DG Research and Innovation

Researchers' Report 2014

Final Report

The report and its annexes are available at:
http://ec.europa.eu/euraxess/index.cfm/general/researchPolicies

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Executive summary

An open and attractive labour market for researchers is a key priority of the European Research Area (ERA) where researchers and knowledge can move freely from one country to another. Significant progress has been made at both European and national level in removing or alleviating some of the obstacles to mobility, improving doctoral training and making research careers more attractive.

Across the EU, Member States and/or institutions have introduced a range of measures, programmes, strategies and legislative acts to address the barriers and train researchers to meet their national R&D targets.

A series of EU policy initiatives such as the development of the EURAXESS network, the 'Scientific Visa Directive', a Human Resources Strategy for Researchers based on the Charter and Code, the Principles of Innovative Doctoral Training and support for a new pan-European supplementary pension fund for researchers have also contributed to this progress. Marie Skłodowska-Curie actions (MSCA) have also set standards for research training, attractive employment conditions and open recruitment for all EU-researchers

Progress has nevertheless been uneven and there remain substantial differences between the Member States. A number of challenges remain in particular in a number of Member States where there is a lack of open, transparent and merit-based recruitment, where some early-stage researchers are ill-equipped for the labour market or where working conditions are relatively poor or where career opportunities are rather limited.

Further efforts are needed by Member States and institutions, with the support of the Commission, to remove the remaining obstacles to researcher mobility, training and attractive careers.

This third annual report monitors what Member States and Associated Countries are doing to remove those obstacles, relating this to compliance with the Innovation Union commitments affecting researchers and actions related to an open labour market for researchers in the 2012 ERA Communication on a Reinforced European Research Area Partnership for Excellence and Growth.[1]

The issues and findings

In brief, the issues identified based on the key findings are:

Stock of researchers: Well-trained, creative and dynamic researchers are indispensable for building and sustaining a competitive knowledge-based economy. However, while Europe has many talented and skilled researchers, and the total head count exceeds that of the US, Japan and China, they account for a significantly lower share of the labour force than is the case in the US and Japan – even if there are indications that the gap is closing. Moreover, Europe still has a long way to go before it matches the US, Japan and China in the ratio of business-to-public sector researchers.

[1] Available at: http://ec.europa.eu/research/era/pdf/era-communication/era-communication_en.pdf

Member States and Associated Countries[2] have reported a range of measures aimed at ensuring they train enough researchers to meet their national R&D targets in their respective countries. These include both regulatory and quasi-regulatory measures, such as national action plans and programmes, and new or updated legislation. They also include 'soft' measures, such as awareness-raising schemes about research careers, and improvements to the quality and relevance of doctoral training or incentives in the form of special awards.

Women in the research profession: Europe is far from having achieved gender equality in research and therefore from optimising its talent pool. Women still face a glass ceiling. They outnumber men at the first two levels of tertiary education, but are considerably less likely to occupy a senior academic position, or to sit on decision-making bodies – they are even less likely to head a higher education institution or university: women accounted for only 16% of heads of these organisations in 2010, the most recent year for which data is available. There is some improvement, based in some cases on specific policies, measures and targets to improve the representation of women, but the rate of progress is highly relative given the gap that needs to be closed in most countries. 'Soft' measures include coaching and mentoring programmes, and awards for women for excellence in research, e.g. in Austria and Switzerland.

Open, transparent and merit-based recruitment procedures: Openness and innovation go hand in hand, i.e. countries with open and attractive research systems are strong performers in terms of innovation. Recruitment based on merit and academic excellence from the very earliest stages and throughout a research career are a prerequisite for research excellence and optimising research talent, and thus for realising ERA. In a number of countries, national authorities and/or research institutions report having taken steps to make the process more transparent. Publishing jobs on portals such as EURAXESS Jobs and meeting the conditions for obtaining the 'HR Excellence in Research' logo contribute to this, and there has been a clear increase in the importance attached to both.

Nevertheless, many researchers' perception is that there is still a long way to go. They believe that protectionism and nepotism are still widespread in a number of countries, and that institutions do not have sufficiently open and transparent recruitment practices. The problem appears to be particularly acute in some Mediterranean countries.

There is more progress to be made in advertising positions more widely and in advertising them in English, e.g. through EURAXESS Jobs, but there have already been major advances. The number of jobs advertised on EURAXESS increased more than five-fold between 2010 and 2013 (to more than 40 000 vacancies in 2013), while several countries have made it compulsory to publish research job vacancies beyond national boundaries (e.g. Austria), or on EURAXESS (e.g. Croatia, Italy and Poland). Countries making high use of EURAXESS include not only the above countries, but also Ireland, Luxembourg, the Netherlands and Sweden. A number of countries have their own national online systems for advertising research positions, so that the EURAXESS data does not give the full picture on transparency.

[2] Countries associated to the Seventh Framework Programme for research and technological development: Norway, Iceland, Liechtenstein, Switzerland, Israel, Turkey, the Former Yugoslav Republic of Macedonia, Serbia, Montenegro and Bosnia & Herzegovina whereas Croatia became a member of the European Union in July 2013.

In line with a recommendation by an European Research Area and Innovation Committee (ERAC) mutual learning workshop held in March 2014, the Commission is setting up a Working Group with Member States and stakeholders to produce an OTM[3] recruitment toolkit/practitioner's guide during 2015, including good-practice examples, templates, and other material useful for HR practitioners/employers of researchers.

Education and training: The first step in increasing the stock of researchers is to ensure that enough young people enter into tertiary education and that enough of these study science, technology, engineering and mathematics (STEM), and that a significant number then embark on a research career by undertaking a doctorate. Moreover, doctoral candidates should receive quality training in line with the Principles for Innovative Doctoral Training (IDTP), endorsed by the Council of Ministers, aimed at fostering excellence and a critical mindset and providing young researchers with transferable skills and exposure to industry and other employment sectors. There has been significant take-up[4] of the IDTP in several Member States while a Working Group of the ERA Steering Group Human Resources and Mobility (ERA SGHRM) has reviewed progress and put forward a roadmap for further action.[5]

There has been a more than 60% increase between 2000 and 2013 in the share of the 30-34 age group who have completed tertiary education (36.8%) and the EU-28 is well on its way to meeting its 2020 target of 40%.

The number of graduates in STEM per thousand population (in the 20-29 age group) increased by more than 60% between 2000 and 2011 (and by more than three quarters in the case of women). The increases were more rapid than in the US and Japan.

There was an increase of more than 60% in the number of new doctoral graduates in the EU over the period 2000 to 2011, slightly more than in the US but significantly more than the one third increase in Japan. The number per thousand is slightly lower than in the US but higher than in Japan.

A wide range of measures have been put in order to attract people to science and provide quality training and opportunities, both during and after doctoral research. They include regulatory and policy measures, communication action plans, tax and financial incentives, mentoring and professional development programmes, improved structuring of doctoral programmes, and partnerships with and placements in the private sector.

Working conditions: Attractive working conditions and career prospects are a key driver for attracting young people into a researcher career and ensuring top-quality research results in public research institutions. However, research careers present a particular challenge during doctoral training and in the early career stages when many researchers are on short, fixed-term contracts or indeed have no contract at all. In such cases, they are often not covered by social security provisions or the provisions are not on a par in terms of health, and in particular parental, unemployment and old-age benefits, with what is available to those on permanent contracts. Thus career paths appear uncertain and years

[3] Open, transparent and merit-based recruitment

[4] Available at: http://ec.europa.eu/euraxess/pdf/research_policies/IDT%20Final%20Report%20FINAL.pdf

[5] Available at: http://ec.europa.eu/euraxess/pdf/research_policies/SGHRM_IDTP_Report_Final.pdf

of pension contributions may be lost. The country profiles report inter alia on a range of actions to improve the status of researchers in the early stages of their careers, both men and women – with more attention paid than in the past to the rights of young fathers, i.e. to parental rather than just maternity leave.

The problems can be compounded by poor remuneration, although there are wide differences across the ERA[6]. On average, as a percentage of the purchasing power adjusted salary of the best paying countries, non-European countries pay better than the EU Member States in all career stages (R1-R4) based on the European Framework for Research Careers (2011)[7]. The gap is 5 to 10 percentage points in R2, R3 and R4 and about 25 percentage points in R1. Amongst the best paying countries are the US (R2-R4), Brazil (R1-R4), Switzerland (R2-R4), Cyprus (R2-R4), Netherlands (R3, R4), Ireland (R4) and Belgium (R1). The higher the career level, the higher the PPP converted salaries are in the US in comparison to all other countries.

EU Member States and Associated Countries continue to support the implementation of the Charter & Code (C&C) which aim to improve researchers' working conditions. More than 480 organisations from 35 countries in Europe and beyond have explicitly endorsed the principles underlying the C&C, many of them membership or umbrella organisations. The Commission's Human Resources Strategy for Researchers (HRS4R) focuses on the practical implementation of the C&C principles. Award of the "HR Excellence in Research" logo[8] recognises institutional progress in implementing C&C principles. Currently, more than 240 organisations are members of the Strategy Group. As of May 2014, more than 180 organisations had received the logo. A significant minority of the logos awarded are within one country (UK), which reflects the strong enabling framework provided by VITAE[9]. In contrast, a number of other Member States[10] are underrepresented from the HRS4R.

Collaboration between academia and industry: Research results have limited value if they are not (fully) exploited. Interaction with the private sector is therefore critical. However, moving out of public sector research into the private sector for a short period during doctoral studies or thereafter is still very much the exception, even though it is perceived as potentially beneficial for a researcher's career, access to funding and the exploitation of research results. Researchers appear to be held back by lack of preparation in areas such as intellectual property and knowledge transfer. As a result, levels of co-publication between the public and private sector are much lower than in the US or Japan.

Many countries acknowledge the problem and are promoting partnerships between universities, research institutions and private companies, and measures to improve the skills of doctoral researchers in areas such as technology transfer and intellectual property. Other measures include the implementation of joint projects, exploitation programmes, research traineeships in companies, inter-sectoral mobility programmes, industrial PhD programmes, and the possibility to combine teaching and private sector research.

[6] See MORE2 study which included a special focus on researcher remuneration.
[7] Available at: http://ec.europa.eu/euraxess/pdf/research_policies/Towards_a_European_Framework_for_Research_Careers_final.pdf
[8] Available at: http://ec.europa.eu/euraxess/index.cfm/rights/strategy4Researcher
[9] Available at: https://www.vitae.ac.uk/
[10] Available at: http://ec.europa.eu/euraxess/index.cfm/rights/strategy4ResearcherOrgs

Belgium, Croatia, Denmark, France, Greece and Norway have all taken steps in the last couple of years to create two-way flows between industry and academia, generally with the aim of bridging the gap between research and market applications.

Mobility and international attractiveness: Mobility is a core concept of the ERA. It is often associated with excellence, the creation of dynamic networks, improved scientific performance, improved knowledge and technology transfer, improved productivity, and ultimately enhanced economic and social welfare.

Evidence shows that the researcher population is highly mobile internationally. Around 31% of EU researchers in the post-PhD phase have worked abroad (EU or worldwide) as researchers for more than three months at least once during the last ten years[11].

In terms of impact, the perception among the majority of researchers is that the mobility experience is largely positive. For example, 80% of internationally mobile researchers felt that the mobility had a positive impact on developing their research skills. More than 60% believed that mobility had (strongly) increased their 'research output' (quality of output, citation impact, patents, number of co-authored publications, etc.) And 55% of researchers thought that career progression had increased as a result of their mobility. It is important to note, however, that a significant proportion (40%) of mobile researchers perceived their mobility experience as having had a negative effect on two particular aspects, namely their "job options" and "progression in their remuneration". The reasons behind this are as yet unclear but include issues such as a lack of recognition of mobility and 'forced' mobility.

EURAXESS is a key tool in supporting mobility, providing researchers with information about the opportunities in Europe and also practical help. EURAXESS, with more than 200 service centres in 40 European countries, assists researchers and their families on issues such as visas, social security rights, housing and child care. These are factors that can make or break a researcher's decision to move across borders. And the demand for information and assistance is certainly there and is growing rapidly: the service centres have received more than 900 000 queries in the last six years.

The share of non-EU doctoral candidates[12] as a percentage of all doctoral candidates serves as a useful indicator of the openness and attractiveness of a research system. The average share for the EU is 24.2%.

Barriers to mobility remain but efforts are being taken to remove or reduce them. For example, to overcome problems that remain with the implementation of the Scientific Visa Directive and which therefore constitute a barrier to non-EU researchers, the European Commission has proposed a recast that will set clearer time limits for national authorities to decide on applications, provide researchers with greater opportunities to access the labour market during their stay, and facilitate mobility within the EU. The proposed Directive is under negotiation by the European Parliament and Council.

[11] MORE2 study

[12] "Non-EU doctoral candidates" refers to foreign doctoral candidates in the case of non-EU countries.

Another important obstacle to mobility relates to social security issues, in particular pension rights. To respond to this need, the Commission is committed to supporting stakeholders in setting up pan-European supplementary pension fund(s) for researchers. A Task Force was created in 2013 to prepare a proposal on the establishment of a pan-European Retirement Savings Vehicle (RESAVER) for professionals employed by research organisations. The Commission has foreseen funding under Horizon 2020 to sponsor the set-up of notably the Institutions for Occupational Retirement Provision (IORP), the insurance scheme as well as the functional administration, including the selection of provider(s). The fund should become operational in 2015.

Measures to remove obstacles to researchers' mobility include reforms linked to the Bologna process, and national (inward, outward and cross-sectoral) mobility schemes. For example, the APART Programme (Austria), awards fellowships to national and international students in support of a post-doctoral thesis, or the continuation of a scientific project. Other initiatives include tax incentives (e.g. Researcher Taxation Scheme in Demark), non-financial incentives (e.g. extended-stay research scholar visa in France) or measures promoting dual careers, such as the Dual Career Network, an initiative of the universities near the Franco-Swiss-German borders.

The extent to which research institutions co-publish and the extent to which their scientific publications are cited in the leading scientific journals other are measures of the attractiveness of public research institutions. The EU, whose researchers primarily co-publish with other EU researchers and who have a tendency to publish to a significant extent with researchers from neighbouring countries, still lags behind the US on both counts, but it is ahead of other countries and leads the US in certain sectors.

This report contains for the first time a composite index of EU research excellence compared with that of other major economies, which can be seen as a proxy for the attractiveness of the EU for its own researchers and those from other countries. The EU is significantly behind the United States, but well ahead of Japan, South Korea, China, India and Brazil – in descending order. Between 2007 and 2012, the level of research excellence in the EU increased by six percentage points to 47.8, and increased in every EU country except Greece. The best-performing EU countries are the Nordic Member States, the Netherlands, the UK and Belgium, all with scores over 60.

Introduction

Background

As the core producers of new knowledge and main agents in its transfer and exploitation, researchers and the institutions in which they perform research create the necessary knowledge base for economic growth. The European Union and its Member States have repeatedly underlined the strategic importance of Europe's scientific knowledge base as a key element for enhancing Europe's global competitiveness and ensuring Europe's future prosperity[13]. A full understanding of the research profession in its complexity is crucial for sound decision and policy-making.

In 2011, Deloitte received a mandate from the European Commission, DG Research & Innovation, to produce an integrated report on the research profession in Europe (*Researchers' Report*) to provide a reliable, complete and up-to-date picture of the research profession in 38 countries[14] (subsequently 'the countries'), taking into account country-specific (policy) contexts in the framework of a multi-annual reporting exercise. This is the third such report monitoring the ERA and in particular an open labour market for researchers[15] in line with the objectives of the Innovation Union, a Europe 2020 Initiative and the ERA Communication on A Reinforced European Research Area Partnership for Excellence and Growth"[16].

Under the reinforced partnership, the Member States, stakeholder organisations and the Commission are working together to enhance the effectiveness and efficiency of the European public research system. In particular the priority area "An open labour market for researchers" aims to ensure the removal of barriers to researcher mobility, training and attractive careers.

The *Researchers' Report 2014* monitors the implementation of the ERA and includes information on a number of impacts at national level from implementation of measures which the countries reported in some monitoring categories during the last two annual reporting exercises. The report also presents a full update of last year's indicators[17] (see *Researchers' Report 2013*)[18] and includes additional indicators[19] in a number of monitoring categories.

The stable structure over the three reports coupled with the set of robust indicators[20], agreed with the Member States, have made this an important tool that allows progress to be monitored over time.

[13] See for example: Communication from the European Commission, "Research and innovation as sources of renewed growth", European Commission (2014)

[14] EU-28 and countries associated to the Seventh Framework Programme for research and technological development: Norway, Iceland, Liechtenstein, Switzerland, Israel, Turkey, the Former Yugoslav Republic of Macedonia (FYROM), Serbia, Montenegro and Bosnia & Herzegovina whereas Croatia became member of the European Union in July 2013.

[15] ERA is defined as a "unified research area open to the world based on the Internal Market, in which researchers, scientific knowledge and technology circulate freely and through which the Union and its Member States strengthen their scientific and technological bases, their competitiveness and their capacity to collectively address grand challenges" (European Commission, 2012c)

[16] European Commission (2012c)

[17] The update of indicators is based on the availability of data (sources) at the time of the production of this report. The *Researchers' Report 2014* and its accompanying Annexes present information with a cut-off date of March 2014. The list of (updated) indicators in scope of this year's report is presented in the Technical Annex "List of indicators".

[18] The report and its annexes are available at: http://ec.europa.eu/euraxess/index.cfm/services/researchPolicies

[19] Mainly benefiting from the results of the Innovation Union Competitiveness Report 2013 (European Commission, 2014a)

[20] For a list of indicators in scope of this report, see Technical Annex "List of indicators"

Using quantitative and qualitative data it deepens and complements the analysis and information contained in other Commission reports including the ERA Progress Report 2014[21], the report on the State of the Innovation Union 2010-2014[22] and the Innovation Union Scoreboard[23]. It also provides detailed information on the policy measures being taken at national and institutional level and identifies remaining gaps on which further action is required.

The main Report as such is complemented by data Annexes, 38 detailed Country Profiles of around 10-15 pages, by around 50 examples of Good Practice and a set of Scorecards which provide a quick visual presentation of where countries stand in relation to the main themes.

The report also benchmarks the EU Member States and Associated Countries against their main competitors, in particular the US, Japan and China, and in a number of cases Brazil, India, Russia, South Africa and/or South Korea as well.

The report looks not only at the issues and the state of play, but also at the measures that the countries are taking to address the issues, and any impact that they have already identified. The data often highlight a large divergence between the best-in-class and those at the other end of the spectrum, and the extent of the gap between which several Member States have to make up in some (but by no means all) areas.

The 2014 report was compiled just as the EU was moving from the 2007-2013 funding cycle to the Multiannual Financial Framework for 2014-2020. In a significant number of countries, researcher programmes are part-funded by the EU Structural Funds for regional and social development. Some of these countries were well enough advanced in their planning processes to be able to provide information on their strategies for the next period; a significant number were not. Where programmes mentioned in the country profiles cover the period 2007-2013 and appear to have come to an end without a successor programme, this is in most cases because the information was not yet available. The changes introduced in any successor programmes may provide an indication of what the countries feel the impact of earlier measures has been. On the whole, however, the data on impact is still limited – across the board.

Monitoring categories

In order to provide a comprehensive picture of the research profession in Europe, the focus is on the following monitoring categories:

1. **"The stock of researchers in Europe"** (Chapter 1): provides an analysis of the current stock of human resources in Europe and in comparison with its main economic competitors (US, Japan and China), and provides an overview of the countries' measures in response to a growing demand for top-level researchers together with some of the limited information available on the impact from the measures;

[21] Available at: http://ec.europa.eu/research/era/index_en.htm

[22] Available at: http://ec.europa.eu/research/innovation-union/pdf/state-of-the-union/2013/state_of_the_innovation_union_report_2013.pdf

[23] Available at: http://ec.europa.eu/enterprise/policies/innovation/files/ius/ius-2014_en.pdf

2. **"Women in the research profession"** (Chapter 2): discusses the remaining gender imbalance in science and provides an overview of countries' remedial measures to ensure equal opportunities for women and men in access to research funding, promotion and decision-making bodies;
3. **"Open, transparent and merit-based recruitment"** (Chapter 3): provides an assessment of the openness of public recruitment procedures in public research institutions across Europe, in particular with reference to the number of openings published on the EURAXESS Jobs portal, and discusses the discrepancy between stakeholders' and public authorities' perceptions of the degree of openness, fairness and transparency of those procedures;
4. **"Education and training"** (Chapter 4): discusses the pivotal role education and training play in generating a sufficiently large pool of skilled researchers to promote a knowledge-based economy. The chapter provides an overview of the countries' measures to attract people to a researcher career, to upgrade the quality of doctoral training and post-doctoral career paths, and to encourage academia-industry partnerships in line with the European Charter for Researchers and Code of Conduct for the Recruitment of Researchers (Charter & Code) [24];
5. **"Working conditions in the research profession"** (Chapter 5): presents the most recent data on working conditions (employment contracts and remuneration), measures to improve and the impact of mobility on career prospects, as well as discussing the issues relating to social security provision for researchers;
6. **"Collaboration between academia and industry"** (Chapter 6): provides the most recent statistics on collaboration between academia and industry in Europe, and in comparison with its main economic competitors (US, Japan and China). It provides information on the extent to which researchers have spent time in the private sector (cross-sectoral mobility), and the motivation, and on co-publication with the private sector;
7. **"Mobility and international attractiveness"** (Chapter 7): presents the most recent figures on researchers' mobility (inward and outward) and discusses different factors influencing researchers' mobility, such as career progression, availability of funding or facilities, and personal/family factors. The chapter also presents information on scientific co-publications and provides an overview of the countries' measures to remove the remaining barriers to researchers' mobility.

For the purpose of the report, researchers are defined as the "professionals engaged in the conception or creation of new knowledge, products, processes, methods and systems and also in the management of the projects concerned"[25]. Furthermore, all doctoral candidates are considered to be researchers[26].

[24] European Charter for Researchers and a Code of Conduct for the Recruitment of Researchers. Available at: http://ec.europa.eu/euraxess/index.cfm/rights/whatIsAResearcher

[25] Frascati Manual (OECD 2002)

[26] In accordance with the new European Framework for Research Careers (2011), research career stages are divided into four broad research profiles:

- R1: First Stage Researcher (up to the point of PhD);
- R2: Recognised Researcher (PhD holders or equivalent who are not yet fully independent);
- R3: Established Researcher (researchers who have developed a level of independence);
- R4: Leading Researcher (researchers leading their research area or field).

Structure of the report

The *Researchers' Report 2014* consists of the main report and a set of accompanying annexes[27]:

1. **Country profiles**: The 38 country profiles provide detailed information on national policies/measures/actions taken on the topics covered by the chapters in the *Researchers' Report 2014*.
2. **Scorecards:** A set of 10 multi-coloured scorecards allow for quick visualisation of the countries' individual progress (or lack thereof) between two different dates for a number of key indicators[28]. The indicators were selected on the basis of their a) relevance for the issue to be monitored, b) comparability between dates (availability of data) and c) robustness of the data set. Scorecards serve as a means of monitoring change between different dates by showing if the value of an indicator has increased, decreased or remained stable.
3. **Good Practices:** The report includes an updated selection of around 50 Good Practices based on the countries' response to this year's reporting exercise. The Good Practices are presented according to the topics of the Report.
4. A further set of **Annexes** (III, IV and V) provide country-by-country analysis of measures supporting women in top-level positions, measures supporting education and training and social security benefits for researchers.

[27] The *Researchers' Report 2014* and all its accompanying Annexes present information with a cut-off date of March 2014.

[28] These indicators were agreed upon by the ERA SGHRM (Steering Group on Human Resources and Mobility).

1. The stock of researchers in Europe

1.1 The stock of researchers in Europe – Highlights

The stock of researchers in Europe in comparison with its main economic competitors:

- The EU has more researchers in absolute numbers than the US, Japan or China, but is lagging behind its main competitors in the share of researchers in the total labour force despite a moderate increase between 2010 and 2011. The Nordic countries and Luxembourg are doing significantly better than the EU average.

The stock of researchers in the business sector:

- The EU still lags behind its major competitors in the number of researchers in the business sector. In the EU-28, 46% of researchers are in the business sector compared with 80% in the United States, 62% in China, and 75% in Japan;
- The number of researchers (FTE) in the business sector stood at 3.08 per thousand labour force in the EU in 2011 compared to 7.70 in the US and 7.84 in Japan; within the EU it was highest (>6) in a number of the Nordic countries and lowest (<1) in some of the new Member States.

Countries' measures to increase the stock of researchers:

- Member State and Associated Countries' measures to ensure they train enough researchers to meet their national R&D targets include National Action Plans, programmes, strategies, legislative acts, white papers, thematic acts and multi-annual development plans. It is generally too early or at least there is currently insufficient information with which to measure the direct or indirect impact of these measures;
- Member States and Associated Countries have established a number of schemes to raise young people's interest in science and research. Some programmes aim to make pursuing a researcher career attractive to specific groups, e.g. schoolchildren – and in particular girls; see also measures under chapter 4 "Education and Training";
- Member States and Associated Countries have taken steps to improve the quality and relevance of doctoral training[29] and provide researchers with training in innovation and entrepreneurship. Many countries have joint academia/business training programmes;
- Only a few countries reported successors to programmes which had come to an end (e.g. Belgium, Romania and Sweden)[30].

1.2 Introduction

As stated previously, well-trained, creative and dynamic researchers are indispensable for building and sustaining a competitive knowledge-based economy. Europe hosts a large pool of talented and skilled researchers. However, the stock as a share of the labour force is well below that of its main trading competitors (United States, China and Japan). In addition, the proportion of researchers employed in the business sector is insufficient to sustain Europe's position as a global economic leader. It has been estimated that an additional one million researchers may be needed in Europe by 2020 to

[29] In line with the Principles for Innovative Doctoral Training

[30] A number of countries were not able to report on successor programmes because these are often derivatives of programmes funded by the EU Structural or other funds and were in transition.

meet an R&D intensity target of 3% GDP[31]. The actual number of researchers required is significantly higher, as many researchers will retire over the next decade[32]. This, combined with the need for many more high-quality research jobs as the research intensity of the European economy increases, will be one of the main challenges facing European education, research and innovation systems in the years ahead[33]. Demand in Europe for highly qualified people is predicted to rise by almost 16 million in the period up to 2020[34].

In order to remain competitive, Europe must, therefore, invest in generating a sufficiently large pool of skilled human resources for research and innovation. Against this backdrop, the "Innovation Union"[35] called for Member States to put in place strategies aimed at training enough researchers to meet their national R&D targets.

Outline

This chapter provides an analysis of the current stock of human resources in research in Europe and presents a comparison of data between last year's report and the most recent quantitative data available. First, it offers an overview of the key indicators showing the stock of researchers in Europe. Second, it discusses the position and trends in the stock of researchers in Europe, and in comparison with its main trading partners: United States, China and Japan. It presents data on Full Time Equivalents (FTE), Head Counts (HC) and the proportion of researchers in the business and public sector. Third, it provides an overview of the measures that countries are taking with a view to training enough researchers to meet their national R&D targets. It then looks at some of the impacts of the countries' measures which it is already possible to discern.

1.3 The stock of researchers in Europe – Key indicators

The table below presents an overview of key indicators and the source for monitoring the stock of researchers in Europe and in comparison with its main competitors.

Table 1: The stock of researchers in Europe - key indicators

Indicators	Data source(s)
Researchers in million	Eurostat
Researchers per thousand labour force	Eurostat
Researchers working in the business and public sectors (in million)	Eurostat
Share of researchers working in the business sector as % of all researchers	Eurostat
Researchers in the business sector per thousand labour force	Eurostat
Researchers in the public sector per thousand labour force	Eurostat

1.4 Human resources in the research profession

In absolute terms, there were 1.63 million FTE researchers in the EU-28 in 2011 compared to 1.49 million in the United States, 0.66 million in Japan and 1.32 million in China. Between 2000 and 2011, the stock of researchers in the EU-28 grew by an annual average >4%. This was faster than in the US and Japan, but slower than in China.

[31] Achieving the target of spending 3% of EU GDP on R&D by 2020 could create 3.7 million jobs and increase annual GDP by close to EUR 800 billion by 2025 (see European Commission (2010b). For more information on the impact of the 3% R&D target on the number of researchers needed in the European research system in 2020, see European Commission (2010a, Appendix 2, p. 82ff).

[32] Excluding the additional need for researchers to replace those retiring

[33] European Commission (2011a)

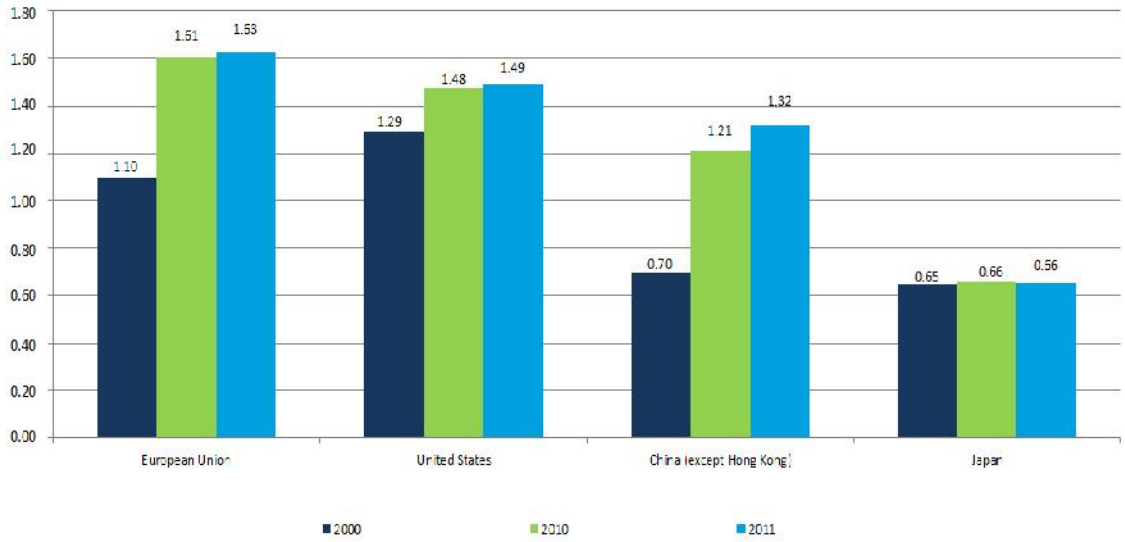
[34] European Commission (2011f)

[35] European Commission (2010a)

Between 2000 and 2011, the stock of EU-28 researchers (in FTE) increased from 1.10 million to 1.63 million. The increase in the United States was from 1.29 million to 1.49 million. In Japan, the number of researchers increased from 0.65 million to 0.66 million. China experienced the biggest increase in the number of researchers from 0.7 million to 1.32 million.

Between 2010 and 2011, the number of researchers (in FTE) increased in Europe by 1.2% and by 0.7% in the US; it remained stable in Japan.

Figure 1: Researchers (FTE), EU-28, US, China, Japan, 2000, 2010 and 2011 (in million)[36]



Source: Deloitte
Data: Eurostat

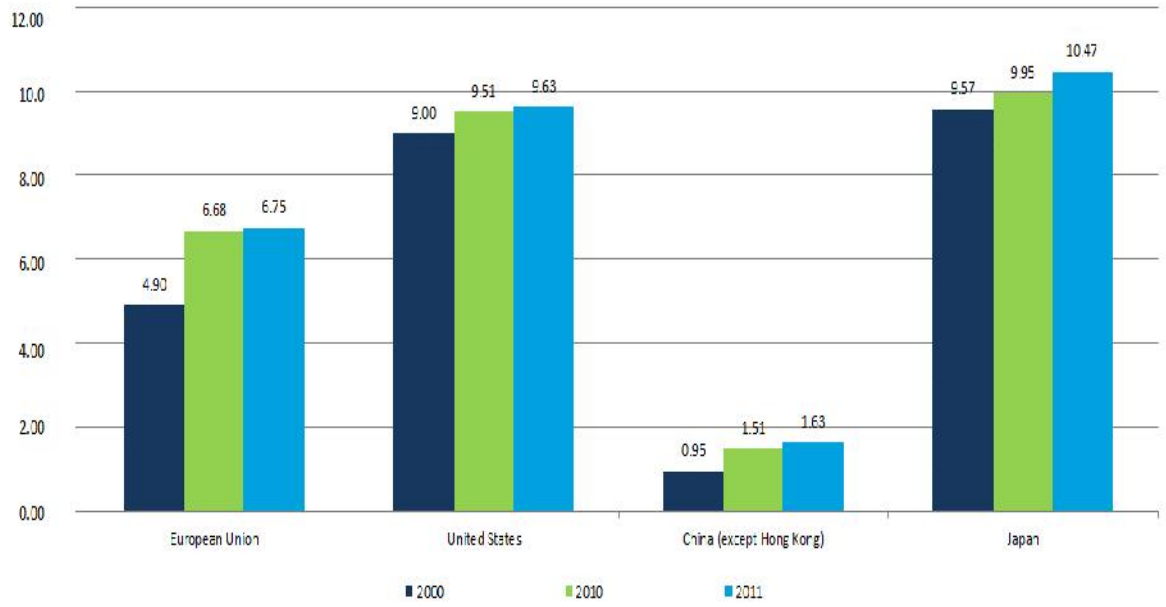
The EU is lagging behind its main competitors in the share of researchers in the total labour force, despite a moderate increase between 2010 and 2011. In 2011, the ratio was 6.75 per 1 000 in the EU-28, compared to 9.63 in the US and 10.47 in Japan. The Nordic countries and Luxembourg are significantly higher than the EU average.

Between 2000 and 2011, the number of researchers (FTE) in relation to the labour force increased from 4.90 to 6.75 in the EU-28, up from 6.68 in 2010. The increase in the United States between 2000 and 2011 was from 9.0 to 9.63. In Japan, it was from 9.57 to 10.47, while China reported an increase from 0.95 to 1.63, still below any European country except Romania. (The total labour force – i.e. including both the employed and unemployed – was some 241 million in the EU-28 in 2011, compared to 155 million in the United States, 63 million in Japan and 807 million in China).

Between 2010 and 2011, the number of researchers (FTE) per 1 000 labour force increased in the EU-28 by 1.1%, less than in Japan (5.2%) and slightly less than in the US (1.3%).

[36] The stock of Chinese researchers in FTE in 2010 presented in the *Researchers' Report 2013* was 1.53 million. This was based on an estimate from Eurostat data up to 2008.

Figure 2: Researchers (FTE) per thousand labour force, EU-28, US, China, Japan, 2000, 2010 and 2011[37]



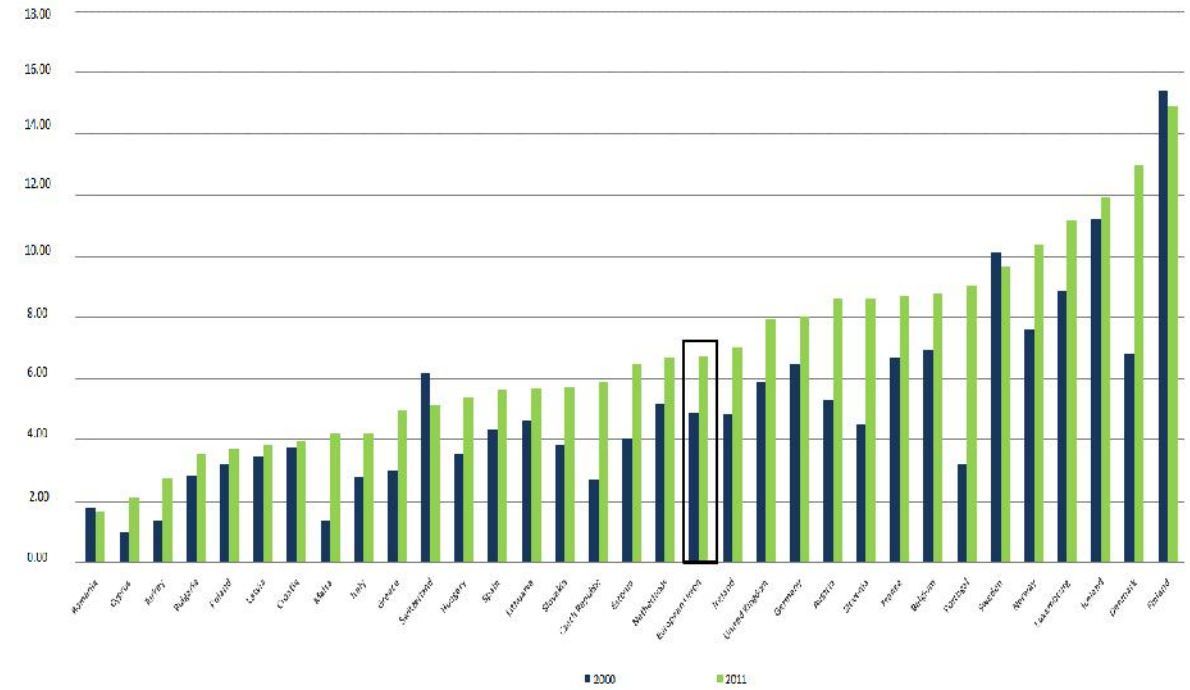
Source: Deloitte
Data: Eurostat

All Nordic countries have a higher share of researchers (FTE) per thousand labour force than the US. Finland and Denmark rank highest of EU-28 countries, with more than fifteen researchers per thousand labour force – higher also than Japan.

Finland reported the highest ratio of all the countries, with 14.9 researchers per thousand labour force in 2011. Five countries had more than 10 researchers per thousand labour force, i.e. Luxembourg and all the Nordic countries except Sweden. Sweden is the sixth ranked country, with just below 10. The top four rank above Japan; the top six rank above the US. Of the EU-28 countries, Romania, Cyprus, Bulgaria, Poland, Latvia and Croatia, report the lowest numbers, with four or fewer researchers per thousand labour force.

[37] The number of researchers in relation to the labour force in China in 2010 presented in the *Researchers' Report 2013* were higher. The data methodology has been revised as from 2008, showing much lower numbers.

Figure 3: Researchers (FTE) per thousand labour force, Europe, 2000 and 2011



Source: Deloitte
Data: Eurostat
*No information available for BiH, FYROM, IL, LI, ME and SR.
** European Union refers to EU-28

The table below shows the performance of the top six European countries (including the top four EU-28 countries) against the EU-28, US and Japan in terms of the number of researchers (FTE) per thousand labour force in 2000, 2010 and 2011.

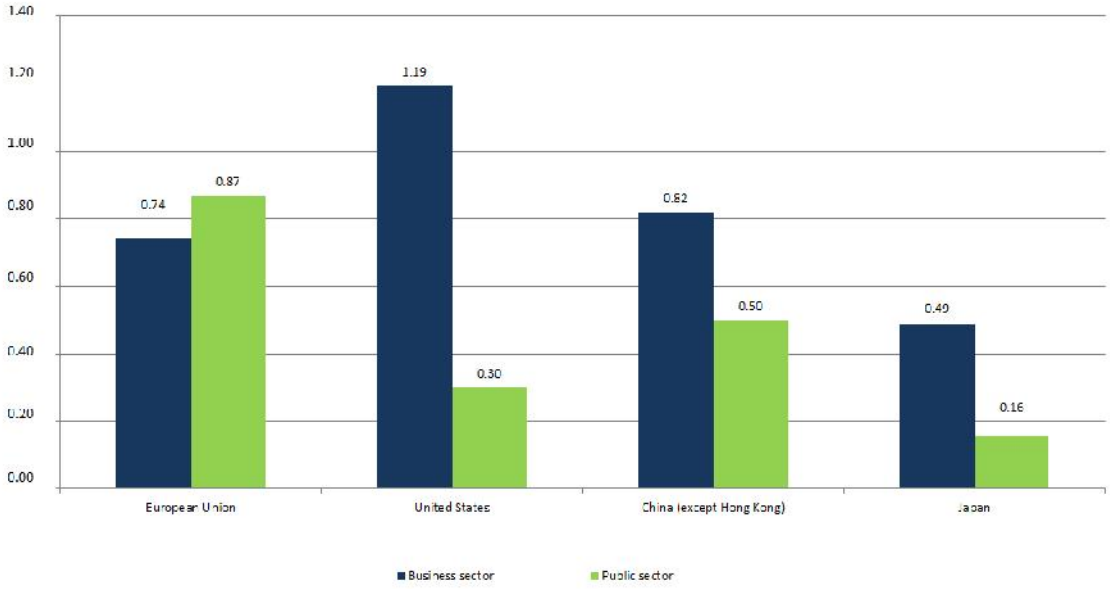
Table 2: Researchers (FTE) per thousand labour force, top six European countries, EU-28, US, Japan, 2000, 2010 and 2011

Country	2000	2010	2011
Finland	15.41	15.51	14.91
Denmark	6.83	12.80	12.98
Iceland	11.20	15.96	11.94
Luxembourg	8.86	11.40	11.16
Japan	**9.57**	**9.95**	**10.47**
Norway	7.62	10.20	10.38
Sweden	10.10	9.97	9.69
United States	**9.00**	**9.51**	**9.63**
European Union	**4.90**	**6.68**	**6.75**

Source: Deloitte
Data: Eurostat

The share of researchers employed in the business sector differs significantly between the EU-28 and other major economies. In the EU-28, more than half the researchers (54%) work in the public sector, and only 46% (742 583) are in the business sector compared with 80% in the United States, 62% in China, and 75% in Japan. See Figure 5.

Figure 4: Researchers (FTE) working in the business and public sectors (in million), EU-28, US, China, Japan, 2011



Source: Deloitte
Data: Eurostat

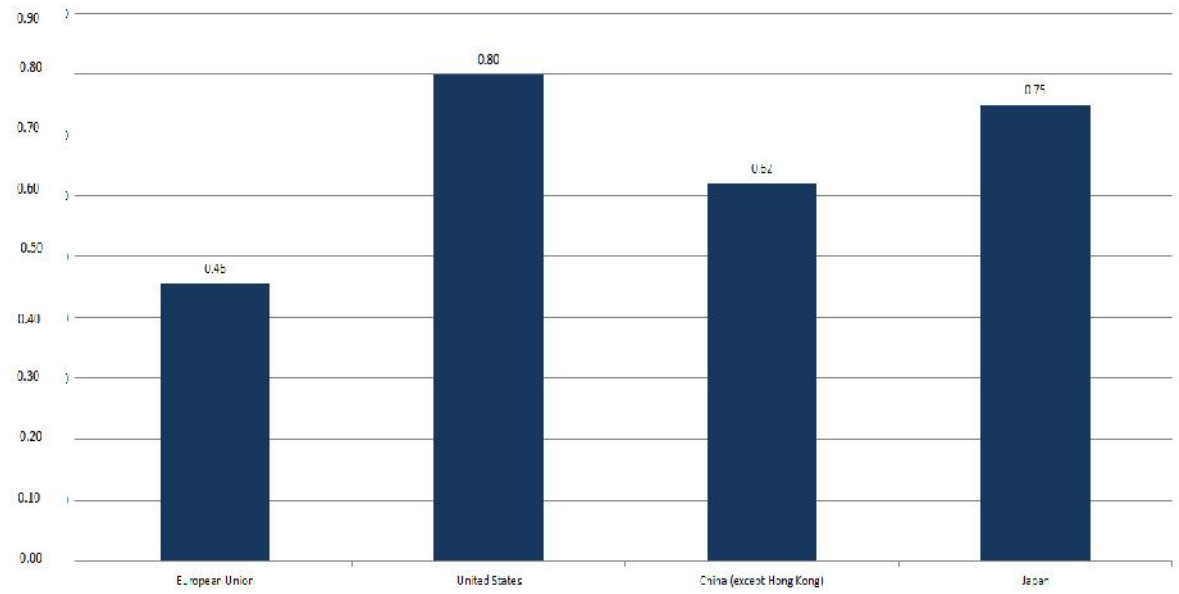
The table below presents the number of researchers (FTE) by sector for the EU-28 for the period 2000-2011.

