OECD Science, Technology and Innovation Outlook 2016 **Policy Profile**

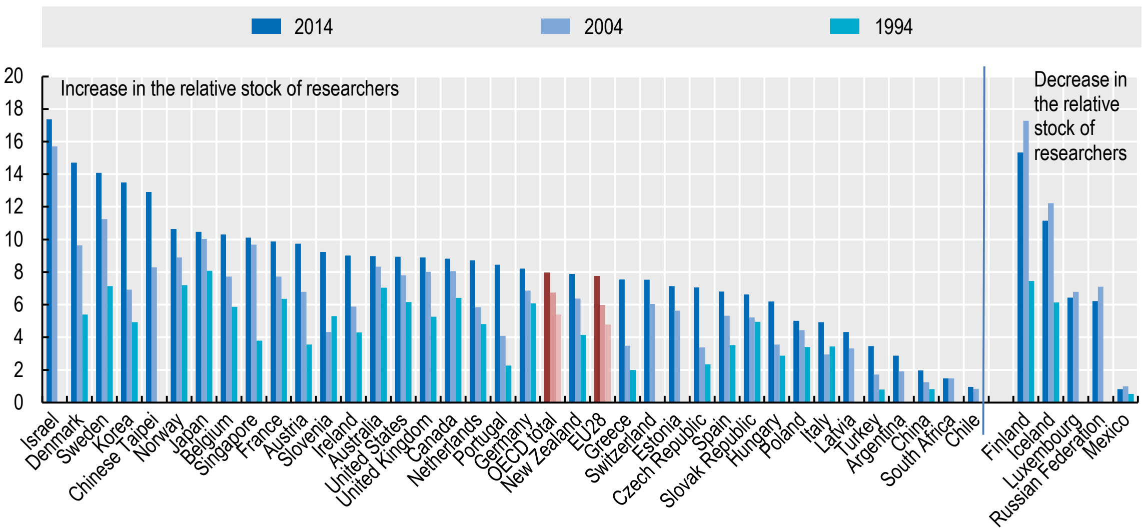
Research careers

Rationale and objectives

Research activities are dependent not only on funding and a prior accumulation of tangible and intangible assets (i.e. technology, software, patented knowledge etc.) but also on the pool of researchers and other highly skilled professionals available. Researchers are "professionals engaged in the conception and creation of new knowledge. They conduct research and improve or develop concepts, theories, models, techniques, instrumentation, software or operational methods" (OECD, 2015a).

Figure 1. The global population of researchers has increased constantly over the past two decades

Researchers per thousand employment, 1994, 2004 and 2014



Notes: 1994 values correspond to 1993 figures for Austria, Denmark, New Zealand, Norway and Sweden and to 1995 figures for the Czech Republic, Germany, Korea, Slovenia and the EU28, 2004 values correspond to 2003 figures for Iceland and New Zealand. 2014 values correspond to 2013 figures for Canada, Iceland, New Zealand, the United States and the OECD total; to 2012 figures for Israel; to 2011 figures for Mexico and to 2010 figures for Australia.

Source: Based on OECD (2016), *OECD Main Science and Technology Indicators (MSTI) Database*, June, www.oecd.org/sti/msti, Eurostat R&D Indicators and UNESCO Institute for Statistics, S&T Indicators, June 2016. Data extracted from IPP.Stat on 30 August 2016, https://www.innovationpolicyplatform.org/content/statistics-ipp.

