legal, administrative or regulatory reforms can give universities and PRIs the autonomy and legitimacy to collect tuition fees, provide and charge for knowledge services, or license and commercialise publicly funded

research results (see the *Policy Profile on Commercialisation of public research*). The actual return on investment of the latter activity is however controversial. Unrealistic expectations have been generated by the spectacular successes of a relatively few institutions and it is not always realised that the success from commercialisation is proportional to the magnitude of the investment in research, as a large portfolio of patents and licences is required to give a reasonable probability of positive returns. What may be possible at a national level is more problematic at institutional level (Heher, 2006; Valdivia, 2013).

Policies play a role in channelling and leveraging private sources of funding for public research. Some policy instruments encourage industry investments in public research while others target wealthy individuals or private non-profit organisations (foundations, charities) to boost patronage of science. A variety of government schemes support collaborative R&D, industrial research contracts and industry-science linkages that indirectly fund public R&D activities. Examples include grants or subsidised loans that require performing R&D projects in co-operation with at least one university or PRI, innovation vouchers, or tax incentives on corporate income tax for expenditures incurred on R&D subcontracted to universities or PRIs.

Private philanthropists can secure additional funding for universities and may exert a strong influence on the orientation and outcomes of public research in specific domains. Many private funds are actually channelled through foundations and associations which play a critical role in supporting innovative research. Although private donations account for a minor share of public research funding as a whole, evidence shows that science philanthropy is concentrated in specific fundamental and translational research areas, as well as in leading institutions at the scientific frontier. Indeed, science patronage is estimated to provide almost 30% of annual research funds to leading US universities (Murray, 2012). A number of governments offer tax-based incentives to encourage private sponsorship. But this can raises questions about the future of research for the public good. Private donations can be oriented by personal interests and may be dissociated from market forces or public goals, thus diverting research towards peripheral fields. This may have a positive impact on elite universities but have little value for the wider scientific community (Broad, 2014).

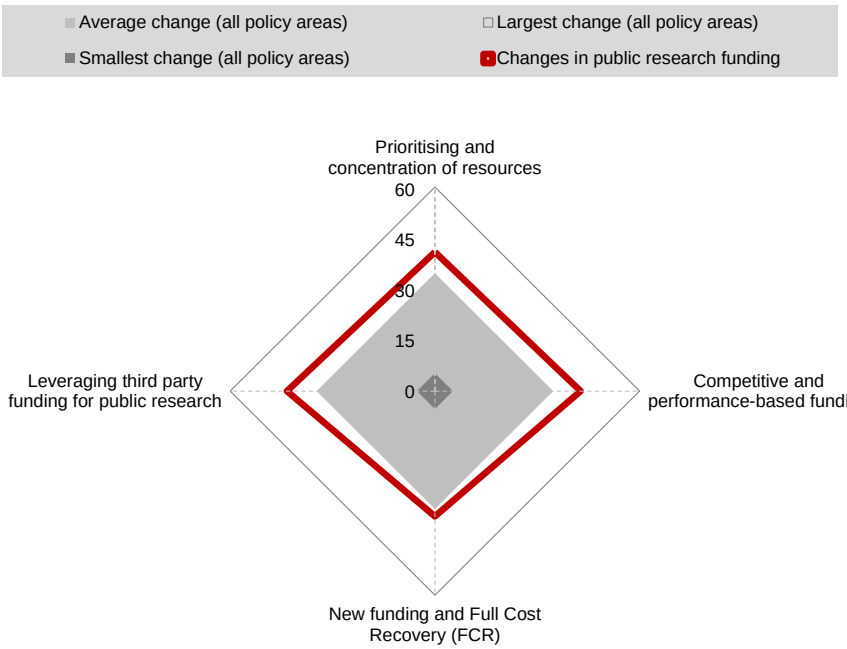
Recent policy trends

An increasing share of public research funding is devoted to “societal grand challenges”. This is exemplified by the EU Horizon 2020 funding structure, and many European countries have mirrored this structural change, which can also be found outside Europe (in Japan for instance, the fifth Science and Technology Basic Plan comprise an important chapter on addressing important social and economic issues). Some countries (Denmark, Ireland…) have also seen a shift of focus towards research areas which are perceived as providing better opportunities for economic return.

In parallel and in synergy with the evolution of strategic research for major challenges, the global trend towards more competitive funding has pursued in most countries with the introduction of performance-based elements in core institutional funding and a move towards more contractual arrangements (Figure 1). However, the issue of finding the right balance between funding instruments remains acute and some countries are reviewing their overall research policy with a view of improving public funding efficiency but following diversified approaches.