Table 3: Researchers (FTE) by sector, EU- 28, 2000-2011 (in million)

Year	Total	Business enterprise sector	Government and higher education sectors
2000	1.10	0.51	0.58
2001	1.15	0.53	0.61
2002	1.18	0.54	0.63
2003	1.22	0.56	0.65
2004	1.31	0.60	0.70
2005	1.37	0.63	0.73
2006	1.42	0.65	0.75
2007	1.46	0.67	0.77
2008	1.52	0.70	0.81
2009	1.56	0.70	0.85
2010	1.61	0.72	0.87
2011	1.63	0.74	0.87

Source: Deloitte
Data: Eurostat

Figure 5: Share of FTE researchers working in the business sector (as % of all researchers), EU-28, US, China, Japan, 2011

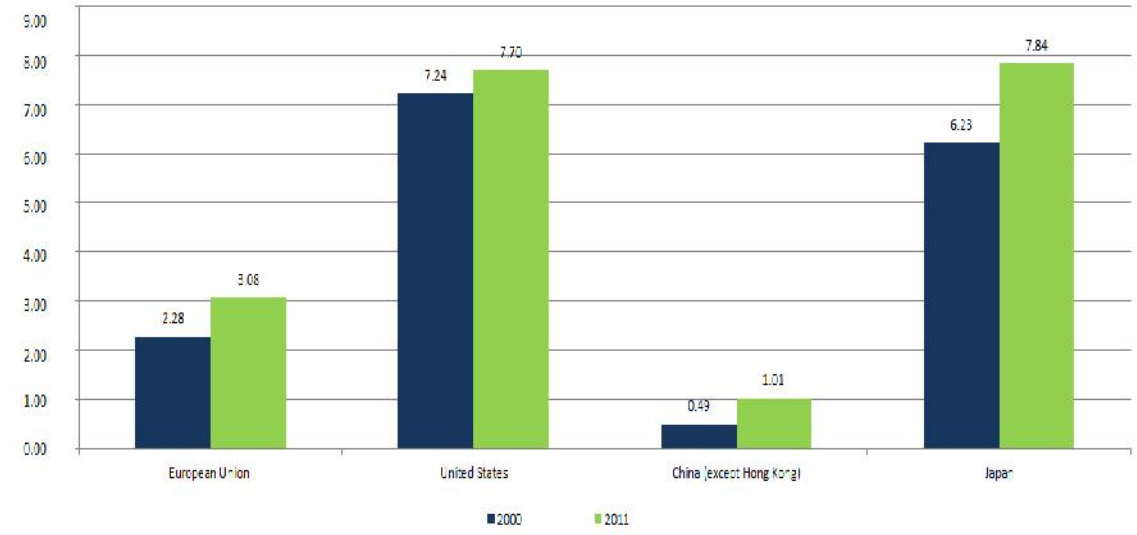


Source: Deloitte
Data: Eurostat

There were 3.08 FTE researchers in the business sector per thousand labour force in the EU-28 in 2011 compared to 7.70 in the US, 7.84 in Japan and 1.01 in China.

Between 2000 and 2011, the stock of EU-28 researchers in the business sector per thousand labour force increased from 2.28 to 3.08. The increase in the United States was from 7.24 to 7.70. In China, the share increased from 0.49 to 1.01, and in Japan from 6.23 to 7.84.

Figure 6: Researchers in the business sector (FTE) per thousand labour force, EU-28, US, China, Japan, 2000 and 2011



Source: Deloitte
Data: Eurostat

The table below shows the performance of the top five European countries (including the top four EU-28 countries) against the EU-28, US and Japan in terms of the number of researchers in the business sector (FTE) per thousand labour force in 2000, 2010 and 2011.

Table 4: Researchers (FTE) in the business sector per thousand labour force, top five European countries, EU-28, Japan, US, 2000, 2010 and 2011 (in million)

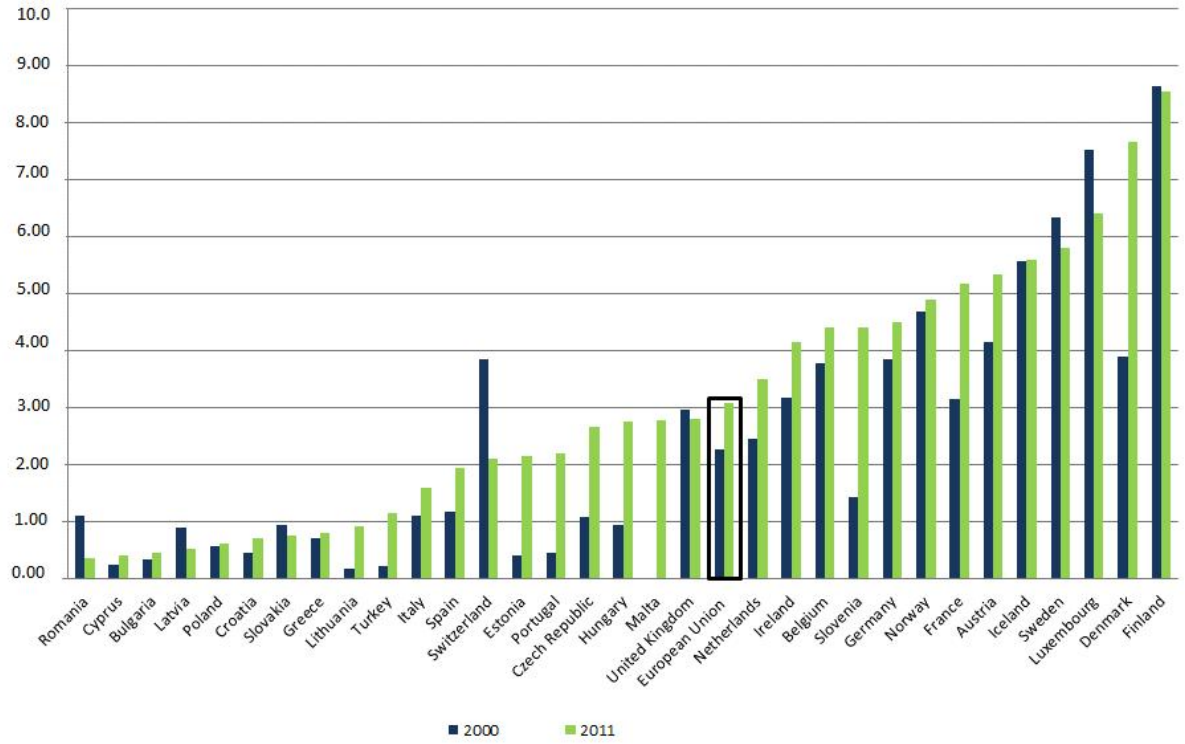
Country	2000	2010	2011
Finland	8.65	8.57	8.56
Japan	6.23	7.44	7.84
United States	7.24	7.60	7.70
Denmark	3.90	7.79	7.68
Luxembourg	7.53	6.31	6.42
Sweden	6.34	6.15	5.82
Iceland	5.58	5.92	5.59
European Union	2.28	2.99	3.08

Source: Deloitte
Data: Eurostat

The number of researchers in the business sector (FTE) per thousand labour force is highest (>6) in a number of the Nordic countries (Finland, Denmark, Sweden and Iceland) and Luxembourg, and lowest (<1) in some of the new Member States such as Romania, Bulgaria, Latvia, Poland, Croatia Slovakia and Lithuania.

Between 2000 and 2011, some European countries more than doubled the ratio of researchers in the business sector per thousand labour force: Czech Republic (+148%) and Hungary (+188%). A number of smaller countries achieved even higher growth, i.e. Slovenia (+210%), Portugal (+390%), Estonia (+423%), Turkey (+432%) and Lithuania (+438%), while in Malta the jump was thirtyfold, albeit from a very low base. In the same period, the share decreased by more than 25% in other countries including Latvia and Romania.

Figure 7: Researchers in the business sector (FTE) per thousand labour force, Europe, 2010 and 2011



Source: Deloitte
Data: Eurostat
* No information available for BiH, FYROM, IL, LI, ME and SR

Table 5: Researchers in the business sector (FTE) per thousand labour force, Europe, 2000, 2010 and 2011

Country	2000	2010	2011
Romania	1.11	0.59	0.36
Cyprus	0.25	0.47	0.42
Bulgaria	0.34	0.45	0.46
Latvia	0.90	0.55	0.54
Poland	0.57	0.69	0.61
Croatia	0.46	0.73	0.71
Slovakia	0.94	0.71	0.77
Greece	0.70	0.80	0.81
Lithuania	0.17	0.82	0.92
Turkey	0.22	1.00	1.15
Italy	1.11	1.53	1.59
Spain	1.19	1.97	1.94
Switzerland	3.85	2.15	2.11
Estonia	0.41	1.87	2.16
Portugal	0.45	1.88	2.20
Czech Republic	1.08	2.40	2.67
Hungary	0.95	2.41	2.75
Malta	0.00	1.93	2.78
United Kingdom	2.96	2.68	2.82
European Union 28	**2.28**	**2.99**	**3.08**
Netherlands	2.47	3.04	3.51
Ireland	3.19	3.61	4.15
Belgium	3.80	4.09	4.40
Slovenia	1.43	3.25	4.42
Germany	3.86	4.46	4.51
Norway	4.4.69	4.82	4.91
France	3.15	5.04	5.19
Austria	4.16	5.27	5.35
Iceland	5.58	5.92	5.59
Sweden	6.34	6.15	5.82
Luxembourg	7.53	6.31	6.42
Denmark	3.90	7.79	7.68
Finland	8.65	8.57	8.56

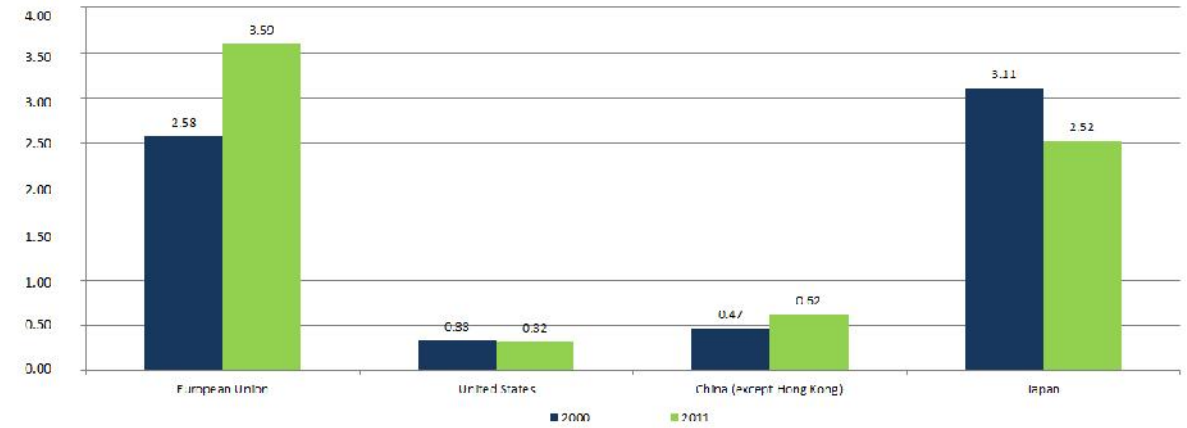
Source: Deloitte
Data: Eurostat

In 2011, there were 3.58 FTE researchers in the public sector per thousand labour force in the EU-28 compared to 0.32 in the US, 0.62 in China and 2.52 in Japan.

Between 2000 and 2011, the number of researchers in the public sector per thousand labour force increased from 2.58 to 3.59 in the EU-28 and from 0.47 to 0.62 in China. Both the US and Japan recorded a decrease in the number of researchers employed in the public sector per thousand labour force. The numbers decreased marginally from 0.33 to 0.32 in the US, and from 3.11 to 2.52 in Japan.

Between 2010 and 2011, the number of researchers (FTE) in the public sector per thousand labour force decreased slightly from 3.61 to 3.59 in the EU-28. It went up slightly in China, from 0.59 to 0.62, while remaining stable in the United States (0.32), and increasing from 2.39 to 2.52 in Japan.

Figure 8: Researchers in the public sector (FTE) per thousand labour force, EU-28, US, China, Japan, 2000 and 2011

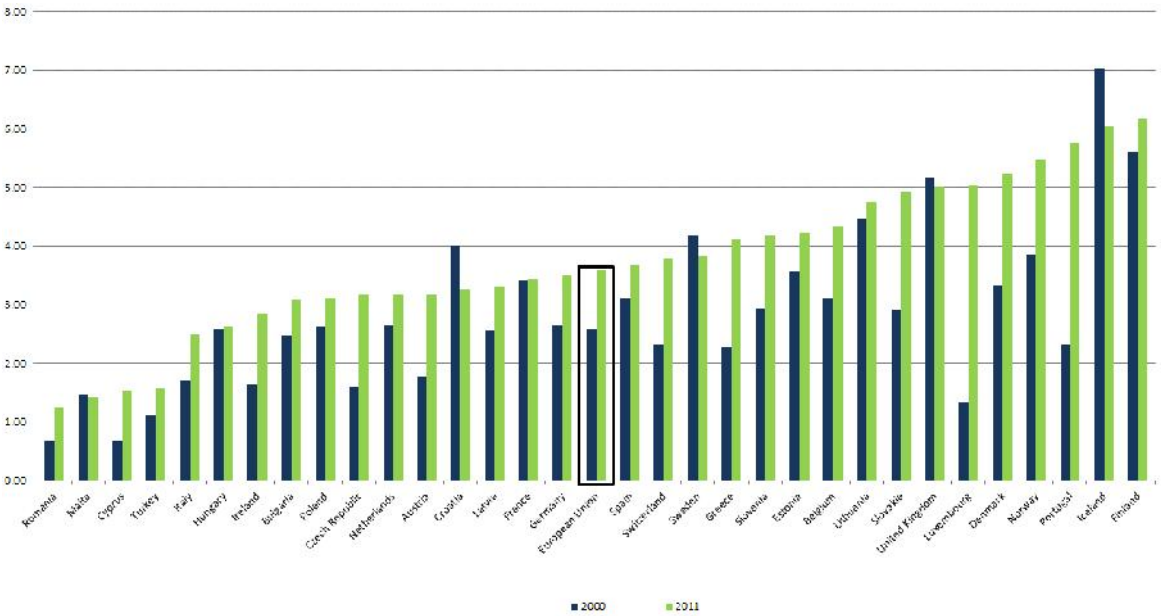


Source: Deloitte
Data: Eurostat

Finland, Iceland, Portugal, Norway and Denmark are the top five countries, with at least five researchers per thousand labour force employed in the public sector, and in some cases significantly more. Romania has the lowest number, with fewer than two researchers in the public sector per thousand labour force.

Between 2000 and 2011, Luxembourg (+278%) showed the most significant increase in the number of researchers in the public sector per thousand labour force followed by Portugal (+149%), Cyprus (+126%) and the Czech Republic (+98%).

Figure 9: Researchers in the public sector (FTE) per thousand labour force, Europe, 2000 and 2011



Source: Deloitte
Data: Eurostat
*No information available for BiH, FYROM, IL, LI, ME and SR
** European Union refers to EU-28

Table 6: Researchers in the public sector (FTE) per thousand labour force, Europe, 2000, 2010 and 2011

Country	2000	2010	2011
Romania	0.68	1.39	1.26
Malta	1.46	1.46	1.43
Cyprus	0.67	1.49	1.52
Turkey	1.13	1.54	1.58
Italy	1.70	2.44	2.50
Hungary	2.57	2.60	2.63
Ireland	1.63	2.88	2.85
Bulgaria	2.47	2.75	3.08
Poland	2.62	3.08	3.11
Czech Republic	1.60	3.10	3.16
Austria	1.77	3.13	3.17
Netherlands	2.65	3.10	3.17
Croatia	4.00	3.33	3.25
Latvia	2.56	2.85	3.30
France	3.41	3.40	3.43
Germany	2.64	3.41	3.50
European Union 28	**2.58**	**3.61**	**3.59**
Spain	3.11	3.85	3.68
Switzerland	2.33	3.60	3.78
Sweden	4.20	3.81	3.83
Greece	2.29	3.27	4.11
Slovenia	2.94	4.13	4.17
Estonia	3.57	3.97	4.22
Belgium	3.09	4.19	4.33
Lithuania	4.46	4.83	4.74
Slovakia	2.92	4.88	4.94
United Kingdom	5.17	5.05	5.01
Luxembourg	1.33	5.08	5.03
Denmark	3.33	4.95	5.23
Portugal	2.31	5.51	5.76
Norway	3.85	5.38	5.48
Iceland	7.04	7.67	6.04
Finland	5.60	6.77	6.19

Source: Deloitte
Data: Eurostat

1.5 Increasing the stock of researchers

Europe needs to invest substantially in its science base in order to remain a relevant economic player at a global level. While in 2011, the EU was the world leader in the absolute number of researchers (FTE), it lags behind its competitors when the figures are expressed in relative terms, i.e. as a percentage of the labour force. Moreover, China is catching up rapidly in the number of researchers (FTE), with an annual growth rate of >8% since 2000 (compared with 4.4% for the EU-28 and 1.4% in the US).

Europe is also facing an innovation gap because the majority of researchers are employed in the public sector. Europe therefore needs to focus on generating a talent pool and strengthening its science base in order to create a genuinely unified ERA "in which all actors, both public and private, can operate freely, forge alliances and gather critical mass in order to compete and cooperate on a global scale"[38].

Against this backdrop, the Communication on the "Innovation Union" defined a set of policy imperatives aimed at strengthening the scientific knowledge base. The Communication called on the Member States to build up the stock of knowledge workers, especially researchers, since much innovation stems from research performed in higher education establishments and research institutes. More concretely it called on Member States to have strategies in place to train enough researchers to meet their national R&D targets (...)"[39].

In their reporting for this report, the vast majority of EU Member States provided information on new measures aimed at training enough researchers to meet their national R&D targets in their respective countries. They are addressing aspects of human resources in the research profession mainly by means of a diverse set of (policy) measures, such as national action plans, programmes and legislative acts, and not by means of one coherent (national) strategy[40].

In order to secure an adequate science base, national governments and institutions have put in place measures to attract sufficient numbers of young people to take science to an advanced (doctoral) level and thus pursue a researcher career. For example, governments have set up a number of awareness schemes to raise young people's interest in science, and in research in general. In addition, dedicated programmes aim to attract specific groups, such as schoolchildren – and girls in particular, to pursue a researcher career[41]. Such measures aim to secure an adequate supply of researchers in the long run. For the short and medium term, Member States have established measures to improve the quality of doctoral training [42] and provide researchers with training courses about innovation and entrepreneurship. In many countries, academia is developing joint training programmes with companies.

The countries in the scope of this report have put in place a plethora of measures to address the gender imbalance in research decision-making and in particular to support women in their career aspirations[43]. However, as recent research shows, Europe is far from achieving gender equality in research[44]. In spite of national and EU-level strategies on gender equality, European research still suffers from a considerable drain of and inefficient use of women. The annual increase in the number

[38] European Commission (2010a)

[39] Ibid

[40] "By the end of 2011, Member States should have strategies in place to train enough researchers to meet their national R&D targets and to promote attractive employment conditions in public research institutions. Gender and dual career considerations should be fully taken into account in these strategies" (European Commission, 2010b)

[41] For information on specific measures aimed to attract people to become researchers see Chapter 4 "Education and training"

[42] For information on specific measures aimed to improve the quality of doctoral training see Chapter 4 "Education and training"

[43] For information on specific measures to support women in top-level positions, see Chapter 2 "Women in the research profession".

[44] European Commission (2013b)

of women researchers is less than half the annual number of female PhD graduates and too few women are in leadership positions or involved in decision-making[45].

National authorities have also put in place different measures to make the recruitment procedures in public research institutions more open and transparent. Open, transparent and merit-based recruitment procedures in public research institutions across Europe are a prerequisite for the realisation of ERA. They are a precondition of high academic performance and teaching excellence by ensuring optimal allocation of human resources based on merit and academic excellence[46]. Speaking at the Irish Presidency Conference on Researcher Careers and Mobility in Dublin Castle in 2013[47], European Commissioner for Research, Innovation and Science, Máire Geoghegan-Quinn said that one of the most important problems which still needs to be tackled in certain areas is the lack of transparent, open and merit-based recruitment: "A lack of open recruitment is simply unfair to people, women in particular. It also prevents universities from putting together the best possible research teams. That's bad for the quality of research, and in the long run, bad for a knowledge society." [48]

Other measures aim to improve researchers' employment and working conditions so as to attract young people into a researcher career, and attract and retain the most talented researchers in Europe[49]. Measures aimed at encouraging life-long learning (e.g. via dedicated career programmes) and improving working conditions (e.g. via the Charter & Code) can have a positive impact on researchers' career development and job satisfaction. European countries have also put various measures in place to boost partnerships between universities, research institutions and private companies so as to make the research profession more attractive[50].

Lastly, many countries have put in place measures to remove the remaining barriers to mobility and increase the attractiveness of public research institutions as an employer. Different national mobility schemes aim to boost researchers' mobility (inward, outward and cross-sectoral). Many of these schemes promote inward mobility from both EU-28 and non-EU countries, providing financial incentives for early stage researchers. Others promote outbound mobility. By removing the remaining barriers to researchers' mobility, the countries aim to make the research profession attractive to young and experienced researchers across Europe[51].

Most non-EU countries covered by this report also reported that they have put in place measures (action plans and programmes) aimed at increasing the stock of researchers, encouraging researchers' mobility and improving the quality of doctoral training.

[45] European Commission (2012c)

[46] For information on specific measures to make the national recruitment systems more open and transparent, see Chapter 3 "Open, transparent and merit-based recruitment"

[47] Available at: http://www.iua.ie/research-innovation/rcm/

[48] European Commission (2013d)

[49] For information on specific measures to improve researchers' employment and working conditions, see Chapter 5 "Working conditions in the research profession"

[50] For information on specific measures to increase collaboration between academia and industry, see Chapter 6 "Collaboration between academia and industry"

[51] For information on specific measures to increase collaboration between academia and industry, see Chapter 7 "Mobility and international attractiveness"

For this year's reporting exercise, the countries were requested not only to report on recent progress but also to provide information on the (likely) impacts of measure(s) implemented or foreseen by providing factual evidence and data on the magnitude of the measures implemented. In many cases, however, it is too early to measure the direct or indirect impact of these measures, since all in all, very few countries reported (likely) impacts resulting from the measure(s) implemented/foreseen at national and regional level.

The input received from the countries on impacts fell predominantly in the following monitoring categories: "Women in the research profession", "Education and training" and "Mobility". The information provided related to the organisation/body responsible for the measure, its duration (start and end date) and possible prolongation or follow-up measures, the number of beneficiaries and the budget allocated. For an overview of the information provided by the countries on the (likely) impacts resulting from the measure(s) implemented/foreseen, see Annex II "Impacts reported".

In terms of measures aiming to increase the stock of researchers, very few countries reported impacts from national measures already in place. One exception was the Regional R&D and Innovation (VRI) programme of Norway, the first part of which was evaluated in 2012. The evaluation confirmed the relevance of the programme, although it pointed to the potential for more impact at corporate level.

Few countries reported successors to programmes which ended in 2013 or earlier[52]. In Belgium, the Annual Science Communication Action Plan (1994-2011) was replaced in 2012 by the Communication Policy Plan 2012-2014 (of some EUR 9 million for 2012). This plan is complemented by the action plan for the stimulation of careers in STEM, a collaboration of the ministries of innovation and science, of work and social economy and of education. In Romania, the National R&D and Innovation (RDI) Strategy 2007-2013 was superseded by its successor, RDI Strategy 2014-2020.

Finally, compared to last year's report, a number of countries reported an update in the number of universities/research institutions having signed the Charter & Code during 2013 (e.g. one additional university in Hungary, the *Fraunhofer Gesellschaft* in Germany, while in Lithuania both the Rectors' Conference and the Conference of Directors of Research Institutes have signed the 'Charter & Code').

Many countries emphasised the importance of EURAXESS Services in their country. For instance, in 2013, the EURAXESS Czech Republic network staff assisted over 700 researchers, providing answers to over 11 000 queries (compared to 5 500 queries reported the previous year); Luxembourg reported a 15% increase in visits. In Ireland, since its launch in May 2013, the role of EURAXESS has been extended significantly, especially with the development of the EURAXESS Business portal (http://www.euraxess.ie/business/). This provides a dedicated entry point for companies focusing on key EURAXESS services of industry relevance. Finally, since 2013, in Italy, universities and public research organisations have been requested to publish their research grant offers but also any PhD fellowships on the EURAXESS Jobs portal.

[52] A number of countries were not able to report on successor programmes because these are often derivatives of programmes funded by the EU Structural or other funds. With the start of the 2014-2020 funding cycle coinciding with the reporting period, many programmes were not far enough advanced for detail to be provided. A number originally scheduled to end in 2013 have been extended to 2015 in order to bridge the gap.

2. Women in the research profession

2.1 Women in the research profession - Highlights

Female researchers in top-level positions – the evolution of a researcher career:

- Female researchers face difficulties in climbing the research career ladder. While the proportion of women is relatively high at tertiary level, it diminishes in the later stages of an academic career, especially in top-level positions (showing a scissors effect);
- Although there are differences across fields of science, men always outnumber women in the highest academic positions (Grade A[53] positions);
- The ratio of women in top-level positions in research rose in nearly every country between 2007 and 2010 but unevenly, and the probability of women reaching a top-level (Grade A) position in research is low. Moreover, progress is slow.

Countries' measures to promote female researchers in top-level positions:

- Most European countries have introduced cross-cutting support measures to promote equal opportunities for men and women, both in general and for the research profession specifically, including setting up special bodies dedicated to the issue of gender balance, the anchoring of the gender balance principle in national constitutions, charters and action plans;
- Measures going beyond general provisions are fewer but have been growing in number, e.g. gender targets and quotas, work-life balance provisions, advanced training, mentoring and empowerment programmes and measures to improve the transparency of appointments;
- Several countries confer awards of excellence on women scientists to raise awareness of women in science and to reward outstanding female researchers. Austria's *Käthe Leichter* awards are among the most long-standing of these;
- Based on a survey among members of the Helsinki Group, the Commission has recently published a new report on Gender Equality policies in Public Research[54].

2.2 Introduction

Europe's knowledge-intensive economies are largely dependent on the excellence of the individuals performing research. An adequately stocked, mobile, human resource base is an essential prerequisite for safeguarding Europe's position as a relevant economic actor[55]. There is mounting evidence, however, that Europe does not make enough of its talent pool, especially of women.

As research[56] shows, the EU is far from achieving gender equality in research. While the proportion of women at the first two levels of tertiary education is higher than that of men, the proportion of women at PhD level is lower. It diverges even more in academic positions, and is greatest in the higher (more prestigious) academic positions. The participation rate of women in science and technology, especially in top-level positions and decision-making bodies, is well below that of men.

[53] Grade A: The single highest grade/post at which research is normally conducted

[54] Available at: http://ec.europa.eu/research/pdf/199627_2014%202971_rtd_report.pdf

[55] European Commission (2010a)

[56] European Commission (2013b)

The implications of gender imbalances in the research profession are highly relevant for the European economy. It has been estimated that the EU will need at least one million new research jobs if it is to reach the R&D expenditure target of 3% of GDP[57]. The participation of women in science and technology can contribute to increasing the quality of innovation and the competitiveness of scientific and individual research, and needs to be promoted[58].

The reasons for the gender imbalance in the research profession are multifaceted[59]. They range from unattractive working conditions for women in public research institutions (e.g. insufficient job security during maternity leave), persisting gender stereotypes in European countries (e.g. 'male bonus'[60]), and unfair and opaque recruitment procedures favouring men above female researchers[61]. Resources, time, social networks, encouragement – unevenly distributed between the sexes – are necessary prerequisites for becoming a successful scientist[62].

The correction of the remaining gender imbalances is a key factor for the success of a European Research Area. It is essential to ensure equal opportunities for women and men in access to research funding, promotion and decision-making bodies.

To this end, the ERA priority area 'Gender equality and gender mainstreaming in research' calls on Member States, research stakeholder organisations and the Commission to "end the waste of talent and to diversify views and approaches in research and to foster excellence" [63].

Outline

This chapter presents the most recent data on female researchers in science in Europe[64]. First, it offers an overview of the key indicators for monitoring the gender balance in research. Second, it sheds light on the proportion of female and male researchers by academic grades and in top-level positions by academic discipline. Third, it presents statistics on the proportion of female researchers in top-level positions in the higher education sector and decision-making bodies, as well as their likelihood of being promoted to top-level positions in research. Fourth, it provides an overview of Member States' and Associated Countries' measures to support women in reaching top-level positions.

[57] European Commission (2010a)

[58] European Commission (2008a)

[59] There is a full body of literature devoted to the topic of gender equality and gender bias in the field of science. See, for example, OECD (2006a) ; Sonnert, G. and Holton, G. (1996a); Zuckerman, H. (1991a)

[60] "(...) the problem is not so much that women encounter discrimination as such, but that people – men and women – who resemble those who are in powerful positions and behave according to masculine traditions of full-time devotion and competition enjoy a bonus that allows them to be assessed as better scientists" (European Commission (2004c, p. 19)

[61] "The low female presence at the highest levels of the scientific hierarchy is an indicator of the inability of research institutions to follow changes in society, such as the increase in women in higher education, which in turn highlights the dysfunction of a system for the evaluation of scientific excellence that has not abolished or weakened the old boy network of co-optation" (European Commission, 2004c, p. 11)

[62] European Commission (2004c)

[63] European Commission (2012c)

[64] The findings presented in this chapter are largely based on information presented in the *Researchers' Report 2013*. There were no updates of the indicators available (WiS database/SHE figures) prior to the publication of this report. The countries' measures in response to the Innovation Union Commitments were updated on the basis of the 2012 reporting exercise.

2.3 Women in the research profession – Key indicators

The table below presents an overview of key indicators and the source for monitoring the situation of women in the research profession.

Table 7: Women in the research profession - Key indicators

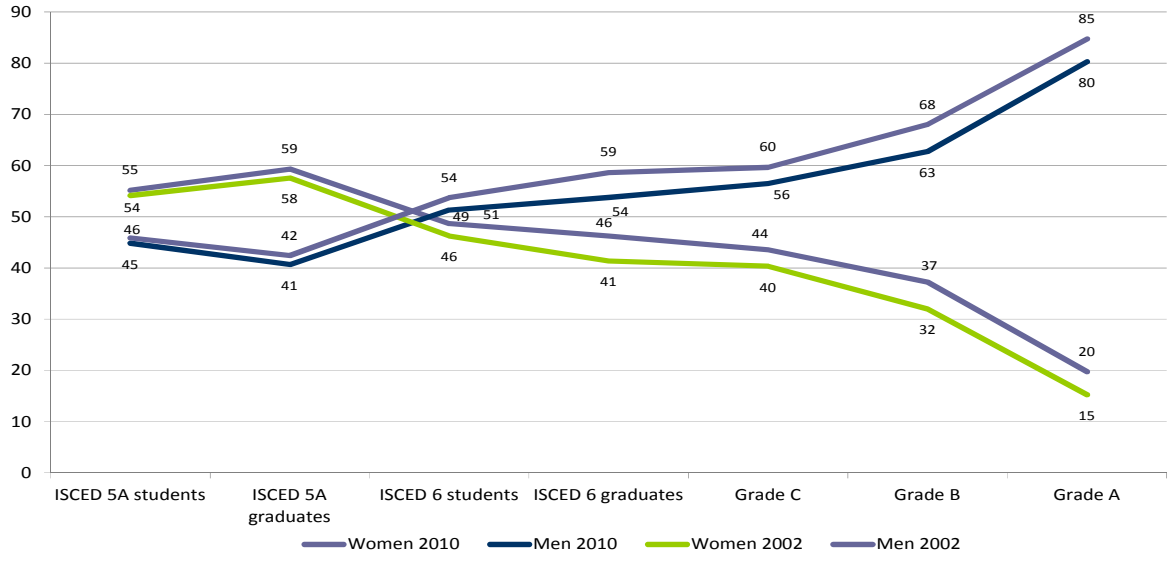
Indicators	Data source(s)
Proportion of academic staff by grade and gender, EU, 2002 and 2010 (%)	WiS[65] database/ SHE figures
Glass Ceiling Index, Europe, 2004 and 2010	WiS database/ SHE figures
Women as Grade A academic staff, Europe, 2010 (%)	WiS database/ SHE figures
Proportion of women as Grade A academic staff by main field of science, Europe, 2010 (%)	WiS database/ SHE figures
Proportion of female heads (president/rector) of institutions in the Higher Education Sector, Europe, 2010 (%)	WiS database/ SHE figures
Proportion of women on boards, Europe, 2010 (%)	WiS database/ SHE figures

2.4 Female researchers in top-level positions – the evolution of a researcher career

Women's careers in research are strongly characterised by vertical segregation: while the proportion of women is relatively high at the level of tertiary education, their proportion diminishes in the later stages of an academic career, especially in top-level positions (scissors effect).

A woman scientist's career differs substantially from a man's. The 'scissors' effect (see figure below) shows the evolution of scientific careers in universities and public research institutes by gender. It provides a graphic illustration of the changes in the gender gap throughout the stages of an academic career.

Figure 10: Proportion of academic staff by grade and gender, EU, 2002 and 2010 (%)



Source: Deloitte

[65] Women in Science (WiS)

Data: WiS database/SHE figures

* Exceptions to the reference years: ISCED 5A Graduates: DK: 2003-2010; FR: 2003-2009; ISCED 6 Students: IT, LU, RO: 2003-2010; SI: 2005-2010; ISCED 6 Graduates: DK; RO: 2003-2010; FR: 2003-2009; WiS database: CZ: 2002-2008; EE: 2002-2004; LT: 2002-2007; DK, FR, CY, AT, PT, RO, SE: 2002-2009; SK: 2002-2011; NL: 2003-2010; UK: 2003-2006.

** Data unavailable: ISCED 6 students: DE; ISCED 5A and 6 Graduates: LU; WiS: EL, IE, MT, PL

Data estimated: EU (by DG Research and Innovation) for WiS, ISCED 6 students and ISCED 5A-6 graduates

Others: Head count (Grades A, B, C): NO: before 2007 biannual data; Grade C unavailable: BG, RO (included in B); LU only 2010 data for ISCED 5A and 6 graduates

The proportion of female students (55%) and female graduates (59%) is higher at the first two levels of academic education (ISCED 5A)[66]. However, men outnumber women as of the third level (ISCED 6 students)[67], when the proportion of women drops back to 49% among PhD students. The gender gap widens further at the PhD level (ISCED 6 graduates), where the proportion of women drops to 46%.

A PhD degree is often required to embark on an academic career. However, the lower representation of women at PhD level statistically diminishes women's chances of pursuing an academic career, and thus reduces female researchers' chances of reaching top-level positions at universities or public research institutes.

The gender gap starts to widen at PhD level; it continues to grow gradually during the research career (Grades C[68] and B[69]). The proportion of women is least at the top of the academic hierarchy, falling back to 20% of Grade A academic staff.

A comparison of data between 2002 and 2010 shows an improvement. Women's relative position at PhD level and at the different levels of the academic career (Grades B and A) shows a positive trend towards more gender balance. This positive long-term trend is reflected in the most recent findings[70], which show that more women are succeeding in climbing the career ladder, especially in the higher echelons of the academic career (Grades C, B and A).

The increase in the number of female researchers in top-level positions in research is nevertheless marginal, especially in light of Member States' objectives of attracting more female researchers into science and technology, and with the European Commission[71] and the Member States' ambitions of reducing gender imbalances in science.

The gender gap has been closing more markedly among scientists than in the labour market in general[72]. However, the relatively higher proportions of women at PhD level have not translated into greater equity at the top. Female researchers face a 'glass ceiling' stopping them from reaching high-level (prestigious) positions in research.

[66] ISCED 5A: Tertiary programmes to provide sufficient qualifications to enter into advanced research programmes & professions with high skills requirements

[67] ISCED 6: Tertiary programmes which lead to an advanced research qualification (PhD)

[68] Grade C: The first grade/post into which a newly qualified PhD graduate would normally be recruited

[69] Grade B: Researchers working in positions not as senior as top position (A) but more senior than newly qualified PhD holders

[70] European Commission (2013b)

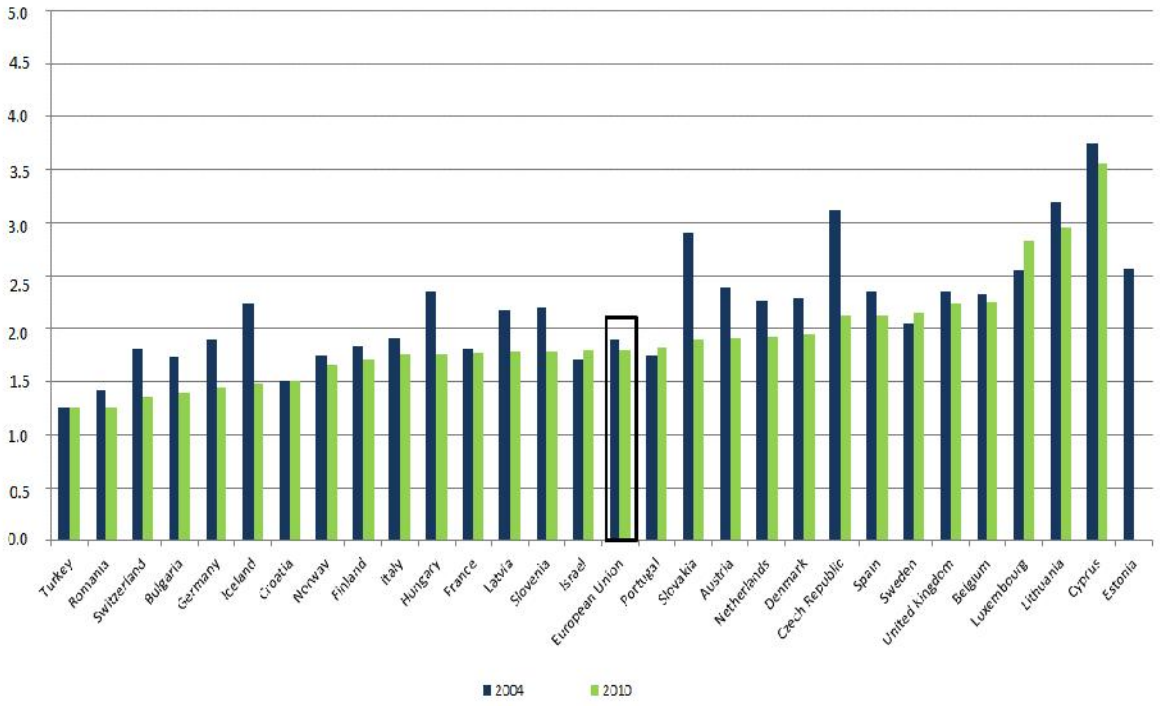
[71] "By the end of 2011, Member States should have strategies in place to train enough researchers to meet their national R&D targets and to promote attractive employment conditions in public research institutions. Gender and dual career considerations should be fully taken into account" (European Commission (2010b)

[72] European Commission (2011b)

Female researchers in all countries face difficulties in climbing the career ladder in the research profession. The probability of women reaching a top-level (Grade A) position in research is highest in Turkey, Romania, Switzerland, Bulgaria and Germany and lowest in Cyprus, Lithuania, Luxembourg, Belgium, UK, Sweden, Spain and the Czech Republic, but relative levels are low and progress is slow.

The Glass Ceiling Index (GCI) illustrates the difficulties women have in gaining access to the highest levels of the academic hierarchy. It measures the relative chance for women, as compared with men, of reaching a top-level position. The GCI compares the proportion of women holding Grade A positions (normally equivalent to Full Professorship) to the proportion of women in academia (Grades A, B and C). The GCI indicates the opportunity, or lack of it, for women to move upwards in their profession. A GCI of 1 indicates no difference in the promotion rate of women and men. The higher the value, the thicker the glass ceiling, and therefore the more difficult it is for women to move into a higher position.

Figure 11: Glass Ceiling Index, Europe, 2004 and 2010



Source: Deloitte
Data: WiS database/SHE figures
*No information available for 2004 and 2007 for BiH, EL, FYROM, IE, LI, MT, ME, PL, and SR and for EE for 2010
** Exceptions to the reference years: CZ: 2004-2008; DK, FR, CY, AT, RO, SE: 2004-2009; UK: 2004-2006; LT: 2004-2007; LU: 2005-2009; PT: 2003-2009; HR: 2008-2010; NO: 2005-2010; IL: 2006-2010; SK: 2004-2011; EE: 2004
*** Data estimated: EU (by DG Research and Innovation)
**** European Union refers to EU-27

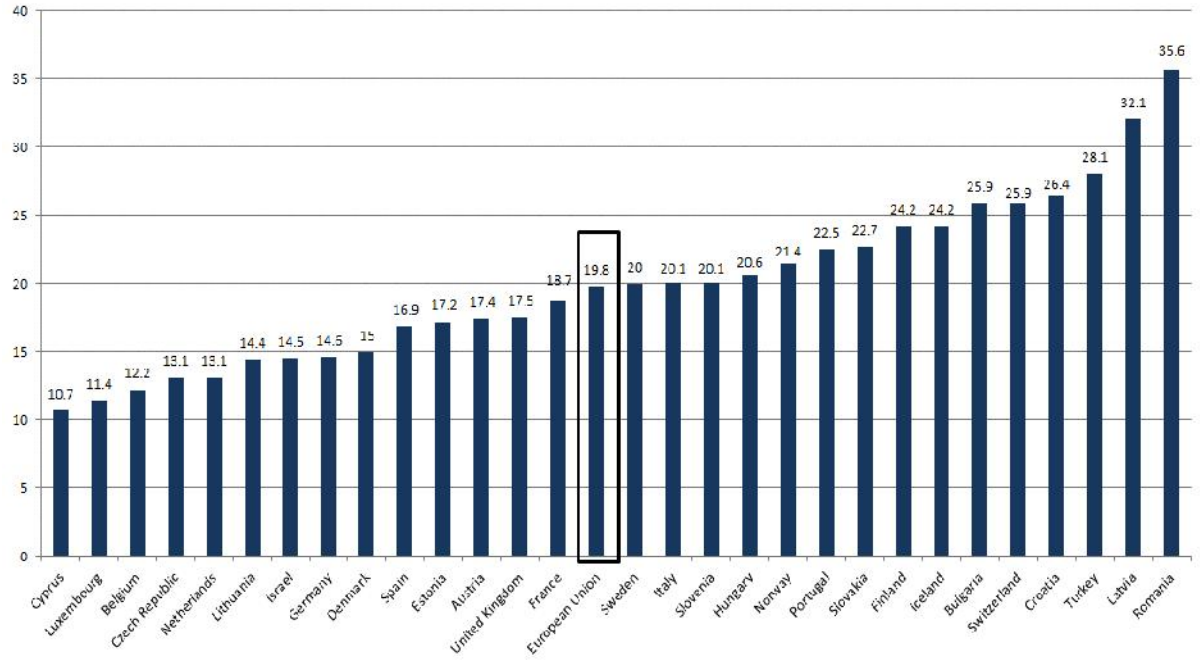
In 2010, the average GCI for the EU was 1.8, with a range from 1.3 in Turkey and Romania (thinner glass ceiling) to 3.6 in Cyprus (thick glass ceiling). Thus, no country reported a GCI equal to or below 1. The GCI was particularly high (>2) in Cyprus, Lithuania, Luxembourg, Belgium, UK, Sweden, Spain and the Czech Republic[73]. The female researchers in these countries have the lowest degree of probability of reaching a top-level academic position.

[73] There are no data for Ireland for 2010, which reported the highest GCI (3.8) in last year's report (*Researchers' Report 2012*).

Between 2004 and 2010, the index decreased or remained stable in most countries (except for Portugal, Sweden and Luxembourg), leading to a lower GCI for the EU. However, the indicator still provides clear evidence of the difficulty female researchers still face in entering high-level positions in research.

The under-representation of women at the higher levels of the academic hierarchy is reflected in the share of women in Grade A academic positions. The culmination of a research career is reaching a top-level position. In 2010, the EU average of the share of women among Grade A academics was 19.8%. The proportion of women in top research positions was highest (>25%) in Romania (35.6%), followed by Latvia (32.1%), Turkey (28.1%), Croatia (26.4%), Switzerland (25.9%) and Bulgaria (25.9%). Cyprus (10.7%), Luxembourg (11.4%), Belgium (12.2%), the Czech Republic (13.1%), and the Netherlands (13.1%) reported lowest (<14%) figures for women in top-level academic positions.

Figure 12: Women as Grade A academic staff, Europe, 2010 (%)



Source: Deloitte
Data: WiS database/SHE figures
*No information available for BiH, EL, FYROM, IE, LI, MT, ME, PL, and SR
** Exceptions to the reference years: 2002: NL, UK, NO: 2003; HR: 2008; IL: 2006; 2010: CZ: 2008; DK, FR, CY, AT, PT, RO, SE: 2009; EE: 2004; LT: 2007; SK: 2011; UK: 2006
*** Data estimated: EU (by DG Research and Innovation)
**** European Union refers to EU-27

The ratio of women in top-level positions in research between 2007 and 2010 rose in nearly every country but unevenly.