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As countries placed greater emphasis on STI to increase their productivity and address societal needs, global R&D expenditure has increased together with the global demand for researchers (Figure 1). National education systems have responded to new demand by increasing their training capacity, thus helping increase the stock of researchers. The number of researchers (in full-time equivalent) has doubled in Korea,

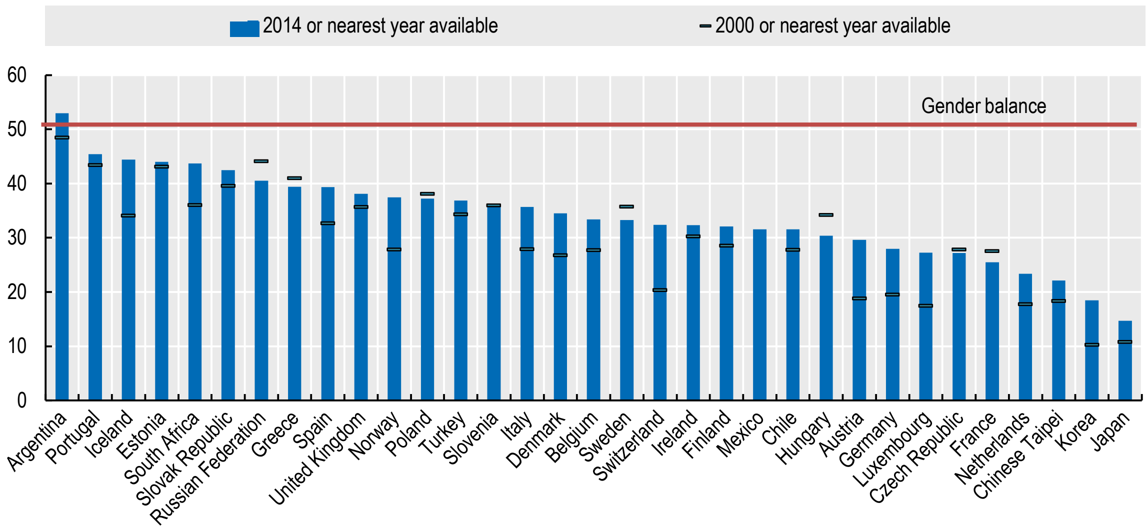
a leading R&D spender country as well as in the Czech Republic, Portugal, Slovenia and Turkey (OECD, 2016). In addition non-OECD countries have increased their supply of researchers. China, for example, now counts more than one and half million researchers in full time equivalent (FTE) in (2014) and has become the world's largest source researchers in 2010, ahead of the United States. The Russian Federation has also 445 million researchers and Chinese Taipei counts 143 million.

Governments together with universities, firms and public research organisations and the social partners have a role to play in ensuring an optimal supply of research skills and the well-functioning of an open and attractive labour market for researchers. Research careers refer to the development paths or trajectories of those individuals, who work in research activities in academia, the business sector or the government and non-profit sectors. Not all researchers possess doctorates (especially in the business sectors) and not all PhD holders work in research. International survey data show that between 10% and 40% of OECD doctorate holders do not work in research and many are employed in jobs unrelated to their doctoral degree (Auriol et al., 2013). Yet, such evidence does not necessarily indicate a loss to STI; indeed, there may be advantages to the deployment of S&T skills across a broad range of sectors in an economy.

Improving the functioning of the academic labour market for researchers however has been the focus of policy reforms in recent years (OECD, 2015b).Many countries have increased wages and improved conditions for early stage research to make careers more attractive and to mitigate against the dual labour market characteristics of academia (i.e. entry level researchers receive low starting pay, temporary contracts and limited tenure track while others enjoy tenured and career track positions) (Kergroach and Cervantes, 2006; Deloitte, 2014). There have also been efforts to reduce or remove regulatory and institutional barriers to the mobility of researchers, across sectors and internationally.

Figure 2. The gender gap in research careers remains noticeable, despite some gradual improvement

Share of women researchers, headcount, 2000 and 2014 or nearest year available



Source: OECD (2016), *Main Science, Technology Indicators (MSTI) Database*, June.

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Similarly policies have attempted to reduce the gender gap in research positions, but it remains a key feature of the research labour market inside and outside academy, even if there are differences by field (Figure 3). Although the share of women engaged in research activities has increased over the past decade in almost all countries for which data are available, research remains predominantly a male activity. The gender imbalance is particularly striking in Japan, Korea and the Chinese Taipei where women account for less than 20% of researcher population (2014).