Figure 1. Public research funding among other areas of STI policy change, 2014-16

Percentage of policy initiatives that have been newly introduced, revised or repealed over the period



Note: The EC/OECD STI Policy survey 2016 aims to review on a biennial basis major changes in national policy portfolio and governance arrangements for STI. The survey builds on the conceptual work carried on under the aegis of the OECD Committee for Scientific and Technological Policy (CSTP) for mapping the policy mix for innovation and therefore covers a broad range of policy areas (Kergroach et al., forthcoming-a). 54 economies participated in 2016, including OECD countries, key emerging economies (e.g. Argentina, Brazil, the People's Republic of China, Colombia, Costa Rica, Egypt, India, Indonesia, Malaysia, Peru, the Russian Federation, South Africa and Thailand), non-OECD EU Member States, and the European Commission. Taken together, countries covered in the STIP survey 2016 account for an estimated 98% of global R&D. Responses are provided by CSTP Delegates and European Research and Innovation Committee (ERAC) Delegates for EU non-OECD countries.

This is an experimental indicator inspired from analytical work done on firm demography (e.g. churning rate). It accounts for the number of major policy initiatives that have been implemented, repealed or substantially revised over 2014-16, as a share of total policy initiatives that were active at the beginning of the period (Kergroach et al., forthcoming-b). Although simple counts do not account for the magnitude and impact of policy changes, the churning rate in STI policy reflects STI policy focus and activity in specific policy areas and over specific periods of time. The chart above shows the intensity of changes in the policy area(s) under review as compared to the whole mapping. Changes in the whole mapping are represented by the smallest, the largest and the average change policy area that changed the less, the policy area that change the most.

Source: Based on EC/OECD (2016) and Kergroach, S. et al. (forthcoming-b).

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In 2013, Austria replaced the formula-based block funding of public universities in their 2013-15 performance contracts with the Higher Education Area Structural Fund of USD 543 million PPP (EUR 450 million), which combines indicator-based performance and co-operative project-based competitive grants. Canada launched in 2015 a new "First Research Excellence Fund" aimed at Canadian postsecondary institutions, which annual allocated fund should gradually reach CAD 200 M, and will support research on a competitive basis. A 2012 European Research Area communication encourages more competitive allocation of institutional funding to PRIs and supports wider uptake of peer reviews for project-based funding. Such policy has been developed in many countries from Central and Eastern Europe. In Poland the increased importance of competitive funding resulted from an overhaul of the R&D system in 2010-2011. In 2014, 65% of the government R&D budget were distributed through competitive calls for proposals, and 29% - allocated

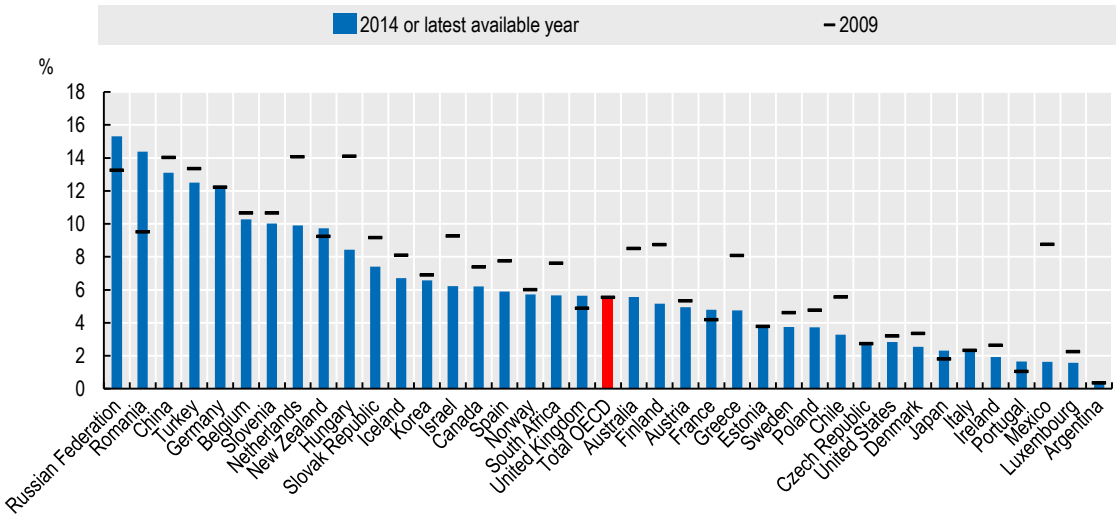
based on the outcomes of institutional assessments. According to the planned budget for 2015, 60% corresponds to project funding and 32% to institutional funding. In Estonia, nearly all research funding is currently distributed through competitive funding mechanisms, although this is now being reassessed as such funding policy may have a negative impact on long-term/innovative research. Indeed, in a small number of countries (such as in Northern Europe), a reversal towards increased block funding appears now to take place.