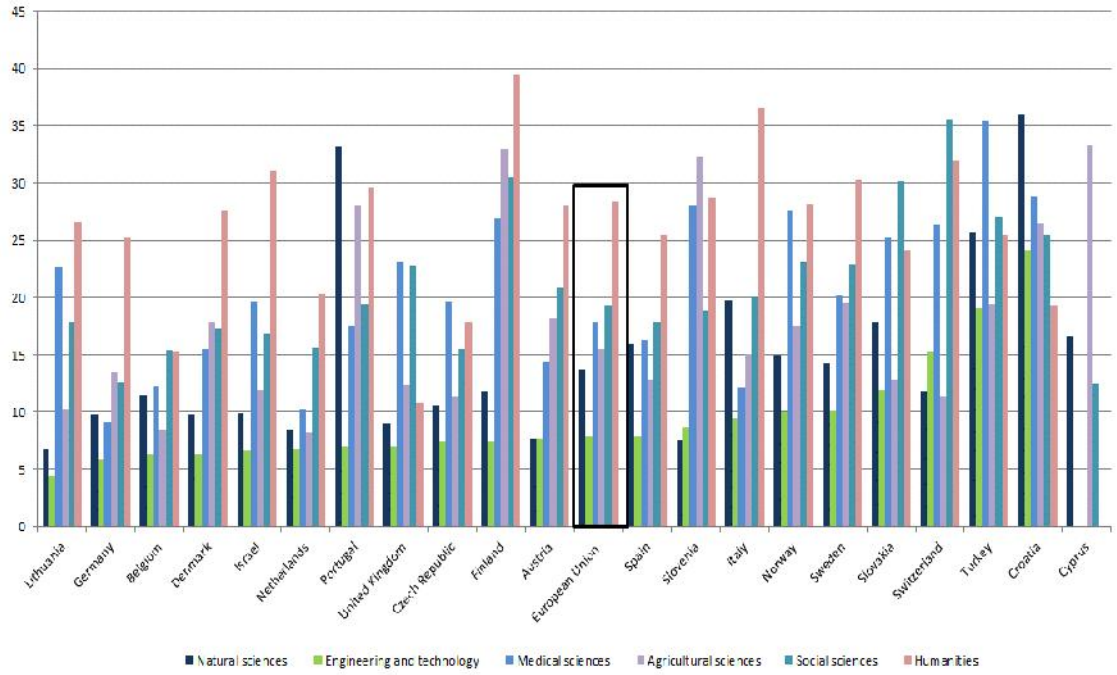
Between 2007 and 2010, the average percentage of women academic Grade A staff in the EU increased from 18.7% to 19.8%, and the majority of countries in the scope of this report reported an increase in the ratio of women in high-ranking academic positions.

Men always outnumber women in the highest academic positions (Grade A positions) in the natural sciences, and engineering and technology, and the differences are significant. The

proportion of women in Grade A positions is higher in the humanities and social sciences, but still lower than men in most cases.

The gender imbalance becomes even more apparent when looking at the proportion of female researchers in top-level positions in the fields of the natural sciences, and engineering and technology (see figure below). An analysis of the differences in the representation of women in scientific fields in the EU reveals that women in Grade A positions are disproportionately under-represented in the fields of natural sciences (13.7%), and engineering and technology (7.9%), compared to figures of 19.4% for the social sciences and 28.4% for the humanities. In most of the countries monitored, there are more female researchers in top-level positions in the humanities than in the other disciplines.

Figure 13: Proportion of woman as Grade A academic staff by main field of science (natural sciences, engineering and technology, medical sciences, agricultural sciences, social sciences, and humanities), Europe, 2010 (%)



Source: Deloitte
Data: WiS database/SHE figures
*No information available for BiH, BG, EE, EL, FR, FYROM, HU, IE, IS, LI, LV, LU, MT, ME, PL, RO and SR
** Exceptions to the reference year: CZ: 2008; DK, CY, AT, PT, SE: 2009; LT: 2007; SK: 2011.
*** Data estimated: EU (by DG Research and Innovation)
**** European Union refers to EU-27

Women are under-represented at the highest levels of academia – in the EU, women head only 16% of universities and HEIs (higher education institutions) as presidents or rectors.

Men dominate in high-ranking positions in institutions in the Higher Education Sector. In fact, the gradual decrease in the proportion of women in higher-ranking positions throughout their career (see scissors effect) severely hampers women's chances of reaching a leading position (president or rector) at a Higher Education Institution (HEI).

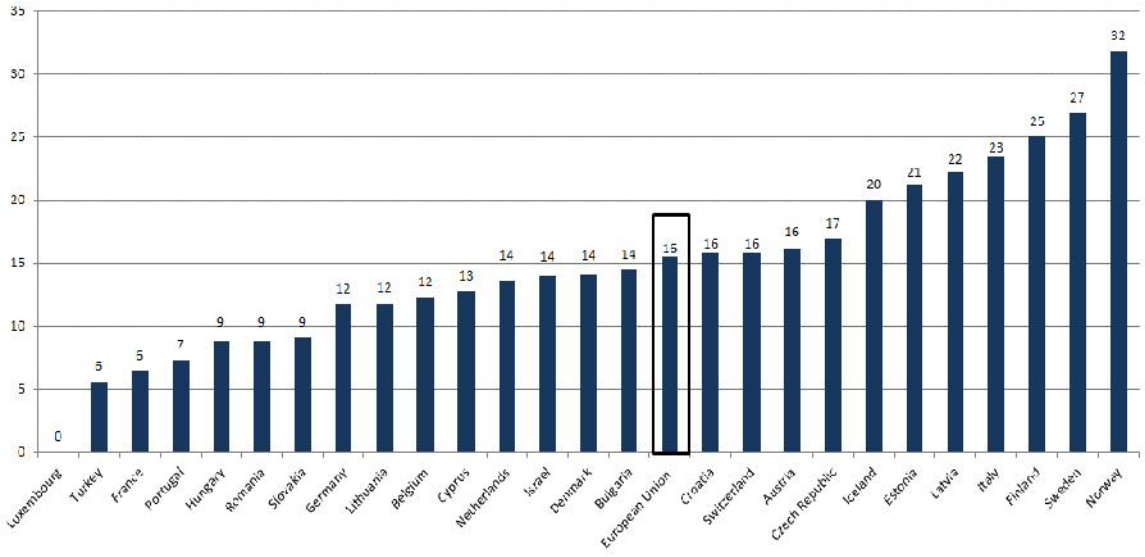
On average in the EU in 2010, women headed only 16% of institutions in the Higher Education Sector. The actual proportion in individual countries in the countries for which statistics are available varied

between 32% in Norway and 6% in France and Turkey. A figure of below 10% was also reported in Portugal (7%), Hungary (9%), Romania (9%) and Slovakia (9%).

The countries show remarkable differences. Yet, it is difficult to detect a pattern. One striking difference is the position of Denmark as an outlier in the Nordic countries. While at least a quarter of the Higher Education Sector heads are women in Norway (32%), Sweden (27%) and Finland (25%), the figure for Denmark is only 14%[74]. At 23%, Italy compares well with the leaders and its position is in sharp contrast with that of France (6%). Austria and Switzerland do well in relative terms (16%), whereas Germany under-performs significantly (12%).

Between 2007 and 2010, the proportion of female heads of institutions in the Higher Education Sector in the EU increased by 3 percentage points and rose in most countries, but at a different pace. Latvia, Austria and Denmark reported a significant increase (>8 percentage points) in the proportion of female heads of HEI institutions during this period, while Cyprus and Israel reported a small decrease (<2 percentage points).

Figure 14: Proportion of female heads (president/rector) of institutions in the Higher Education Sector, Europe, 2010 (%)



Source: Deloitte
Data: WiS database/SHE figures
*No information available for BiH, EL, ES, FYROM IE, LI, ME, MT, PL, SI, SR and UK
** Exceptions to the reference year: PT: 2012; SK: 2011; SE: 2008; HR: 2009.
***Data estimated: EU (by DG Research and Innovation)
**** European Union refers to EU-27

There is a low ratio of women on the boards of universities and HEIs, i.e. there is a gender imbalance in the most important decision-making bodies.

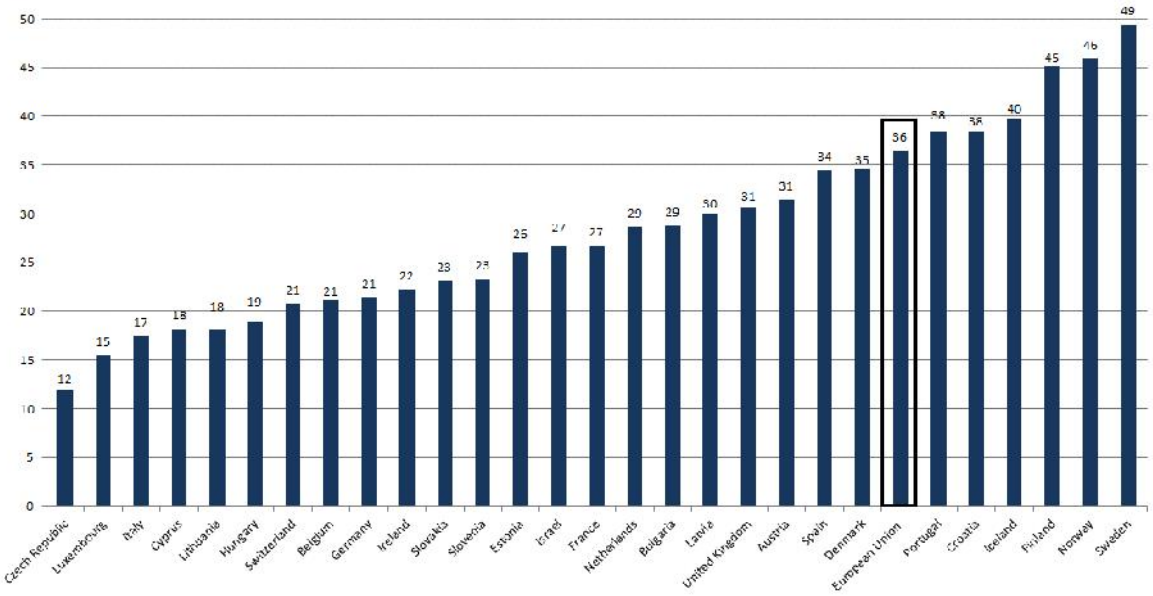
The situation is similar when analysing the proportion of women in decision-making bodies. On average in the EU, only 36% of board members[75] are women. In the EU, the figure tops 40% only in Sweden (49%), and Finland (45%). It is high in Norway as well (46%). The participation of women on

[74] The figure for Denmark was 5% in the *Researchers' Report 2012.*

[75] The notion covers, according to the SHE figures, membership of scientific commissions, R&D commissions, boards, councils, committees and foundations, academy assemblies and councils, and also different field-specific boards, councils and authorities (European Commission (2013b), p. 116

boards is lowest (<20%) in the Czech Republic (12%), Luxembourg (15%), Italy (17%), Cyprus (18%), Lithuania (18%) and Hungary (19%). Portugal (38%) (and Croatia (38%)) show figures slightly above the EU average, whereas Denmark (35%) and Spain (34%) have ratios slightly below the EU average.

Figure 15: Proportion of women on boards, Europe, 2010 (%)



Source: Deloitte
Data: WiS database/SHE figures
*No information available for BiH, EL, FYROM IE, LI, ME, MT, PL, SI, SR
** Exceptions to the reference year: FR: 2002; IE: 2004; BE, LT, SE: 2007; CZ: 2008; PT, UK: 2009
*** Data estimated: EU, EU-25, EU-15 (by DG Research and Innovation)

2.5 Support for women in top-level positions

The great majority of European countries have introduced general support measures to promote equal opportunities for men and women. There do not yet appear to be enough measures addressing work-life balance, transparency and appointment procedures. This year, the majority of countries have reported new measures to address the issues at a high (government) level.

The paucity of women in senior positions inevitably means that the individual and collective opinions of women are less likely to be voiced in policy-and decision-making processes. This may lead to biased decision-making on topics relating to the future development of research careers. In addition, if female scientists are not visible and not seen to be succeeding in their careers, they cannot serve as role models for attracting and training young women in scientific professions[76].

The countries in scope of this report have put in place a plethora of measures aiming to address the gender imbalance in research decision-making and to support women in their career aspirations. The table below provides an overview of different measures[77] the countries have taken to promote (more)

[76] European Commission (2008a)

[77] The countries' reported measures are listed individually in one of the three overarching categories: 1. Fair access to research funding; 2. Appointment/promotion to decision-making posts at a later stage of a researcher career; 3. Leadership support for the principle of gender balance). Each measure is listed only once and is categorised on the basis of its key objective (as some measures may correspond to different categories)

women to top-level academic positions. For a comprehensive overview of these measures, see Annex III "Women in the research profession".

Table 8: Support for women in rising to top-level positions – overview of national measures

Country	Women in top-level research positions					
	Type of measure					
		Appointment/promotion to decision-making posts at a later stage of researcher career				
	Measures explicity to improve research funding	Gender parity on boards, targets & quotas	Work life balance	Training / support for high level positions	Transparency in appointment procedures & results	General support by national authorities for the principle of gender balance
AUSTRIA	✓✓✓✓✓	✓✓✓✓	✓	✓✓✓✓		✓✓
BELGIUM		✓				✓✓✓✓✓✓✓✓✓
BIH						✓
CROATIA						✓✓✓✓✓✓✓
CYPRUS	✓✓✓					
CZECH REPUBLIC			✓	✓		✓✓✓✓
DENMARK	✓	✓				✓✓✓✓✓
ESTONIA		✓			✓	✓✓
FINLAND		✓			✓	✓✓✓✓
FRANCE		✓✓✓	✓	✓✓✓	✓	✓✓✓✓✓✓✓✓✓
FYROM						✓✓
GERMANY	✓✓✓✓	✓		✓✓✓✓✓✓		
GREECE		✓				✓
HUNGARY		✓				✓✓✓
IRELAND	✓✓	✓		✓	✓	✓✓✓✓✓✓✓
ITALY	✓	✓		✓		✓
LATVIA	✓					
LITHUANIA						✓✓
LUXEMBOURG		✓✓				✓
MALTA	✓			✓		✓✓✓
MONTENEGRO						✓
NETHERLANDS	✓✓			✓		✓
NORWAY		✓✓		✓	✓✓✓	
POLAND	✓✓	✓	✓			✓
ROMANIA				✓		
SERBIA						✓
SLOVENIA	✓	✓				✓✓✓✓
SPAIN		✓✓✓				✓✓
SWEDEN		✓			✓✓	✓✓✓✓✓
SWITZERLAND		✓✓	✓	✓✓		✓✓✓✓✓
UNITED KINGDOM					✓	✓✓✓✓✓✓

Source: Deloitte, *Researchers' Report* 2014, Annex 'Country files'

* Updated information is not available this year for BG, PT, SK, IC, LI and IL

** No relevant information reported for Turkey

*** Information presented in this table is limited to the input provided by individual countries in their response to the Deloitte questionnaire (2011) and subsequent updates (reporting exercise 2012 and 2013).

The measures fall into three overarching categories[78]. The first group is composed of measures to improve (junior) female researchers' access to research funding. Fair access to funding, especially at an early stage of a researcher career, is a pre-condition for successful promotion to higher posts. The types of measure vary from training activities to improve women's (research) proposal writing capabilities, career development programmes, talent programmes, awards, coaching activities and special funding schemes dedicated to women to bonus points for gender-balanced project teams.

For example, the Industrial PhD Programme of the National Foundation for Research, Technology and Development (Austria) supports highly qualified women in working in applied research. The TALENTA programme (Germany), a support and development programme, aims to provide support for two years to female scientists and female graduates at Fraunhofer launching their own career development.

[78] Based on European Commission (2008a)

The second group of measures encompasses activities and instruments to facilitate women's access to top-level positions (on boards, in the higher education sector and public research institutes) and ultimately raise their chances of appointments and promotions to top-level research jobs. These measures target female researchers at an advanced level of their academic career in particular. The measures include concrete gender targets and quotas in order to reach gender parity on boards, work-life balance provisions enabling women to pursue a position of responsibility, advanced training and support (mentoring/empowerment) as well as measures to enhance transparency in the appointment procedures[79] designed to produce the effect that women will not be discriminated against.

During this year's reporting exercise, a significant number of countries reported new measures to facilitate women's access to top-level positions, such as gender targets and quotas to reach gender parity on boards. For example, the Irish Research Council launched its Gender Strategy and Action Plan 2013-2020 in 2013. Due to under-representation by gender, Ireland, like other countries, is currently under-utilising a significant cohort of the population of highly talented researchers. There is also a gender dimension to the definition of research projects. This may not always be relevant in terms of the research content, it is well established that, where it is, failure to integrate sex and gender analysis into the design, implementation, evaluation and dissemination of the research can lead to poor results and missed opportunities. The Strategy and Action Plan includes both sexes, and aims to provide equal outcomes for both men and women. The Council will also only fund excellent research, and excellent research fully considers whether a potential sex and/or gender dimension is relevant to the research content and fully integrates sex/gender analysis where relevant.

In France, the Act of 22 July 2013 on higher education and research, makes it compulsory for HEIs to have a structural equal opportunities programme. Gender balance is a prerequisite of nominations to the governance entities and of election lists in HEI's, and a number of government bodies in the fields of education and research.

In the Czech Republic, on 31 January 2013, the Senate of the Parliament of the Czech Republic adopted an amendment to the Higher Education Act No. 111/1998 Coll., which strives to improve the conditions of women who decide to have a child during their studies. On 15 February 2013, the President of the Republic signed the bill into law.

In Denmark, in December 2012, the equality legislation was amended in order to address the issue of gender imbalance on corporate boards. One amendment, under the responsibility of the Ministry of Business and Growth, states that the 1 100 largest companies must each set realistic and ambitious targets for the underrepresented gender on boards. A second amendment, under the responsibility of the Ministry for Gender Equality and Ecclesiastical Affairs, aims to ensure a more equitable distribution of women and men on state enterprise boards. This bill requires all state institutions (which includes universities) and companies to set targets for the number of the underrepresented gender on their boards and other collective management bodies.

[79] Comprises measures favouring women in selection procedures and measures promoting an open, fair and transparent recruitment irrespective of gender.

Finally, in Malta, the Directory of Professional Women aims to identify women in various sectors who have the possibility of being appointed to serve on Boards, Committees, Representations or any other decision-making positions.

The third group are different types of government measure to stimulate a discussion around the topic of gender balance and to provide leadership support for the principle of gender balance in research. This group encompasses national laws, action plans, the setting up of committees and working groups with the aim of reducing the gender imbalance in the research profession.

For example, the Slovenian Ministry of Higher Education, Science and Technology in 2001 established a National Committee on Women in Science. The National Committee has an Annual Work Plan and reports annually to the Ministry. It is an advisory/expert body. It has 15 members from different institutions and scientific disciplines and its main focus is collecting data and raising awareness, networking of researchers from different scientific disciplines dealing with gender issues, and cooperation with other relevant organisations in Slovenia and the Helsinki Group on Women and Science[80].

In Belgium, all Flemish universities have action plans on gender equality in the research profession. These were drawn up in collaboration with the Flemish Interuniversity Council. They will start the implementation of these plans in 2014. In addition, in early 2014, the Wallonia-Brussels Federation allocated a EUR 150 000 budget to finance a "Gender contact person" (*personne de contact genre*) in each university of the Wallonia-Brussels Federation. They will be in charge of gender matters within their university. Their first mission will be to write an annual report on gender balance.

In Hungary, the Ministry of National Economy and the National Innovation Office, held a roundtable discussion on the topic of women in science at the beginning of 2014. As a result of this event, a Cooperation Agreement was signed by the National Innovation Office and the Woman in Science Association. The agreement stipulates that the parties will cooperate in examining the gender dimension to science and research.

Many European countries have adopted various leadership support measures to promote gender equality in the research profession. These include the setting up of special bodies dedicated to the issue of gender balance, the anchoring of the gender balance principle in national Constitutions, Charters, Action Plans, the development of Laws and Acts on gender equality/equal treatment, Memoranda of Understanding, performance agreements, etc. Special bodies, such as Units/Offices within Ministries, Committees/Councils, Equality Centres, Ombudsmen for Equality or Equality Boards responsible for monitoring the equal representation of both sexes, covering, amongst others, the research profession, are common.

[80] The Helsinki Group on Women and Science was established in November 1999 as part of the Commission action plan "Women and Science: mobilising women to enrich European research". The group's mandate is to exchange experience and inform the Commission about policies and measures implemented at local, regional, national and European levels to promote gender equality in science. For more information about the group's mandate, see: http://ec.europa.eu/research/science-society/document_library/pdf_06/mandate-final-march2007_en.pdf

In addition, several countries confer awards[81] of excellence on female scientists to raise awareness of women in science and to reward outstanding female researchers for their contribution to research. For example, the "Girls of the Future – in the footsteps of *Maria Skłodowska-Curie*" competition (Poland) aims to support talented young female researchers and promote their scientific achievements.

The *Käthe Leichter* State Award for 'Women's and Gender Studies' and for 'Equality in the World of Work' (Austria) is awarded for outstanding achievements by women in the social sciences, the humanities and the cultural sciences or outstanding achievements in gender equality. The award is endowed with EUR 5 000 and is conferred by the cabinet member responsible for women's issues.

In 2009, the Czech Ministry of Education, Youth and Sports introduced the *Milada Paulova* Award for life-long achievement in science for female researchers. The award aims to recognise publicly and financially the research achievements of prominent Czech female researchers in a particular discipline, including the fields of pedagogy, supervision, cooperation with civil society and the industrial sector.

Further analysis is needed to assess the direct and indirect effects of these measures on raising the share of female researchers in top-level positions in public research institutions in Europe. Especially for some of the more recent measures, it is too early to assess the impact.

[81] There were no new awards reported in the 2013 reporting exercise (*Researchers' Report 2014*).

3. Open, transparent and merit-based recruitment

3.1 Open, transparent and merit-based recruitment – Highlights

Openness and research performance:

- Openness and innovation go hand-in-hand, i.e. countries with open and attractive research systems are strong performers in terms of innovation (c.f. Innovation Union Scoreboard).

Public authorities' perception of the national recruitment system in public research institutions:

- The vast majority of national authorities consider that their national recruitment systems are largely open and transparent; moreover, many countries' public authorities and public research institutions report having taken steps to make recruitment systems more open, transparent and merit-based, e.g. by publishing vacancies on portals such as EURAXESS Jobs, establishing rules for the composition of selection panels and training staff on recruitment panels;
- A comprehensive review[82] of all universities or research institutes who had gained the Human Resources Excellence in Research Award by 2013 reveals that 90% had reviewed or were in the process of reviewing recruitment processes. It is important to bear in mind that this is a rather selective group involving institutions who have adopted HR strategies for researchers.

Stakeholders' perception of the national recruitment system in public research institutions:

- The perception of many researchers, particularly in some Member States, is that public institutions' recruitment rules and procedures are neither open nor transparent. Reasons include protectionism/nepotism, the lack of a human resources strategy in institutions, the lack of information and awareness of job portals such as EURAXESS Jobs;
- Levels of dissatisfaction vary by a factor of more than three to one across the EU.

Key indicators to assess the openness and fairness of a recruitment system for researchers:

- Excellent progress has been made at EU level in publishing vacancies: there was an eight-fold increase in the number of jobs advertised on EURAXESS Jobs between 2007 and 2013; in some countries, e.g. Austria, Croatia, Italy and Poland, publication on EURAXESS or other cross-border portals is mandatory.

Towards a practitioner's toolkit:

- Member States [83] and the Commission have agreed to set up a working group with stakeholders to develop a practitioner's toolkit on open, transparent and merit-based recruitment based on good practice.

3.2 Introduction

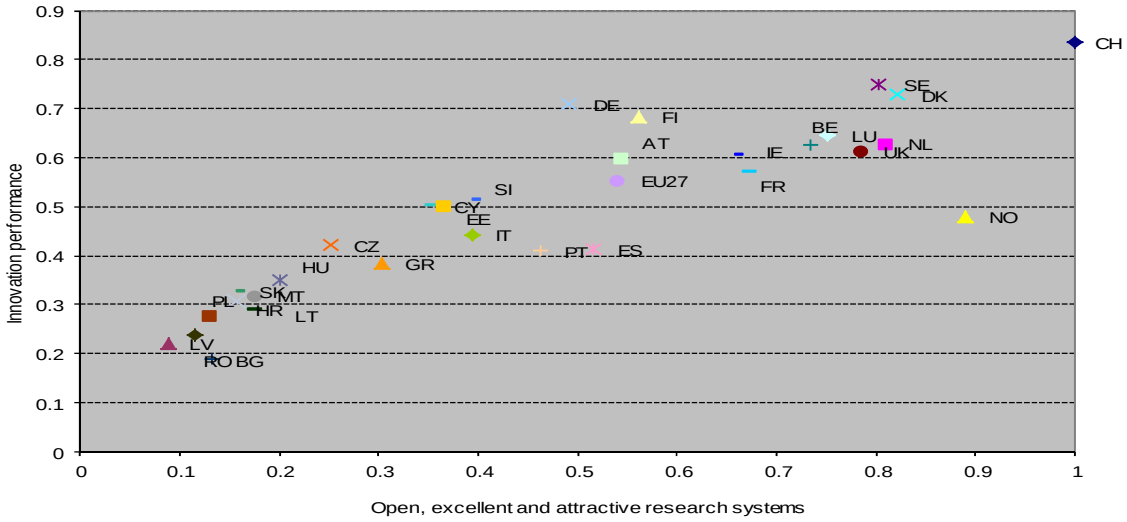
Evidence shows that openness and innovation go hand-in-hand, i.e. countries with open and attractive research systems[84] are strong performers in terms of innovation.

[82] Available at: http://www.vitae.ac.uk/CMS/files/upload/Vitae-HR-Strategies-for-researchers-Report-2013.pdf

[83] In the course of a European Research Area and Innovation Committee (ERAC) mutual learning seminar organised in 2014

[84] Based on the following three Innovation Union Scoreboard indicators: international scientific co-publications, scientific publications among top 10% most cited and non-EU doctorate students.

Figure 16: Open, excellent and attractive research systems and Innovation Performance



Source: DG Research and Innovation calculations based on Innovation Union Scoreboard 2014

Open, transparent and merit-based recruitment procedures in public research institutions across Europe are a prerequisite for the realisation of ERA. They are a precondition of high academic performance and teaching excellence by ensuring optimal allocation of human resources based on merit and academic excellence. Moreover, transparent recruitment procedures offer researchers equal opportunities at all stages of a researcher career by granting applicants fair access to competition-based research posts nationally and internationally. Fair access to attractive research positions in turn has a positive impact on the attractiveness of the research career. Transparent recruitment procedures are also indispensable for facilitating researchers' mobility. Research positions should be filled based on open, transparent and merit-based recruitment procedures proportionate to the level of the position in line with the basic principles of the Charter & Code[85].

Table 9: Open, transparent and merit-based recruitment – a definition

A recruitment system can be defined as open, transparent and merit-based if it meets all or some of the following criteria:	
I.	Job vacancies are published on the relevant national websites;
II.	Job vacancies are published on relevant Europe-wide online platforms, e.g. EURAXESS;
III.	Job vacancies are published in English;
IV.	Institutions systematically establish selection panels;
V.	Institutions establish clear rules for the composition of selection panels;
VI.	Institutions publish the composition of a selection panel;
VII.	Institutions publish the selection criteria together with the job advert;
VIII.	Institutions stipulate minimum time periods between vacancy publication and the deadline for applying;
IX.	Institutions place the burden on the employer to prove that the recruitment procedure was open and transparent;
X.	Institutions offer applicants the right to receive adequate feedback;
XI.	Institutions have a complaint mechanism in place;
XII.	Institutions provide staff on recruitment panels with appropriate training.

Source: Deloitte, based on the European Commission SGHRM Questionnaire (2011)

[85] European Charter for Researchers and a Code of Conduct for the Recruitment of Researchers. More information available at: http://ec.europa.eu/euraxess/index.cfm/rights/europeanCharter

Mobility is a core of the concept of the ERA. Transparent recruitment policies and procedures in all European countries have the potential to facilitate researchers' mobility by matching supply and demand for the best-suited research positions across Europe.

While researcher mobility contributes to excellence, several obstacles stand in the way of a genuine European research labour market. One of the most important is the lack of transparent, open and merit-based recruitment. This makes research careers less attractive and hampers mobility, gender equality and research performance. In its Conclusions on 'A reinforced European research area partnership for excellence and growth'[86], the Council of the European Union fully supported this conclusion.

National authorities acknowledge the positive impact of an open recruitment system on scientific quality and productivity, researchers' international mobility, the attractiveness of research careers, and equal access to job opportunities for women and men. The vast majority of national authorities consider the recruitment system in their countries to be largely fair and transparent. This is in sharp contrast to the perceptions of many researchers in certain countries who perceive the public institutions' recruitment rules and procedures to be neither fair nor transparent. Researchers frequently cite the absence of open access to job opportunities as a disincentive to starting or remaining in a research career in Europe. This discrepancy is partly due to a lack of clear evidence on the degree of openness of national recruitment systems which this chapter attempts to address.

Outline

This chapter presents the most recent data on the openness of the public recruitment systems in Europe as well as the countries' perceptions of the degree of openness of the national research systems. First, it offers an overview of the key indicators for monitoring open recruitment. Second, it presents the most recent figures on the number of researcher posts advertised through the EURAXESS Jobs portal per thousand researchers in the public sector. Third, this chapter presents statistics on the share of researchers in the public sector who are satisfied with the extent to which research job vacancies are advertised externally by their institution in the different countries and according to different researchers' career stages. Fourth, the report presents an overview of the countries' perceptions of the level of openness and transparency of their national research systems.

3.3 Open, transparent and merit-based recruitment – Key indicators

The table below presents an overview of key indicators and the source for monitoring open, transparent and merit-based recruitment in Europe.

[86] Council of the European Union (2012)

Table 10: Open, transparent and merit-based recruitment - Key indicators

Indicators	Data source(s)
Researcher posts advertised through the EURAXESS Jobs portal, Europe, 2009-2013	EURAXESS JOBS
Researcher posts advertised through the EURAXESS Jobs portal per thousand researchers in the public sector, Europe, 2013	EURAXESS JOBS
Share of researchers in the public sector satisfied with the extent to which research job vacancies are advertised externally by their institution, Europe, 2012 (%)	MORE2 study
Share of researchers in the public sector satisfied with the extent to which research job vacancies are advertised externally by their institution, by career stages, Europe, 2012 (%)	MORE2 study

3.4 The EURAXESS Jobs Portal

In 2003, the European Commission launched the European Researcher's Mobility Portal[87] to provide researchers with up-to-date information about jobs and funding opportunities. In 2008 this portal became part of the broader EURAXESS – Researchers in Motion portal[88], which offers, among other things, practical information on job vacancies and fellowship programmes.

The job market for researcher positions must be open and transparent so as to ensure an optimal allocation of posts based on supply and demand. Open, transparent and merit-based recruitment is thus indispensable for the realisation of ERA. The number of research posts advertised via the EURAXESS Jobs portal provides an indication as to the level of (international) transparency in each country. It provides information on the number of research-related positions posted by employers. It is reasonable to assume that there is a positive correlation between the number of job postings on international job platforms, such as EURAXESS Jobs and the openness of a recruitment system.

This indicator should however be treated with caution. The publication of job vacancies on relevant Europe-wide online platforms such as EURAXESS Jobs is only one of many indications of an open, transparent and merit-based recruitment system (see the definition of an open, transparent and merit-based recruitment system in Table 11). Countries such as Germany, which report a relatively low number of research posts advertised on the EURAXESS Jobs portal per thousand researchers in the public sector, have set up national systems. The indicator nevertheless shows a general trend on a certain level of openness of recruitment practices in European countries. However, it is not possible to calculate with precision the level of transparency in each country due to the indicator's (methodological) limitations. Moreover, it should be noted that open recruitment alone is not the remedy for some countries to, for example, attract foreign researchers. It needs to be part of a package including better salaries, faster visa procedures, etc.

Between 2009 and 2013, the total number of research-related jobs posted on the EURAXESS Jobs increased sharply from 4 997 to 40 207, including information from other national research job portals. This was due to concerted efforts by the Commission and several Member States to ensure that a much larger proportion of research vacancies were posted on the portal. This positive trend serves as an indicator of improved accessibility of information on publicly funded research posts across Europe.

[87] Known as EURAXESS Jobs after the launch of the EURAXESS – Researchers in Motion brand in June 2008

[88] Four pillars compose the EURAXESS – Researchers in Motion initiative and its portal: Jobs, Services, Rights and Links

Table 11: Researcher posts advertised through the EURAXESS Jobs portal, Europe, 2009-2013

Year	Job Vacancies total (online and via xml)
2009	4 997
2010	7 324
2011	30 186
2012	36 521
2013	40 207

Source: Deloitte
Data: EURAXESS JOBS

However, in the Public Consultation on the ERA Framework[89], 67% of respondents cited the lack of awareness of job portals such as EURAXESS Jobs as a key factor inhibiting open and transparent recruitment procedures. Thus, the openness of recruitment systems through an increased number of job postings on international portals such as EURAXESS Jobs must go hand in hand with an increased awareness of the existence of such portals.

According to a recent large-scale survey[90], almost two thirds of respondents use the EURAXESS Jobs portal, but a third needed to be convinced of its utility. Universities attach high value to open recruitment and emphasise that there are other effective routes for research post recruitment such as national, European and international scientific journals. The survey results showed that 16.7% of respondents used the portal for all open vacancies of research posts and 48.2% used the portal for some research posts. The proportion not yet having used the portal was 29.7%, while a further 4.5% were not aware of its existence. Only 0.9% saw no reason to use the portal.

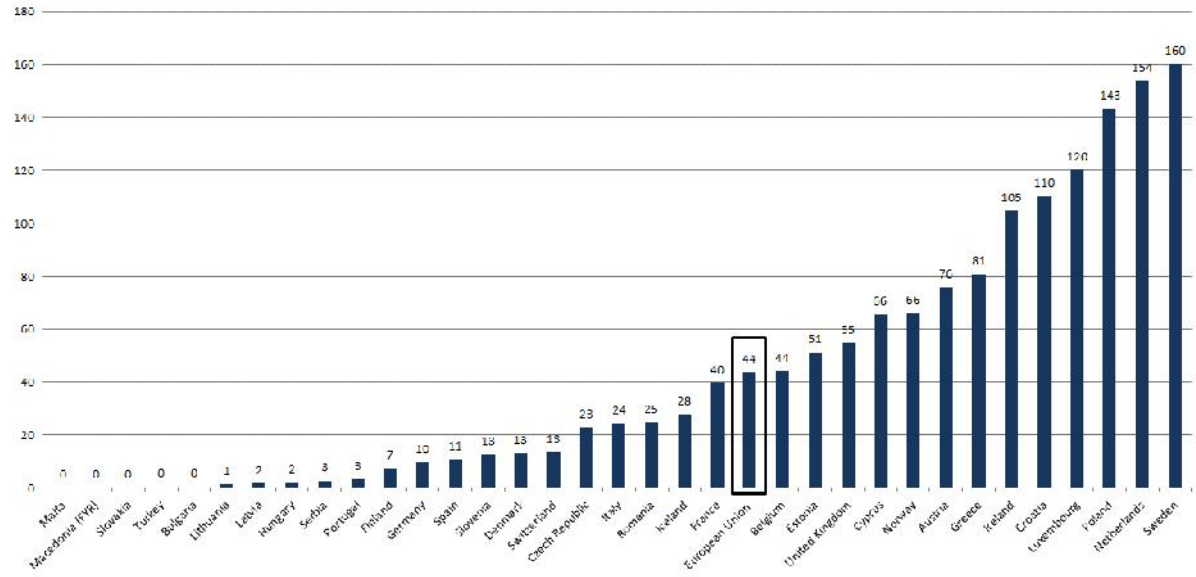
The share of research posts advertised on the EURAXESS Jobs portal per thousand researchers in the public sector provides an indication as to the level of (international) transparency in each country. Sweden, the Netherlands, Poland, Luxembourg, Croatia and Ireland rank best for the share of jobs posted on the EURAXESS Jobs portal.

Generally speaking, if job positions are not advertised publicly and widely, the chances of recruiting the best possible talent are more limited. In 2013, the average number of job postings on the EURAXESS Jobs portal per thousand researchers in the public sector for the EU-28 was 44, with a range from 160 in Sweden to five or fewer in several countries. The number of jobs advertised via the online platform was particularly high (>100) in Sweden (160), the Netherlands (154), Poland (143), Luxembourg (120), Croatia (110) and Ireland (105). Thus, researchers across Europe benefit from more open and transparent access to research-related jobs in these countries.

We note a low (<5) share of researchers posts advertised on the EURAXESS Jobs portal per thousand researchers in the public sector in a range of countries: Portugal, Serbia, Hungary, Latvia, Lithuania, Bulgaria, Turkey, Slovakia, FYROM and Malta. Switzerland, Denmark, Slovenia, Spain, Germany and Finland also report relatively a low (<15) numbers of job postings on EURAXESS per thousand researchers in the public sector, though Germany, for example, has a national system as noted above.

[89] European Commission (2012a)
[90] European University Association (2014)

Figure 17: Researcher posts advertised through the EURAXESS Jobs portal per thousand researchers in the public sector, Europe, 2013



Source: Deloitte
Data: EURAXESS JOBS
*No information available for BiH, IL, LI, ME
** Figures are rounded to the nearest 10
*** European Union refers to EU-28

The number of research posts advertised on the EURAXESS Jobs portal continued to rise in a number of European countries between 2012 and 2013, albeit at a different pace.

Between 2012 and 2013, the average number of research posts advertised via the EURAXESS Jobs portal per thousand researchers in the public sector in the EU-28 increased from 40.8 to 43.7 (+7%), and a number of countries within the scope of this report reported an increase in the number of research posts advertised on the portal, though the pattern of increases was uneven.

3.5 Open recruitment in institutions

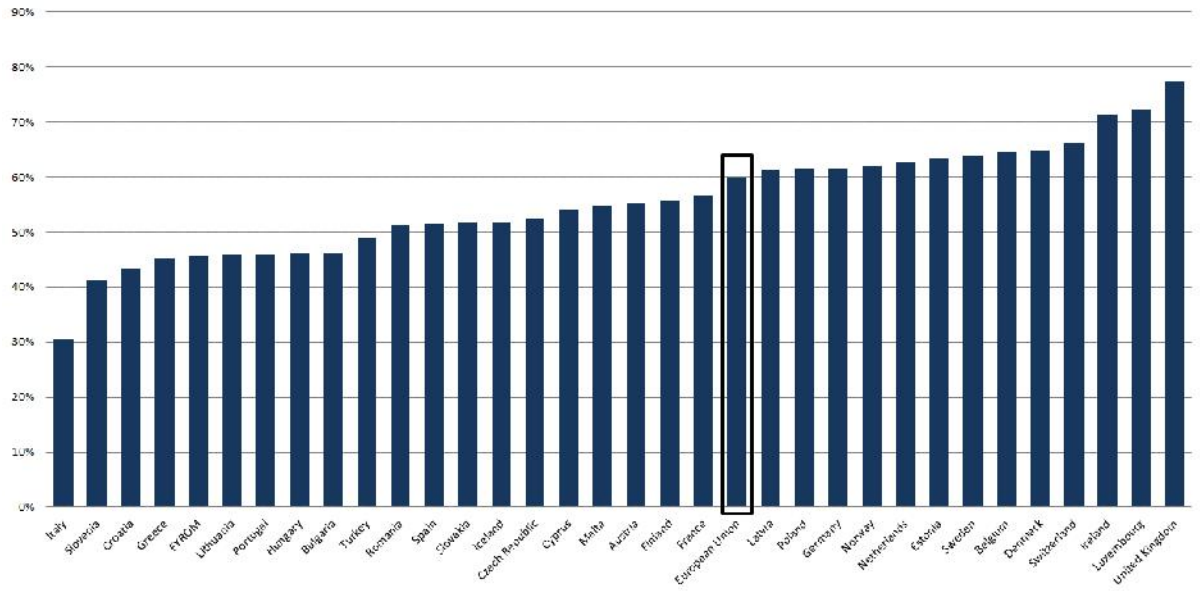
The majority of EU researchers in the public sector (60%) are satisfied with the extent to which research job vacancies are advertised externally by their institution. The remaining 40% are dissatisfied with the situation, but this average masks significant differences between Member States.

According to a recent large-scale survey[91], 60% of EU researchers on average are satisfied with the extent to which research job vacancies are advertised externally by their institutions, meaning that 40% are dissatisfied. The country differences show a similar pattern compared to the number of researcher posts advertised on the EURAXESS Jobs portal per thousand researchers in the public sector. Researchers who benefit from working in more open, excellent and attractive research systems[92] in countries such as the UK (22% of researchers were not satisfied), Ireland, Denmark, Belgium and the Netherlands are also more likely to be satisfied with the extent to which research

[91] IDEA Consult (2013)
[92] See Innovation Union Scoreboard 2013, available at: http://ec.europa.eu/enterprise/policies/innovation/files/ius-2013_en.pdf

jobs are advertised externally by their institutions in those countries. In contrast, 54% in Portugal, 55% in Greece and 69% in Italy expressed dissatisfaction. Accordingly, efforts need to focus on those countries where the dissatisfaction is particularly acute.

Figure 18: Share of researchers in the public sector satisfied with the extent to which research job vacancies are advertised externally by their institution, Europe, 2012 (%)

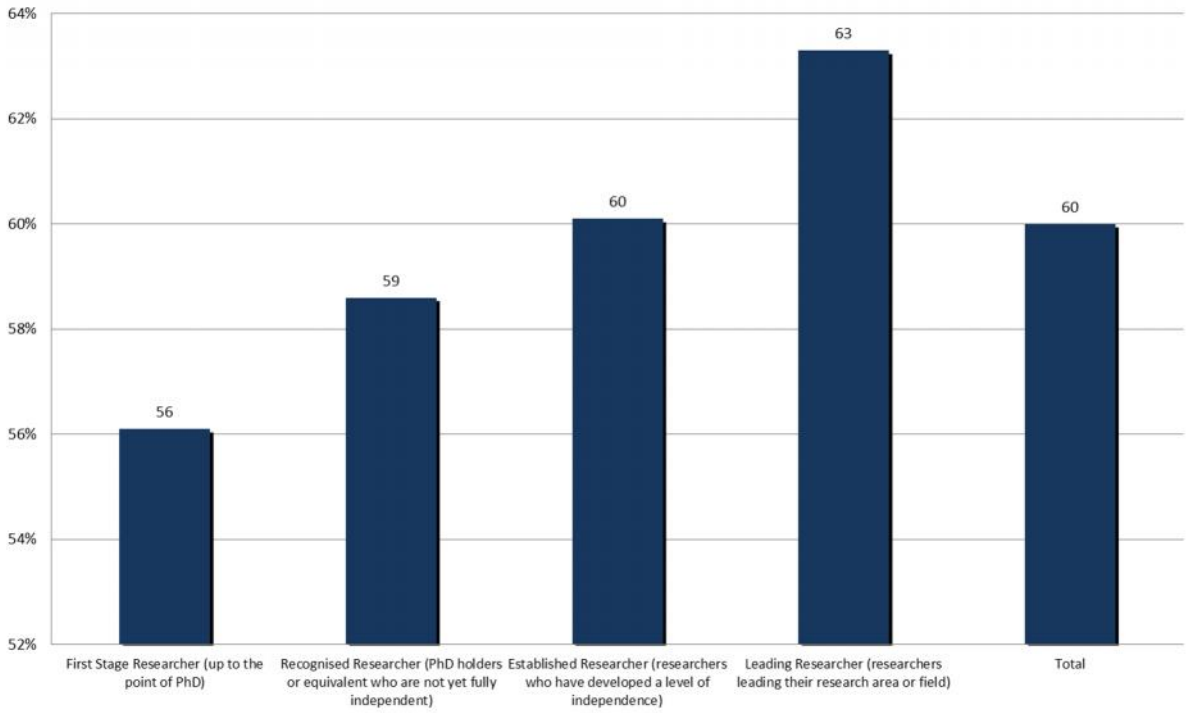


Source: Deloitte
Data: MORE2 study "Support for continued data collection and analysis concerning mobility patterns and career paths of researchers", IDEA Consult (2013)
*No information available for BiH, IL, LI, ME and SR
** European Union refers to EU-27

As shown in the figure below, the level of satisfaction increases during the researcher's career, though not dramatically: from a 56% satisfaction level among First Stage Researchers (R1) to 63% among Lead Researchers (R4).

In general, European researchers are more satisfied with the transparency of the recruitment process (65%) and that the recruitment is merit-based (66%) than with the extent to which vacancies are advertised (60%). It is difficult to know what to read into this as one might have expected researchers to be more dissatisfied about the transparency of the process. But most countries are the opposite. For example, 46% of researchers in Italy are satisfied with the transparency of the process, while only 31% are satisfied with the extent to which posts are advertised. The differences appear subtle, and it is difficult to detect a pattern.

Figure 19: Share of researchers in the public sector satisfied with the extent to which research job vacancies are advertised externally by their institution, by career stages, Europe, 2012 (%)



Source: Deloitte
Data: MORE2 study "Support for continued data collection and analysis concerning mobility patterns and career paths of researchers", IDEA Consult (2013)

There is wide acknowledgement among stakeholders of the importance of an open, transparent and merit-based recruitment system as a precondition of excellence and innovation in research, and of attracting women. The European Science Foundation (ESF) argues that "*The importance of transparency of recruitment criteria and their accountability in order to ensure equal opportunities in all stages of the career process is a precondition to excellence and innovation in research. The lack of transparency and accountability (...) appear to disadvantage women scientists and other minority groups of researchers. This leads to a limited pool of potential* candidates *at the expense of scientific excellence*".[93]

The position of the League of European Research Universities (LERU) is similar: "*It is well known that Europe is still under-utilising a considerable amount of its female intellectual capacity. Transparency of all assessment and recruitment procedures is essential at junior and senior levels; having consistent and rigorous recruitment processes for academic staff is critical for women's success*."[94]

The vast majority of national authorities consider the recruitment system in their country to be largely open and transparent. Most countries report that public authorities and public research institutions have taken concrete steps to make the recruitment system more open, transparent and merit-based, by establishing selection panels, granting rights to applicants to receive adequate feedback, and establishing rules for the composition of selection panels.