There are also major external challenges that are likely to affect the long-term capacity of governments and public research institutions to strengthen the attractiveness of research careers.

- **Globalisation** of R&D and growing international co-operation offer opportunities for accessing and attracting foreign pools of skills and talents but it also increases the risk of brain drain for sending countries, notably developing economies (see the *policy profile International mobility of the highly-skilled*).

- **Population ageing**, especially in OECD countries raises the issue of the renewal of research populations, especially at a time when there are signs of a declining interest in science and scientific careers among youth.

- **Digitalisation** and digital technologies are impacting research in a number of ways: digital tools such as big data analytics are opening new research areas allowing participation of citizen in the steering of science but also its performance (i.e. citizen science) and in fostering open science. Digitalisation and technologies such as artificial intelligence will also bring new skills requirements, including in research labs (see also the chapter on "*the Future of Science Systems*" and the policy profile *Open science*) while making some research tasks redundant or easily automated.

- **Tight fiscal budgetary conditions** could weigh on the capacity of the public research sector to maintain research staff in employment and recruit new researchers. The risk is substantial since the public sector remains the main sector of employment of researchers, especially women, in many countries and accounts for a disproportionate share of employed researchers, even in countries where most R&D is performed by the business sector (see chapter 3 on *The Future of science systems*).

Major aspects and instruments

Few countries have dedicated strategies for improving the attractiveness of research careers; instead most countries support research careers through their national STI or research strategy. Policy in support of research careers seeks to address challenges on both the supply- and demand-sides with a view to ensuring the employability of researchers and improving their lifelong learning capacity. As part of this broader framework, a frequent strategic objective is to increase the supply of researchers as to meet national R&D spending targets (see policy profile *National strategies for STI*). This is the case of China whose 12th Five-Year Plan for S&T Development (2011-15) aims to raise the number of researchers to 43 per 10 000 employees. Turkey's National Innovation Strategy has set the number of full-time equivalent (FTE) researcher to 300 000, of which 180 000 in the private sector by 2023. The European Commission's European Charter for Researchers and the Code of Conduct for the Recruitment of Researchers are key components of the European Strategy to make research careers more attractive.

On the supply-side, several countries have created new PhD programmes and introduced improvements to the quality and relevance of doctoral training, for instance by revising curricula and extending the scope of research training to entrepreneurship and transferable skills, or by raising awareness on intellectual property issues and the societal and ethical dimension of public research activities. Higher education policies also encourage the participation of young people in doctoral programmes, including women and minorities (see the policy profile *Strengthening education and skills for innovation*) through tuition-free fellowships and scholarships are targeted to women, minorities and under-represented students.

On the demand-side, STI policies provide incentives to public research organisations, on the one hand, and firms, on the other hand, to employ researchers. Policy action is typically channelled through public research funding mechanisms (e.g. research excellence initiatives), university performance agreements or public support to business R&D (see also the policy profiles *Strengthening education and skills for innovation, Financing public research and Government financing of business R&D and innovation*).

- For example, Austria's National Development Plan for Universities (2016-21) envisages that the two next performance contracts will focus on creating attractive career paths for young academics.

- Belgium seeks to reduce the costs of researcher employment through tax allowances on R&D wages.

- The French Tax Credit for R&D (CIR) offsets some of the costs of employing doctorate holders against the corporate tax base during the first two years. In 2015, Turkey implemented a financial assistance scheme to support firms located in technology development zones and employing doctorate holders.

- Through its *Distinguished Researchers Programme*, launched in 2016, Japan selects outstanding young researchers and provides financial support to institutes that employ them, including those in the industrial sector.

Research funding policies in many countries also aim to improve the remuneration and working conditions of researchers, especially younger researchers. In addition to 'soft' non-financial support, such as awareness-raising programmes about research careers, young researchers receive financial support in the form of fellowships, research funding and new job opportunities. In 2016 Japan initiated a new programme to offer financial support (up to a maximum of JPY 6 million per person) to institutes employing distinguished young researchers. Junior Grants in the Czech Republic support excellent junior scientists by helping them to establish their own research groups. Turkey's Career Development Program offers financial support for the R&D projects of medical researchers who are starting their careers.