Ireland has introduced a performance-funding framework whereby up to 10% of an institution's core funding is be allocated on the basis of institutional performance criteria. Institutional performance is assessed through self-assessment and peer reviews in accordance with mutually agreed mission-based contracts. Italy is currently allocating about 13% of the university budget to performance–based indicators. Of the USD 1 060 million PPP (EUR 800 million) for 2013, two-thirds reflect research performance. New Zealand appropriated an additional USD 69 million PPP (NZD 100 million) in Budget 2012 to increase the volume of performance-based research funding to USD 200 million PPP (NZD 300 million) a year. The Polish law on higher education was amended in 2012 to foster performance-based financing and to introduce a new management model in university departments and research centres that have been granted the leading national research centre (KNOW) status. Additional funding is provided for employees' remuneration, scholarships and infrastructure upgrade. In 2012 Turkey adopted a performance-based system to fund research centres and is implementing institutional performance evaluations in universities. A new Entrepreneurial and Innovative University Index was developed to encourage entrepreneurship and innovation in universities; the first ranking was published in 2013.

The sources of public research funding have also changed as a result of greater industry involvement (OECD, 2011). However, firms' investment in R&D, including in public research, suffered as a result of the global financial crisis. The share of higher education and government R&D expenditure funded by industry dropped significantly over the crisis years and has since exceeded pre-crisis levels in only a few countries (Figure 2).

Figure 2. Public research funded by industry, 2009 and 2014

As a percentage of total higher education and government R&D expenditure



Source: OECD, Research and Developments Statistics (RDS) Database, March 2016, www.oecd.org/sti/rds; Eurostat STI Databases (http://epp.eurostat.ec.europa.eu/portal/page/portal/science_technology_innovation/data/database); Data retrieved from IPP.Stat on 9 September 2016 <http://dotstat.oecd.org//Index.aspx?QueryId= >.

StatLink http://dx.doi.org/10.1787/888933445159

Note: Data for Argentina, Austria, Belgium, France, Germany, Iceland, Israel, Italy, New Zealand, Norway, Poland, Portugal, Sweden and the United States refer to 2013 instead of 2014. Data for Australia and South Africa refer to 2012 instead of 2014. Data for Mexico refer to 2011 instead of 2014. Data for 2009 refer to 2006 for Australia and 2011 for Greece.

Incentives for industry to invest in public research have been reinforced in several countries and at the EU level. Tax incentives for R&D are increasingly used to leverage private funding for public research (see the *Policy Profile on Tax incentives for R&D and innovation*). In Italy, the Destinazione Italia plan includes several tax credit measures for enterprises investing in research. The tax credit fund guaranteed about USD 800 million PPP (EUR 600 million) for 2014-16. Germany's Academic Freedom Act 2012 allows non-university academic institutions to make greater use of third-party private funds. Likewise, Luxembourg revised the performance agreements of public research organisations for 2011-13 to bring third-party funding up to 30% of institutions' budgets.

Sweden has been encouraging strategic public-private partnerships since 2013 by providing USD 35 million PPP (SEK 300 million) to support two large national initiatives to address societal challenges and increase international competitiveness through systems innovation, strategic innovation areas and challenge-driven innovation. It aims to leverage USD 25 million PPP (SEK 220 million) of private funding and further USD 80 million PPP (SEK 700 million) in 2016 for a public engagement of USD 80 million PPP. Since 2012, the UK Research Partnership Investment Fund has provided USD 725 million (GBP 500 million) research capital to support R&D partnerships between universities, business and charities. These partnerships can raise over the double of funding (USD 1.5 billion – GBP 1 billion) from private sources. At EU level, the Joint Technology Initiatives (JTIs) are new long-term public-private partnerships that support large-scale multinational research with a view to accelerating the development of solutions to social and environmental challenges and to reversing the declining role of industry in Europe. The JTIs will receive about USD 12 billion PPP (EUR 10 billion) from the private sector over the next seven years. Priority areas include aeronautics, medicines, electronic components and systems, transport and bio-based industries.

The impact of science philanthropy is expected to increase as central government budgets remain under severe fiscal pressure. In 2014 Norway reintroduced a scheme for private donations to research that was first implemented in 2006 and repealed in 2012. The donation reinforcement scheme gives a top-off of 25% to private donations above USD 340 000 PPP (NOK 3 million) to long-term basic research. However, Finland repealed tax exemptions on private donations to higher education institutions at the end of 2012. Private foundations play an increasing role in complementing public funding in selected research areas, particularly in the health sector. In France, research on rare diseases is largely supported by the AFM (Association Française contre la Myopathie), while at more global level, the Gates foundation now provides a very large share of research funding related to tropical diseases.

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