[93] European Science Foundation (2010)
[94] League of European Research Universities (2011)

The contributions by countries within the scope of this report revealed that national authorities consider their national recruitment systems to be open and transparent (c.f. Researchers Report 2013). As we have seen, the result is in sharp contrast to the perceptions of many researchers in several Member States who perceive the public institutions' recruitment rules and procedures to be insufficiently open, transparent and merit-based[95]. It is therefore important to assess the countries' and public institutions' measures aimed at making European researchers' recruitment systems more open and transparent.

Public authorities and institutions have put a number of measures in place to make national recruitment systems more open, transparent and merit-based. Austrian Universities, for example, must advertise research job vacancies (for scientific and research staff) internationally, i.e. at least EU-wide (Amendment to the Universities Act, 2006). In Poland, the 2005 Law on Higher Education, as amended in 2011, states that public higher education institutions must publish their research vacancies on the European EURAXESS portal. In Italy, Law no. 240/2010 requires all (fixed-term) positions to be made publicly available on the national and EU websites.

The Wallonia-Brussels Federation's *Fonds de la Recherche scientifique*-FRS-FNRS (Fund for Scientific Research) has reformed its recruitment system right across the selection process. In detail, the reform:

- eliminates the age criterion formerly applied to applicants for FRS-FNRS mandates;
- provides pre-defined evaluation criteria that are communicated to the candidates in advance;
- provides candidates with feedback;
- develops an evaluation procedure for the selection of projects that involves more external experts from outside the Wallonia-Brussels Federation);
- advertises the calls for candidates and the mechanisms for obtaining a mandate in FRS-FNRS/Associated Funds more widely on different internet portals (FRS-FNRS, EURAXESS, etc.); and
- provides a renewed internet portal containing information of better quality on the FRS-FNRS procedures (mechanisms, calls, results, etc.).

In Spain, transparency in recruitment is governed by Law 19/2013 "on transparency, access to public information and good governance". This law applies to public universities, independent organisations and state agencies belonging to the general, regional or local administration. Any organisation receiving public subsidies of more than EUR 100 000, or for whom public subsidies represent more than 40% of their annual income, are required to make their procedures public (active dissemination of information) and ensure free access to the related information. This is designed to support the open recruitment of researchers in publicly funded organisations.

Many public research institutions have taken steps to review their recruitment systems. A comprehensive review[96] of all universities or research institutes who had gained the HR Excellence in Research logo by 2013 reveals that more than 90% had reviewed or were in the process of reviewing recruitment processes. Institutions were typically encouraging staff to involve at least three people in selection panels, including a representative from HR, having a gender balance on panels and creating

[95] IDEA Consult (2013)

[96] Available at: http://www.vitae.ac.uk/CMS/files/upload/Vitae-HR-Strategies-for-researchers-Report-2013.pdf

a policy/guideline for recruitment panels to adhere to, including external experts as well as training all staff involved in the process.

Institutional and cultural barriers remain in a number of countries and institutions[97]. A European Research Area and Innovation Committee (ERAC) Mutual Learning seminar was held in March 2014 and produced a report and a set of recommendations[98]. As a result, Member States[99] have agreed to set up a working group (within the ERA SGHRM) in cooperation with stakeholders in order to develop a practitioner's toolkit on open, transparent and merit-based recruitment based on good practice**.**

[97] Available at: http://ec.europa.eu/euraxess/pdf/research_policies/OTM%20Final%20Report.pdf

[98] Available at: http://ec.europa.eu/euraxess/pdf/research_policies/ERAC%20Final%20Report.pdf

[99] In the course of a European Research Area and Innovation Committee (ERAC) mutual learning seminar organised in 2014.

4. Education and training

4.1 Education and training – Highlights

Tertiary graduates in Europe:

- The EU has a 2020 target of 40% of the EU population aged 30-34 having completed tertiary education. The figure in 2013 was 36.8%, an increase of 13.9 percentage points since 2000;
- In terms of the population aged 25-64 having completed tertiary education, the EU is lagging behind its main economic competitors, such as Canada, Japan, the US and South Korea;
- The number of tertiary graduates in Science, Technology, Engineering and Mathematics (STEM) subjects per thousand population aged 20-29 in the EU is increasing more rapidly than in the US and Japan. The number of women graduates in STEM subjects per thousand women in the population aged 20-29 is increasing far more rapidly than in the US and Japan. However, the share of STEM degrees in the total number of academic degrees awarded in the EU remains stable.

Doctoral graduates in Europe:

- The number of new doctoral graduates per thousand population aged 25-34 in the EU is close to the figure for the US and well above the figure for Japan;
- This share of new doctoral graduates is increasing at much the same rate in the EU as in the US, but faster than in Japan; the figure for women has been rising rapidly in the EU;
- This share is highest in Nordic EU Member States, German-speaking countries and the UK.

Countries' measures to attract people to science and provide quality training for researchers:

- Measures to attract people to a research career include mentoring programmes, science communication action plans and financial support programmes for students to upgrade the quality of doctoral training, e.g. in the UK, improvements to post-doctoral career paths, and academia-industry partnerships;
- Traineeships and financial support/incentives, e.g. in Austria, are among the wide range of measures to interest students at every level in taking science to an advanced level; women and those studying STEM subjects are often specific targets;
- Measures to promote quality training include partnerships and inter-sectoral mobility programmes between academia and the private sector, programmes to bring research results to market, a strategic agenda in the UK to improve competencies, research traineeships in business, financial assistance, tax incentives for enterprises hiring young researchers, voucher schemes and industrial PhD programmes, e.g. in Germany;
- Universities are increasingly offering doctoral training in structured programmes in line with the Principles for Innovative Doctoral Training. There has been significant take-up[100] of the Principles in several Member States while a Working Group of the ERA SGHRM has reviewed progress and put forward a roadmap for further action.[101]

[100] Available at: http://ec.europa.eu/euraxess/pdf/research_policies/IDT%20Final%20Report%20FINAL.pdf

[101] Available at: http://ec.europa.eu/euraxess/pdf/research_policies/SGHRM_IDTP_Report_Final.pdf

4.2 Introduction

It has been estimated that Europe needs at least an additional one million researchers by 2020 to meet its R&D targets of 3% of GDP[102] and remain competitive worldwide. As demonstrated in the first chapter, Europe must invest in generating a sufficiently large pool of skilled researchers to promote a knowledge-based economy and counteract its international competitors.

Europe's success in securing an adequate science base depends on a number of key factors. First, national governments and institutions must secure the foundation of their research systems by attracting sufficient numbers of young people into taking science to an advanced (doctoral) level and thus pursuing a research career. Second, the quality of Europe's education systems, including the universities, must meet the highest international standards throughout in order to attract and retain the most talented minds in Europe. Third, researchers must have access to the highest quality of (doctoral) training in order to be fully equipped to pursue and develop their careers in Europe. Fourth, there is a need to develop a strong relationship between the academic world and the business sector with a view to the latter attracting and absorbing more researchers as well as establishing an "environment of open innovation" [103], where research results are brought to market and ideas are effectively exploited. However, as this chapter demonstrates, Europe will need to invest substantially in education and training in order to meet its objectives.

Outline

This chapter presents the most recent data on education and training for researchers in Europe and its major competitors. First, it offers an overview of the key indicators for monitoring education and training. Second, it presents the most recent figures on the number of tertiary graduates, including women tertiary graduates and graduates in STEM subjects. Third, it presents statistics on the proportion of new doctoral graduates in the EU-28, US and Japan, including women and non-EU doctoral graduates studying in Europe. Fourth, the chapter closes with an overview of European countries' measures to attract people to become researchers, to enhance the quality of doctoral training and to further encourage partnerships between industry and academia.

4.3 Education and training – Key indicators

The table below presents an overview of key indicators for monitoring education and research training in Europe and in comparison with its main competitors and gives the source.

Table 12: Education and training - Key indicators

Indicators	Data source(s)
Population aged 30-34 having completed tertiary education, Europe, 2000 and 2013 (%)	Eurostat Labour Force population survey/IUS
Population aged 25-64 having completed tertiary education, EU and main competitors, 2011 (%)	Eurostat, OECD
Tertiary graduates in Science, Technology, Engineering and Mathematics (STEM) studies (ISCED 5 & 6) per thousand population aged 20-29, Europe, US and Japan, 2000 and 2011	UNESCO OECD Eurostat education survey
Women tertiary graduates in STEM studies (ISCED 5 & 6) per thousand women aged 20-29, Europe, US and Japan, 2000 and 2011	UNESCO OECD Eurostat education survey

[102] European Commission (2010a)

[103] European Commission (2008b)

Indicators	Data source(s)
New doctoral graduates (ISCED 6) per thousand population aged 25-34, EU, US and Japan, 2000-2011	UNESCO OECD Eurostat education survey/IUS
New women doctoral graduates (ISCED 6) per thousand population aged 25-34, Europe, 2000 and 2011	UNESCO OECD Eurostat education survey
Doctorate graduates in S&E[104] per 1 000 population aged 25-34, R&D intensity, Europe, US, China and Japan, 2011	Eurostat, OECD, China Statistical Yearbook 2012

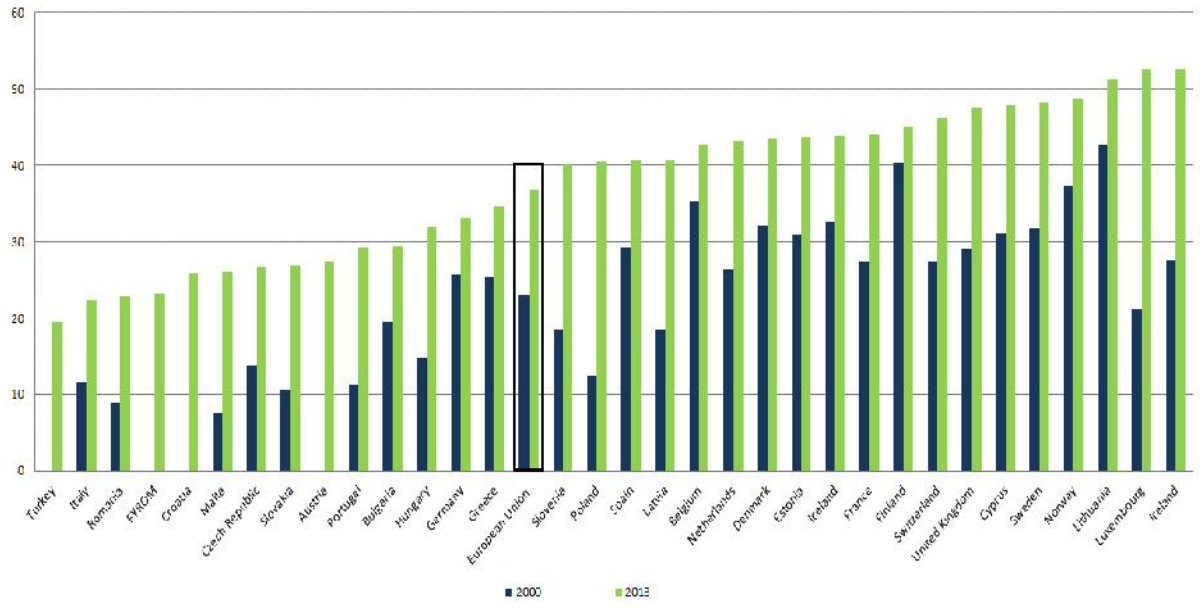
4.4 Tertiary graduates in Europe

The percentage of the EU-28 population aged 30-34 having completed tertiary education averaged 36.8% in 2013, a significant increase of 13.9 percentage points since 2000 (22.9%). Between 2012 and 2013, the EU-28 average increased by one percentage point from 35.7% to 36.8%.

The Europe 2020 growth strategy[105] set a key target of increasing the share of the EU population aged 30-34 having completed tertiary education from 31% (in 2010) to at least 40% by 2020. In 2013, the average was 36.8%, a significant increase of 13.9 percentage points since 2000 (22.9%). Between 2012 and 2013, the EU-28 average increased by one percentage point from 35.7% to 36.8%.

In 2013, 16 EU Member States (along with Iceland, Norway and Switzerland) had achieved or exceeded the target of 40%. Ireland was at the top at around 53%. Nine EU Member States (together with FYROM and Turkey) were below 30%, while Hungary, Germany and Greece reported figures of 30-35%.

Figure 20: Population aged 30-34 having completed tertiary education, Europe, 2000 and 2013 (%)



Source: Deloitte
Data: Eurostat Labour Force population survey/IUS
* No information available for 2000 for AT, HR, FYROM and TR
** European Union refers to EU-28

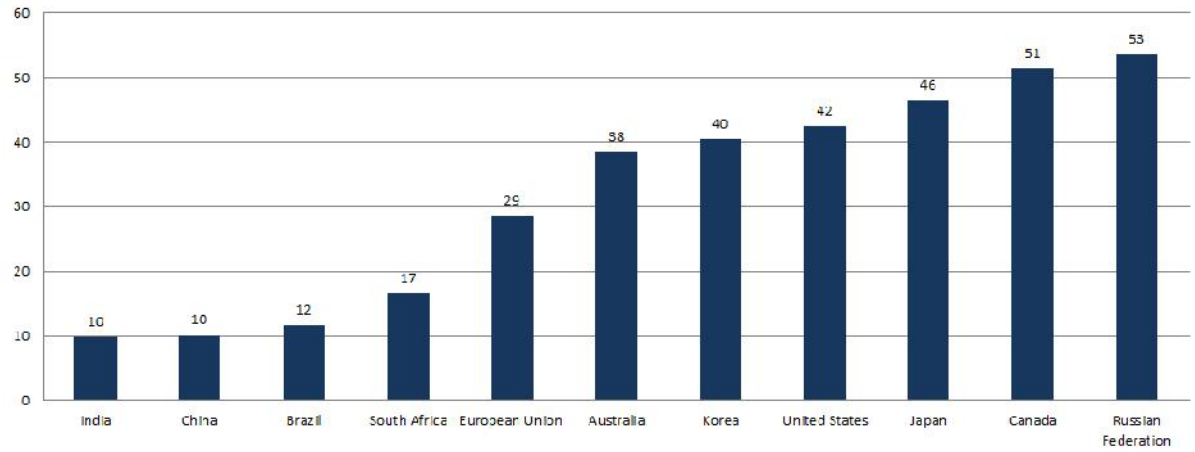
[104] Science and Engineering

[105] European Commission (2010d)

The EU is lagging behind its main economic competitors like Canada, Japan, the US and South Korea in the percentage of the population aged 25-64 having completed tertiary education. This stood at 29% in the EU-28 in 2011.

This section provides a comparison of the EU's performance with some of its main global competitors, including Australia, the BRICS countries (Brazil, Russia, India, China and South Africa), Japan, South Korea and the US using a larger age group (aged 25-64)[106]. In 2011, the percentage of the population aged 25-64 having completed tertiary education in the EU was 29%, far behind major economic competitors, like Russia (53%), Canada (51%), Japan (46%), the United States (42%) and South Korea (40%).

Figure 21: Population aged 25-64 having completed tertiary education, EU and main competitors, 2011 (%)



Source: Deloitte
Data: Eurostat, OECD

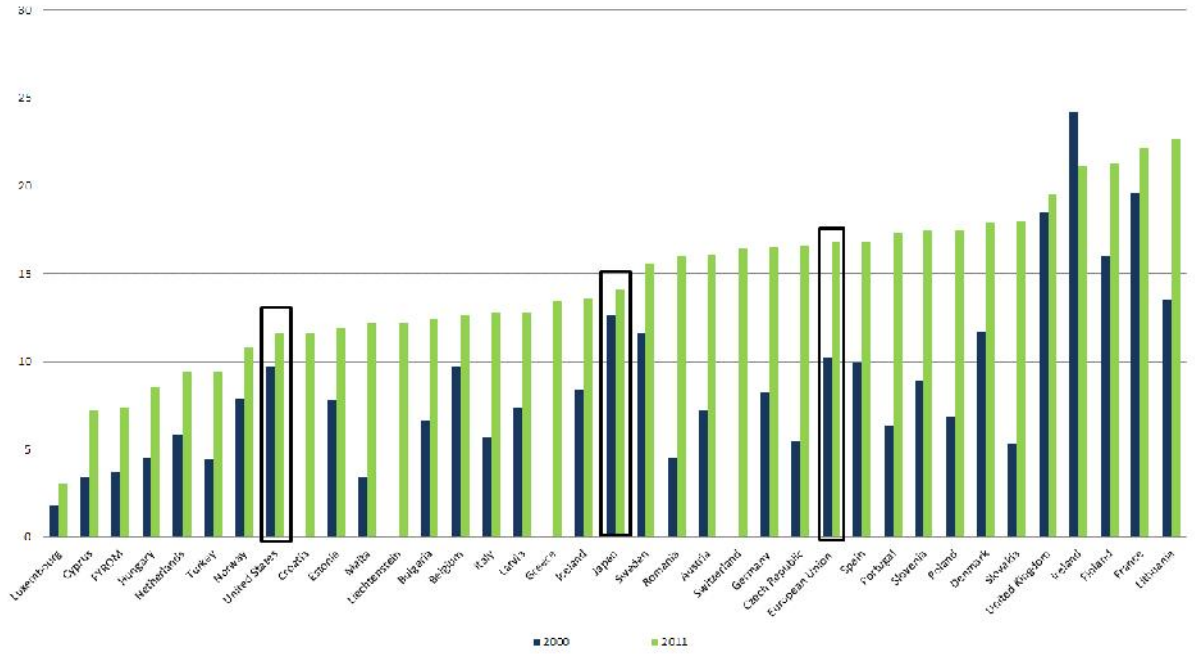
In line with the overall increase in the numbers in tertiary education, the number of tertiary graduates in Science, Technology, Engineering and Mathematics (STEM) subjects per thousand population aged 20-29 in the EU increased from 10.2 (in 2000) to 16.8 (in 2011). This was a higher growth rate than in the US and Japan. However, the share of STEM degrees in the total number of academic degrees has remained virtually unchanged in the EU over this period.

In 2011, the proportion of graduates (ISCED 5 & 6) in STEM subjects per thousand population aged 20-29 in the EU was 16.8, more than in Japan (14.1) and in the United States (11.6). The European countries which reported the highest proportion of graduates in STEM subjects in 2011 (>20) were Lithuania (22.6), France (22.1), Finland (21.2) and Ireland (21.1). The lowest numbers (<10) were reported in Turkey (9.4), Netherlands (9.4), Hungary (8.5), FYROM (7.3), Cyprus (7.2) and Luxembourg (3).

The number of tertiary graduates in STEM subjects per thousand population aged 20-29 in the EU increased from 10.2 per thousand population aged 20-29 in 2000 to 16.8 in 2010 (Figure 23).

[106] Compared to the group aged 30-34 having completed tertiary education.

Figure 22: Tertiary graduates in Science, Technology, Engineering and Mathematics (STEM) studies (ISCED 5 & 6) per thousand population aged 20-29, Europe, US and Japan, 2000 and 2011



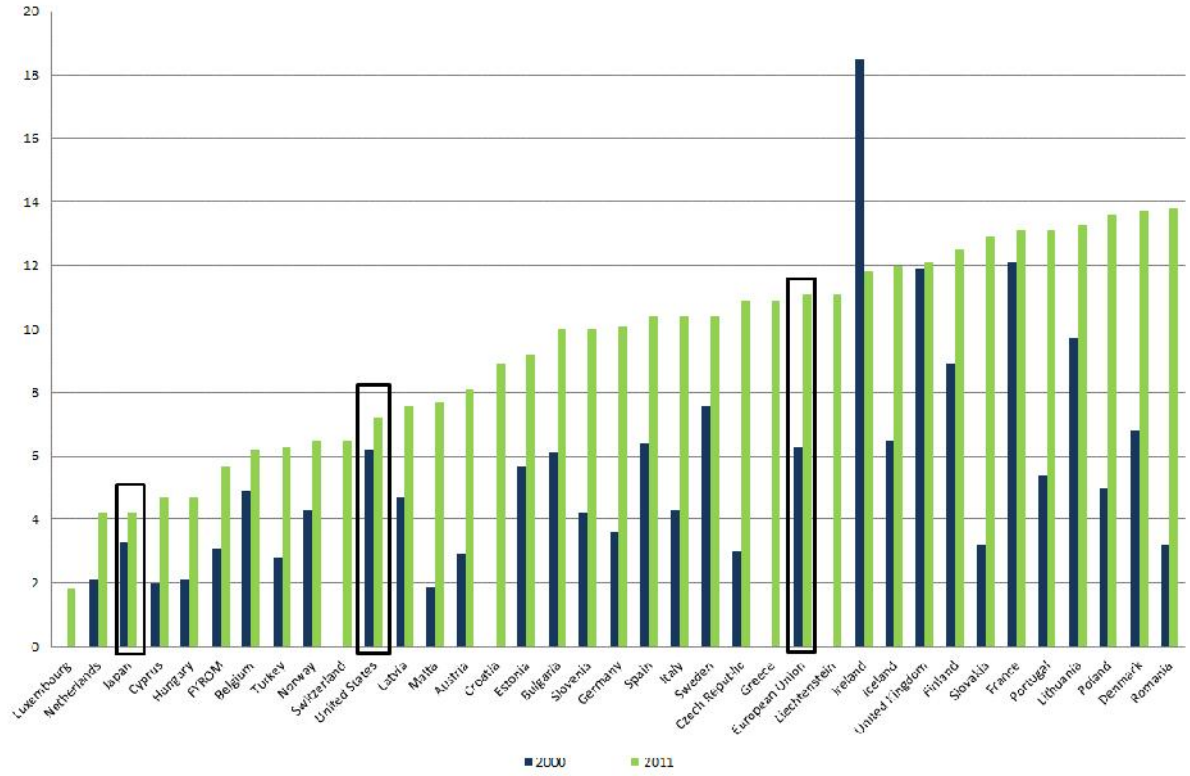
Source: Deloitte
Data: UNESCO OECD Eurostat education survey
* No information available for 2000 for EL, CH, HR and LI
** European Union refers to EU-27

The number of women graduates in STEM subjects per thousand women population aged 20-29 increased from 6.3 (in 2000) to 11.1 (in 2011), significantly outstripping the increase in the US and Japan.

In 2011, the proportion of women graduates in STEM subjects (ISCED 5 & 6) per thousand women aged 20-29 in the EU was 11.1, more than in the United States (7.2) and Japan (4.2). The ratio was highest (>12) in a number of new EU Member States, such as Romania (13.8), Poland (13.6), Lithuania (13.3) and Slovakia (12.9) as well as in Denmark (13.7), Portugal (13.1), France (13.1), Finland (12.5) and UK (12.1). The lowest EU numbers (<5) were in Hungary (4.7), Cyprus (4.7), the Netherlands (4.2) and Luxembourg (1.8).

The number of women graduates in STEM in the EU per thousand population in this age group increased from 6.3 in 2000 to 11.1 in 2011. Although the vast majority of countries conformed to the rising trend, the extent of the growth differed substantially. Between 2000 and 2011, a number of EU countries increased the number of women graduating in STEM very noticeably, such as (in descending order) Romania (from 3.2 to 13.8), Slovakia (from 3.2 to 12.9), Poland (from 5 to 13.6), the Czech Republic (from 3 to 10.9), Portugal (from 5.4 to 13.1), Denmark (from 6.8 to 13.7) and Germany (from 3.6 to 10.1).

Figure 23: Women tertiary graduates in Science, Technology, Engineering and Mathematics (STEM) studies (ISCED 5 & 6) per thousand women aged 20-29, Europe, US and Japan, 2000 and 2011



Source: Deloitte
Data: UNESCO OECD Eurostat education survey.
* No information available for 2000 for EL, CH, HR, LI and LU
** European Union refers to EU-27

4.5 New doctoral graduates in Europe

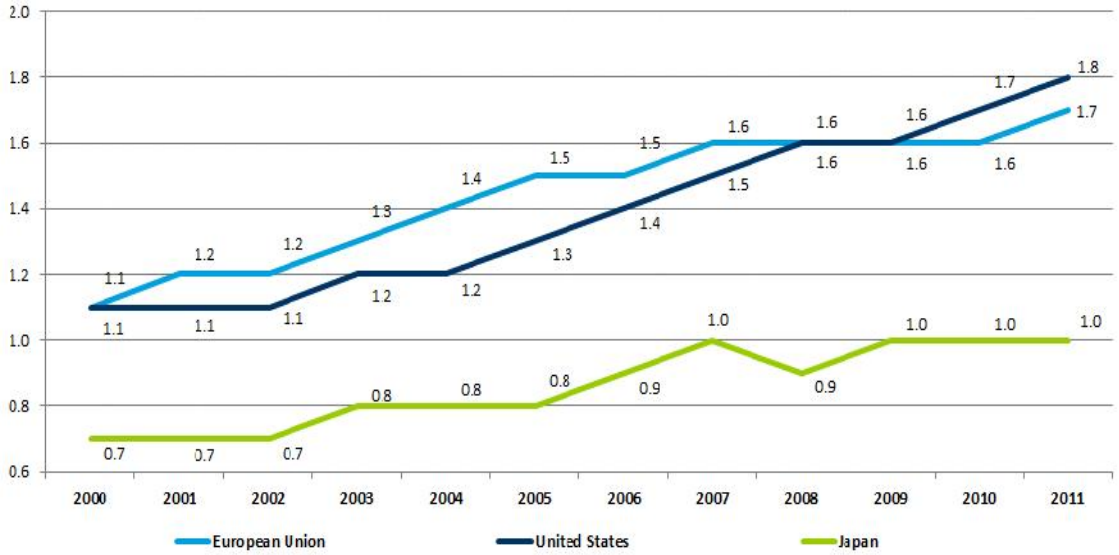
The number of new doctoral graduates in the EU has risen significantly in the past decade, increasing from around 72 000 in 2000 to around 118 000 in 2011.

The number of new doctoral graduates in the EU increased from 72 251 (in 2000) to 117 958[107] (in 2011). The increase for the US was from 44 808 in 2000 to 73 041 in 2011. In Japan, the number of new doctoral graduates increased from 12 192 in 2000 to 15 910 in 2011.

The number of new doctoral graduates (ISCED 6) per thousand population aged 25-34 in the EU increased from 1.1 in 2000 to 1.7[108] in 2011. The increase in the United States was from 1.1 in 2000 to 1.8 in 2011, while in Japan, it went from 0.7 in 2000 to 1.0 in 2011.

[107] Eurostat
[108] Computed by Deloitte by including Italy in the total provided by Eurostat

Figure 24: New doctoral graduates (ISCED 6) per thousand population aged 25-34, EU, US and Japan, 2000-2011

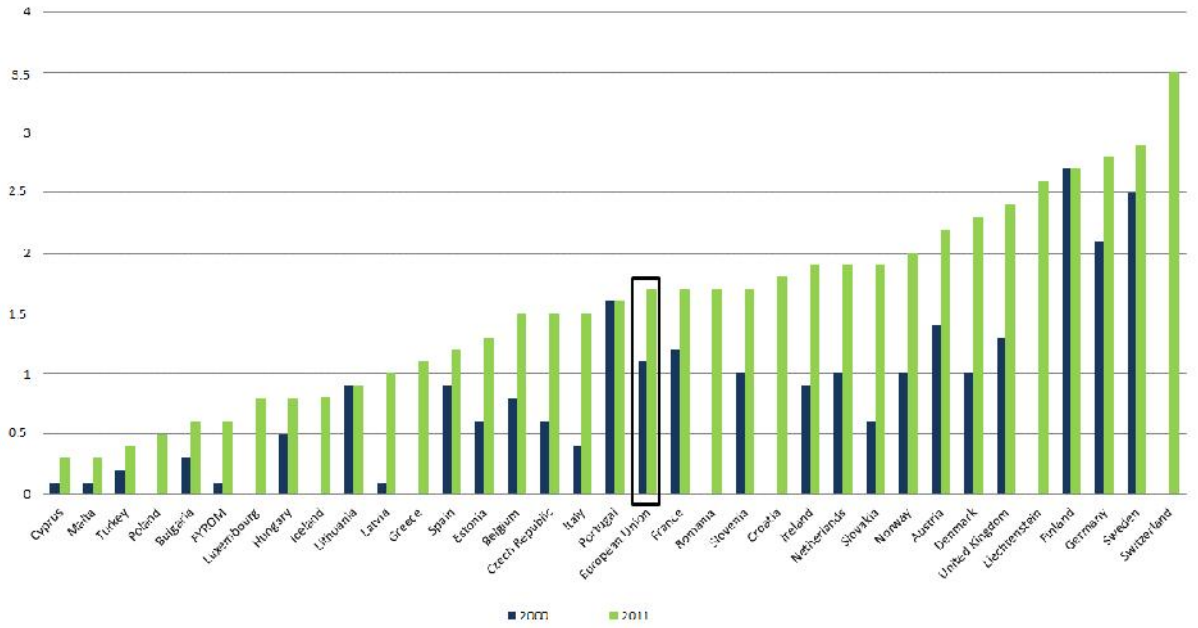


Source: Deloitte
Data: UNESCO OECD Eurostat education survey/IUS

The highest number of new doctoral graduates per thousand population aged 25-34 in Europe in 2011 was in Switzerland. The leading EU countries were Sweden, Germany, Finland, UK, Denmark and Austria.

In 2011, the average number of new doctoral graduates per thousand population aged 25-34 for the EU was 1.7, with a range from 3.5 in Switzerland to 0.5 or less in some other European countries. The countries can be grouped into three clusters: those countries with a number of new ISCED 6 graduates above 2.0 per thousand population, those in the 1.0-1.9 range, and those below 1.0.

Figure 25: New doctoral graduates (ISCED 6) per thousand population aged 25-34, Europe, 2000 and 2011

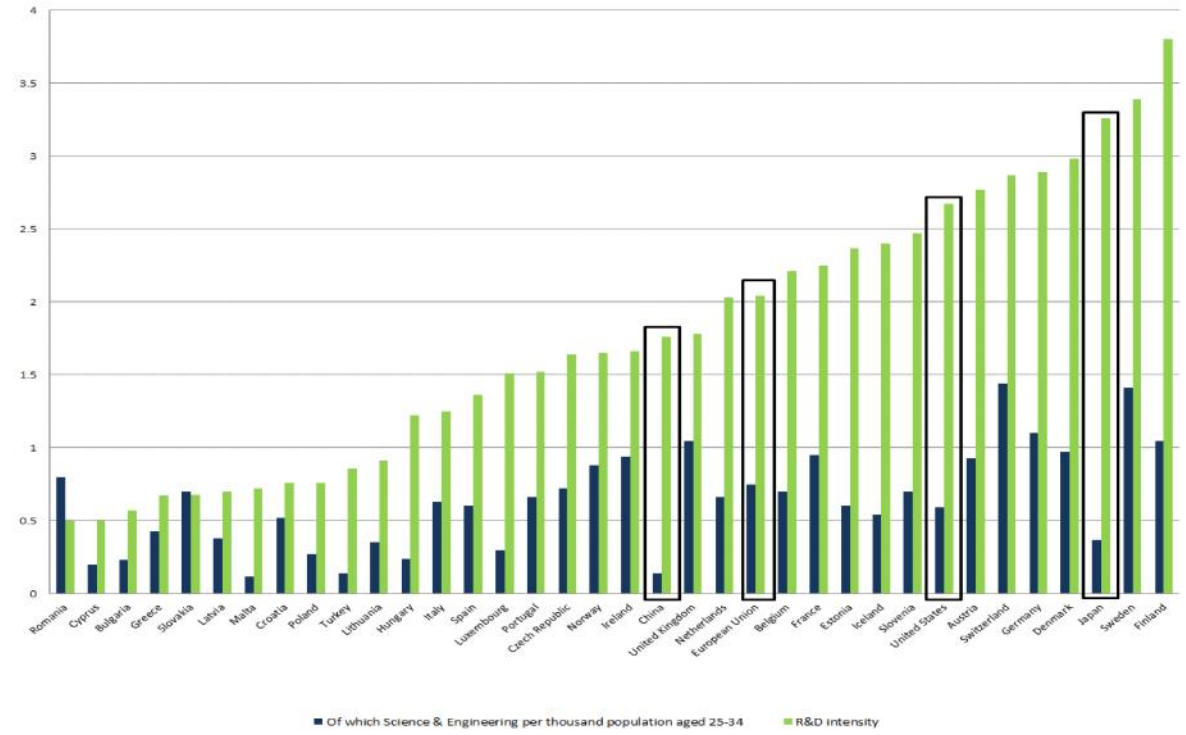


Source: Deloitte
Data: UNESCO OECD Eurostat education survey/IUS
* No information available for 2000 for EL, CH, HR, LI, LU, PL and RO

EU Member States with a high R&D intensity are also those with the highest intensity of doctorate graduates in science and engineering (S&E).

EU Member States with a high number of new doctoral graduates per thousand population aged 25-34 (Sweden, Germany, Finland, UK, Denmark and Austria) are also the countries with the highest research intensity (R&D expenditure >2.5 of GDP) in the EU, with the exception of the UK[109]. The same pattern holds for doctorate graduates in S&E. Malta, Cyprus and Poland are countries with a relatively low number of ISCED 6 graduates per 1 000 people aged 25–34 years. On the other hand, the growth in the number of ISCED 6 graduates in the period 2005–2011 was the highest in Cyprus and Malta, countries with relatively new and small higher education systems. STEM graduates at ISCED 5 and 6 levels are in demand in many economic sectors. In some countries a considerable proportion of STEM graduates work outside STEM professions[110].

Figure 26: EU Doctorate graduates in S&E per 1 000 population aged 25-34, R&D intensity, Europe, US, China and Japan, 2011



Source: Deloitte
* Data: Innovation Union Competitiveness Report 2013
** European Union refers to EU-27

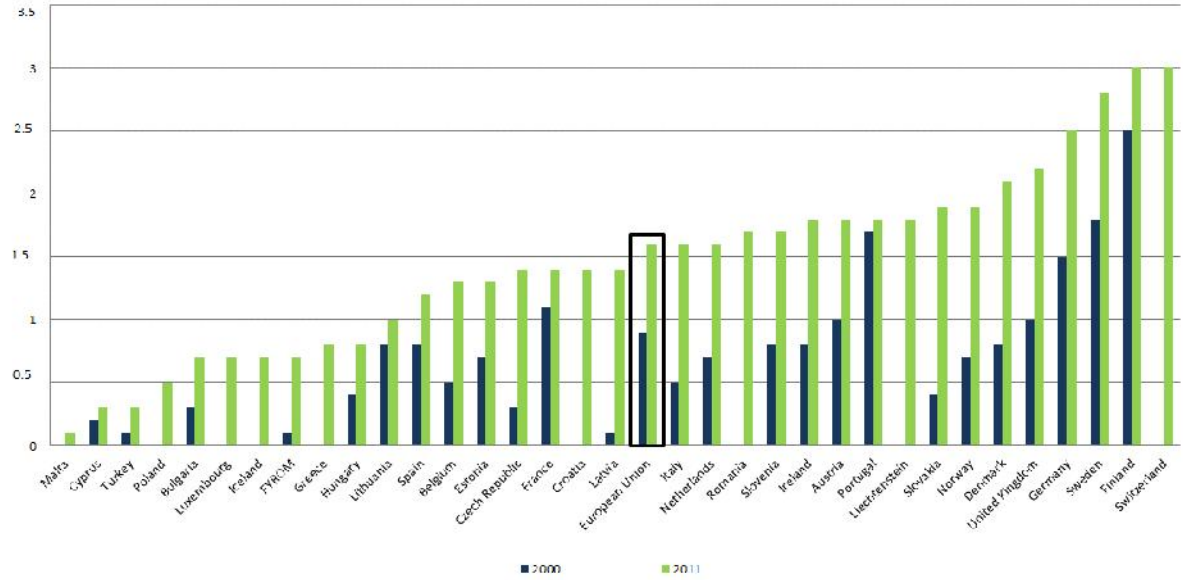
The average number of new women doctoral graduates in the EU increased by from 0.9 to 1.6 per thousand women in the population aged 25-34 between 2000 and 2011. In 2011, Finland reported the highest number of new women doctoral graduates; Malta the lowest.

Between 2000 and 2011, the number of new women doctoral graduates (ISCED 6) per thousand population aged 25-34 increased in all European countries. Between 2000 and 2011, Slovakia,

[109] European Commission (2014a)
[110] Idem.

Denmark, Latvia, Norway, UK and Italy reported the highest increase in the proportion of new women doctoral graduates. In Bulgaria, Hungary, Spain, France, Lithuania, Turkey and Cyprus, the number increased only slightly, but from different baselines.

Figure 27: New women doctoral graduates (ISCED 6) per thousand population aged 25-34, Europe, 2000 and 2011



Source: Deloitte
Data: UNESCO OECD Eurostat education survey
* No information available for 2000 for CH, EL, HR, LU, MT, PL and RO

4.6 Attracting people to science and providing quality training for researchers

European countries are implementing various measures to attract people to a research career. These include mentoring programmes, science communication action plans and financial support programmes for students (scholarships) and measures to upgrade the quality of doctoral training (e.g. offering structured programmes in line with the Principles for Innovative Doctoral Training [111]) and post-doctoral career paths (e.g. in-company training programmes, professional development provision and tenure tracks). They are also developing measure to encourage academia-industry partnerships (e.g. via research traineeships in companies and inter-sectoral mobility programmes).

Europe needs to safeguard a sufficient supply of highly qualified researchers both to promote research and development, and accelerate the introduction of innovative business models by European enterprises [112]. In an attempt to increase the research culture, many European countries have developed measures to attract students to the research world and systematically expose students to interdisciplinary knowledge with the aim of producing better research. Special attention is paid to measures intended to bridge the gap between basic and applied research, encourage the dialogue between science and business, and promote interaction between research and economic development.

[111] Available at: http://ec.europa.eu/euraxess/pdf/research_policies/Principles_for_Innovative_Doctoral_Training.pdf
[112] European Commission (2010b)

Universities increasingly offer doctoral training in structured programmes in line with the Principles for Innovative Doctoral Training[113], which reflect the Salzburg Principles and the Recommendations of the EUA[114], Member States' good practice[115] and the experience of the Marie Curie Actions. The Principles were endorsed in the Council Conclusions on the modernisation of higher education, Brussels, 28 and 29 November 2011, and Member States have committed themselves to link, wherever relevant and appropriate, national funding for doctoral programmes to the principles[116]. This year, experts designated by the Commission are visiting a number of doctoral schools in order to learn how to further spread the use of these principles.

The principles relate to:

1. Research Excellence
2. Attractive Institutional Environment (in line with the Charter & Code);
3. Interdisciplinary Research Options;
4. Exposure to industry and other relevant employment sectors;
5. International networking;
6. Transferable skills training;
7. Quality Assurance.

The table below provides an overview of different measures[117] implemented in 38 European countries to promote research careers to the general public, to provide researchers with quality training and to encourage partnerships between industry and academia.

[113] Available at: http://ec.europa.eu/euraxess/pdf/research_policies/Principles_for_Innovative_Doctoral_Training.pdf

[114] Available at : http://www.eua.be/cde/publications.aspx

[115] Available at: http://ec.europa.eu/euraxess/pdf/research_policies/IDT%20Final%20Report%20FINAL.pdf

[116] Available at: http://www.consilium.europa.eu/uedocs/cms_data/docs/pressdata/en/educ/126375.pdf

[117] The countries' reported measures are listed individually in one of the three overarching categories: 1. Attract young people to science and the research profession; 2. Quality of doctoral training and life-long learning; 3. Collaboration between academia and industry. Each reported measure is listed only once and is categorised on the basis of its key objective (as some measures may correspond to different categories)

Table 13: Measures aimed to attract young people to science and the research profession, raise the quality of doctoral training, and enhance collaboration between academia and industry

Country	Education and training		
	Types of measure		
	Attract young people to science and the research profession	Quality of doctoral training and life-long learning	Partnership between academia and industry
AUSTRIA	✓✓✓✓✓✓✓✓✓✓	✓✓✓✓✓✓✓✓✓	✓✓✓✓✓✓✓✓✓✓✓✓✓✓✓✓✓✓✓
BELGIUM	✓✓✓✓✓	✓✓✓✓✓	✓✓✓✓✓✓✓✓✓✓✓
BiH	✓✓✓✓✓✓✓✓✓	✓✓	✓✓✓✓✓✓✓✓
CROATIA		✓✓✓✓✓✓✓	✓✓✓✓✓✓✓✓✓✓✓✓
CYPRUS	✓✓✓	✓✓✓✓✓✓✓	✓✓✓
CZECH REPUBLIC	✓		✓
DENMARK	✓✓✓✓✓✓✓✓✓✓✓✓✓	✓✓	✓✓✓✓✓✓✓✓✓✓✓✓✓✓✓
ESTONIA	✓✓✓✓✓✓✓✓	✓✓✓✓✓	✓✓✓✓✓✓✓✓
FINLAND	✓✓✓✓	✓	✓✓✓
FRANCE	✓✓✓✓	✓✓	✓✓✓✓✓✓
FYROM	✓✓✓	✓✓✓✓	✓✓✓✓✓✓
GERMANY	✓✓✓✓✓✓✓✓✓✓✓✓	✓✓✓✓✓✓✓✓✓✓✓	✓✓✓✓✓✓
GREECE	✓✓	✓✓✓	✓✓✓✓✓✓✓
HUNGARY	✓✓✓✓✓✓	✓✓✓✓	✓✓✓✓✓✓
IRELAND	✓✓✓✓✓✓✓✓✓✓✓✓✓✓✓✓✓	✓✓✓✓✓✓✓✓✓✓	✓✓✓✓✓✓✓✓✓✓✓✓✓✓✓✓✓✓✓✓✓✓✓✓✓✓✓
ITALY	✓✓	✓✓✓	✓✓✓✓✓✓
LATVIA		✓✓✓	✓✓
LITHUANIA	✓✓✓✓✓✓	✓✓✓	✓✓✓✓✓✓✓
LUXEMBOURG	✓✓✓✓✓	✓✓✓✓✓✓✓	✓
MALTA	✓✓✓✓✓✓✓✓	✓✓	✓✓✓
MONTENEGRO	✓✓	✓	✓✓✓✓✓✓
NETHERLANDS	✓✓✓✓✓	✓	✓✓
NORWAY	✓✓✓✓✓✓✓✓✓✓✓✓	✓✓✓✓	✓✓✓✓✓✓✓✓✓✓✓✓
POLAND	✓✓✓✓✓✓	✓✓	✓✓✓✓✓✓✓✓✓✓✓✓✓
ROMANIA	✓	✓✓✓✓✓✓✓✓	✓✓✓✓✓
SERBIA	✓✓✓✓	✓✓✓	✓
SLOVENIA	✓✓✓	✓✓✓✓✓	✓✓✓✓✓✓
SPAIN	✓✓✓✓✓✓✓✓	✓✓✓	✓✓✓✓✓✓✓✓✓✓✓✓
SWEDEN	✓	✓✓	✓✓✓✓
SWITZERLAND	✓✓✓	✓✓✓✓✓✓✓	✓✓✓✓✓✓
TURKEY	✓✓✓✓✓✓	✓	✓✓✓✓✓✓✓✓✓
UNITED KINGDOM	✓✓✓✓✓✓✓✓✓	✓✓✓✓✓✓✓✓	✓✓✓✓✓

Source: Deloitte, "Researchers' Report 2014", Annex 'Country files'
Updated information is not available for BG, IL, IS, LI, PT and SK
Information presented in the table is based on individual country responses to the Deloitte Questionnaire (2011) and its subsequent updates (reporting exercise 2012 and 2013).

In this year's reporting exercise, the vast majority of countries reported new measures supporting education and training. The measures fall into three categories. The first group gathers together all measures national authorities and/or institutions have put in place to attract people to take science to an advanced (doctoral) level and thus potentially to become researchers. The measures target primary, secondary and higher education students, especially women and students in STEM subjects. Measures for the improvement of European education systems and university curricula are also covered by this category.

The second cluster of measures includes all activities taken by the national authorities and/or the institutions to enhance the quality and efficiency of doctoral training and provide life-long learning to researchers in accordance with national priorities and industry requirements. This category includes measures such as the development of National Skills Agendas[118] to improve researchers' employment skills and competencies at all career stages (from early career to star researchers). It also covers national qualifications frameworks, skill grids, doctoral studies curricula and other career

[118] European Commission (2009b)

development programmes (e.g. entrepreneurship and economic courses, communication and interpersonal skills, intellectual property rights awareness, career management and research management).

The third group encompasses all measures aiming to develop doctoral training in cooperation with industry and to better link academia and the industry sector, leading to projects of joint interest and exploitation of research results by the enterprises. Such measures are industry financing of PhDs, companies' involvement in curriculum development, inter-sectoral mobility, state funding to enterprises for the recruitment of new researchers and young PhD holders, tax reductions for companies' R&D personnel, setting up of technology transfer networks, etc.[119]. For a detailed discussion on partnerships between industry and academia, see chapter "Collaboration between academia and industry" in this report. As depicted in the table, all 38 countries have put various measures in place in all three categories.

In relation to the first category, a significant majority of European countries reported the implementation of one or more of the following types of measure: mentoring programmes, science communication action plans, financial support programmes for students (scholarships), etc. A few countries have adopted concrete national legislation or strategies to make their education systems more attractive to young people and/or improve universities' curricula. Most European countries also organise events promoting a scientific culture (such as science fairs, awareness campaigns, science festivals, exhibitions, etc.), while many of the countries promote summer academies and youth camps, maths competitions, talent contests and awards for women researchers.