Labour market policies can encourage greater mobility across sectors and improving the match between skills supply and demand through national skills frameworks and information systems (e.g. platforms for job or research funding opportunities).

International mobility of researchers is key focus area. Many governments inside and outside the OECD seek to attract and retain foreign talent through changes in immigration laws, access to civil servant employment and pension systems, or networking and relocation assistance. There are also a large range of subsidies that target researcher mobility at different stages of their career. Finally financial support for mobility is often available through international joint research projects (see the policy profile *International Mobility of the Highly Skilled*).

Gender balance in science and research careers is a long-standing policy issue. Several countries have adopted quotas for research positions, including for senior positions, or representation on university boards and research panels. New rules and funding arrangements have also been made to monitor progress on gender mainstreaming including improving the balance between work and family. For instance:

- The Swedish Research Council grants funding to men and women on an equal basis according to the gender ratio of funding applicants. The Czech Science Foundation gives preferential treatment to women scientists by subtracting maternity leave from the experience required to get research grants. Since 2013, Austria's w_fFORTE Programme funds applied research projects led by women.

- Korea's Third Women S&E Promotion Basic Plan (2014-18) aim to raise the share of female scientists and engineers in new recruitments to 30% by 2018, and to increase the share of women serving on the S&T related government committees to 40%. The Aspasia programme in the Netherlands aims to help women attain senior lecturer positions. The 2013 French Law on Higher Education and Research ensures gender parity at Universities' Strategic Advisory Boards, the Higher Education and Research Assessment Board and the Research Council.

- Norway's Ministry of Education and Research appointed in 2016 a Committee for Gender Balance and Diversity in Research on a 4-year term with a USD million (NOK 5 million) budget. Ireland launched the HEA Review of Gender Equality in Higher Education in 2015. The UK STEM Diversity Programme aims to better understand underrepresented groups in science.

- Japan's Initiative for Realising Diversity in the Research Environment, launched in 2015, seeks to promote favourable conditions in work environments for childbirth, childrearing and nursing.

- Other policy initiatives include wider government plans, e.g. Finland's 2016 Government Action Plan for Gender Equality and Spain's Action Plan for Equal Opportunities in the Information Society (2014-2017).

Recent policy trends

Most of recent STI policy action in support of research careers has been put on restructuring career paths, while initiatives to strengthen the supply of research skills have been less frequent (Figure 3). Overall, countries reviewed in the EC/OECD STI Policies Survey 2016 have been less active in the area of gender mainstreaming than in others (e.g. on issues related to international mobility, see the related policy profile).

A number of OECD countries and major non-OECD economies have taken measures to improve researchers' career prospects by consolidating tenure tracks, diversifying career paths and increasing flexibility in trajectories, including through greater cross-sectoral mobility.

- A revision of the University Act (2015) in Austria enables universities to offer full professorships via a shorter appointment procedure than previously. In 2015 Norway implemented a trial of a 300 tenure track positions where candidates are offered tenure positions (as associate professor or professor) after 6-7 years if they fulfil certain formal conditions. Sweden is creating the position of assistant lecturer as part of a longer term strategy to introduce a system of tenure-track at all universities and colleges.

- Ireland's "Innovation 2020" Strategy develops a coherent policy for a more structured progression in the public sector and provides career support for PhDs and post-doctorates, e.g. advice, mentoring and placement with a wide range of career possibilities in industry, academia and public service.

- Peru has proposed the creation of a special category of researchers – the National Body of Researchers – who may be seconded to universities, research centres and businesses to promote certain research projects.