For example, the Talents Programme of the Ministry of Transport, Innovation and Technology, administered by the Austrian Research Promotion Agency (FFG) (Austria) supports RTD talents (especially women), by offering traineeships and providing financial support for (regional) education projects in schools in the field of mathematics, informatics, science and technology. In particular, it finances traineeships for female students and traineeships for pupils (boys and girls), encourages networking (FEMtech Network), enhances the visibility of women experts (FEMtech Female Expert Database), promotes the achievements of successful women in research (FEMtech Female Expert of the Month), offers career support (FEMtech Career Initiative), supports research projects (FEMtech Research Projects Initiative) and seeks to improve women´s career opportunities in science and technology in particular. It also supports cooperation between academic institutions, research institutes and private companies with schools and kindergartens (Talente regional cooperation projects). In 2013, 1 504 traineeships for pupils were funded under the "discover talents" action line. The budget is about EUR 1 500 000 per year.

The 'Young Researchers' Programme' (Slovenia) aims to increase the number of students following PhD studies, incorporating specific measures to promote research in science, technology, engineering and mathematics (STEM) subjects. Since 2006, it has provided financing for more than 1 200 young researchers annually.

In Spain, the JAE-doc Programme provides grants lasting for a period of three years for the recruitment of post-doc juniors to work for the Spanish National Research Council. In order to attract and train

[119] Ibid

secondary school students to become researchers, the Ministry of Education has also organised national Olympics in mathematics, physics and chemistry. Together with the Spanish Foundation for Science and Technology (FEYCT), the Ministry of Education also organises summer campuses at university centres. In 2013, 1 808 students were due to take part in this programme.

In Malta, the Master It! (2013-2015) programme provides scholarships in STEM subjects to support graduates to follow post-graduate studies at Master level both in Malta and abroad.

In Ireland, the Science Foundation Ireland (SFI) aims to fund PhD Fellowships in Science, Technology, Engineering and Maths Education (STEM) that are designed to support the requirement for fourth-level professionals in STEM education to educate and prepare teachers at all levels, but especially in primary and post-primary schools.

The Higher Education Authority and the Irish Independent (Newspaper) host an annual competition inviting postgraduate research students in any discipline at an Irish higher-education institution to make a short submission on the difference that their research work will make to a particular aspect of Irish life, to the country as a whole or internationally.

In Denmark, the *Kangerlussuaq* Scientific Summer school aims to inspire and teach natural science to upper secondary school students from Greenland, Denmark and the US and, in addition, to enhance the interest in Arctic science.

The measures put in place by European countries in the second category include university decrees and ministerial orders to increase the quality of doctoral training, guidelines on life-long learning activities, national roadmaps, financial support to PhD and post-doctorate students, in-company training programmes, etc. The vast majority of countries have also established Centres of Excellence as well as doctoral/research schools, while, in a few countries, career development centres and special agencies have the main responsibility for researchers' skills development.

For example, the VITAE programme (UK) supports knowledge exchange and the development of a strategic agenda to train and support high-level researchers to further improve their skills competencies. The Flemish Community 'Support programme for Young Researchers' in Belgium aims to train young researchers, develop careers and open up career prospects, reinforce the international orientation of researchers' careers and cooperate within Flanders. A first evaluation carried out by the Expertise Centre on R&D monitoring in 2013, showed that the money had been used by the universities to reinforce their HR policy for young researchers and create more opportunities for training and career development for them. In 2013, the objective is to make this programme a permanent funding programme for the universities.

The Helmholtz Association (Germany) provides structured doctoral training in the form of research schools and graduate schools, and grants universities access to the Helmholtz Association's laboratories and research infrastructures. The Helmholtz Research Schools are joint programmes established on the basis of cooperation agreements between Helmholtz Centres and universities with the aim of supporting young researchers. The Research Schools provide structured doctoral training over a period of three years in areas of mutual scientific interest and scientific excellence. The

Graduate Schools offer PhD students an interdisciplinary education that teaches them important skills for a career in science or the private sector. Thirteen Helmholtz graduate schools and 21 Helmholtz research schools have been funded since 2006.

Hungarian universities develop and promote their own post-doctoral programmes financed by the State. When an education institution plans to introduce a new PhD curriculum, it needs the approval of the Hungarian Accreditation Committee. In 2012, there were 174 accredited doctoral schools in 27 universities in Hungary. The Act on Higher Education (2005) further supports the strategic ambition of increasing the quality of doctoral training in Hungarian institutions. On 1 January 2012, a new Act on Higher Education came into force. The new Act on Higher Education (Act CCIV of 2011, in force since 1 January 2012) further supports the strategic ambition of increasing the quality of doctoral training in Hungarian institutions.

The 2010 Law on Education (Romania) brought changes designed to enhance the quality of doctoral training, such as:

- increases in performance-based funding for doctoral studies;
- dual statute of students as both doctoral students and research assistants or university assistant for a pre-determined period;
- the mobility of research grants;
- more flexibility in the internal organisation of the doctorate schools and enhanced autonomy for the university;
- a requirement that doctoral programmes be organised only on a full time basis; and
- a national code of doctoral studies of which the objective is to promote and implement procedures for enhancing the quality of the organisation and content of doctoral programmes, rights and obligations of doctoral students, doctorate coordinators and others.

In Croatia, in 2013, the University of Rijeka Technology Transfer Office organised several workshops and seminars for students and researchers on the importance of intellectual property rights, and technology and knowledge transfer.

In Hungary, several quality improvement regulations were adopted over the period 2012-2013. They included 387/2012. (XII.19.) Government Regulation on Doctoral Procedures and the Habilitation Decision of the Hungarian Accreditation Committee (HAC) at its meeting of June 7, 2013.

In Ireland, the Irish Universities Deans of Graduate Studies Group has developed a statement to communicate to students, supervisors and employers the skills and attributes of a PhD graduate.

In Latvia, the Research, Technological Development and Innovation Guidelines for 2014-2020 foresee continuing the support for doctoral studies, in particular by increasing the number of doctoral students in the following scientific areas: nature, life sciences, information technologies, forestry, agriculture and engineering. In particular, the Guidelines foresee the establishment of a grant system for doctors' degree study programmes.

Finally, European countries' measures to boost partnerships between universities, research institutions and private companies include the implementation of joint projects, programmes to bring research results to market, research traineeships in companies, inter-sectoral mobility programmes,

various government funding mechanisms and tax reduction provisions for enterprises hiring young researchers, voucher schemes, industrial PhD programmes, etc. Some countries also encourage and sustain long-term cooperative public-private partnerships (for instance, under a Memorandum for Cooperation) whereas other countries prefer to create networking platforms and innovation clusters to link universities with the business world.

For example, the *Fraunhofer-Gesellschaft* (Germany) supports application-based research in cooperation with the private sector. Students are offered the possibility of pursuing a PhD in applied research in close collaboration with industry. The number of PhD degrees supported by *Fraunhofer* was 1 204 in 2007 (compared to 941 in 2005) and nearly doubled by 2011.

The Danish Industrial PhD Programme aims to offer doctoral training in cooperation with the industry sector. It is a three-year research project and research training programme with an industrial focus conducted jointly by a private company, an industrial PhD student and a university. It inspired the European Parliament to fund the kick-start of the Marie Skłodowska-Curie European Industrial doctorates.

The Centres for Research-based Innovation (SFI) scheme (Norway) seeks to promote innovation by providing funding for long-term research conducted in close cooperation between R&D-performing companies and prominent research groups. The scheme is designed to enhance technology transfer, internationalisation and researcher training. The Centres for Research-based Innovation (SFI) scheme provided NOK 155 million (some EUR 21 million) for top-up financing of 21 Centres in 2012. The SFIs are centres of excellence which include a frontline knowledge-based industrial partner.

In response to the review of university-business collaboration in February 2012 by Professor Tim Wilson[120], the UK government announced new plans to strengthen that collaboration, including promotion of a new framework for business and universities to work together and support the Council for Industry and Higher Education (CIHE) to create a National Centre for Universities and Business.

The Swedish Higher Education Ordinance provides for a position of 'adjunct professor' of up to six years part-time (20-50%). The adjunct professor should be an expert from industry given the opportunity to work within a university for a certain period of time.

In Croatia, the TEST programme provides funding for research projects that develop new technologies and that upon completion of the research phase strive to further commercialise and create new products or services.

In Denmark, the Strategic Platforms for Innovation and Research (SPIR) and societal partnerships fund large strategic partnership initiatives between industry, research and technology institutions and the public sector which seek to strengthen the link between strategic research, technology development and innovation, and thereby promote efficient knowledge dissemination, develop solutions for society and possibilities for fast application of new technologies and knowledge in connection with innovation in the private and public sector and in connection with developing solutions to societal challenges.

[120] Available at: https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/32383/12-610-wilson-review-business-university-collaboration.pdf

In Greece, the promotion of Industrial Research & Technology (PAVET 2013) programme aims to encourage industrial research and experimental development in eight thematic categories and also to promote cooperation between enterprises, or between enterprises and research institutions.

In Norway, the Large-Scale Programme Initiative supports programmes developed in a dialogue between the research establishment, industry and the public administration, and extends across various sectors and value chains.

In Belgium, the BEWARE FELLOWSHIP (Belgium Wallonia Research) programmes are co-financed by the COFUND programme of the European Union (FP7 – Marie Curie Actions). The *Industry programme* will grant 57 mandates over 5 years and the *Academia programme* will fund 80 manages over five years. Both will be available to researchers who have spent fewer than 12 months in Belgium in the previous three years (irrespective of whether they are Belgian or foreign nationals). The *Industry programme* will enable SMEs or accredited research centres to benefit from the expertise of highly qualified foreign researchers to encourage the innovation process within the Walloon host. The first call for proposals was launched in January, 2014. The *Academia programme* focuses on technology transfer. Researchers spend time at a French-speaking University, in partnership with a Walloon company. Over the period covered by the mandate (18-36 months), six months must be spent in the company. The first call for proposals was launched in March 2014.

The Industrial Chairs programme (France) aims to provide accompanying support to research projects led jointly by public research institutions and businesses. It encourages the integration of eminent French (whether expatriate or not) or foreign professors into higher education and research institutions or research organisations, and reinforces the best initiatives developed in French higher education and research. The programme involves establishing a strong and lasting partnership between the research institution and businesses in a high priority and strategic area for the parties concerned. The aim is to provide more effective support to industrial research in all areas. The industrial chairs' objective is firstly to carry out fundamental and applied research, and secondly to ensure training through high-level research. Researchers from all disciplines can submit a project on any topic they choose.

5. Working conditions in the research profession

5.1 Working conditions in the research profession – Highlights

Researchers' contractual conditions:

- A significant proportion of researchers in the higher education sector is employed on a fixed-term contract or has no contract at all. This is most pronounced during earlier career stages;
- There are significant differences between Member States with the share of researchers on an open-ended or longer fixed-term contract being higher, on average, in Southern and Eastern European countries;
- Researchers' working conditions are not just a contract issue; other factors which can have a major impact include the remuneration package, access to research funding, provision of training and career development, career prospects, etc.

Researchers' remuneration:

- Remuneration levels differ substantially across European countries (correlating with the cost of living) and in comparison with other parts of the world. There is a substantial difference between the progression of researchers' salaries across seniority levels and across countries;
- Nevertheless, on average, non-European countries tend to pay better than the EU Member States in all career stages. The gap widens in most cases as researchers become more senior.

Researchers' career development – Charter & Code, HR Strategy for Researchers and "HR Excellence in Research" logo:

- EU Member States and Associated Countries continue to support the implementation of the Charter & Code (C&C) which aim to improve researchers' working conditions. Nearly 500 organisations from 35 countries in Europe and beyond have explicitly endorsed the principles of the C&C, many of them membership or umbrella organisations;
- The Commission's Human Resources Strategy for Researchers (HRS4R) focuses on the practical implementation of the C&C principles. As of May 2014, more than 180 organisations had between awarded the "Human Resources Excellence in Research" logo. A significant minority have been awarded within one country (UK) reflecting the existence of a strong enabling framework (VITAE). A number of other Member States[121] are underrepresented from the HRS4R.

Social security provisions:

- Researchers on stable employment contracts generally have social security coverage (including rights to statutory pensions, healthcare and unemployment benefits). Those without stable employment contracts, in particular doctoral candidates lack this provision to varying degrees.

5.2 Introduction

Employment and working conditions are essential determinants of the attractiveness of any career. The level of attractiveness depends largely on (the combination of) the following factors: clear career prospects with attractive employment opportunities (permanent positions), competitive salaries,

[121] Available at: http://ec.europa.eu/euraxess/index.cfm/rights/strategy4ResearcherOrgs

sufficient social security benefits (including statutory pension rights, healthcare and unemployment benefits), and the possibility of balancing work and personal life.

Attractive working conditions and career prospects are a prerequisite for attracting and retaining the most talented researchers in Europe and ensuring the realisation of the ERA. They are a key driver for attracting young people into a researcher career and ensuring top-quality research results in public research institutions in Europe.

Looking at Europe as a whole, research careers in the public sector appear relatively unattractive. Often, researchers feel trapped in a circle of temporary contracts and grants. This causes frustration and can lead to the loss of talented individuals from pursuing a research career in Europe[122].

There are significant variations between researchers' salary levels between the ERA and other parts of the world as well as significant salary differences between European countries. In addition, researchers face limited career development opportunities in general, especially at the beginning of their careers.

Outline

This chapter presents the most recent data on working conditions (employment contracts, remuneration and career prospects) in Europe as well as national measures aiming to safeguard sufficient social security provisions for researchers. First, it offers an overview of the key indicators for monitoring working conditions in research. Second, it sheds light on the contractual conditions of researchers in Europe. Third, it presents statistics on the remuneration levels at different stages of a researcher career in Europe and at international level. Fourth, it discusses the impact of researchers' mobility on their career progression. Lastly, it offers an overview of the countries' social security provisions (statutory pension rights, healthcare and unemployment benefits) for researchers.

5.3 Working conditions in the research profession – Key indicators

The table below presents an overview of key indicators and the source for monitoring the working conditions in the research profession.

Table 14: Working conditions in the research profession - Key indicators

Indicators	Data source(s)
Researchers employed on fixed-term contracts, Europe, 2012 (%)	MORE2 study
Estimated shares of researchers in the higher education sector by employment contract status and by country of affiliation, Europe 2012 (%)	MORE2 study
Remuneration of doctorate holders working as researchers compared to doctorate holders working as non-researchers (difference in median gross annual earnings), Europe (2009), US (2008) (%)	OECD, Science, Technology and Industry Scoreboard, 2011
Gross annual salaries and PhD stipends of university researchers as percentage of the best paying country within career stages, EU, the rest of Europe, and selected competitors and emerging economies	MORE2 study
Post-PhD researchers indicating that their time as mobile researcher had positive, negative or no impact on career progression, EU, 2012 (%)	MORE2 study

[122] European Commission (2013g)

5.4 Employment contracts in the research profession

In 2012, many researchers worked on a fixed-term contract or had no contract at all. This was most pronounced during earlier career stages (R1 - First Stage Researcher and R2 – Recognised Researcher).

The type of employment contract has a significant impact on the attractiveness of researchers' employment and working conditions. Young researchers are often employed on temporary short-term contracts to help carry out specific research projects to the detriment of academic independence, job security and sufficient social security. Senior researchers, on the other hand, are often employed on permanent contracts, with progression based on seniority rather than performance.

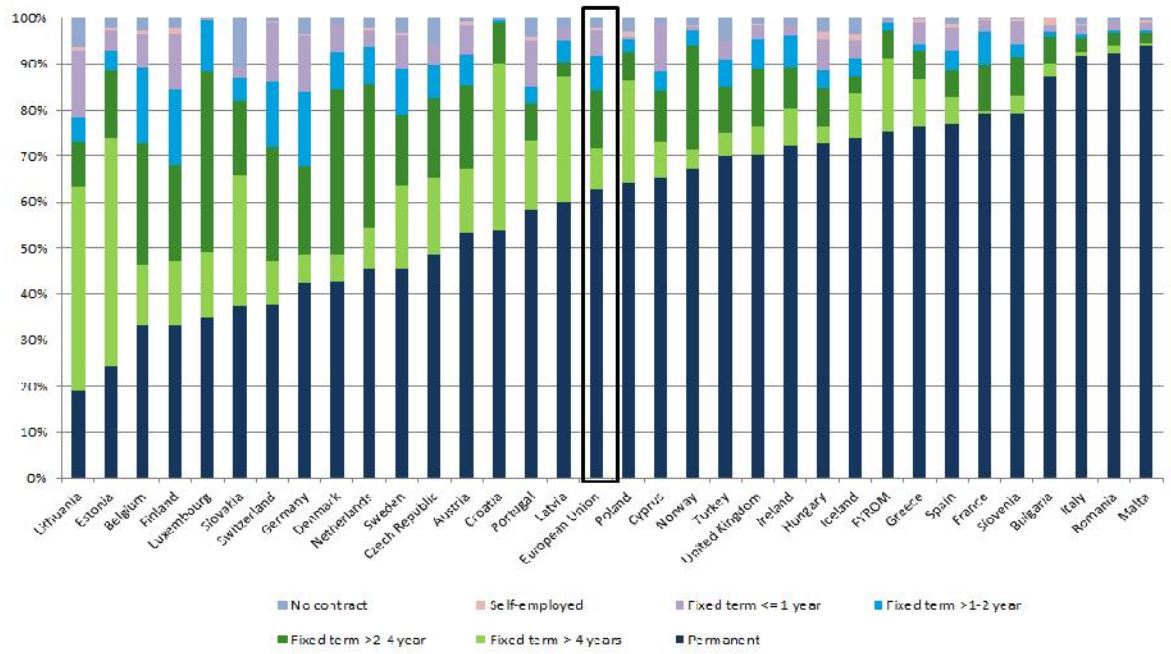
In 2012, researchers with no contracts, 'others' (often student status) and those with a fixed-term contract of one year maximum accounted for 31% of R1[123] PhD researchers, 10% of R2[124], 4% of R3[125] and 3% of R4[126]. Moreover, 55% of researchers in the R1 group with a PhD and 47% of the R2 group also had fixed-term contracts, albeit of a slightly longer duration than 12 months. These figures highlight the precarious contractual situation of early-stage researchers, particularly PhD researchers. The share of permanent (open-ended) contracts increases from lower (13% of R1 in PhD) to higher career stages (90% of R4). This suggests that researchers typically find stable positions only relatively late during their career paths, after having completed their doctorate[127].

In 2012, the highest proportion of public sector researchers with an open-ended or fixed-term contract of more than four years was in a number of the new Member States. It is important to note however that there are a number of other factors which can have a major impact on a researcher's working conditions. This includes the remuneration package, access to research funding, provision of training and career development, career prospects, etc.

In 2012, the highest proportion of researchers in the higher education sector employed on an open-ended contract (>70%) was in a number of the first- and second-generation Member States, e.g. Ireland (72%), Spain (77%), France (79%) and Italy (92%). In the same year, the highest share of researchers with a fixed-term contract of more than four years (>35%) was in a number of new Member States, e.g. Estonia (50%), Lithuania (44%), as well as Croatia (36%). The share of researchers with a fixed-term contract of one year or under ranged (in descending order) from 14% in Lithuania to less than 1% in FYROM and Croatia. Due to differences between countries in the interpretation of the term 'contract' as well as variations in the composition of the survey sample, these data should be treated with caution.

[123] R1: First Stage Researcher (up to the point of PhD)
[124] R2: Recognized Researcher (PhD holders or equivalent who are not yet fully independent)
[125] R3: Established Researcher (researchers who have developed a level of independence)
[126] R4: Leading Researcher (researchers leading their research area or field)
[127] IDEA Consult (2013)

Figure 28: Estimated shares of researchers in the higher education sector by employment contract status and by country of affiliation, Europe 2012 (%)



Source: Deloitte
Data: MORE2 study "Support for continued data collection and analysis concerning mobility patterns and career paths of researchers", IDEA Consult (2013)
* No information available for BiH, IL, LI and ME and SR
** European Union refers to EU-27

5.5 Remuneration in public research institutions

In several countries, doctorate holders working as a researcher tend to earn more than those employed as a non-researcher, irrespective of the sector of employment.

Competitive salaries in public research institutions are a key component of an attractive academic career. There are, however, significant variations between researchers' salary levels within the ERA compared to other regions of the world and in different sectors. These differences distort the European single labour market and can contribute to researchers taking up more attractive opportunities in other (economic) sectors or outside Europe[128]. The difference in median gross national earnings of doctorate holders employed as researchers compared with those working as non-researchers in different sectors provides a useful indication of researchers' salary levels[129].

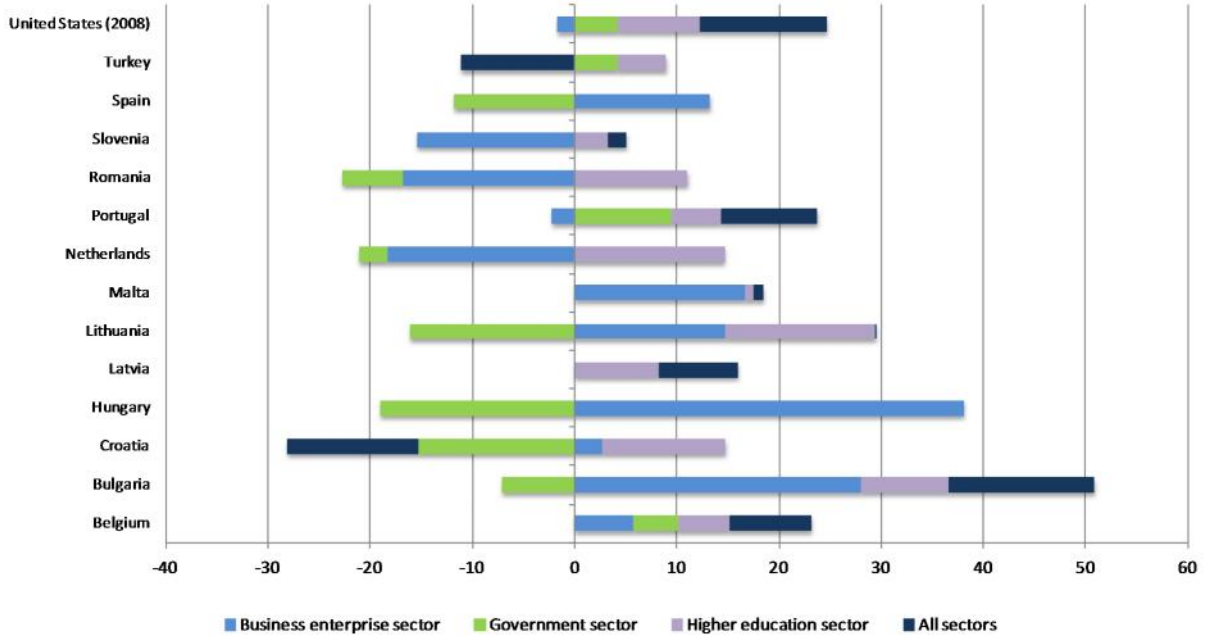
On average, gross annual earnings in all sectors are higher for doctorate holders working as researchers than those employed as non-researchers. Croatia and Turkey are exceptions. In all countries for which data are available, gross national earnings in the higher education sector are higher for doctorate holders working as researchers than those employed as non-researchers. Other sectors show a more diverse picture, though gross annual earnings of doctorate holders in the

[128] European Commission (2008b)

[129] Doctorate holders are defined (OECD, 2011a) as all economically active or inactive residents below the age of 70 who have completed, anywhere in the world, the second stage of tertiary education (ISCED level 6) leading to an advanced research qualification. The percentage difference in median gross annual earnings between doctorate holders working as researchers and those not working as researchers is calculated as the difference between the former and latter groups, divided by median gross annual earnings of doctorate holders not working as researchers

business enterprise sector working as a researcher compared to those working as non-researchers are substantially higher in most countries (>20%). Doctorate holders working as a researcher in the business enterprise sector earn substantially less than those working as a non-researcher, however, in Portugal, Romania, Slovenia and the Netherlands. Data for the government sector also show a diverse picture. Doctorate holders employed in the government sector working as a researcher have comparatively higher salaries than those working as non-researchers in Belgium, Portugal and Turkey. The opposite holds true for Bulgaria, Croatia, Hungary, Lithuania, Romania, Spain and the Netherlands.

Figure 29: Remuneration of doctorate holders working as researchers compared to doctorate holders working as non-researchers (difference in median gross annual earnings), Europe (2009), US (2008) (%)



Source: Deloitte
Data: OECD, Science, Technology and Industry Scoreboard, 2011
'All sectors' includes: business enterprise sector, government sector, higher education sector, 'other education' and private non-profit sectors.

On average, non-European countries outperform the EU Member States in terms of purchasing power adjusted salaries. Amongst the best paying countries are the US (R2-R4), Brazil (R1-R4), Switzerland (R2-R4), Cyprus (R2-R4), the Netherlands (R3, R4), Ireland (R4), and Belgium (R1). Denmark pays the highest stipends for PhD candidates across all countries.

The MORE2 Remuneration Cross-Country Report[130] provides a detailed description and analysis of researchers' remuneration in over 45 countries. This comparative study contains a set of country profiles covering the EU Member States, 13 other European countries, as well as the USA, Canada, Japan, China, South Korea, Singapore, Australia, Brazil and Russia.

On average, as a percentage of the purchasing power adjusted salary of the best paying countries, non-European countries pay better than the EU Member States in all career stages (R1-R4) based on

[130] Idea Consult (2013)

the European Framework for Research Careers (2011)[131]. The gap is 5 to 10 percentage points in R2, R3 and R4 and about 25 percentage points in R1. The largest differences occur with the US and Brazil (>80% of the highest salaries in all career stages compared to 45-55% in EU27).

Amongst the best paying countries are the US (R2-R4), Brazil (R1-R4), Switzerland (R2-R4), Cyprus (R2-R4), Netherlands (R3, R4), Ireland (R4), and Belgium (R1). Denmark pays the highest stipends for PhD candidates across all countries. US universities pay relatively low amounts for the R1 level researchers (both in terms of stipends but also to a lesser extent in terms of salaries for employed PhD candidates), but the higher the career level, the higher the PPP converted salaries are in the US in comparison to all other countries. However, as this study points out, some of the difference may be compensated for by better levels of social security provision in the EU, but this is difficult to quantify.

Bulgaria, Romania, Lithuania, Latvia and Hungary pay relatively low levels in each of the categories, sometimes as little as 20% or less of what the best paying country pays.

A comparison of EU countries with non-EU countries is strongly affected by the sample of non-EU countries[132]. While on average non-European countries offer higher gross annual salaries and PhD stipends to university researchers in comparison with the best paying country within the career stage, the difference diminishes when comparing EU-15 countries with those OECD countries that are not EU Member States. Average researcher salaries in EU-12 countries are similar to those in non-OECD countries.

[131] Available at: http://ec.europa.eu/euraxess/pdf/research_policies/Towards_a_European_Framework_for_Research_Careers_final.pdf

[132] For a detailed discussion of researchers' remuneration levels, see the MORE2 report (Idea Consult, 2013).

Table 15: Gross annual salaries and PhD stipends of university researchers as percentage of the best paying country within career stages, EU, the rest of Europe, and selected competitors and emerging economies

	EU		EU15	AT	BE	DE	DK	ES	FI	FR	GR	IE	IT	LU	NL	PT	SE	UK		EU12	BG	CY	CZ	EE	HU	LT	LV	PL	RO	SI
Salaries																														
Salary R1	45		60	70	>80	80	75	40	45	35	<20	.	.	.	65	.	60	75		30	<20	65	35	.	25	<20	<20	25	<20	55
Salary R2	50		60	80	80	70	65	45	55	25	50	50	60	.	75	75	55	55		35	<20	>80	40	35	25	<20	20	30	<20	70
Salary R3	55		65	65	80	65	65	60	60	45	45	75	65	.	>80	65	55	65		40	<20	>80	40	35	25	<20	.	30	<20	65
Salary R4	55		70	75	75	60	65	60	.	45	45	>80	75	.	>80	65	60	80		35	<20	>80	55	40	35	<20	<20	30	20	55
Annual Stipends for PhD candidates																														
R1	40		55	.	75	45	>80	55	35	65	20	45	60	.	.	55	.	75		20	20	.	<20	20	20	20	.	20	25	35

	non-EU	OECD non-EU		other Eur.	OECD Eur.	non-OECD Eur.	AL	BA	CH	FO	HR	IS	ME	MK	NO	RS	RU	TR		non-Eur.	OECD non-Eur.	AU	BR	CA	CN	IL	JP	KR	SG	US
Salaries																														
Salary R1	50	60		40	65	30	20	<20	60	.	50	40	35	40	>80	40	.	25		70	60	.	>80	.	.	55	75	30	.	75
Salary R2	50	60		45	70	35	.	35	>80	.	45	40	30	45	80*	35	.	25		55	55	60	>80	45	25	45	70	40	.	>80
Salary R3	55	65		50	65	40	30	40	>80	.	45	45	35	50	65*	35	.	40		65	65	70	>80	80	25	45	70	40	.	>80
Salary R4	60	70		55	70	45	.	45	>80	.	60	45	30	50	70	25	.	70		65	70	65	>80	75	30	45	65	65	.	>80
Annual Stipends for PhD candidates																														
R1	40	45		40	60	35	<20	40	.	.	35	60	50	65	.	30	.	30		40	40	45	.	35	.	20	.	.	45	65

Source: MORE2 expert survey. Minimum, average and maximum of gross annual salaries and PhD stipends (in PPPs) of each country are compared with minimum, average, and maximum of the best paying country in the covered sample respectively. The resulting shares for each country are then averaged within the country and rounded to 5 percentage points. The shown shares for country groups are averages across the respective countries. Countries covered: other Europe: AL, BA, CH, FO, HR, IS, ME, MK, NO, RS, RU, TR; non-Europe: AU, BR, CA, CN, IL, JP, KR, SG, US; OECD (excl. EU): AU, CA, CH, IL, IS, JP, KR, NO, US.*) The Norwegian Associate Professor is classified as both R2 and R3. Therefore, for Norway the comparison of R2 and R3 with the best paying country might be upward and downward biased respectively.

5.6 Researchers' career development – Charter & Code, HR Strategy for Researchers and "HR Excellence in Research" logo

EU Member States and Associated Countries continue to support the implementation of the Charter & Code (C&C) which aim to improve researchers' working conditions. The Commission's Human Resources Strategy for Researchers (HRS4R) focuses on the practical implementation of the C&C principles. Currently, some 230 organisations are members of the Strategy Group.

The '*Recommendation on the European Charter for Researchers and a Code of Conduct for the Recruitment of Researchers'* [133] spells out the roles, responsibilities and rights of researchers as well as of their employers and funders.

EU Member States and Associated Countries support the implementation of the Charter & Code[134]. The aim of the Charter is to ensure that the nature of the relationship between researchers and employers or funders is conducive to successful performance in generating, transferring, sharing and disseminating knowledge and technological development, and to the career development of researchers. The objectives of promoting the Charter & Code principles are to improve researchers' working conditions in accordance with common European principles (as set out in the Charter & Code).

More than 480 organisations from 35 countries in Europe and beyond had explicitly endorsed the principles underlying the Charter & Code, many of them membership or umbrella organisations. Together they represent more than 1 200 universities, research institutes and funding agencies. Several researcher associations have also endorsed the Charter & Code in writing, representing thousands of individual researchers.

The Human Resources Strategy for Researchers incorporating the Charter & Code[135] was launched in 2008 and provides European Commission support for employers and funders of researchers in the practical implementation of the Charter & Code principles. This five-step process enables organisations to truly integrate the principles in their own human resources policy, thereby promoting the organisation as a stimulating and favourable workplace, or as a funder that promotes the provision of such a favourable environment through its funding rules. Award of the 'HR Excellence in Research' logo recognises institutional progress in implementing Charter & Code principles. Currently, more than 240 organisations are members of the Strategy Group. As of May 2014, more than 180 had received the logo.

For example, the promotion of the Charter & Code and broad implementation of their principles at Austrian universities was part of the negotiations for 2010-2012 performance agreements with universities. The implementation of the Charter & Code is part of the National Action Plan for Researchers. In Austria, 18 universities have signed the Charter & Code. In addition, four funding organisations, three umbrella organisations, three research organisations and three universities of applied sciences have signed the Charter & Code.

[133] Available at: http://ec.europa.eu/euraxess/index.cfm/rights/whatIsAResearcher
[134] Council of the European Union (2008b)
[135] Available at: http://ec.europa.eu/euraxess/index.cfm/rights/strategy4Researcher

In Germany, three science organisations (the German Rectors' Conference (HRK), the German Academic Exchange Service (DAAD), and the Alexander von Humboldt Foundation (AvH)) have signed the 'Charter & Code'. The universities of Freiburg, Erlangen-Nürnberg, and Potsdam as well as the Cologne University of Applied Sciences and WZB Social Science Research Center Berlin have individually endorsed the 'Charter & Code'. In 2013, WZB was the first German institute to be awarded the 'HR Excellence in Research' logo.

The Irish Research Council (IRC) and the Irish Universities Association are spearheading an initiative to have all Irish Higher Education Institutions receive the Commission's endorsement of their recruitment policies and working conditions for researchers via permission to use the 'HR Excellence in Research' logo. This initiative has so far resulted in the award of the logo to University College Dublin, University of Limerick and University College Cork and put four of the remaining Irish universities, six Institutes of Technology, and three other research performers on the path to receiving the logo, in addition to the IRC, which is also implementing the process.

VITAE, the UK organisation championing researchers and research staff, manages a Researcher Development Framework (RDF). Within this Framework, thirty major UK organisations (e.g. Funding Councils, Research Councils, the Quality Assurance Agency, the unions and Universities UK) are involved in knowledge exchange and the development of a strategic agenda to train and support high-level researchers to further improve their skills competencies. The VITAE programme provides national leadership and strategic development, and works with higher education institutions, policy makers, stakeholders, employers and individual researchers. Institutions in other Member States also have plans to introduce similar professional development frameworks, as recommended in a report adopted by the ERA Steering Group on Human Resources and Mobility on 23 May 2012[136].

The Danish Council for Independent Research (DFF) offers a comprehensive career programme for excellent research, the *Sapere Aude* programme. The Council's initiative provides encouragement for individual and talented researchers to conduct their own research programme independently and to develop international networks.

For the majority of EU researchers, mobility has had a positive impact on their career progression across different employment sectors.

Mobility (e.g. between institutions, cross-sectoral and/or international) can have a positive impact on researcher' career progression by stimulating knowledge transfer, improving scientific outputs (such as publications), facilitating access to infrastructure and know-how, and granting access to international networks of professionals.

According to a recent large-scale survey on researchers' mobility[137], the internationally mobile researchers in the category of those having been mobile >3 months in the last ten years during their

[136] Available at: http://ec.europa.eu/euraxess/pdf/research_policies/SGHRM-WG1-on-HR-Issues-Final-report-May-2012.pdf
[137] IDEA Consult (2013)

post-PhD career feel that the output effects (quality of output, citation impact, patents, number of co-authored publications) are the most important factors related to mobility.

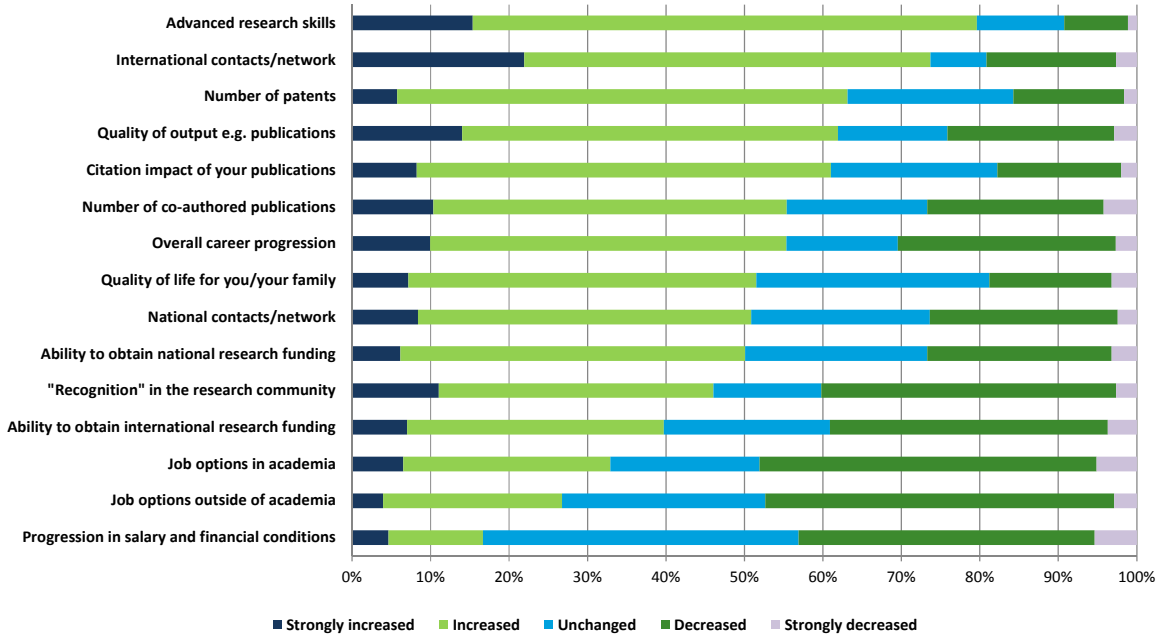
On average, 60% perceive these factors as having (strongly) increased as a result of being internationally mobile compared to around 25% of researchers who perceive quality and co-authored publications as having (strongly) decreased and 15-17% who cite patents and citation impact as having (strongly) decreased. This leaves around 14-21% of researchers who see no change in these factors as a result of being internationally mobile.

Other important effects are the advancement of research skills (80% increased, 11% unchanged and 9% decreased) and the development of international contacts and networks (74% increased, 7% unchanged and 19% decreased).

Although overall career progression has increased as a result of being internationally mobile according to 55% of researchers (compared to 14% for who it is unchanged and 31% for whom it has decreased), other career-related factors are less affected. For example, the ratio of those perceiving that the ability to obtain international research funding has increased or decreased is the same (39-40%). Job options in academia (33% increase versus 48% decrease) or outside (27% increase versus 47% decrease) as well as progression in remuneration (17% increase versus 43% decrease) have decreased for more researchers than increased.

The pattern is very similar for the recently mobile (researchers who were internationally mobile for >3 months in the last 5 years).

Figure 30: Post-PhD researchers indicating that their time as a mobile researcher (>3 months in last 10 years) had positive, negative or no impact on career progression, EU, 2012 (%)



Source: Deloitte
Data: MORE2 study "Support for continued data collection and analysis concerning mobility patterns and career paths of researchers", IDEA Consult (2013)
*Post PhDs refer to post-doctoral or equivalent, established or leading researchers (R2, R3 and R4 researchers)
**Mobility is defined as having worked abroad for more than three months at least once in the last ten years

5.7 Social security benefits (sickness, unemployment, old-age)[138]

While researchers on stable employment contracts tend to enjoy social security coverage (including statutory pension rights, healthcare and unemployment benefits), those without stable employment contracts lack this provision to varying degrees.

Social security provisions (including statutory/supplementary pension rights, healthcare/sickness, parental, unemployment benefits and sabbatical leaves) are an important element of an attractive career in research. Employers (universities, research institutions, funding agencies as well as the private sector) must ensure that researchers at all career stages enjoy fair and attractive funding conditions and/or salaries with adequate and equitable social security provisions in accordance with existing national legislation and national or sectoral collective bargaining agreements[139].

The EU ministers responsible for research (Competitiveness Council)[140] invited Member States, in accordance with their national legislation, *"to ensure appropriate social security coverage to all researchers, including doctoral candidates, who are engaged in remunerated research activity"*[141].

Mobile researchers moving to another country often face difficulties when it comes to their social security and pension rights. There are basic problems deriving from the lack of awareness of social security rights, the absence of supplementary pension schemes for their retirement, problems with the portability of their pension rights when moving from the public to the private sector (as well as from one country to another), sometimes resulting in significant losses of their acquired social security rights[142].

[138] For a detailed overview of the countries' social security provisions for researchers (sickness, unemployment and old-age), see Annex V
[139] European Commission (2005a)
[140] Conclusions 2 March 2010
[141] Available at: http://www.consilium.europa.eu/uedocs/cms_data/docs/pressdata/en/intm/113121.pdf
[142] European Commission (2005a)

6. Collaboration between academia and non-academia

6.1 Collaboration between academia and non-academia – Highlights[143]

Collaboration between researchers from academia and non-academia:

- Although the nature of PhD training is diversifying and the majority of PhD graduates embark on careers outside of academia (evidence shows that in France, Germany and the UK over 50 % of all PhD degree holders now take up jobs outside academia), early stage researchers are often inadequately informed about career paths outside of academia and have insufficient experience in industry and other relevant employment sectors. Only one in ten early-stage researchers reported receiving training in entrepreneurship or intellectual property rights during their PhD[144];
- Around one in four researchers in academia have been mobile to another sector (public or government, not-for-profit, industry) during their PhD, either in or outside their country. They are more likely to have moved to the public or the not-for-profit sector than to industry;
- Around 30% of EU researchers (in the post-PhD career stages) have been mobile for a period of more than three months: 12% to private industry, 7% to the private not-for-profit sector and 15% to the public or government sector;
- The most important motives for private sector employment are career progression, the possibility of being able to gain experience, increased employability, availability of research funding and being able to bring research to market;
- Around one in four respondents to the ERA public consultation[145] felt that EU researchers are equipped for the business sector market. Three in four acknowledge that they lack awareness of intellectual property rules and knowledge-transfer opportunities;
- Only a limited number of European researchers collaborate formally with the business sector in public-private co-publications. The number of scientific public-private co-publications per million population is considerably higher in the US and Japan than in the EU.

Countries' measures to increase collaboration between academia and industry:

- Measures to boost partnerships between universities, research institutions and private companies include joint projects, exploitation programmes, research traineeships in companies, inter-sectoral mobility programmes (from academia to industry, and vice-versa) and industrial PhD programmes, which may serve the dual purpose of promoting mobility and improving ties between academia and industry;
- Some countries encourage and sustain long-term cooperative partnerships (for instance, under a memorandum for cooperation), whereas others prefer to create networking platforms and innovation clusters to link universities and the business world.

[143] For more information on academia-industry cooperation, please see section 4.6 "Attracting people to science and providing quality training for researchers"

[144] MORE2 Study – Survey of researchers in Higher Education Institutions

[145] European Commission (2012a)

6.2 Introduction

Research, education and innovation are three central and strongly interdependent drivers of the knowledge-based society. Together they are referred to as the "knowledge triangle"[146]. Close collaboration between research, education and innovation is vital for the realisation of ERA and for maintaining Europe's competitiveness vis-à-vis its main economic competitors (US, Japan and China). Partnerships with business are very important because knowledge-sharing, human resources, proximity to other company sites and market demand make countries attractive for R&D activities[147].

The first chapter showed the comparatively low share of EU researchers employed in the business sector. This is partly due to insufficient collaboration between academia and industry. There are other plausible reasons such as researchers' inadequate skills sets, absence of training, a lack of entrepreneurial mind-set, etc.

Consequently, there is a need to develop a stronger relationship between the academic world and the business sector. As described in the chapter on "Education and training", European countries have put various measures in place to boost partnerships between academia and non-academia[148].

It is important to note that Europe is not homogenous. There are stark differences between countries with regard to collaboration between academia and industry. Austria, Belgium, Croatia, Germany, Ireland, Poland and Spain, for example, have introduced a plethora of measures aimed to encourage partnerships between academia and industry while other countries report fewer[149].

A further analysis is needed to assess the direct and indirect effects of these measures on the collaboration between academia and industry. For some of the more recent measures especially, it is too early to assess the impact.

Outline

This chapter presents the most recent data on collaboration between academia and non-academia in Europe and in comparison with its main economic competitors (US, Japan and China). First, it presents statistics on researchers' inter-sectoral mobility. Second, it offers an overview of the main motives for private sector employment. Third, it presents the most recent figures for the EU, US, Japan and China on public-private co-publications between different sectors (universities, research institutes and industry) as an indicator of the level of collaboration between academia and industry.

6.3 Collaboration between academia and non-academia – Key indicators

The table below presents an overview of key indicators for monitoring collaboration between the academic world and the business sector.

[146] European Commission, ERA Website: Available at: http://ec.europa.eu/research/era/understanding/what/era_in_the_knowledge_triangle_en.htm

[147] European Commission (2014a)

[148] For a detailed presentation of the countries' measures, see also Annex IV "Measures supporting education and training" in this report.

[149] For a full overview of countries' measures aimed to encourage collaboration between academia and industry, see Annex IV "Measures supporting education and training" in this report.

Table 16: Collaboration between academia and industry - Key indicators

Indicators	Data source(s)
Work placement or internship in the non-academic sector during PhD (per country of PhD), Europe, 2012 (%)	MORE2 study
Post-PhD researchers indicating inter-sectoral mobility > 3 months in private industry, Europe, 2012 (%)	MORE2 study
Motives for private sector employment, EU, 2012 (%)	MORE2 study
Public-private co-publications between two or more sectors (universities, research institutes, industry) per million population, EU, China, Japan and US, 2003 and 2008	Science-Metrix/Scopus

6.4 Mobility between academia and non-academia

Around one in four researchers (23%) were mobile to a sector outside of academia during their PhD, in or outside their country. This was made up of 4% of researchers who were active in private industry, 9% in the private not-for-profit sector and 10% in the public or government sector. The proportion of researchers who have had a work placement or internship in the non-academic sector during their PhD is highest in some of the new Member States and lowest in some of the older Member States.

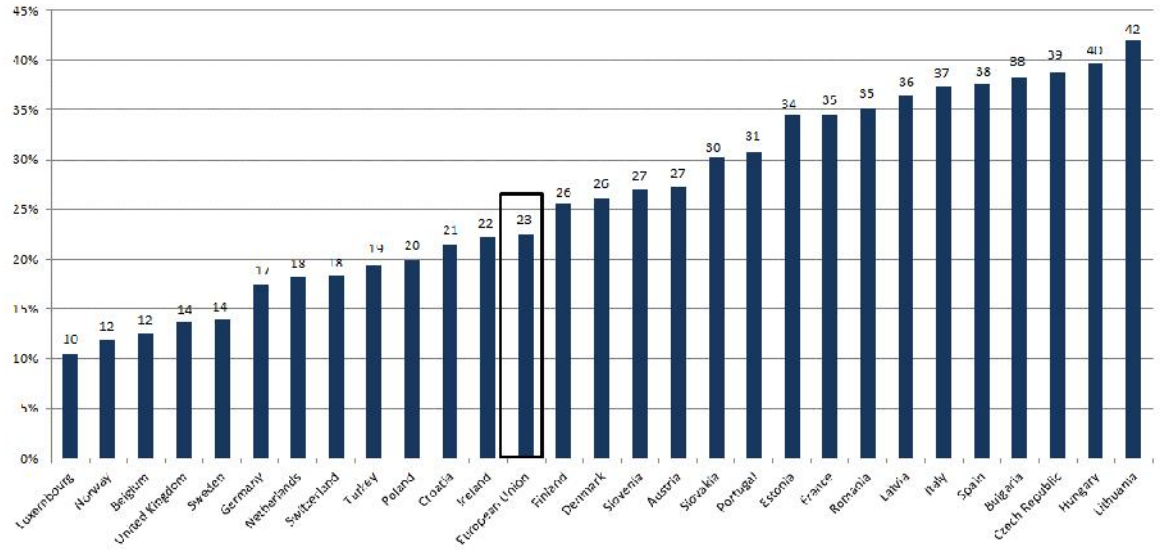
EU-wide, 23% of researchers[150] indicated that they had been mobile to a sector outside of academia, in- or outside their country[151]. This was made up of 4% in private industry, 9% in the private not-for-profit sector and 10% in the public or government sector. Overall, the highest proportion of researchers who have had a work placement or internship in the non-academic sector during their PhD (>35%) was in a number of new EU Member States (in descending order): Lithuania (42%), Hungary (40%), the Czech Republic (39%), Bulgaria (38%) and Latvia (36%). The lowest numbers (<15%) were reported in some of the older Member States (in descending order): Sweden (14%), UK (14%), Belgium (12%) and Luxembourg (10%). Eastern and Southern European countries thus have relatively high levels of inter-sectoral mobility. One explanation could be the interpretation of the terminology 'work placement', e.g. as 'work' and, in particular, as to whether the work in non-academia was actually part of the PhD[152].

[150] The survey was addressed to researchers in HEI in the EU. Researchers are referred to as PhD candidates and R2 (post-doctoral or equivalent) PhD holders.

[151] Idea Consult (2013)

[152] Idea Consult (2013)

Figure 31: Work placement or internship in the non-academic sector during PhD (per country of PhD), Europe, 2012 (%)



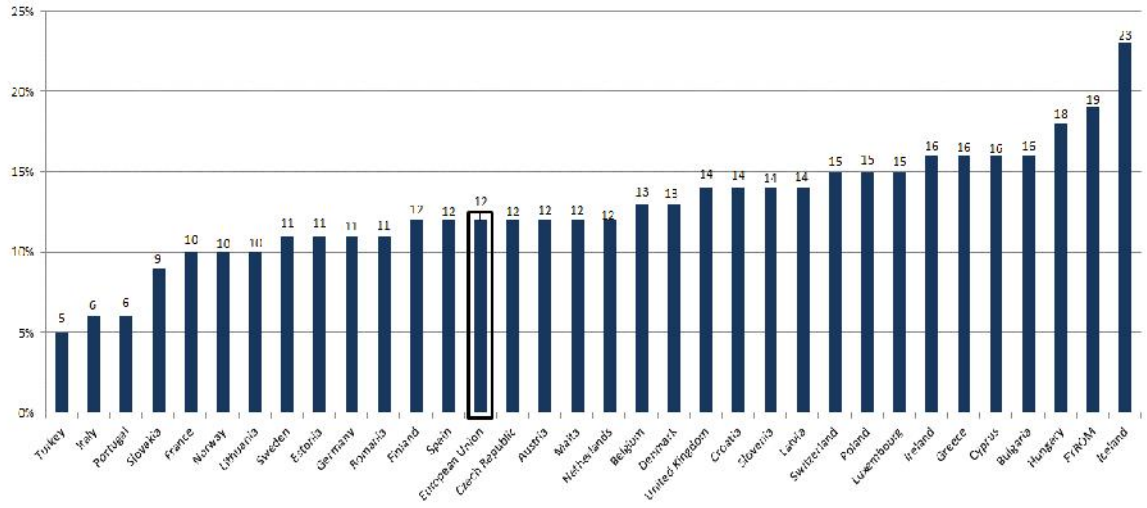
Source: Deloitte
Data: MORE2 study "Support for continued data collection and analysis concerning mobility patterns and career paths of researchers", IDEA Consult (2013)
* No information available for BiH, CY, EL, FI, FYROM, IL, IS, LI, ME and SR
** The data are presented for PhD candidates and R2 PhD holders (post-doctoral or equivalent)
*** European Union refers to EU-27

During the post-doctoral career stages, 30% of EU researchers have been inter-sectorally mobile for a period of more than three months: 12% to private industry, 7% to the private not-for-profit sector and 15% to the public or government sector. When looking solely at mobility to private industry, there is no clear pattern between new and old Member States.

The MORE2 study[153] found that 30% of the EU-27 post-PhD researcher population has at some time been active in another sector for a period of more than three months. The share of researchers indicating a period of inter-sectoral mobility of more than three months in private industry was 12% on average for the EU-27. It was highest (>15%) in Iceland (23%), FYROM (19%), Hungary (18%), Ireland, Greece, Cyprus and Bulgaria (all at 16%). The figures were lowest (<10%) in Slovakia (9%), Italy (6%), Portugal (6%) and Turkey (5%).

[153] Idea Consult (2013)

Figure 32: Post-PhD researchers indicating inter-sectoral mobility > 3 months in private industry, Europe, 2012



Source: Deloitte
Data: MORE2 study "Support for continued data collection and analysis concerning mobility patterns and career paths of researchers", IDEA Consult (2013)
* No information available for BiH, IL, LI, ME and SR
** European Union refers to EU-27

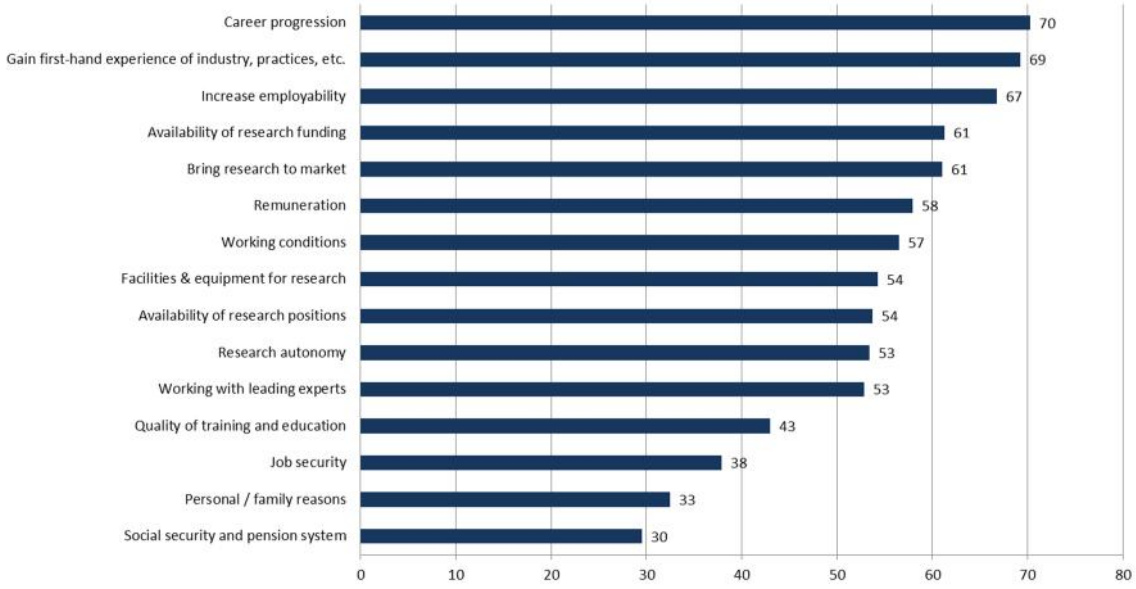
The most important motives for private sector employment are career progression, the possibility of being able to gain experience, increased employability, availability of research funding and being able to bring research to the market.

The MORE2 study[154] also looked at researchers' motives for taking up employment in the private sector. The most important factors motivating researchers to become mobile (>60%) in descending order are: career progression (70%), gaining first-hand experience in industry (69%), increasing employability (67%), availability of research funding (61%) and bringing research to the market (61%). This matches the motives for international mobility, where career progression and working with leading experts are considered most important[155].

The least important motives for moving to the private sector (<40%) were in descending order: job security (38%), personal/family reasons (33%) and social security and pension systems (30%), aspects which are also not considered to be important motives for international mobility.

[154] Ibid
[155] Ibid

Figure 33: Motives for private sector employment, EU-27, 2012 (%)



Source: Deloitte
Data: MORE2 study "Support for continued data collection and analysis concerning mobility patterns and career paths of researchers", IDEA Consult (2013)

6.5 Public-private co-publications between different sectors

The number of public-private co-publications between different sectors (universities, research institutes, industry) per million population provides some indication as to the degree of collaboration between academia and industry. Only a limited number of European researchers collaborate formally in this way with the business sector. The number of public-private co-publications per million population is considerably higher in the US and Japan than in the EU.

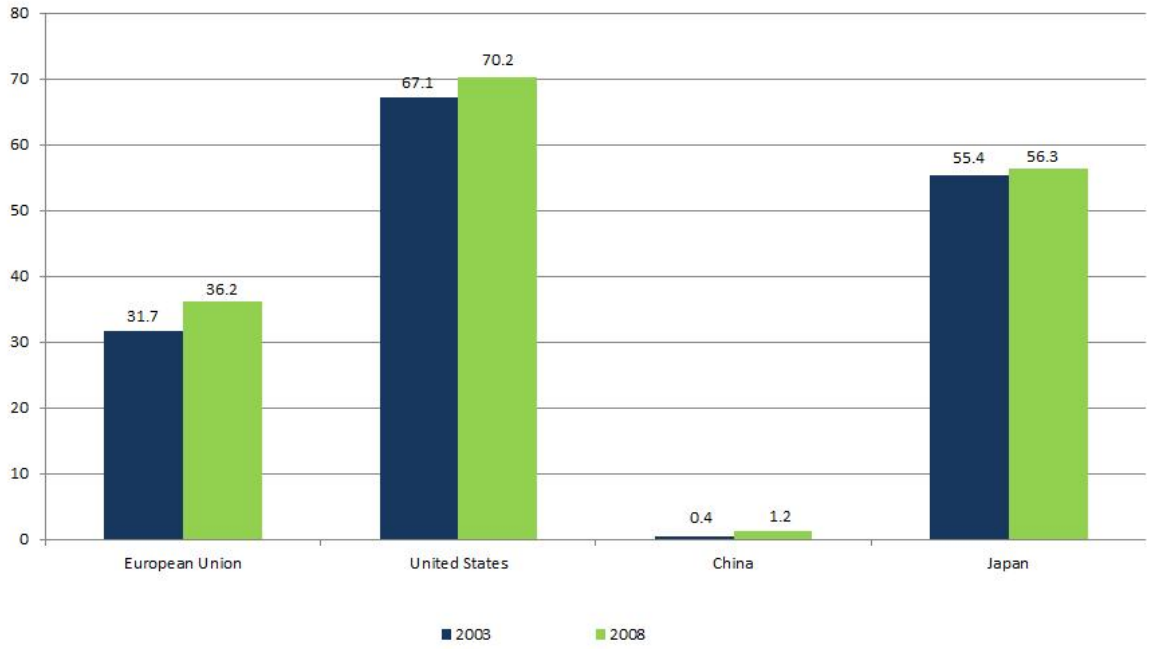
The number of public-private co-publications between different sectors (universities, research institutes, industry) per million population in 2008 [, stood at 70.2 for the US, followed by Japan (56.3), EU-27 (36.2) and China (1.2).

Between 2003 and 2008, the number of public-private co-publications between different sectors per million population increased in the EU-27 from 31.7 to 36.2 (14%). The increase in the United States was from 67.1 to 70.2 (4.6%). In Japan, the number of public-private co-publications between different sectors per million population increased from 55.4 in 2003 to 56.3 in 2008 (approximately 1.6%). China reported a substantial increase in scientific public-private co-publications between two or more sectors per million population (200%) from 0.4 in 2003 to 1.2 in 2008.

"One factor behind the lower public-private scientific cooperation in the EU could be that in general universities and PROs are not the main cooperation partners for innovative firms, except in Finland, Austria and Belgium. Another reason may be the lower size and intensity of researchers in the private sector in Europe, given that public-private cooperation to a large extent is made by people"[156].

[156] European Commission (2011b)

Figure 34: Public-private co-publications between two or more sectors (universities, research institutes, industry) per million population, EU, China, Japan and US, 2003 and 2008



Source: Deloitte
* Data: Science-Metrix/Scopus
** European Union refers to EU-27

7. Mobility and international attractiveness

7.1 Mobility and international attractiveness – Highlights

Mobility of researchers in Europe[157]:

- Around one in three (31%) EU researchers in the post-PhD phase have been 'internationally mobile' for at least three months in the last 10 years (2012 data); men are significantly more likely to have been internationally mobile at this stage than women;
- 'EURAXESS – Researchers in motion' plays an important role in providing access to information and support services for researchers wishing to pursue their research careers in Europe[158].

Mobility of doctoral candidates:

- Fewer than one in ten EU-27 doctoral candidates are studying in another Member State, but the ratio varies considerably across the EU; Austria, Ireland, the Netherlands, and the UK attract large numbers of doctoral students from other EU countries;
- Europe proves to be an attractive destination for many non-EU doctoral candidates who make up 24% of the total doctoral population in the EU; the highest shares of non-EU PhD candidates are found in the UK (31%) and France (35%);

Factors influencing and motivations for mobility[159]:

- The key factors determining mobility are 'career progression', 'leading experts', 'available funds', 'facilities & equipment', 'available positions' and 'quality of training; researchers cite 'personal/family reasons', 'obtaining funding', 'logistical issues' and 'finding a suitable position' as the main barriers;
- Barriers to mobility remain but efforts are being taken to remove or reduce them. For example, to overcome problems that remain with the implementation of the Scientific Visa Directive, the Commission has proposed a recast that will set clearer time limits for national authorities to decide on applications, provide researchers with greater opportunities to access the labour market during their stay, and facilitate mobility within the EU;
- Another important EU initiative is the forthcoming Retirement Savings Vehicle for European Research Institutions (RESAVER)[160], which will remove barriers to researchers' mobility and ensure safe and sustainable pensions for research professionals.

Countries' measures to remove the remaining barriers to mobility:

- Measures to remove obstacles to researchers' mobility include reforms linked to the Bologna process, and national (inward, outward and cross-sectoral) mobility schemes. The APART Programme (Austria), awards fellowships to national and international students in support of a post-doctoral thesis, or the continuation of a scientific project;
- Other incentives include promotion of 'dual careers'[161] (including a scheme straddling northeast France, southwest Germany and Basel in Switzerland), special visas to attract researchers to carry out in research or teach at universities (e.g. in France), and tax incentives.

[157] For more information on researcher mobility, see MORE2 study (Idea Consult 2013).

[158] 'EURAXESS – Researchers in motion' is available at: http://ec.europa.eu/euraxess/

[159] For more information on factors influencing researcher mobility, see MORE2 study (Idea Consult 2013).

[160] Available at: http://ec.europa.eu/euraxess/index.cfm/rights/resaver

[161] Dual career couples are defined by the fact that both partners are highly qualified and follow their career path while not foregoing having children and a family life.

Attractiveness of public research institutions:

- Publications are a proxy for excellence and therefore attractiveness: in 2012, the EU was second to the US in the production of international scientific co-publications, but in 2009 (most recent data available) still lagged behind the US in terms of scientific publications in the top 10% most-cited publications worldwide;
- European researchers co-publish mainly with colleagues from other European countries and with at least one author from a non-EU country. Within Europe, researchers from most countries collaborate intensively with colleagues from large countries in particular;
- The EU leads scientific excellence in several sectors but lags behind the US in strategic areas.

7.2 Introduction

As stated previously, mobility is a core concept of the ERA. There are different types of mobility. Physical mobility from one place to another is the most common form of mobility. It includes inward mobility (attracting researchers from abroad), outward mobility (researchers going abroad) and inter-sectoral mobility (between academia and industry)[162]. In addition, a distinction can be made between long-term mobility (to another country for the duration of several months or years) and short-term mobility (visits or project-related activities). Mobility also includes moving to another country to change jobs or being mobile with the same employer for short- or long-term. Moreover, there are increasingly new forms of mobility such as combined part-time positions, interdisciplinary mobility and virtual mobility[163].

There are many factors affecting each individual researcher's motivation, and the likelihood and duration of becoming and/or remaining mobile. Researcher mobility (inward, outward and cross-sectoral) depends largely on a (combination of): open, transparent and merit-based recruitment[164], portability of publicly funded grants[165], transparent transfer conditions, clear immigration rules and procedures, attractive employment and working conditions[166] – including career prospects with long-term employment opportunities, competitive salaries, sufficient social security benefits (including statutory pension rights, health care and unemployment benefits), and the possibility of balancing personal and private life.

During the last decade, the European Commission, in cooperation with Member States, has initiated a wide range of initiatives to facilitate researchers' mobility and increase the attractiveness of Europe as a destination for leading researchers. These include measures to facilitate access to information on mobility (via the EURAXESS portals[167]), a "Scientific Visa" package[168] facilitating administrative

[162] For more information on collaboration between academia and industry, see chapter "Collaboration between academia and industry" in this report.

[163] European Science Foundation (2013)

[164] Transparent recruitment policies and procedures in all European countries have the potential to facilitate researchers' mobility by matching supply and demand for the best-suited research positions across Europe. For a detailed discussion on recruitment practices in European countries, see chapter "Open, fair and merit-based recruitment" in this report.

[165] Access to and Portability of Grants. Report adopted by the ERA Steering Group on Human Resources and Mobility on 23 May 2012. Available at: http://ec.europa.eu/euraxess/pdf/research_policies/access_to_and_portability_of_grants_may_2012.pdf

[166] Attractive employment and working conditions and career prospects are a prerequisite for attracting the most talented researchers in Europe and facilitating researchers' mobility For a detailed discussion on researchers' working conditions in European countries, see chapter "Working conditions in the research profession" in this report.

[167] EURAXESS Researchers in Motion. Available at: http://ec.europa.eu/euraxess/

[168] It includes a Council Directive 2005/71/EC (12 October 2005) and two Recommendations: the 2005/761/EC on short-term visas and the 2005/762/EC on long-term admission

procedures for third country researchers entering the European Community, the adoption of the European Charter for Researchers and the Code of Conduct for the Recruitment of Researchers in Europe[169] to improve researchers' rights across Europe (the Charter & Code) and the Europe 2020 "Innovation Union" [170] initiative to remove obstacles to researchers' mobility as well as Marie Skłodowska-Curie Actions.

EURAXESS plays a crucial role because it provides access to a complete range of information and support services for researchers wishing to pursue their research careers in Europe. There are now EURAXESS Service Centres in 40 European countries dealing with an increasing number of mobility-related problems per year (150 000 in 2012). EURAXESS Jobs provides job seekers with around 10 000 offers on any given day.

EURAXESS Ireland recently launched a new Industry User Interface for business users. Companies can advertise vacancies, search an online database of researcher CVs, access the fast track research visas system and search for funding support opportunities. The Commission will explore the possibility of rolling this out to other countries so that business users across Europe will have a tailored interface.

EURAXESS Links continues to support European researchers in the US and Canada, Japan, Brazil, India, China and the ASEAN region. The mandate of the Links now includes promoting Europe as an attractive place for international researchers. For example, EURAXESS Links Information Officers act as intermediaries between the non-EU country and a EURAXESS Service Centre, thus speeding up the provision of information on immigration procedures.

Fast-track immigration is an important consideration for internationally mobile researchers and is thus an important factor in helping attract the best global talent to Europe. Ireland[171] has been successfully operating the Scientific Visa for non-EU researchers since 2007. A 2013 survey of researchers who had used the fast track scheme in revealed that 23% of them would definitely not have come to Ireland if the scheme were not in place.

In March 2013, the Commission proposed a recast[172] of the Scientific Visa Directive that will set clearer time limits for national authorities to decide on applications, provide researchers with greater opportunities to access the labour market during their stay, and facilitate mobility within the EU. The proposed Directive is under negotiation by the European Parliament and Council.

Mobile researchers face obstacles related to social security, in particular with regard to their pensions. To respond to this need, the Commission is committed to supporting stakeholders in setting up pan-European supplementary pension fund(s) for researchers. A Task Force was created in 2013 to prepare a proposal on the establishment of a pan-European Retirement Savings Vehicle (RESAVER) for professionals employed by research organisations. The Commission has foreseen funding under Horizon 2020 to sponsor the set-up of notably the IORP and the insurance scheme as well as the

[169] European Commission (2005a)

[170] European Commission (2010b)

[171] The scheme, which is free of charge and open to universities and companies, is operated by the EURAXESS Ireland office based in the Irish Universities Association and supported by the government Department of Jobs, Enterprise and Innovation.

[172] European Commission (2013e)

functional administration, including the selection of provider(s). The fund should become operational in 2015.

Outline

This chapter presents the most recent data on researchers' mobility and international attractiveness. First, it offers an overview of the key indicators for monitoring researchers' mobility. Second, it presents the most recent figures on researchers' mobility (inward, outward and cross-sectoral). Third, it presents information on different factors influencing researchers' mobility. Fourth, it presents statistics on scientific publications and co-publications, which serve as an indicator for cooperation between researchers in different countries. Fifth, the chapter presents information on the attractiveness of European countries and institutions by means of a number of useful indicators. Sixth, it provides an overview of the countries' measures to remove the remaining barriers to researchers' mobility.

7.3 Mobility and international attractiveness – Key indicators

The table below presents an overview of key indicators for monitoring mobility and international attractiveness in Europe and gives the source.

Table 17: Mobility and international attractiveness - Key indicators

Indicators	Data source(s)
Foreign (non-EU) doctoral candidates (ISCED 6) in the EU by the top 30 countries of origin, 2011	UNESCO OECD Eurostat education survey
Non-EU doctoral candidates as a percentage of all doctoral candidates, Europe, 2011	Eurostat/Innovation Union Scoreboard 2014
Doctoral candidates (ISCED 6) with a citizenship of another EU Member State, Europe, 2008 and 2011 (%)	EUROSTAT OECD UNESCO survey
Researchers (post-PhD) having spent a period of at least three months as researchers in another country in the last 10 years, Europe, 2012 (%)	MORE2 study
Differences in gender of researchers (post-PhD) having spent a period of at least three months as researchers in another country in the last 10 years, Europe, 2012 (%)	MORE2 study
Factors motivating EU researchers (post-PhD) to spend a period of at least three months as researchers in another country in the last 10 years, EU, 2012	MORE2 study
Factors motivating European researchers (post-PhD) to spend a period of at least three months as researchers in another country in the last 10 years, by career stages, EU, 2012	MORE2 study
Importance of barriers as reasons for international non-mobility in post-PhD career, EU, 2012 (%)	MORE2 study
International scientific co-publications per million population, Europe, US, Japan and China, 2012	Science-Metrix/ Scopus/IUS
Scientific publications in the top 10% most-cited publications worldwide as a percentage of all scientific publications, Europe, US, Japan and China, 2009 (%)	Science-Metrix/Scopus /IUS
Main producers of scientific publications, EU, 2000 and 2008	Innovation Union Competitiveness Report 2011[173]
Co-publications with an author from another EU Member State by five main partners in Europe, other countries, 2010 (%)	Science-Metrix/Scopus

[173] European Commission (2011a)

Indicators	Data source(s)
Scientific publications in the top 10% most-cited publications by sector, Europe, US and Asia (Japan, China, Republic of Korea and India)	Science-Metrix
Scientific collaboration pattern for all scientific priorities in Europe, other countries, 2000-2011	Science-Metrix using Scopus
Composite indicator of research excellence, Europe, 2007 and 2012	JRC calculations using data from Science-Metrix (highly cited publications), OECD (PCT patent applications), CWTS Leiden Ranking (world class universities) and Scimago (research institutes), and ERC/DG RTD CORDIS (ERC grants data). Population and R&D data are from Eurostat and OECD, GDP data from World Bank World Development Indicators
Composite indicator for researcher excellence, Europe, US, China, Japan, Republic of Korea, India and Brazil, 2007 and 2012	JRC calculations using data from Science-Metrix (highly cited publications), OECD (PCT patent applications), CWTS Leiden Ranking (world class universities) and Scimago (research institutes) and ERC/DG RTD CORDIS (ERC grants data). Population and R&D data are from Eurostat and OECD, GDP data from World Bank World Development Indicators

7.4 Researchers' mobility – non-national (foreign) doctoral candidates

The share of non-EU doctoral candidates[174] as a percentage of all doctoral candidates serves as a useful indicator of the openness and attractiveness of a research system. EU-wide, there were an estimated 745 000[175] doctoral candidates in 2011: 68% were EU-27 nationals studying in their own country, while 8% were EU-27 nationals studying in another EU-27 country. The remaining 24% are from outside the EU. The highest number of foreign (non-EU) doctoral candidates in the EU-27 came from China (2011).

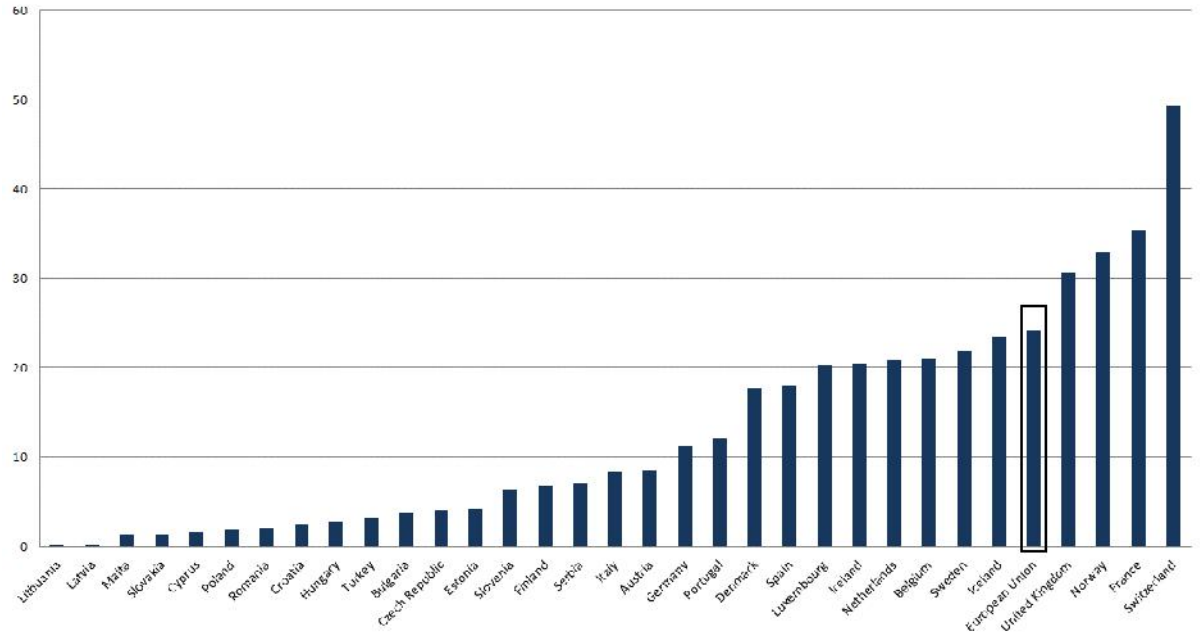
In the UK and France, the share of non-EU doctoral candidates is between 30% and 35%. The proportion of foreign doctoral candidates is even higher in Switzerland — almost half, and it is above 30% in Norway, but this includes those from EU countries. In addition to the cases of France and the UK, there is a relatively high share (10-20%)) of non-EU doctoral candidates in a number of other older Member States, e.g. Spain (18.0%), Denmark (17.7%), Portugal (12.0%) and Germany (11.2%) while

[174] "Non-EU doctoral candidates" refers to foreign doctoral candidates in the case of non-EU countries

[175] Source: Eurostat

the lowest share of non-EU doctoral candidates as a percentage of all doctoral candidates (<5%) is in a number of the new Member States, ranging from 4.2% in Estonia to 0.03% in Lithuania.

Figure 35: Non-EU doctoral candidates as a percentage of all doctoral candidates, Europe, 2011



Source: Deloitte
Data: Innovation Union Scoreboard 2014[176]
* European Union refers to EU-27

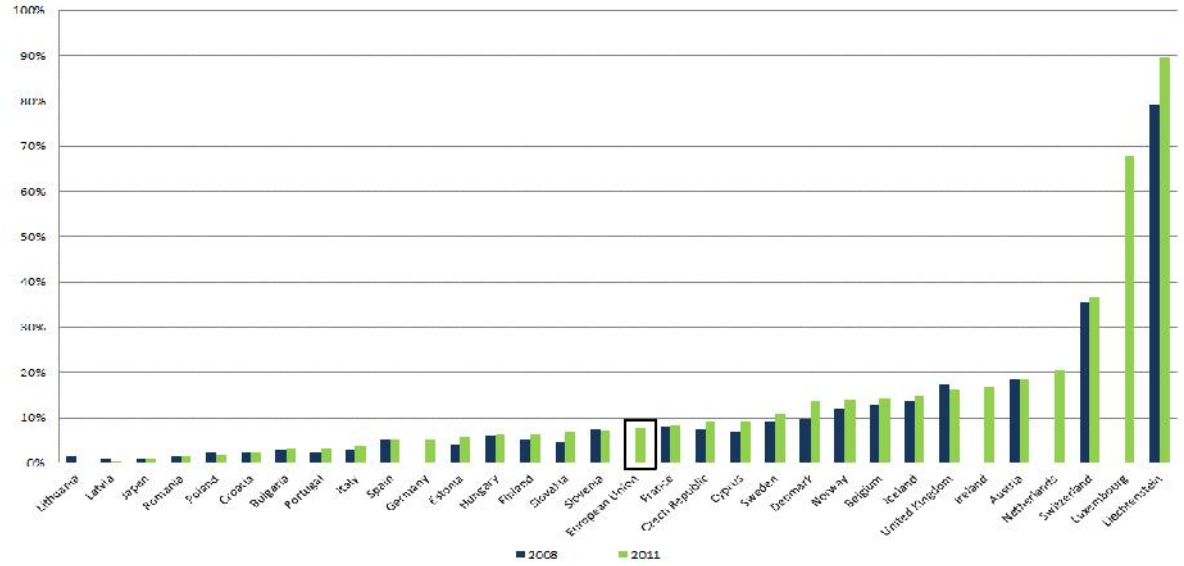
7.5 Intra-EU researchers' mobility

The Netherlands (20.4%)[177] is the EU country where the highest proportion of doctoral students from other EU countries are to be found, followed by Austria (18.5%), Ireland (16.9%) and the UK (16.2%). The EU average is (7.7%)[178]. The Member States with the lowest relative inflows of doctoral candidates from other EU countries are some of the new Member States, and Italy and Portugal.

The highest level of doctoral candidates with citizenship of another EU Member State in 2011 (>10%) was in a number of the older Member States, e.g. Netherlands (20.4%), Austria (18.5%), Ireland (16.9%), UK (16.2%), Belgium (14.2%), Denmark (13.8%) and Sweden (10.9%). In terms of absolute numbers, the UK is the first choice, followed by Germany, France, Austria and Spain. The lowest share (<5%) was in a number of the new Member States, ranging from 3.1% in Bulgaria to 0.2% in Lithuania.

[176] European Commission (2014b)
[177] Luxembourg being an exception due to the proximity of the other countries.
[178] There is no EU average for 2008 because data for Germany are missing.

Figure 36: Doctoral candidates (ISCED 6) with a citizenship of another EU Member State, Europe, 2008 and 2011 (%)

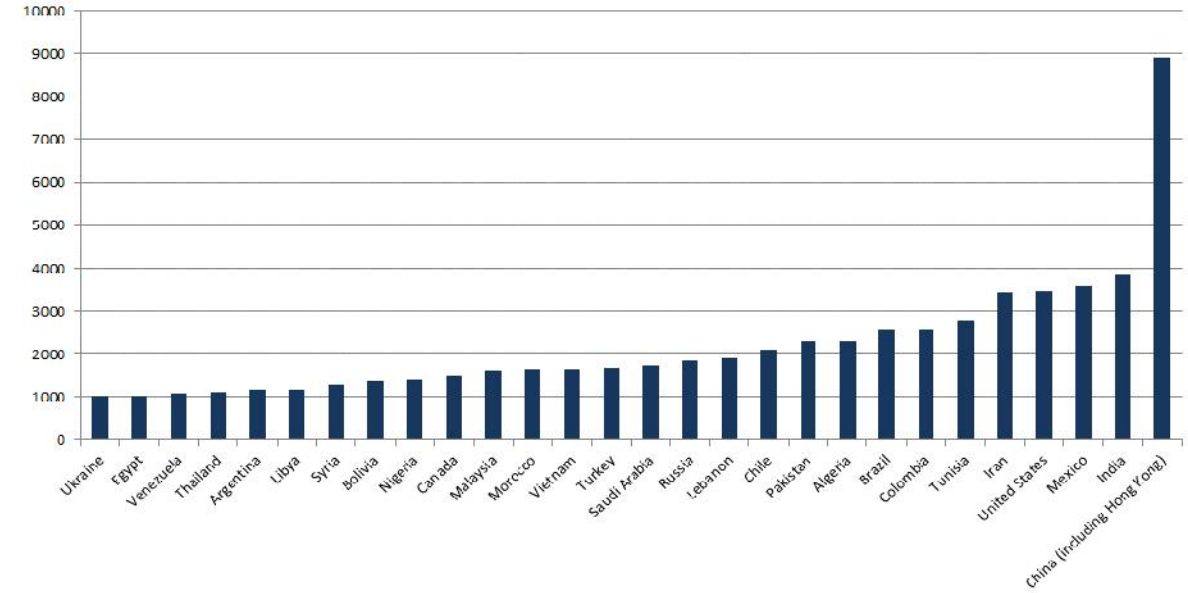


Source: Deloitte
Data: EUROSTAT OECD UNESCO survey
* No information available for 2008 DE, IE, NL and LUX
** European Union refers to EU-27

In 2011, the highest number of foreign (non-EU) doctoral candidates in the EU came from China.

According to 2011 data, the most important country of origin of non-EU doctoral candidates was China with 8 896 doctoral candidates, followed by India (3 854), Mexico (3 591) the United States (3 456) and Iran (3 419). Between 2 000 and 3 000 doctoral candidates came (in descending order) from Tunisia, Colombia, Brazil, Algeria, Pakistan and Chile each, while fewer than 1 200 non-EU doctoral students came from (in descending order) Libya, Argentina, Thailand, Venezuela, Egypt and the Ukraine.

Figure 37: Foreign (non-EU) doctoral candidates (ISCED 6) in the EU by the top 30 countries of origin, 2011



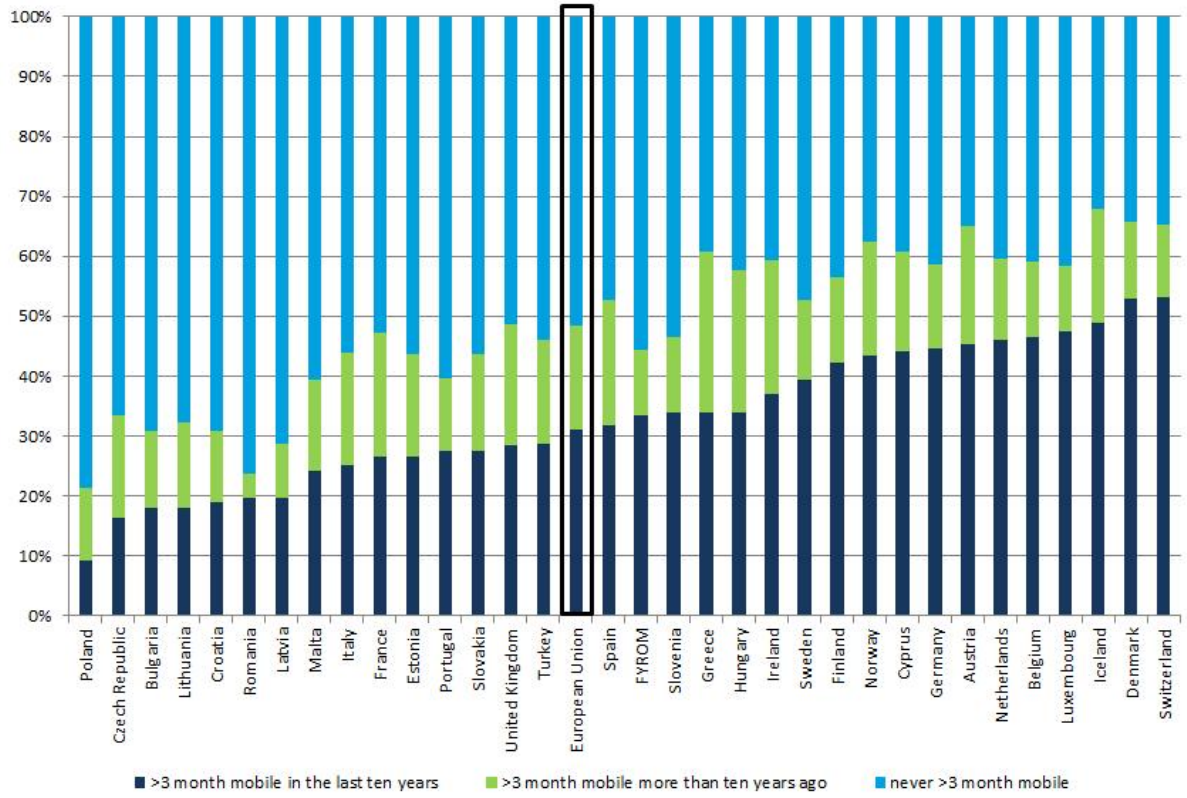
Source: Deloitte
Data: UNESCO OECD Eurostat education survey

7.6 Researchers having spent some time as a researcher in another country

Mobility is a feature of the career path of many researchers. Around one in three EU researchers (31%) in their post-PhD phase have been 'internationally mobile' for at least three months in the last 10 years.

Switzerland and Denmark have the highest levels of mobile researchers on this criterion (>50%). Researchers from Latvia, Romania, Croatia, Lithuania, Bulgaria, Czech Republic and Poland were the least mobile of those in the study population (<20%). In Greece, Hungary, Ireland, Spain, France and the UK, on the other hand, a relatively large group of researchers was mobile for three months more than ten years ago (>20%).

Figure 38: Researchers (post-PhD) having spent a period of at least three months as researchers in another country in the last 10 years, Europe, 2012 (%)



Source: Deloitte
Data: MORE2 study "Support for continued data collection and analysis concerning mobility patterns and career paths of researchers", IDEA Consult (2013)
* No information available for BiH, IL, LI, ME and SR
** European Union refers to EU-27

The ratio of male researchers having spent a period of at least three months as a researcher in the last ten years in another country (34%) is higher than for women researchers (25%).

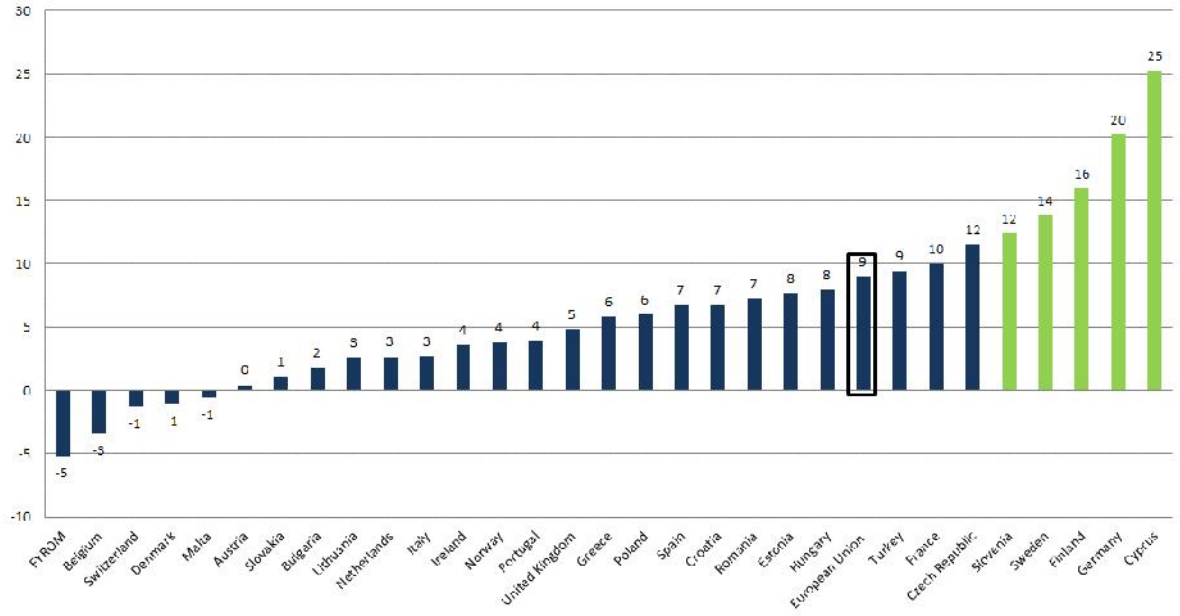
The MORE2 study[179] revealed a difference between mobility patterns when looking at the proportion of female and male researchers. The ratio of male researchers indicating that they have spent a period

[179] Idea Consult (2013)

of at least three months as a researcher in another country in the last ten years was higher (34%) than that of women (25%). While this holds true across all scientific domains, the difference was slightly greater in the social sciences and humanities (35% compared to 24%).

Variations in this gender gap also occur across countries. Male researchers are substantially more likely to be mobile in Cyprus (+25 percentage points), Germany (+20 pp), Finland (+16 pp), Sweden (+14 pp), Slovenia (+12 pp) and the Czech Republic (+12 pp). Female researchers are more mobile than their male counterparts in FYROM, Belgium, Switzerland, Denmark and Malta.

Figure 39: Differences in gender for researchers (post-PhD) having spent a period of at least three months as researchers in another country in the last 10 years, Europe, 2012 (percentage points)



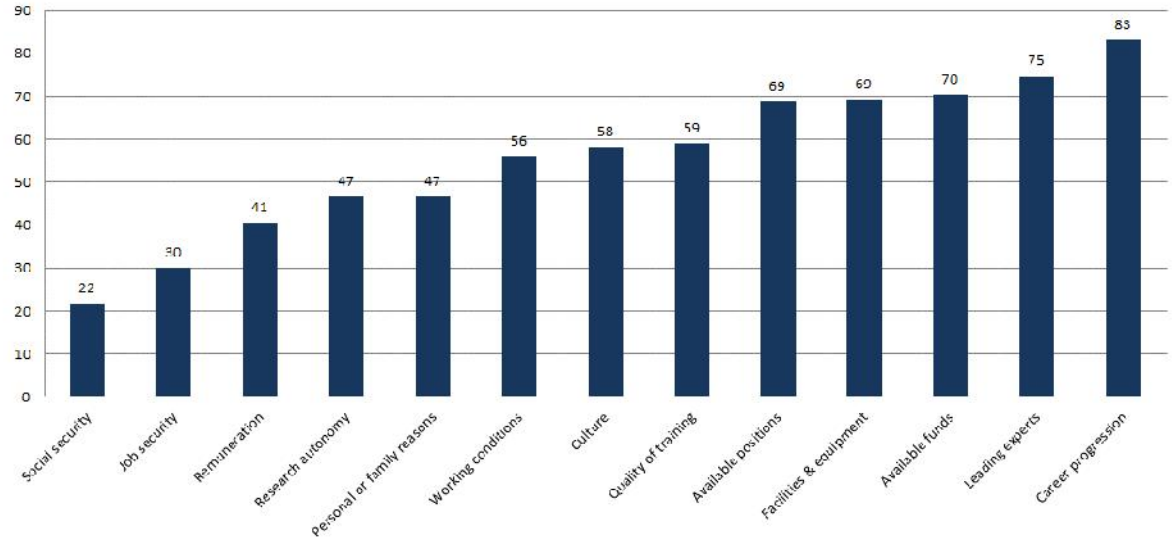
Source: Deloitte
Data: MORE2 study "Support for continued data collection and analysis concerning mobility patterns and career paths of researchers", IDEA Consult (2013)
* No information available for BiH, IL, IS, LI, LU, LV, ME and SR
** European Union refers to EU-27

7.7 Factors influencing and motivations for mobility

The most important factors influencing researchers' mobility are 'career progression', 'leading experts', 'available funds', facilities & equipment', 'available positions' and 'quality of training'. 'Personal/family reasons' are the most important factors dissuading researchers from becoming mobile.