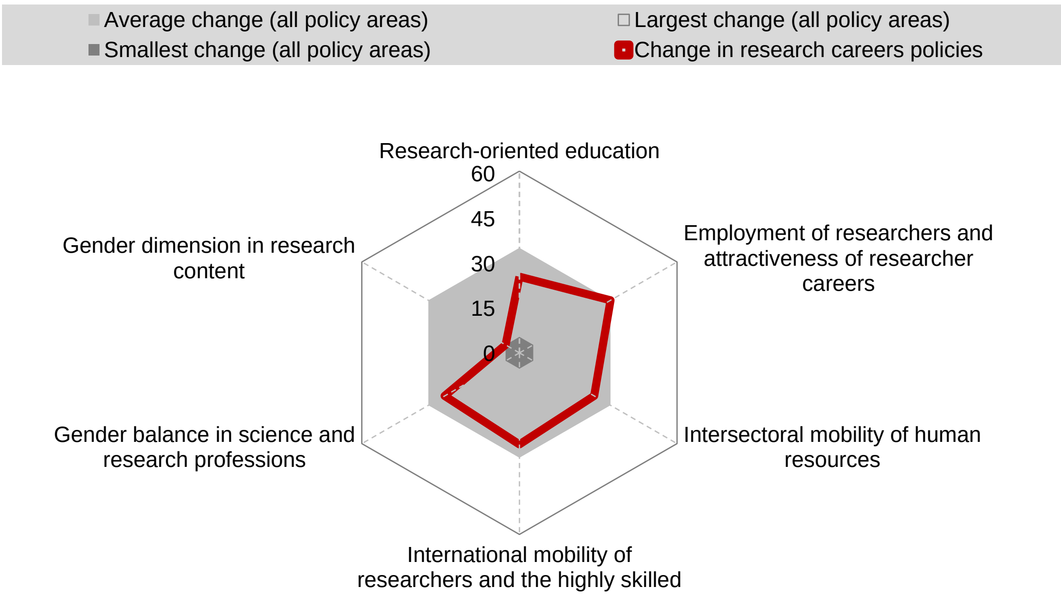
- Germany's *Graduate Schools Scholarship Programme* funds PhDs with a study plan structured for a career in research or industry. Belgium (Flanders) has implemented piloted traineeships, "Innovatiestages", in co-operation with universities in order to increase the mobility between universities and companies. France has strengthened the recognition of doctorate qualifications in all sectors beyond higher education and public research. Ireland's National Framework for Doctoral Education encourages the employability of doctoral graduates across a broad range of economic sectors by mandating greater focus on ensuring non-field-specific transferable skills. The new Croatian Qualifications Framework (MODOC) aims to modernise doctoral education and better prepare doctorate holders for a wide range of careers.

- The deployment of industrial PhD schemes continues to be common policy feature for many countries. Norway's *Industrial PhD Scheme* supports individuals employed by the private sector to pursue a doctoral degree relevant to the firm. It provides an annual grant to cover salary and other expenses for the company's employee. This grant is available for projects in all branches of industry and is not limited to specific fields.

Fumasoli and Goastellec (2015) have pointed out that recruitment patterns and career progress in academic markets have been gradually standardised and formalised across Europe. And the spread of tenure track models and state regulations on career progress have favoured the emergence of internal academic labour markets in countries that traditionally relied more on external labour markets (Musselin, 2010). Several countries have implemented platforms and infrastructures to enhance the visibility on the domestic and international research labour market. The EURAXESS Researchers in Motion is a unique pan-European initiative providing access to a complete range of information and networking support services to researchers wishing to pursue their research careers in Europe. Spain has created an Employability and Employment of Spanish Graduates Map. The Italian Financial Law 2010 has been amended in 2014 in order to increase inter-university mobility.

Figure 3. Policies in support of research careers 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 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 that accounts for the number of major policy initiatives implemented, repealed or substantially revised during 2014-16 as a share of total policy initiatives active at the beginning of the period. Although simple counts do not account for the magnitude and impact of policy changes, this ratio 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 (forthcoming), *International Database on STI Policies (STIP);* and Kergroach *et al.* (forthcoming-b).

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