There are many factors motivating European researchers to become mobile or dissuading them from taking such a decision. The vast majority of researchers (83%) consider career progression as an important motive, followed by collaboration with leading experts (75%), availability of funds (70%), facilities and equipment (70%), available positions (69%) and quality of training (59%). There is a similar emphasis on research and career-related motives as in the case of post PhD degree mobility (see chapter on "Education and Training"). Factors like remuneration (40%), job security (30%) and social security (22%) are less important for mobility.

Figure 40: Factors motivating EU researchers (post-PhD) to spend a period of at least three months as researchers in another country in the last 10 years, EU, 2012 (average scores) (%)



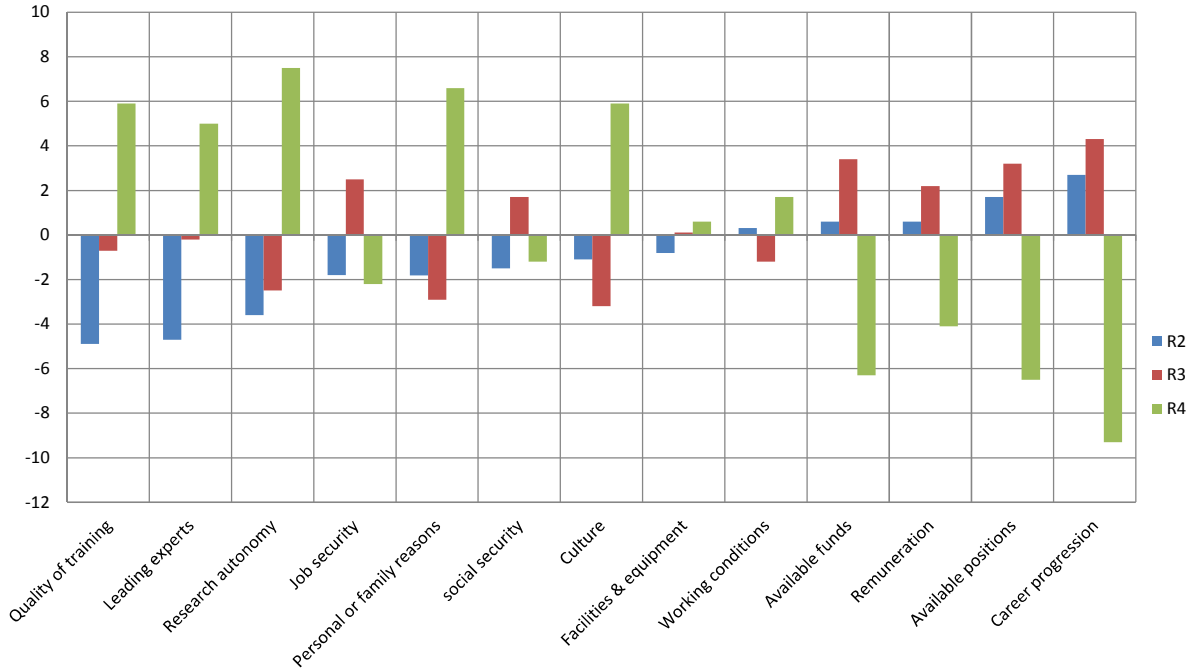
Source: Deloitte
Data: MORE2 study "Support for continued data collection and analysis concerning mobility patterns and career paths of researchers", IDEA Consult (2013)

The degree of importance of motives for becoming mobile show remarkable differences when comparing the different career stages (R4, R3 and R2). For established researchers (R4), research autonomy, personal and family reasons, the quality of training and culture stand out as the most important factors for becoming mobile. Established researchers usually have a leading role in their research area or field and if a foreign position is available they are mostly attracted by the autonomy offered[180].

By contrast, for independent researchers (R3), career progression, available funds, available positions, job security, remuneration and social security are the most important factors for becoming mobile. The most important motives for post-doctoral researchers (R2) are career progression, available positions, remuneration, available funds and working conditions. Thus, the factors motivating European researchers (post-PhD) to spend a period of at least three months as researchers in another country in the last ten years differ substantially between the different stages of a researcher's career.

[180] Idea Consult (2013)

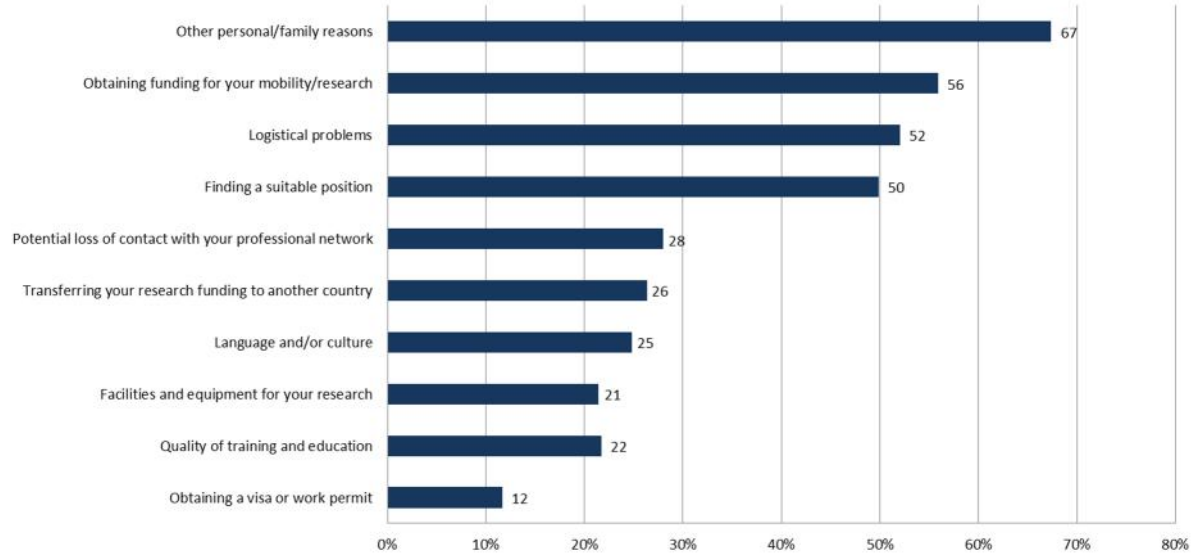
Figure 41: Factors motivating EU researchers (post-PhD) to spend a period of at least three months as researchers in another country in the last 10 years, EU, 2012 (%)



Source: Deloitte
Data: MORE2 study "Support for continued data collection and analysis concerning mobility patterns and career paths of researchers", IDEA Consult (2013)
* R2: post-doctoral researcher; R3: independent researcher; R4: established researcher (European Framework for Research Careers (2011))

Researchers rank personal and family reasons as the most important barriers for pursuing an international career (mobility as a post-doc). Problems associated with obtaining funding for mobility or research and logistical issues are amongst the top three barriers hampering researchers' mobility. Facilities and equipment for research, the quality of training and education and obtaining a visa or work permit are less important factors.

Figure 42: Importance of barriers as reasons for international non-mobility in post-PhD career, EU, 2012 (%)



Source: Deloitte
Data: MORE2 study "Support for continued data collection and analysis concerning mobility patterns and career paths of researchers", IDEA Consult (2013)

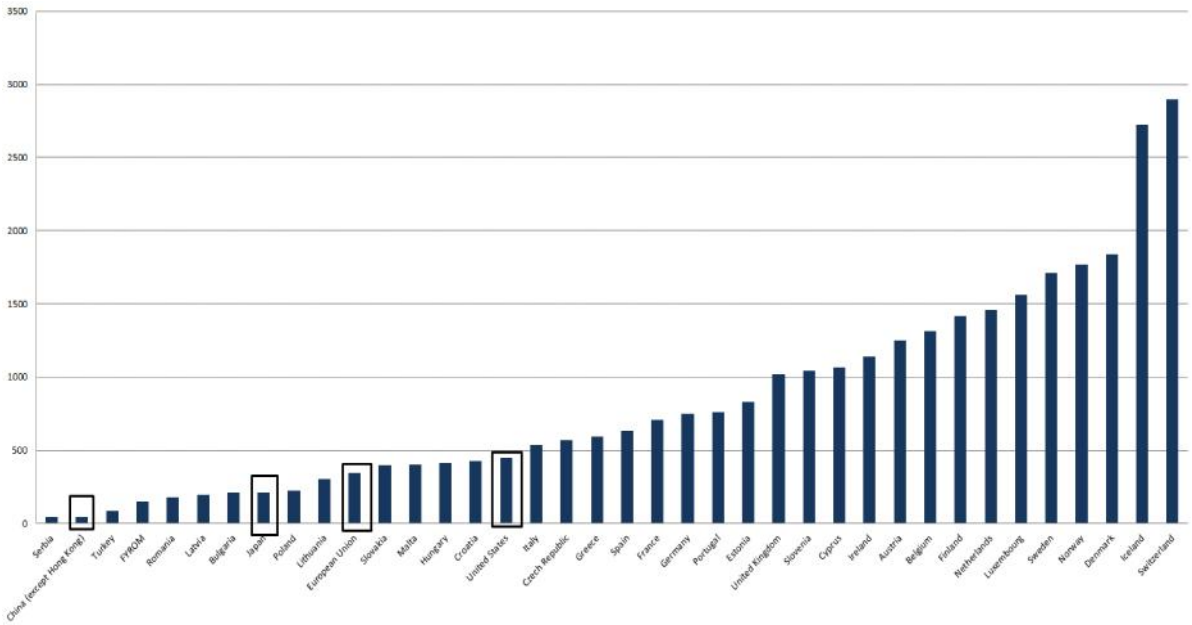
7.8 Scientific co-publications with an author from another country

In 2012, the EU-28 was second to the United States in the production of international scientific co-publications. Several Member States co-publish more than the US in relative terms.

In 2012, the EU lagged behind the United States in terms of international scientific co-publications per million population[181]. The EU average was around 343 co-publications per million population in comparison with around 448 in the United States, 215 in Japan and 46 in China. The EU average should be seen in context: only co-publications with non-EU countries are included. This obviously creates a downward distortion. For individual Member States, the picture is different with many co-publishing more than the US in relative terms.

Switzerland and Iceland have very high levels, of more than 2 500 co-publications per million population, followed by a number of Nordic countries such as Denmark, Norway, Sweden and Finland (in descending order) and Luxembourg, Netherlands, Belgium, Austria, Ireland, Cyprus, Slovenia and UK with more than 1 000 co-publications per million population. The lowest number (<500) of co-publications per million population was in a number of new Member States, such as Croatia, Hungary, Malta, Slovakia, Lithuania, Poland, Bulgaria, Latvia and Romania (in descending order).

Figure 43: International scientific co-publications per million population, Europe, US, Japan and China, 2012



Source: Deloitte
Data: Science-Metrix/Scopus /Innovation Union Scoreboard 2014
* No information available for BiH, IL, LI and ME. The EU-28 average should be seen in context: only co-publications with non-EU countries are included. This obviously creates a downward distortion.

[181] International scientific co-publications are a proxy for the quality of scientific research as collaboration increases scientific productivity. The numerator refers to the number of scientific publications with at least one co-author based abroad (where abroad is non-EU for the EU-27).

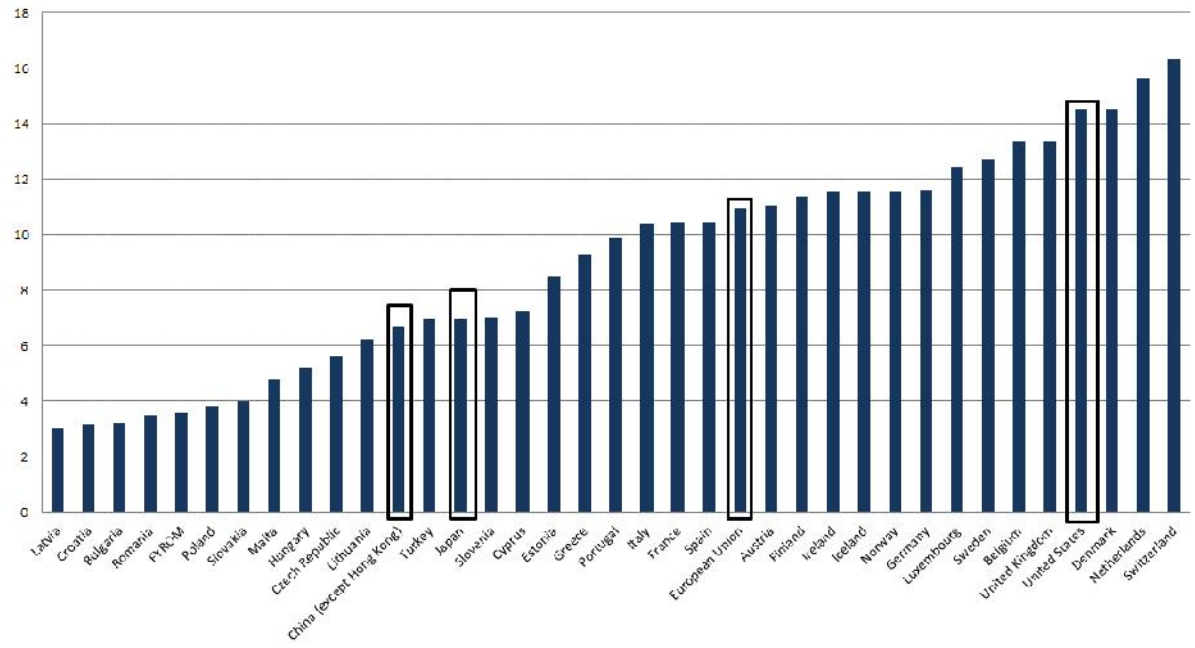
In 2009, the EU lagged behind the US in terms of scientific publications in the top 10% most-cited publications worldwide. The indicator is a proxy for the excellence of the research system as highly cited publications are assumed to be of higher quality.

When it comes to the scientific quality of research worldwide, a better measure is a country's capacity to produce scientific publications with high international impact. The number of citations that a scientific publication generates is an indication of its excellence and its chance of generating further scientific results.

In 2009, 10.95% of EU scientific publications were in the top 10% most-cited publications worldwide in comparison with 14.5% scientific publications produced in the United States.

Individually, the best performance (>10%) in the EU-28 was shown (in descending order) by Netherlands, Denmark, UK, Belgium, Sweden, Luxembourg, Germany, Ireland, Finland, Austria, Spain, France and Italy. Countries like France and Germany, where researchers are more likely to publish more in their own language, are more likely to underperform on this indicator relative to their real academic excellence[182]. The share is lowest (<5%) in a number of new Member States (in descending order): Slovakia, Poland, Romania, Bulgaria, Croatia and Latvia.

Figure 44: Scientific publications in the top 10% most-cited publications worldwide as a percentage of all scientific publications, Europe, US, Japan and China, 2009 (%)



Source: Deloitte
Data: Science-Metrix/Scopus/Innovation Union Scoreboard 2014
* No information available for BiH, IL, LI and ME

The number of scientific co-publications provides insight into cooperation between researchers from different countries. European researchers co-publish mainly with colleagues from other European countries (85-95%) and with at least one author from a country outside the EU. Within Europe, researchers from most countries collaborate

[182] European Commission (2011c)

intensively with colleagues from large countries in particular (i.e. France, Germany, Italy and UK).

The table below presents the main EU producers of scientific publications for 2000 and 2008, and the annual average growth (2000-2008). In 2008, the EU Member States with the highest number of scientific publications were the UK (21.5% of all EU publications), Germany (20.4%), France (15.0%), Italy (11.6%) and Spain (9.6%).

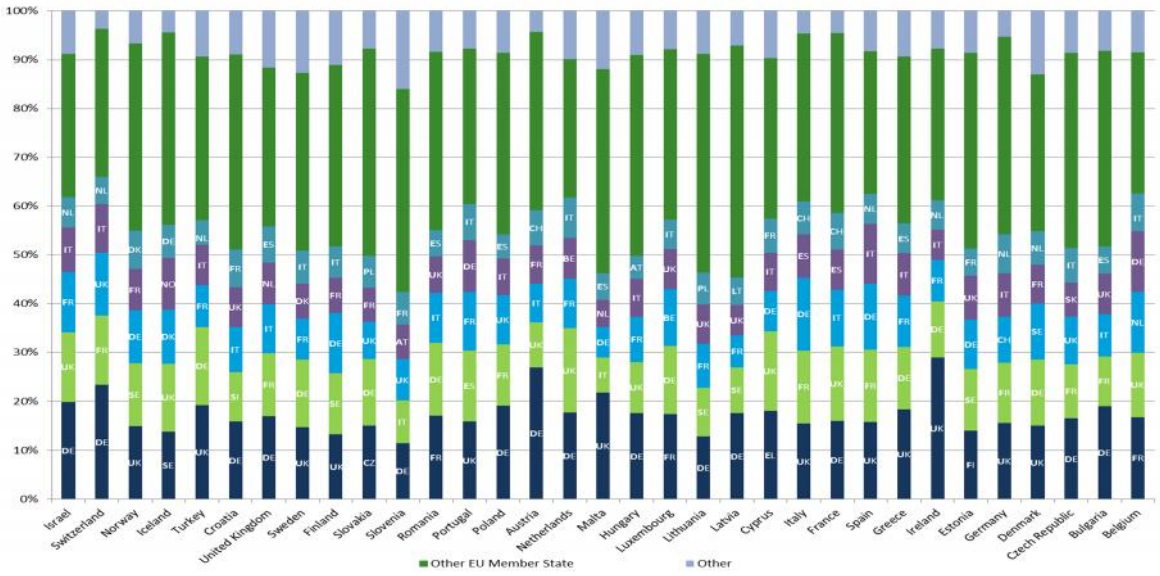
Table 18: Main producers of scientific publications, EU, 2000 and 2008

Country	2000	2008	Average annual growth (%)
European Union	367 207	546 837	5.1
United Kingdom	84 422	117 742	4.2
Germany	77 958	111 288	4.5
France	57 081	81 911	4.6
Italy	38 708	63 408	6.4
Spain	27 089	52 664	8.7

Source: Deloitte
Data: Innovation Union Competitiveness Report 2011

In 2008, EU transnational co-publications represented 33.5% of all EU publications, as opposed to 30.5% in 2003 (+9.8%). European researchers co-publish mainly with colleagues from other EU countries (85-95%). Researchers from Germany, France, Italy, and the UK are the main partners for co-publications. This can largely be explained by their high research capacity as reflected in the comparatively large volume of scientific publications. Geographical proximity also plays a significant role: for instance, there is a clear preference for collaboration between Belgium and the Netherlands, the Czech Republic and Slovakia[183].

Figure 45: Co-publications with an author from another EU Member State by five main partners in Europe, other countries, 2010 (%)



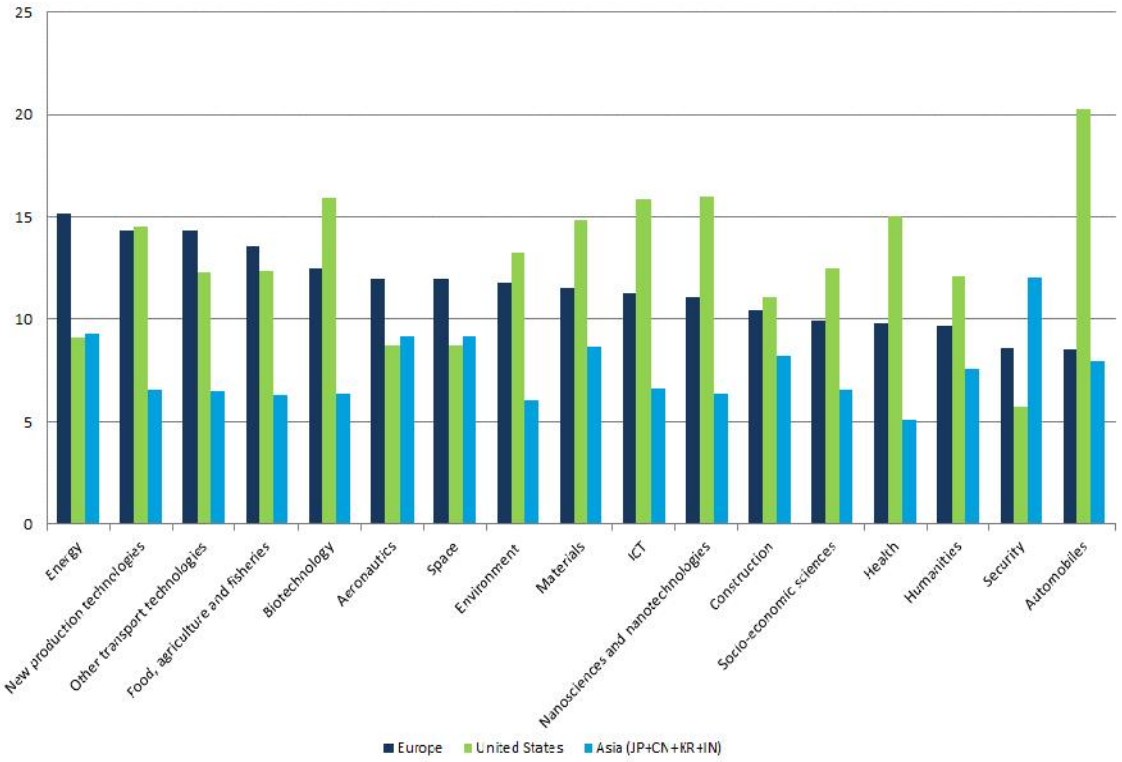
Source: Deloitte
Data: Science-Metrix/Scopus
* No information available for BiH, FYROM, LI, ME and SR

[183] European Commission (2011b)

The EU leads scientific excellence in several sectors but lags behind the US in strategic areas.

The figure below compares the extent to which the EU has scientific publications in the top 10% most-cited publications by sector by comparison with the United States and leading Asian countries (Japan, China, Korea and India). The EU has a leading scientific position in the world scientific (in terms of high-impact) in energy, science for transport technologies (other than automobiles)[184] and in the combined area of food, agriculture and fisheries. The scientific quality in the EU in the areas of environment and science for new production technologies is similar to that in the United States. However, the US outdoes the EU in most scientific fields in terms of quality (scientific impact). This includes strategic areas such as automobiles, nanoscience and nanotechnology, information and communication technology (ICT), biotechnology, health and materials. The most striking differences are in the areas of automobiles and biotechnology. (Yet, the EU is among the world's largest producers of motor vehicles; the automotive industry represents Europe's largest investor in research and development (R&D) and it makes a major contribution to EU's Gross Domestic Product (GDP)). Japan has world scientific excellence in security, followed by the EU.

Figure 46: Scientific publications in the top 10% most-cited publications by sector, Europe, US and Asia (Japan, China, Korea and India), 2008



Source: Deloitte
Data: Science-Metrix

[184] 'Other transport technologies' refer to all areas of transport except automobiles, aeronautics and space.

Collaboration inside Europe is growing, although eastern European countries tend to participate less than would be expected statistically.

International cooperation is becoming increasingly important in science inside Europe and beyond. It is an important part of the science and innovation structures[185]. The Collaboration Index (CI)[186] provides some indication of the level of collaboration between international partners. The old Member States tend to have a higher CI, whereas some of the new Member States tend to collaborate less internationally than would be expected given the size of their (scientific) production. Of the remaining countries of those selected, only the EFTA states, which are part of the ERA, collaborate more internationally than would be expected from the size of their publication output. Asian countries, Brazil, Russia and the United States collaborate less internationally than would be expected on this measure, whereas Israel collaborates on an international scale as much as could be expected given the size of its scientific output[187].

Table 19: Scientific collaboration pattern for all scientific priorities in Europe, other countries, 2000-2011

Country	Total Scientific Publications	Collaboration Index Score	Growth Index Score
Switzerland	190 956	1.60	1.06
Belgium	150 988	1.38	1.03
Luxembourg	3 819	1.36	0.99
Netherlands	295 610	1.33	1.03
Sweden	195 617	1.33	1.00
Iceland	6 367	1.32	0.97
Austria	107 569	1.30	1.02
Denmark	110 363	1.30	0.99
United Kingdom	976 359	1.30	1.05
Germany	816 294	1.25	1.03
Norway	92 199	1.24	1.03
France	598 502	1.22	1.04
Cyprus	5 189	1.16	0.97
Ireland	56 697	1.12	1.04
Liechtenstein	406	1.12	1.05
Portugal	65 816	1.11	0.72
Finland	100 537	1.10	0.82
Italy	462 763	1.04	1.04
Hungary	49 870	1.00	0.86
Israel	113 342	1.00	1.03
Estonia	9 022	0.97	0.93
Spain	371 526	0.95	0.99
United States	3 739 514	0.93	0.65
Bulgaria	16 013	0.92	0.98

[185] European Commission (2014a)

[186] The collaboration index is the ratio of a country's observed number of international co-publications to its expected number of international co-publications given the size of its scientific output. When the CI is above one, a country collaborates more with international partners than expected given the size of its production. When it is below one, the opposite is true. The growth index shows the trend.

[187] European Commission (2014a)

Country	Total Scientific Publications	Collaboration Index Score	Growth Index Score
Greece	99 057	0.88	1.04
FYROM	2 574	0.87	1.08
Slovakia	25 784	0.84	1.05
Latvia	3 528	0.81	1.04
Czech Republic	77 820	0.78	1.04
Malta	1 433	0.78	1.05
Romania	31 694	0.76	1.02
Slovenia	24 881	0.75	0.75
Russia	158 973	0.75	0.99
South Korea	295 238	0.73	0.82
Brazil	248 474	0.68	1.03
Poland	151 288	0.65	0.96
Japan	841 660	0.65	0.99
Lithuania	11 945	0.62	0.94
China (except Hong Kong)	1 620 092	0.51	1.02
Croatia	30 193	0.49	1.15
India	320 513	0.48	0.95
Turkey	184 626	0.41	0.86

Source: Deloitte
Data: Innovation Union Competitiveness Report 2013

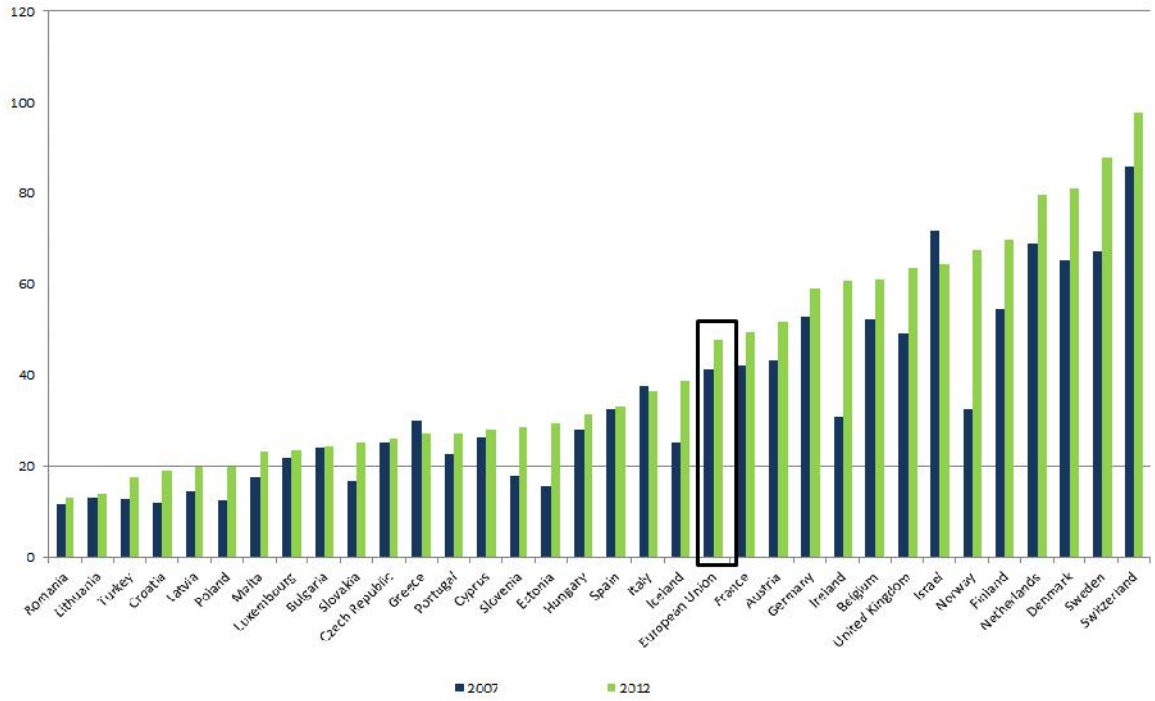
Switzerland, Sweden, Denmark, Netherlands, Finland and Norway score highest on the composite indicator of research excellence; Latvia, Croatia, Turkey, Lithuania and Romania the lowest.

The research excellence composite index summarises different aspects of research excellence at national level. It can be seen as a proxy for the attractiveness of the EU for its own researchers and those from other countries. The composite index measures output quality by focusing on the top 10% most-cited publications per total publications, the number of high quality patents that a country has per million population, the number of world-class universities and public research institutes, and the total value of European Research Council (ERC) grants received in comparison to public R&D spending.

In 2012, the composite indicator measuring research excellence was 47.8 for the EU-28. Between 2007 and 2012, the level of research excellence increased in the EU from 41.3 in 2007 to 47.8 in 2012.

In the EU-28, research excellence was highest in some of the Nordic countries such as Sweden, Denmark and Finland (in descending order), followed by a mix of larger and Mediterranean countries. It was lowest (<20) in some of the new Member States such as Latvia, Croatia, Lithuania and Romania (in descending order). Between 2007 and 2012, we observe catch-up in some lower-performing countries, and some stagnation in the middle group, e.g. Luxembourg and Spain.

Figure 47: Composite indicator of research excellence, Europe, 2007 and 2012



Source: Deloitte
* Data: JRC calculations using data from Science-Metrix (highly cited publications), OECD (PCT patent applications), CWTS Leiden Ranking (world class universities) and Scimago (research institutes) and ERC/DG RTD CORDIS (ERC grants data). Population and R&D data are from Eurostat and OECD, GDP data from World Bank World Development Indicators.

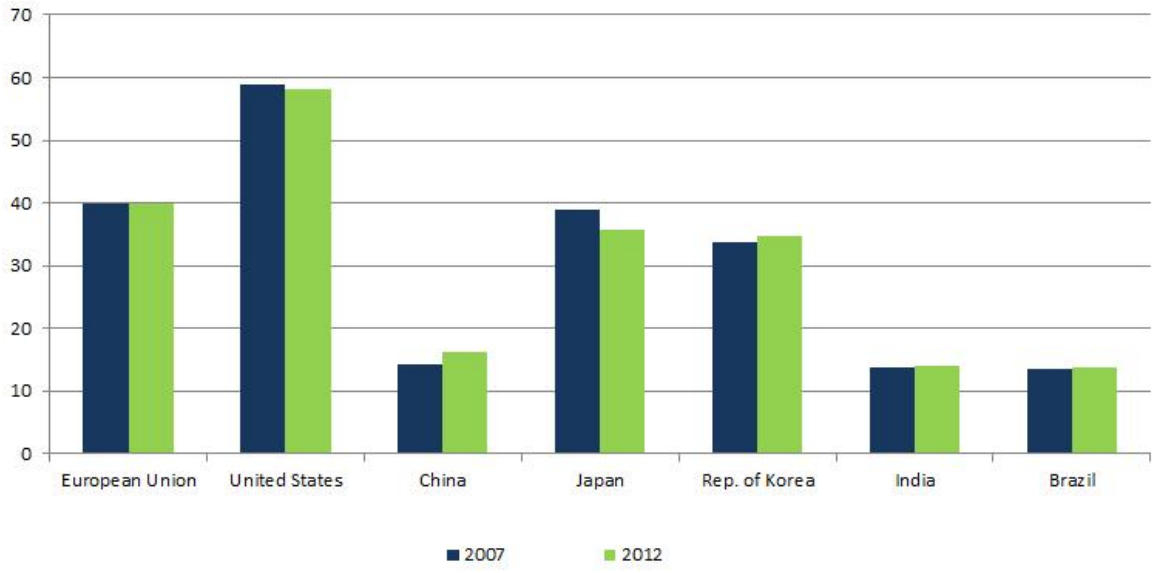
Research excellence is relatively high in the EU-28, although it is clearly higher in the United States.

Research excellence scores[188], considering the number of highly cited publications, high-quality patents, world-class universities and public research institutes, illustrate the strong position of the United States in terms of research quality, followed by the EU-28, Japan and South Korea (in descending order).

Between 2007 and 2012, research quality in the EU-28, the US, India and Brazil remained relatively stable, while China and South Korea are catching up with their main trading competitors. The scores measuring research excellence have decreased in Japan over the same time period.

[188] A comparison of the EU with the United States and other research leaders in the world can only take into consideration three of the four variables measuring research excellence (highly cited publications, high quality patents and world class universities and public research institutes), since the number of ERC grants is only comparable for countries inside the ERA.

Figure 48: Composite indicator for researcher excellence, Europe, US, China, Japan, Republic of Korea, India and Brazil, 2007 and 2012



7.9 Removing the remaining barriers to researchers' mobility

The EU Member States have put various measures in place to remove obstacles to researchers' mobility. These include reforms in the university and higher education sectors linked to the Bologna process. In addition, many countries have introduced national mobility schemes to boost different researchers' mobility (inward, outward and cross-sectoral). Many of these schemes promote inward mobility from both the EU and non-EU countries providing financial incentives for early stage researchers.

The APART Programme (Austria), for example, awards fellowships to national and international students in support of a post-doctoral thesis, or the continuation of a scientific project. In 2012, about 30% of the fellows conducted research at universities or research institutions abroad. The percentage of foreign researchers among APART fellows in 2010-2012 was 18%. The "Joint Excellence in Science and Humanities" Programme of the Austrian Academy of Sciences aims to support Austrian research in establishing and fostering international contacts. On the basis of research visits of 2-6 months for incoming and outgoing initiatives, the programme contributes to establishing sustainable scientific relations.

The Momentum (*Lendület*) Programme of the Hungarian Academy of Sciences (Hungary) supports the re-integration of outstanding Hungarian researchers working abroad by providing personal allowances for two to three years for projects carried out in Hungary in the field of their speciality. The Programme invites researchers to take part in scientific/development programmes in Hungary. In 2013, 14 young scholars from among the 104 candidates were able to set up an independent research team using the total sum of HUF 633.7 million (some EUR 2.1 million) provided for the first years by the Academy. Consequently, together with the scholars who have previously received awards, 79 research teams have since the summer of 2013 been able to conduct research into promising internationally significant achievements of total funding of nearly HUF 3 billion (some EUR 10 million). In keeping with the call for applications, the heads or research teams must raise funds from Hungarian and

international competitive sources comparable to the support they receive from the government for five years.

DFF-MOBILEX mobility grants (Denmark) facilitate more career paths and increase the internationalisation of Danish research by enabling researchers who are at the beginning of their research careers to carry out research projects based on their own scientific interests at research institutions in Denmark as well as abroad. DFF-MOBILEX mobility grants are awarded for a period of 24 months, within a financial framework of DKK 2.5 million (some EUR 335 000), including overheads for the hosting institution.

The SFI Research Professorship Programme (Ireland) is intended to support national strategic priorities by assisting research bodies in their recruitment of world-leading researchers for Professorial Chairs or similar leadership positions in targeted scientific areas. The Programme may also act as a mechanism to support the recruitment of individuals who possess a strong industry background, as well as directorship roles in established research centres within Ireland. The recruitment of iconic scientists and engineers will build the national research and enterprise base, and enhance Ireland's reputation as a centre of excellence for research.

In France, a residence permit entitled "research scholar visa" allows the holder to perform research and teaching activities in France under the terms of a hosting agreement. Foreign researchers may obtain residence permits for more than one year but no longer than four years. The permit's duration reflects the time required or expected to be required for the work to be delivered as described in the hosting agreement. The prefecture for the applicant's place of residence has jurisdiction (CESEDA, article L313-4). All the beneficiary's family members are automatically eligible for a residence permit entitled "vie privée et familiale" (covering spouse and children who entered France as minors, article L. 313-8 of CESEDA as amended by law 2011-672 of June 16, 2011).

The r4d programme (Switzerland) of the Swiss National Science Foundation and the Swiss Agency for Development Cooperation is aimed at researchers in Switzerland and in developing and emerging countries who wish to execute a joint research project on global issues. The programme focuses on reducing poverty and protecting public goods in developing countries. For its duration from 2012 to 2022, the r4d programme has an overall budget of CHF 97.6 million.

Other measures support researchers' outbound mobility, such as the KOLUMB Programme (Poland) awarding fellowships to the best young scholars to enable them to stay (from 6-12 months) at the world's leading research centres.

The 'Mobility of Spanish university lecturers and researchers in foreign centres' Programme (Spain) offers senior researchers with permanent positions in a public research institution the opportunity to apply and spend three to twelve months at a foreign institution. Young researchers with a temporary or permanent contract in a public research institution can also apply for a four- to ten-month stay at a foreign institution. In 2012, the total budget was EUR 7.59 million. There were no calls in 2013.

The objective of the 'Brains (Back) to Brussels' Programme (BB2B) (Belgium), is to attract foreign researchers and Belgian researchers currently settled abroad. It offers two kinds of support, one for

short-term research projects in a Brussels-based higher education institution and the other for long-term projects for researchers who ultimately plan to settle down in Brussels. While the first option is only accessible to highly qualified researchers, the second option is available to any researcher wishing to plan a career in Brussels. The host institution is therefore strongly involved in the measure and must commit itself to offer a long-lasting position to the researcher.

Non-financial incentives include measures promoting 'dual careers', such as the Dual Career Network (France, Germany and Switzerland). The French Universities of Strasbourg and Haute-Alsace are part of the 'Dual Career Network' with the Universities of Freiburg (Germany) and Basel (Switzerland), and the *Karlsruher Institut für Technologie* (Germany). The network welcomes couples, helps them search for jobs in nearby universities or within the same geographical area, and assists them with accommodation and childcare.

The universities and higher education organisations in Vienna, Lower Austria and Upper Austria are joining forces in a network: "Dual Career Service Wien - *Niederösterreich* – *Oberösterreich*". In close coordination with this Dual Career Service, the Vienna Science and Technology Fund (WWTF) offers Dual Career Service Support. The Dual Career Advice office of the Institute of Science and Technology Austria (IST Austria) offers individualised job search information and assistance to spouses and partners of newly appointed scientists and employees. It helps facilitate the job search process and identify suitable employment opportunities in Vienna and the surrounding areas.

The Swiss Federal Equal Opportunity at Universities Programme initiated a DCC project in 2012 in order to build up dual career structures and measures at every Swiss university. It also established a fund for the support of incoming couples at professorial and postdoc level taking into consideration a gender equality aspect in the respective funding.

Some countries provide tax incentives to facilitate researchers' mobility in Europe. For example, under the 'Researcher Taxation Scheme' (Denmark), researchers and highly paid employees recruited abroad who are able to meet a number of conditions, and have not been a Danish tax resident in the previous 10 years can be employed at a special 26% tax rate for 60 months. In addition, in line with the circular on exemption from payment of pension contributions for certain temporary employees in the State (Denmark), foreign academic staff recruited abroad and employed on a temporary contract can request that their total pension (both employer contribution and their own contribution) be paid as part of their salary during their employment. This arrangement can only be agreed upon for a period of up to five years (six years if this is agreed between the appointing authority and the organisations mandated to negotiate).

Other countries, e.g. France, offer special visas to attract researchers to engage in research or teach at university level. Since 2011, France's consulates have granted a "VLS-TS visa" (Extended-stay research scholar visa) to holders of a master's degree or higher wishing to enter France to take up scholarships, engage in research or teach at university level. Public and private institutions of higher education and research organisations may use this visa category to bring doctoral candidates, research scholars and research faculty to France to perform research or teach at university level.

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9. Table of figures

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11. Annex I: Data

11.1 "The stock of researchers in Europe"

Table 20: Researchers (FTE) per thousand labour force, Europe, US, China, Japan, 2000, 2010 and 2011

Country	2000	2010	2011
China	**0.95**	**1.51**	**1.63**
Romania	1.79	1.99	1.63
Cyprus	0.98	2.15	2.12
Turkey	1.35	2.54	2.73
Bulgaria	2.82	3.23	3.56
Poland	3.19	3.77	3.72
Latvia	3.46	3.40	3.84
Croatia	3.75	4.07	3.97
Malta	1.35	3.39	4.21
Italy	2.81	4.14	4.23
Greece	3.00	4.59	4.97
Switzerland	6.18	5.23	5.13
Hungary	3.53	5.01	5.38
Spain	4.36	5.83	5.64
Lithuania	4.63	5.65	5.66
Slovakia	3.85	5.62	5.72
Czech Republic	2.70	5.55	5.87
Estonia	4.02	5.94	6.48
Netherlands	5.20	6.13	6.67
European Union 28	**4.90**	**6.68**	**6.75**
Ireland	4.82	6.49	7.01
United Kingdom	5.90	8.18	7.95
Germany	6.50	7.87	8.02
Austria	5.31	8.46	8.59
Slovenia	4.49	7.40	8.61
France	6.69	8.54	8.72
Belgium	6.95	8.34	8.79
Portugal	3.19	8.21	9.03
United States	**9.00**	**9.51**	**9.63**
Sweden	10.10	9.97	9.69
Norway	7.62	10.20	10.38
Japan	**9.57**	**9.95**	**10.47**
Luxembourg	8.86	11.40	11.16
Iceland	11.20	15.96	11.94
Denmark	6.83	12.80	12.98
Finland	15.41	15.51	14.91

Source: Deloitte
Data: Eurostat, 2014
No data available for Bosnia and Herzegovina, Fyrom, Israel, Liechtenstein, Montenegro and Serbia.

Table 21: Researchers in the business sector (FTE) per thousand labour force, Europe, 2000, 2010 and 2011

Country	2000	2010	2011
Romania	1.11	0.59	0.36
Cyprus	0.25	0.47	0.42
Bulgaria	0.34	0.45	0.46
Latvia	0.90	0.55	0.54
Poland	0.57	0.69	0.61
Croatia	0.46	0.73	0.71
Slovakia	0.94	0.71	0.77
Greece	0.70	0.80	0.81
Lithuania	0.17	0.82	0.92
Turkey	0.22	1.00	1.15
Italy	1.11	1.53	1.59
Spain	1.19	1.97	1.94
Switzerland	3.85	2.15	2.11
Estonia	0.41	1.87	2.16
Portugal	0.45	1.88	2.20
Czech Republic	1.08	2.40	2.67
Hungary	0.95	2.41	2.75
Malta	0.00	1.93	2.78
United Kingdom	2.96	2.68	2.82
European Union 28	**2.28**	**2.99**	**3.08**
Netherlands	2.47	3.04	3.51
Ireland	3.19	3.61	4.15
Belgium	3.80	4.09	4.40
Slovenia	1.43	3.25	4.42
Germany	3.86	4.46	4.51
Norway	4.4.69	4.82	4.91
France	3.15	5.04	5.19
Austria	4.16	5.27	5.35
Iceland	5.58	5.92	5.59
Sweden	6.34	6.15	5.82
Luxembourg	7.53	6.31	6.42
Denmark	3.90	7.79	7.68
Finland	8.65	8.57	8.56

Source: Deloitte
Data: Eurostat, 2014
No data available for Bosnia and Herzegovina, Fyrom, Israel, Liechtenstein, Montenegro and Serbia.

Table 22: Researchers in the public sector (FTE) per thousand labour force, Europe, 2000, 2010 and 2011

Country	2000	2010	2011
Romania	0.68	1.39	1.26
Malta	1.46	1.46	1.43
Cyprus	0.67	1.49	1.52
Turkey	1.13	1.54	1.58
Italy	1.70	2.44	2.50
Hungary	2.57	2.60	2.63
Ireland	1.63	2.88	2.85
Bulgaria	2.47	2.75	3.08
Poland	2.62	3.08	3.11
Czech Republic	1.60	3.10	3.16
Austria	1.77	3.13	3.17
Netherlands	2.65	3.10	3.17
Croatia	4.00	3.33	3.25
Latvia	2.56	2.85	3.30
France	3.41	3.40	3.43
Germany	2.64	3.41	3.50
European Union 28	**2.58**	**3.61**	**3.59**
Spain	3.11	3.85	3.68
Switzerland	2.33	3.60	3.78
Sweden	4.20	3.81	3.83
Greece	2.29	3.27	4.11
Slovenia	2.94	4.13	4.17
Estonia	3.57	3.97	4.22
Belgium	3.09	4.19	4.33
Lithuania	4.46	4.83	4.74
Slovakia	2.92	4.88	4.94
United Kingdom	5.17	5.05	5.01
Luxembourg	1.33	5.08	5.03
Denmark	3.33	4.95	5.23
Portugal	2.31	5.51	5.76
Norway	3.85	5.38	5.48
Iceland	7.04	7.67	6.04
Finland	5.60	6.77	6.19

Source: Deloitte
Data: Eurostat, 2014
No data available for Bosnia and Herzegovina, Fyrom, Israel, Liechtenstein, Montenegro and Serbia.

11.2 "Women in the research profession"

Data for the chapter on "Women in the research profession" are largely based on the 2012 'SHE Figures' report, as presented in the Researchers' Report 2013.

11.3 "Open, transparent and merit-based recruitment"

Data for the chapter on "Open, transparent and merit-based recruitment" are largely based on the 2012 'MORE Study' report, as presented in the *Researchers' Report 2013*.

11.4 "Education and training"

Table 23: Population aged 30-34 having completed tertiary education, Europe, 2000, 2011 and 2013 (%)

Country	2000	2011	2013
Turkey	N/A	16.3	19.5
Italy	11.6	20.3	22.4
Former Yugoslav Republic of Macedonia, the	N/A	20.4	23.1
Croatia	16.2	24.5	25.9
Malta	7.4	21.4	26.0
Czech Republic	13.7	23.7	26.7
Slovakia	10.6	23.2	26.9
Austria	N/A	23.8	27.3
Portugal	11.3	26.1	29.2
Bulgaria	19.5	27.3	29.4
Hungary	14.8	28.1	31.9
Germany	25.7	30.7	33.1
Greece	25.4	28.9	34.6
European Union 28	22.9	34.5	36.8
Slovenia	18.5	37.9	40.1
Poland	12.5	36.5	40.5
Latvia	18.6	35.9	40.7
Spain	29.2	40.6	40.7
Belgium	35.2	42.6	42.7
Netherlands	26.5	41.1	43.1
Denmark	32.1	41.2	43.4
Estonia	30.8	40.3	43.7
Iceland	32.6	44.6	43.9
France	27.4	43.3	44.0
Finland	40.3	46.0	45.1
Switzerland	27.3	43.8	46.1
United Kingdom	29.0	45.8	47.6
Cyprus	31.1	46.2	47.8
Sweden	31.8	46.8	48.3
Norway	37.3	48.8	48.8
Lithuania	42.6	45.7	51.3
Luxembourg	21.2	48.2	52.5
Ireland	27.5	49.7	52.6

Source: Deloitte
Data: Eurostat Labour Force population survey/IUS
No data available for Bosnia and Herzegovina, Israel, Liechtenstein, Montenegro and Serbia.

Table 24: Tertiary graduates in Science, Technology, Engineering and Mathematics (STEM) studies (ISCED 5 & 6) per thousand population aged 20-29, Europe, US and Japan, 2000, 2010 and 2011

Country	2000	2010	2011
Luxembourg	1.8	N/A	3.0
Cyprus	3.4	4.9	7.2
Former Yugoslav Republic of Macedonia, the	3.7	6.4	7.3
Hungary	4.5	8.3	8.5
Turkey	4.4	9.1	9.4
Netherlands	5.8	9.2	9.4
Norway	7.9	9.9	10.8
United States	**9.7**	**10.7**	**11.6**
Croatia	N/A	11.6	11.6
Estonia	7.8	11.3	11.9
Malta	3.4	8.0	12.2
Liechtenstein	N/A	8.4	12.2
Bulgaria	6.6	11.4	12.4
Belgium	9.7	12.2	12.6
Italy	5.7	N/A	12.8
Latvia	7.4	10.7	12.8
Greece	N/A	12.8	13.4
Iceland	8.4	13.6	13.6
Japan	**12.6**	**13.8**	**14.1**
Sweden	11.6	14.0	15.6
Romania	4.5	15.6	16.0
Austria	7.2	15.5	16.1
Switzerland	N/A	17.2	16.4
Germany	8.2	14.8	16.5
Czech Republic	5.5	16.5	16.6
Spain	9.9	13.9	16.8
European Union 27	**10.2**	**15.2**	**16.8**
Portugal	6.3	14.4	17.3
Slovenia	8.9	14.8	17.4
Poland	6.8	15.8	17.5
Denmark	11.7	16.5	17.9
Slovakia	5.3	18.3	18.0
United Kingdom	18.5	18.7	19.5
Ireland	24.2	20.1	21.1
Finland	16.0	24.2	21.2
France	19.6	21.7	22.1
Lithuania	13.5	18.7	22.6

Source: Deloitte
Data: UNESCO OECD Eurostat education survey
No data available for Bosnia and Herzegovina, Israel, Montenegro and Serbia.

Table 25: Women tertiary graduates in Science, Technology, Engineering and Mathematics (STEM) studies (ISCED 5 & 6) per thousand women aged 20-29, Europe, US and Japan, 2000, 2010 and 2011

Country	2000	2010	2011
Luxembourg	N/A	N/A	1.8
Netherlands	2.1	3.8	4.2
Japan	**3.3**	**4.0**	**4.2**
Cyprus	2.0	3.8	4.7
Hungary	2.1	4.9	4.7
Former Yugoslav Republic of Macedonia, the	3.1	5.2	5.7
Belgium	4.9	5.9	6.2
Turkey	2.8	5.8	6.3
Norway	4.3	6.2	6.5
Switzerland	N/A	6.7	6.5
United States	**6.2**	**6.8**	**7.2**
Latvia	4.7	6.9	7.6
Malta	1.9	5.4	7.7
Austria	2.9	7.3	8.1
Croatia	N/A	8.9	8.9
Estonia	5.7	8.9	9.2
Bulgaria	6.1	9.1	10.0
Slovenia	4.2	8.7	10.0
Germany	3.6	9.3	10.1
Italy	4.3	N/A	10.4
Spain	6.4	8.6	10.4
Sweden	7.6	9.6	10.4
Czech Republic	3.0	10.2	10.9
Greece	N/A	10.5	10.9
European Union 27	**6.3**	**9.9**	**11.1**
Liechtenstein	N/A	10.7	11.1
Ireland	18.5	11.2	11.8
Iceland	6.5	12.0	12.0
United Kingdom	11.9	11.5	12.1
Finland	8.9	13.7	12.5
Slovakia	3.2	13.4	12.9
France	12.1	12.7	13.1
Portugal	5.4	10.8	13.1
Lithuania	9.7	10.9	13.3
Poland	5.0	12.4	13.6
Denmark	6.8	12.2	13.7
Romania	3.2	12.7	13.8

Source: Deloitte
Data: UNESCO OECD Eurostat education survey
No data available for Bosnia and Herzegovina, Israel, Montenegro and Serbia.

Table 26: New women doctoral graduates (ISCED 6) per thousand population aged 25-34, Europe, 2000 and 2011

Country	2000	2011
Malta	N/A	0.1
Cyprus	0.2	0.3
Turkey	0.2	0.3
Poland	N/A	0.5
Bulgaria	0.3	0.7
Former Yugoslav Republic of Macedonia, the	0.1	0.7
Luxembourg	N/A	0.7
Iceland	0.0	0.7
Greece	N/A	0.8
Hungary	0.4	0.8
Lithuania	0.8	1.0
Spain	0.8	1.2
Belgium	0.5	1.3
Estonia	0.7	1.3
Czech Republic	0.3	1.4
France	1.1	1.4
Latvia	0.1	1.4
Croatia	N/A	1.4
Italy	0.5	1.6
Netherlands	0.7	1.6
European Union 27	**0.9**	**1.6**
Slovenia	0.8	1.7
Romania	N/A	1.7
Ireland	0.8	1.8
Liechtenstein	N/A	1.8
Portugal	1.7	1.8
Austria	1.0	1.8
Norway	0.7	1.9
Slovakia	0.4	1.9
Denmark	0.8	2.1
United Kingdom	1.01.3	2.2
Germany	1.5	2.5
Sweden	1.8	2.8
Finland	2.5	3.0
Switzerland	N/A	3.0

Source: Deloitte
Data: UNESCO OECD Eurostat education survey
No data available for Bosnia and Herzegovina, Israel, Montenegro and Serbia.

Table 27: Doctorate graduates in S&E per 1 000 population aged 25-34, R&D intensity, Europe, US, China and Japan, 2011

Country	Graduates (ISCED 6) per 1 000 population aged 25-34	Of which Science & Engineering per 1 000 population aged 25-34	R&D intensity
Romania	1.66	0.80	0.50
Cyprus	0.31	0.20	0.50
Bulgaria	0.62	0.23	0.57
Greece	1.05	0.43	0.67
Slovakia	1.86	0.70	0.68
Latvia	1.05	0.38	0.70
Malta	0.33	0.12	0.72
Poland	0.49	0.27	0.76
Croatia	1.35	0.52	0.76
Turkey	0.37	0.14	0.86
Lithuania	0.92	0.35	0.91
Hungary	0.82	0.24	1.22
Italy	1.50	0.63	1.25
Spain	1.22	0.60	1.36
Luxembourg	0.79	0.30	1.51
Portugal	1.61	0.66	1.52
Czech Republic	1.53	0.72	1.64
Norway	2.05	0.88	1.65
Ireland	1.91	0.94	1.66
China	**0.25**	**0.14**	**1.76**
United Kingdom	2.44	1.05	1.78
Netherlands	1.85	0.66	2.03
European Union 28	**1.70**	**0.75**	**2.04**
Belgium	1.52	0.70	2.21
France	1.59	0.95	2.25
Estonia	1.27	0.60	2.37
Iceland	0.77	0.54	2.40
Slovenia	1.72	0.70	2.47
United States	**1.75**	**0.59**	**2.67**
Austria	2.16	0.93	2.77
Switzerland	3.51	1.44	2.87
Germany	2.79	1.10	2.89
Denmark	2.30	0.97	2.98
Japan	**1.04**	**0.37**	**3.26**
Finland	2.71	1.05	3.80
Sweden	2.88	1.41	3.39
Former Yugoslav Republic of Macedonia, the	0.61	0.10	N/A
Liechtenstein	2.63	0.00	N/A

Source: Deloitte
Data: Innovation Union Competitiveness Report 2013
No data available for Bosnia and Herzegovina, Israel, Montenegro and Serbia.

11.5 "Working conditions in the research profession"

Data for the chapter on "Working conditions" are largely based on the 2012 'MORE study' report, as presented in the *Researchers' Report 2013*.

11.6 "Collaboration between academia and industry"

Data for the chapter on "Collaboration between academia and industry" are largely based on the 2012 'MORE Study' report, as presented in the *Researchers' Report 2013* and a number of new indicators.

Table 28: Composite indicator of research excellence, Europe, 2007 and 2012

Country	2007	2012
Romania	11.8	13.2
Lithuania	13.3	14.1
Turkey	12.7	17.6
Croatia	12.0	18.9
Latvia	14.6	19.9
Poland	12.5	20.0
Malta	17.7	23.3
Luxembourg	21.7	23.5
Bulgaria	24.2	24.5
Slovakia	16.8	25.2
Czech Republic	25.1	26.1
Greece	29.9	27.2
Portugal	22.8	27.3
Cyprus	26.3	28.1
Slovenia	18.0	28.8
Estonia	15.6	29.4
Hungary	28.0	31.5
Spain	32.6	33.2
Italy	37.5	36.5
Iceland	25.3	38.7
European Union 28	41.3	47.8
France	41.9	49.5
Austria	43.4	51.9
Germany	52.9	59.0
Ireland	30.9	60.9
Belgium	52.3	61.1
United Kingdom	49.3	63.5
Israel	71.7	64.5
Norway	32.6	67.6
Finland	54.6	69.9
Netherlands	69.1	79.7
Denmark	65.4	81.1
Sweden	67.4	87.9

Country	2007	2012
Switzerland	85.9	97.7

Source: Deloitte
Data: JRC calculations using data from Science-Metrix (highly cited publications), OECD (PCT patent applications), CWTS Leiden Ranking (world class universities) and Scimago (research institutes) and ERC/DG RTD CORDIS (ERC grants data). Population and R&D data are from Eurostat and OECD, GDP data from World Bank World Development Indicators.
No data available for Bosnia and Herzegovina, Liechtenstein, Montenegro and Serbia.

11.7 "Mobility and international attractiveness"

Table 29: Foreign (non-EU) doctoral candidates (ISCED 6) in the EU by top 30 countries of origin, 2011

Country	2011
Russia	1 862
Lebanon	1 913
Chile	2 107
Pakistan	2 307
Algeria	2 309
Brazil	2 572
Colombia	2 585
Tunisia	2 764
Iran	3 419
United States	3 456
Mexico	3 591
India	3 854
Ukraine	1 011
Egypt	1 028
Venezuela	1 073
Thailand	1 111
Argentina	1 155
Libya	1 164
Syria	1 289
Bolivia	1 381
Nigeria	1 417
Canada	1 493
Malaysia	1 598
Morocco	1 628
Vietnam	1 644
Turkey	1 686
Saudi Arabia	1 744
China	8 896

Source: Deloitte
Data: UNESCO OECD Eurostat education survey

Table 30: Researchers (post-PhD) having spent a period of at least three months as researchers in another country in the last 10 years Europe, 2012 (%)

Country	>3 month mobile in the last ten years	>3 month mobile more than ten years ago
Romania	19.7	4.0
Latvia	19.7	9.1
Former Yugoslav Republic of Macedonia, the	33.5	10.8
Luxembourg	47.4	11.0
Croatia	18.9	12.0
Poland	9.1	12.1
Switzerland	53.1	12.1
Portugal	27.4	12.3
Belgium	46.5	12.7
Denmark	53.0	12.7
Slovenia	33.8	12.8
Bulgaria	18.0	12.8
Sweden	39.5	13.3
Netherlands	46.1	13.5
Czech Republic	16.2	17.3
Germany	44.7	14.0
Lithuania	18.1	14.1
Finland	42.3	14.2
Malta	24.2	15.3
Slovakia	27.6	16.0
Cyprus	44.1	16.7
Estonia	26.6	17.1
Turkey	28.6	17.4
European Union 27	**31.0**	**17.4**
Italy	25.2	18.8
Norway	43.4	19.0
Iceland	48.9	19.0
Austria	45.4	19.6
United Kingdom	28.5	20.1
France	26.5	20.8
Spain	32.3	21.2
Ireland	36.9	22.5
Hungary	34.0	23.6
Greece	33.9	26.8

Source: Deloitte
Data: MORE2 study
No data available for Bosnia and Herzegovina, Israel, Liechtenstein, Montenegro and Serbia.

Table 31: International scientific co-publications per million population, Europe, 2012

Country	2012
Serbia	45.2
Turkey	84.7
Former Yugoslav Republic of Macedonia, the	146.8
Romania	177.4
Latvia	195.6
Bulgaria	212.9
Poland	225.5
Lithuania	304.3
European Union 28	**343.2**
Slovakia	399.1
Malta	400.0
Hungary	411.9
Croatia	427.5
Italy	532.4
Czech Republic	567.5
Greece	590.2
Spain	631.2
France	706.9
Germany	745.7
Portugal	761.2
Estonia	831.5
United Kingdom	1 021.3
Slovenia	1 041.6
Cyprus	1 066.1
Ireland	1 137.5
Austria	1 247.8
Belgium	1 313.4
Finland	1 415.4
Netherlands	1 456.8
Luxembourg	1 558.5
Sweden	1 711.9
Iceland	2 724.7
Norway	1 767.3
Denmark	1 839.6
Switzerland	2 894.2

Source: Deloitte
Data: Science-Metrix/Scopus/IUS
No data available for Bosnia and Herzegovina, Israel, Liechtenstein and Montenegro.

Table 32: Scientific publications in top 10% most-cited publications worldwide as percentage of total scientific publications, Europe, US, Japan and China, 2009

Country	2009
Latvia	3.03
Croatia	3.18
Bulgaria	3.22
Romania	3.50
Former Yugoslav Republic of Macedonia, the	3.57
Poland	3.81
Slovakia	3.97
Malta	4.77
Hungary	5.20
Czech Republic	5.61
Lithuania	6.23
Turkey	7.00
Slovenia	7.03
Cyprus	7.21
Estonia	8.49
Greece	9.26
Portugal	9.85
France	10.41
Italy	10.37
Spain	10.44
European Union 28	**10.95**
Austria	11.07
Finland	11.40
Norway	11.54
Ireland	11.54
Iceland	11.54
Germany	11.64
Luxembourg	12.42
Sweden	12.71
Belgium	13.39
United Kingdom	13.39
Denmark	14.54
Netherlands	15.63
Switzerland	16.36

Source: Deloitte
Data: Science-Metrix/Scopus/IUS
No data available for Bosnia and Herzegovina, Israel, Liechtenstein, Montenegro and Serbia.

Table 33: Scientific publications in the top 10% most-cited publications by sector, Europe, US and Asia (Japan, China, Republic of Korea and India)

Sector	Europe	United States	Asia
Energy	15	9	9
New production technologies	14	15	7
Other transport technologies	14	12	6
Food, agriculture and fisheries	14	12	6
Biotechnology	12	16	6
Aeronautics	12	9	9
Space	12	9	9
Environment	12	13	6
Materials	12	15	9
ICT	11	16	7
Nanosciences and nanotechnologies	11	16	6
Construction	10	11	8
Socio-economic sciences	10	12	7
Health	10	15	5
Humanities	10	12	8
Security	9	6	12
Automobiles	9	20	8

Source: Deloitte
Data: Science-Metrix

Table 34: Scientific collaboration pattern for all scientific priorities in Europe, other countries, 2000-2011

Country	Total Scientific Publications	Collaboration Index Score	Growth Index Score
Switzerland	190 956	1.60	1.06
Belgium	150 988	1.38	1.03
Luxembourg	3 819	1.36	0.99
Netherlands	295 610	1.33	1.03
Sweden	195 617	1.33	1.00
Iceland	6 367	1.32	0.97
Austria	107 569	1.30	1.02
Denmark	110 363	1.30	0.99
United Kingdom	976 359	1.30	1.05
Germany	816 294	1.25	1.03
Norway	92 199	1.24	1.03
France	598 502	1.22	1.04
Cyprus	5 189	1.16	0.97
Ireland	56 697	1.12	1.04
Liechtenstein	406	1.12	1.05
Portugal	65 816	1.11	0.72
Finland	100 537	1.10	0.82
Italy	462 763	1.04	1.04
Hungary	49 870	1.00	0.86
Israel	113 342	1.00	1.03
Estonia	9 022	0.97	0.93
Spain	371 526	0.95	0.99
United States	3 739 514	0.93	0.65
Bulgaria	16 013	0.92	0.98
Greece	99 057	0.88	1.04
FYROM	2 574	0.87	1.08
Slovakia	25 784	0.84	1.05
Latvia	3 528	0.81	1.04
Czech Republic	77 820	0.78	1.04
Malta	1 433	0.78	1.05
Romania	31 694	0.76	1.02
Slovenia	24 881	0.75	0.75
Russia	158 973	0.75	0.99
South Korea	295 238	0.73	0.82
Brazil	248 474	0.68	1.03
Poland	151 288	0.65	0.96
Japan	841 660	0.65	0.99
Lithuania	11 945	0.62	0.94
China (except Hong Kong)	1 620 092	0.51	1.02
Croatia	30 193	0.49	1.15
India	320 513	0.48	0.95
Turkey	184 626	0.41	0.86

Source: Deloitte

Data: Science-Metrix, using Scopus

Table 35: Composite indicator for researcher excellence, Europe, US, China, Japan, Republic of Korea, India and Brazil, 2007 and 2012

Country	2007	2012
EU-28*	39,8	40,0
United States	58,8	58,1
China	14,3	16,2
Japan	38,8	35,8
Rep. of Korea	33,6	34,8
India	13,8	14,1
Brazil	13,5	13,9

Source: Deloitte

Data: JRC calculations using data from Science-Metrix (highly cited publications), OECD (PCT patent applications), CWTS Leiden Ranking (world class universities) and Scimago (research institutes) and ERC/DG RTD CORDIS (ERC grants data). Population and R&D data are from Eurostat and OECD, GDP data from World Bank World Development Indicators.

EU28 Composite Scores excluding the ERC indicator

12. Annex II: Impacts reported

12.1 Measures supporting women in top-level positions

The table below provides an overview of the impacts of measures supporting women in top-level positions. The information is based on the 2012 and 2013 reporting exercise with the participating countries within the scope of this study. An update of information was not available this year for Bulgaria, Portugal, the Slovak Republic nor for Iceland, Israel and Liechtenstein.

Table 36: Measures supporting women in top-level positions (Impact reported)

Country	Measures explicitly to improve research funding	Appointment/promotion to decision-making posts at a later stage of researcher career				General support by national authorities for the principle of gender balance
		Gender parity on boards, targets & quotas	Work-life balance	Training / support for high-level positions	Transparency in appointment procedures & results	
AUSTRIA	– The Hertha Firnberg Programme: for highly qualified female post-docs of any scientific discipline: to date, 169 199 Hertha Firnberg fellowships have been granted; – L'ORÉAL Austria (Fellowships in Basic Research for Young Female Scientists): since the implementation of the programme in 2007, 17 doctoral candidates and 11 post-docs have been granted a fellowship.	– Initiative to raise the proportion of women in highly skilled positions in research, technology and innovation (RTD field), Ministry of Transport, Innovation and Technology (BMVIT): The initiative calls for an increase in the proportion of women project leaders by six percentage points yearly, from 15.8% in 2010. By 2012, it had risen to 24%. New targets are under discussion.		– Media training: in 2013, when courses resumed, 121 people participated in 15 sessions. It is planned to offer the media training in 2014 as well; – FEMtech Traineeship Initiative for female students: the number of traineeships for female students funded between September 2012 and May 2013 was 490. The budget was EUR 3.7 million; – Training of members of university boards (ongoing) by the Ministry of Science and Research: Sixty individual training courses were offered in 2013. The total budget for 2013 was EUR 250 000;		

Country	Measures explicitly to improve research funding	Appointment/promotion to decision-making posts at a later stage of researcher career				General support by national authorities for the principle of gender balance
		Gender parity on boards, targets & quotas	Work-life balance	Training / support for high-level positions	Transparency in appointment procedures & results	
				– w-fFORTE – Laura Bassi Centres of Expertise: by 2013 there had been 230 publications, 21 dissertations, 2 new patents and 2 licences.		
BELGIUM						– All Flemish universities have action plans on gender equality in the research profession. These were drawn up in collaboration with the Flemish Interuniversity Council. They will start the implementation of these plans in 2014; – In early 2014, the Wallonia-Brussels Federation allocated a EUR 150 000 budget to finance a "Gender contact person" (personne de contact genre) in each university of the Wallonia-Brussels Federation. They will be in charge of gender matters within their university. Their first mission will be to write an annual report on gender balance.
BOSNIA AND HERZEGOVINA	– In the Federation of Bosnia and Herzegovina, women were project managers in 379 of the 871 applications in response to calls for	– According to the Statistical Yearbook of the Republic of Srpska, 2013, Research and Development, the total number of women				

Country	Measures explicitly to improve research funding	Appointment/promotion to decision-making posts at a later stage of researcher career				General support by national authorities for the principle of gender balance
		Gender parity on boards, targets & quotas	Work-life balance	Training / support for high-level positions	Transparency in appointment procedures & results	
	scientific, research and development projects of the Federal Ministry of Education and Science in the period 2008-2013. Women were project managers in 78 of the 185 projects approved.	researchers in top-level positions in 2012 was 7 (of 33), compared to 9 out of 27 in 2011.				
DENMARK				– The former Minister of Science, Technology and Innovation held a roundtable discussion with representatives from Danish universities, research councils and the private sector in 2009 on how to improve the retention of talented female researchers. The Minister of Science gathered best practice examples on recruitment and retention of female talents in "Female research talents – the unused reserve of Danish research" (2009). After the roundtable discussion, the Danish Agency for Higher Education noticed an increase in the number of initiatives on equal opportunities at Danish universities.	– In December 2012, the equality legislation was amended in order to address the issue of gender imbalance on corporate boards. The new legislation entered into force on 1 April 2013 and the Danish universities have begun developing compliance policies.
GERMANY	– W2/W3 programme for outstanding women			– Female Professors Programme promoting		

Country	Measures explicitly to improve research funding	Appointment/promotion to decision-making posts at a later stage of researcher career				General support by national authorities for the principle of gender balance
		Gender parity on boards, targets & quotas	Work-life balance	Training / support for high-level positions	Transparency in appointment procedures & results	
	researchers (HGF): the funding volume is generally a lump sum of up to EUR 1 million for W3 positions and EUR 750 000 for W2 positions over a period of five years. This finances the position itself and the necessary resources.			outstanding women researchers: 270 additional female professors were appointed at German Higher Education Institutions. As a result of the positive evaluation of the programme on the development of equal opportunities in institutions of higher education, the Joint Science Conference of the Federal Government and the Heads of Government of *Länder* (GWK) decided in 2012 to continue the programme for a second period of five years until 2017; – Fraunhofer (2013-2019): Until 2019, about 400 female scientists are to be promoted.		
LITHUANIA	– Equal Opportunities in Research (LYMOS): support was awarded to 27 academic trips and 34 scholarships were awarded to researchers returning to work after maternity leave. These were not as effective as had been hoped;					

Country	Measures explicitly to improve research funding	Appointment/promotion to decision-making posts at a later stage of researcher career				General support by national authorities for the principle of gender balance
		Gender parity on boards, targets & quotas	Work-life balance	Training / support for high-level positions	Transparency in appointment procedures & results	
	– In 2009-12, the number of female students increased in all fields of science (Humanities, Social Sciences, Physical Sciences, Biomedical Sciences and Engineering).					
MALTA			– As of 2013, there had been 1 request by a MGSS beneficiary who submitted a request for a suspension of studies due to maternity leave. This was granted. No projected funds for the scholarship will be lost by the beneficiary because she will continue to benefit from these funds on resuming her studies.			
NORWAY		– In 2013 the total budget for Gender Balance in Senior Positions and Research Management (BALANSE) project was NOK 15 million (some EUR 2.0 million) and				

Country	Measures explicitly to improve research funding	Appointment/promotion to decision-making posts at a later stage of researcher career				General support by national authorities for the principle of gender balance
		Gender parity on boards, targets & quotas	Work-life balance	Training / support for high-level positions	Transparency in appointment procedures & results	
		four projects received support.				
POLAND	– L'Oréal Polska Grants for Women in Science Awards: on the list of winners there already are 65 women from various academic centres in Poland. Nominations are evaluated by 16 judges - eminent scholars and representatives of Polish science. In 2014, for the first time, the Ministry of Science and Higher Education is an official partner of the competition.					
SWEDEN						– The Swedish Council of Higher Education has been tasked with compiling, analysing and spreading knowledge about different kinds of gender projects supported by the former Delegation for Gender Equality in the Higher Education sector. The report was submitted to the Ministry of Education and Research in April 2014.
SWITZERLAND						– Swiss University Conference programme "Equal Opportunity at Universities"/Gender Studies

Country	Measures explicitly to improve research funding	Appointment/promotion to decision-making posts at a later stage of researcher career				General support by national authorities for the principle of gender balance
		Gender parity on boards, targets & quotas	Work-life balance	Training / support for high-level positions	Transparency in appointment procedures & results	
						2013-2016: For 2013-2016, the ten Swiss universities have adopted their own action plans for gender equality measures. This programme is a successor programme to the Swiss Federal Equal Opportunity at Universities Programme, which ran from 2000-11/12.

Source: Deloitte, 2012 and 2013 reporting exercise

12.2 Measures supporting education and training

The table below provides an overview of the impacts of measures supporting education and training. The information is based on the 2012 and 2013 reporting exercise with the participating countries within the scope of this study. An update of information was not available this year for Bulgaria, Portugal, the Slovak Republic nor for Iceland, Israel and Liechtenstein.

Table 37: Measures to attract young people to science and the research profession, to increase the quality of doctoral training and life-long learning (including the development of a Skills' agenda) and to develop partnerships between academia and industry by fostering doctoral training in cooperation with industry (Impact reported)

Country	Attract young people to science and the research profession	Quality of doctoral training and life-long learning	Collaboration between academia and industry
AUSTRIA	– The Talents Programme supports: In 2013, 1 504 traineeships for pupils were funded under the "discover talents" action line. The budget is about EUR 1 500 000 per year; – The Austrian Job Exchange for Research, Development and Innovation: some 5 500 job offers in 2013; – Austrian organisations posted 1 042 positions on EURAXESS Jobs (in comparison to 779 in 2012 and 525 in 2011). As of 9 December 2013, there were 301 registrations from Austrian organisations on the EURAXESS Jobs portal; – Young Science programme: Kids and Junior Universities Initiative (2001-ongoing): children between the ages of 7 and 15 explore science with the support of researchers. Since 2008 more than 90 000 children and teenagers have benefited from the initiative. Fifteen Kids Universities took place in Austria in 2013; Sparkling Science: To date, 57 000 pupils have worked with some 700 researchers and 700 teachers in 211 projects covering current scientific questions in the field of humanities, life sciences, natural sciences, computer sciences, engineering and medicine. The number of schools involved in the project in Austria is 356; there are 38 partner schools located abroad.		– COMET Competence Centre Programme: As of end-year 2013, there were 21 COMET K-Centers (5 K2 Centers and 16 K1 Centers) as well as 24 K-Projects running with federal funding of approx. EUR 50 million per year; – AplusB Programme supports young researchers in the formation of enterprises. In total, eight regional AplusB Centres ensure a sustainable increase in the number of academic spin-offs from universities, universities of applied science and non-university research institutions by supporting technology transfer through exploitation of research results by the industry. An analysis of academic start-ups supported by the AplusB programme from 2002 to 2009 has demonstrated that these companies have a high level of research and development intensity in high-tech sectors, employ highly qualified personnel, are engaged in technology transfer and show significant growth and survival rates. The programme will be evaluated in 2014; – Endowed Professorship: The 1st call was launched on 30 January 2014 as part of the RTI Initiative Production of the Future with a total amount of EUR 5 million; – Forschungskompetenzen für die Wirtschaft - Research Competences for Industry: Since 2012, there have so far been two calls for qualifications seminars with a combined budget of EUR 3.75 million, and two calls for qualifications networks with a combined budget of EUR 9.3 million.

Country	Attract young people to science and the research profession	Quality of doctoral training and life-long learning	Collaboration between academia and industry
			– There has been one call for innovation lectures with a budget of EUR 3.45 million; – Production of the Future Programme (BMVIT): Since 2011, a total of EUR 47 million has targeted high-level research groups. In the fourth call there were 451 participants (50% RTD organisations and 50% companies).
BELGIUM	– Annual Science Communication Action Plan attracts pupils, students and teachers into a research career by promoting science, technology and technological innovation. In 2012, the Annual Science Communication Action Plan was replaced by the Communication Policy Plan 2012-2014. The action plan for the stimulation of careers in STEM, a collaboration of the Ministries of Innovation and Science, Labour and Social Economy, and Education, is complementary to this plan.	– Support Programme for Young Researchers of the Flemish community: The Flemish Community finances the Support Programme for Young Researchers with a yearly budget of EUR 4 million.	
BOSNIA AND HERZEGOVINA	– 'Co-funding of research, scientific training and study visits at home and abroad', Federal Ministry of Education and Science: Every year, approximately 25-30 researchers receive support. The total budget is BAM 50 000-70 000 (some EUR 30 500 -35 500); – Competition for funding/co-funding of scientific research and research and development projects in the Federation of Bosnia and Herzegovina, Federal Ministry of Education and Science: Every year, the funding/co-funding scheme supports approximately 30-40 projects. The total budget is BAM 500 000 (some EUR 255 500); – 'Fund for student loans', the Federation of Bosnia and Herzegovina: a total of 200 student loans during the academic year 2011/2012 under a scheme launched in 2008. The total amount of funds was BAM 500 000 (some EUR 255 000). Each of the		– The Innovation Centre Foundation (Banja Luka) hosts 15 start-ups with an average of four employees, and 17 development teams that will become start-ups in the foreseeable future; the Innovation Centre Foundation employs a total of 110 employees.

Country	Attract young people to science and the research profession	Quality of doctoral training and life-long learning	Collaboration between academia and industry
	students received an amount of BAM 2 500 (some EUR 1 278); – Dr Milan Jelić Fund: This annually provides 110 scholarships for undergraduates (75 scholarships for students studying at national universities and 35 scholarships for students at foreign universities); 15 scholarships for postgraduate students; and 10 scholarships for doctoral students at national and foreign universities. In December 2012, 14 students were awarded study grants as financial support for their own initiatives of scientific and other sorts of cooperation between foreign and national universities and scientific institutions. The annual budget of the Dr Milan Jelic Fund is BAM 750 000 (some EUR 385 000); – Participation in national and international scientific meetings, Federal Ministry of Education and Science: Every year, approximately 40-50 researchers receive support. The total budget is BAM 60 000-80 000 (some EUR 30 500-41 000); – Programme for young researchers: The Programme provided support to four young researchers in 2010, eight in 2011, eight in 2012 and four in 2013. The annual budget of this programme is BAM 160 000 (some EUR 82 000); – Scholarships of the Ministry of Education and Culture of Republika Srpska: In 2012-13: 357 students who enrolled for the first time in the study of mathematics and physics, and students in the second, third and fourth year of study of mathematics, physics, informatics, electrical engineering, mechanical engineering and geodesy. Total annual budget in 2013 BAM 428 400 (some EUR 220 000).		
CROATIA	– In 2012 the Ministry of Science awarded financial support to 18 programmes in the		– Connectivity Programme: From 2007 to December 2013, the Fund financed 42 projects.

Country	Attract young people to science and the research profession	Quality of doctoral training and life-long learning	Collaboration between academia and industry
	field of science popularisation in the total amount of some EUR 71 000 (some HRK 550 000).		Grant size per single project is EUR 10 000. The average project duration is six months; – Research Cooperability Programme: From 2007 to December 2013, the Fund financed 43 projects within the Programme. The minimum grant size per single project is EUR 100 000 and the maximum is EUR 200 000. The average project duration is two years; – Young Researchers and Professionals Programme: From 2007 to December 2013, the Fund financed 25 projects within the Programme. The minimum grant size per single project is EUR 50 000 and the maximum is EUR 100 000. The average project duration is two years.
CYRPUS			– University-Industry Liaison Offices: There have been more than 900 compared to an initial target of 400.
CZECH REPUBLIC	– In 2012, HEIs spent CZK 1 049 million (some EUR 38 million) in total on scholarships for doctoral students, compared to CZK 1 083 million (some EUR 42 706) in 2011. Of this, CZK 999 million (some EUR 36 million) came from the funds of Ministry of Education, Youth and Sports. The amount for scholarships for doctoral students is only 5% of the ministry's budget for HEIs (excluding EU funds).		
DENMARK	– Application of Science, Languages and Talent initiatives: The programme will be evaluated in autumn 2014; – Elite Programmes at the Universities: The financial support for the elite programmes will be phased out in 2014. The university can however decide to continue activities established under this initiative.		
ESTONIA	– ERMOS Programme (Estonian Research Mobility Scheme), 2007-2013: The total budget is EUR 4.6 million. These grants will be financed from the state budget in future. The grant covers remuneration,	– AHHAA Science Centre: In 2012, it hosted some 173 500 visitors.	

Country	Attract young people to science and the research profession	Quality of doctoral training and life-long learning	Collaboration between academia and industry
	research expenses and a one-time relocation allowance.		
FRANCE	– University Institute of France (IUF): In 2013, some 520 of the 1 350 members of the IUF were 'Juniors'.	– In the 2012-2013 academic year, 65.2% of young researchers enrolled in the first year of doctoral training had specific funding for this. Of these 31% were funded through a doctoral contract (three-year employment contract) and 10% through a CIFRE convention (see table 9); a further 38% were funded through "other" doctoral contracts (e.g. from other ministries, research organisations or a local authority). Doctoral contracts are all employment contracts carrying the rights of employees. A minority were funded by fellowships rather than being on contract. The fellowships are generally funded by foreign organisations or countries; – As of September 2011, the Ministry of Higher Education and Research had accredited 286 doctoral schools (Ecoles Doctorales) with 65 000 doctoral trainees.	– The CIFRE scheme (Industrial Agreement of Training through Research) has been proven to increase the employability of researchers in the private sector: more than six out of ten doctors according to a study in 2009 were recruited in the CIFRE partner company (42%) or laboratory (16%), while others were recruited elsewhere. The vast majority of doctors funded by means of a CIFRE find employment within 6 months (90%) and a further 6% within 12 months; – Carnot Institutes Network: The Carnot institutes received in 2012 a new EUR 182 million endowment for actions to support SMEs and international cooperation under the Investments for the Future programme.
FORMER YUGOSLAV REPUBLIC OF MACEDONIA		– 'Equipping Laboratories for Scientific Research and Applicative Activities' (2009-14): Since then, an additional 58 laboratories have been funded, bringing the total to 80.	
GERMANY	– School Labs Initiative (Helmholtz Association): More than 50 000 pupils visit the 24 school labs at the Helmholtz Centres every year to conduct experiments and to learn about interdisciplinary scientific thinking and work; – Tiny Tots Science Corner (Haus der kleinen Forscher - HdkF) Initiative (Helmholtz Association): The initiative has reached more than 28 000 nurseries and teachers and over one million children. The Federal Ministry of Education and Research (BMBF) will provide an additional EUR 2 million for including six- to ten-year-old children until 2015;	– Leibniz Association (WGL): Since 2006, 31 Leibniz Graduate Schools have been established where young researchers get the opportunity to pursue their doctoral studies in an excellent, cooperative and transdisciplinary research environment; – International PhD Programmes in Germany – IPID (DAAD): At present, 38 international PhD programmes are funded by the DAAD; – More than 60 International Max Planck Research Schools (IMPRS): about 41% of these are in the areas of chemistry, physics and technology, 37% in biology and medicine, and the rest in the humanities and social sciences.	– A total of 10 "Forschungscampi" and 15 "Spitzencluster" provide young researchers with outstanding opportunities to work at the interface between science and industry in a challenging and innovative environment.

Country	Attract young people to science and the research profession	Quality of doctoral training and life-long learning	Collaboration between academia and industry
	– Helmholtz-Postdoc-Programme (HGF): The programme started in 2012 with the funding of 35 postdocs. In 2013, 20 postdocs were selected for funding; – Helmholtz Young Investigator Groups (HGF): To date, 183 Helmholtz young investigators groups have been funded with a total funding volume of more than EUR 118 million; – Otto Hahn Groups (three to four new groups every year) and the Max Planck Research Groups (122 in total) offer young researchers an opportunity to head a research team at an early stage of their career for a limited period of time. Researchers gain research and management experience.		
GREECE	– EXCELLENCE (ARISTEIA) I & II 2011, 2012 under the National Strategic Reference Framework (2007-2013): The total budget was some EUR 10061 million. A similar programme is being designed for the programming period 2014-2020; – Financing research proposals which were positively evaluated in the 4th and 5th Call of ERC Grants Schemes 2012 and 2013: The duration of the projects is 42 months. The budget was EUR 7.5 million in 2012 and EUR 2.5 million in 2013; – Support of Postdoctoral Researchers (2010-2013): The total budget was EUR 3 026 million. A similar programme is being designed for the programming period 2014-2020.	–	– In 2013, the evaluation of a group of publicly funded R&D&I Programmes, mainly implemented in the previous programming period (3rd Community Support Framework), was launched (through an open tender). Among the programmes covered by this evaluation are the "Spin-off" Programme (CREATION) and the Clusters Programme (Corallia).
HUNGARY	– Hungarian Talent Programme: In 2013, funding was provided to 72 national and transnational programmes, camps and workshops focusing on nurturing talents; – The two sub-programmes of the National Excellence Programme: funded the following number of fellows in 2013: • Magyary: 1 638	– As part of the National Excellence Programme (see above), two fellowships for doctoral candidates were introduced under the Magyary sub-programme: the János Apáczai Csere Fellowship and the Ányos Jedlik Fellowship. The former is for doctoral programme students; a total of 190 fellowships were awarded in 2013. The	– Kecskemét College, Mercedes-Benz Manufacturing Hungary Ltd. and Knorr-Bremse Ltd: in the academic year 2013/2014, 44 students joined this training scheme.

Country	Attract young people to science and the research profession	Quality of doctoral training and life-long learning	Collaboration between academia and industry
	• Hungarians living abroad: 39 • Danube-Strategy: 31 • Bilateral agreements: 7 • New Central Europe: 6. The Programme also supports employees of higher-education institutions. In 2013, 3 366 MSc or PhD students and 1 083 HEI employees received funding.	latter is for doctoral candidates; a total of 118 fellowships were awarded in 2013. There is also an opportunity for PhD students under the Andrássy Europe Fellowship scheme which is part of the Danube Strategy sub-programme. Three fellowships were awarded in 2013; – In 2013, there were 175 accredited doctoral schools in 27 universities in Hungary.	
IRELAND	– In 2013, 90% of students sat 'Science' in the Junior Certificate examination; – BT Young Scientist and Technologist Exhibition: since its inception, more than 65 000 students have entered over 31 000 projects for exhibition. The 2013 exhibition was the biggest ever, with 1 879 ideas entered from 4 189 students from 362 schools; – Bonus points scheme for Higher Level Mathematics: a much larger percentage of the Mathematics cohort presented at higher level in 2013 than at any time in the past (25.6% in 2013 compared to 22.1% in 2012 and 15.8% in 2011). This represents a 62% increase over 3 years; – Total university Masters graduates in SET (Science, Engineering and Technology) and HSS (Humanities and Social Sciences) increased from 6 193 in 2005 to 8 109 in 2012. There were also an additional 1 701 Masters graduates from the Institute of Technology sector in 2012. The number of PhD graduates increased from 774 in 2005 to 1 436 in 2012 from the university sector (+85%). The number of SET PhD graduates increased from 576 in 2005 to 920 in 2012 (+60%), with an additional 73 SET PhD graduates from the Institute of Technology sector;	–	– ELEVATE scheme (2013 to 2018): aims to offer 45 three-year fellowships via two calls for proposals of which the first has been launched and awards made; – Technology Centres: There are currently 14 Technology Centres in operation with a further two due to be launched in 2014 in the Dairy Technology and Connected Health sectors. EUR 100 million has been approved in funding for the Technology Centres and over 300 companies are already benefiting from Ireland's largest industry-led research programme driving innovation and delivering results in the areas of cloud computing, analytics and learning technologies, manufacturing and materials, energy, food and health, financial services and business processes; – Technology Gateway: a nationwide network of 12 industry-focused Gateways was established in eight IoT's, representing a EUR 23 million investment over five years from January 2013 to December 2017. During 2013, these Gateways completed 208 industrially relevant projects for companies, and 210 collaborative projects are planned for 2014.

Country	Attract young people to science and the research profession	Quality of doctoral training and life-long learning	Collaboration between academia and industry
	– SFI Discover Programme: has committed approximately EUR 2.1 million to the Discover Programme in 2014.		
LITHUANIA	– National Higher Education Programme (2007-13): It will be replaced by National Development Programme for Higher Education and R&D for the years 2013-2020 and its Action Plan for 2013–2015; – Post-doc internship implementation in Lithuania: In 2009-2013, a total of 225 post-doc grants were awarded; – Researchers' Career Programme (2007-2013): The programme itself will not be extended under the Multiannual Financial Framework 2014-2020, but the programme-based projects and activities will be continued or new ones will be carried out.	– In 2012, 488 scholarships were granted to doctoral candidates by the Research Council.	– Twenty-five projects were approved with the budget of about EUR 11.6 million (under the measures for public-private R&D cooperation and commercialisation of research results). These are being implemented over the period 2012-2014; – Thirteen projects with a total budget of EUR 0.125 million were funded in 2012 by the Ministry of Education and Science. During the 2012-2013 period, 17 start-ups were established by young entrepreneurs from universities; – The Agency for Science, Innovation and Technology (MITA) is responsible for administering this measure and provides financial support for business and research organisations. In 2011, the allocation was some EUR 67 000 and 14 applications were granted. In 2012, the allocation was more than EUR 350 000 and 86 applications were supported. In 2013, more than EUR 390 000 were allocated and 62 applications were funded. Thus, in the period 2011-2013, a total of 162 applications were funded.
LUXEMBOURG	– AFR grant scheme: The success rate in 2013 was 35% at PhD level and 47% at postdoc level and dropped to 20% for the first call in 2014. Some EUR 24 million were awarded in 2013 (of which EUR 1 million was covered through the Marie Curie COFUND scheme). As of December 31, 2013, 415 AFR-funded projects (328 PhDs and 87 Postdocs) were running; – AFR data for 2013 show that of all successful applicants in 2013 the percentage of women was 37% (compared to 44% of women at the application stage); – The FNR awards up to 90 new AFR grants for PhDs every year. The funding period	– AFR beneficiaries are entitled to a "training allowance" of EUR 2 000 per year (EUR 6 000 per PhD grant) to participate in training seminars, summer schools and international conferences.	– Public-Private Partnerships under the AFR: The AFR contribution to employment contracts comes to EUR 39 175 per year for PhDs (supplemented by EUR 3 781 for a PPP) and EUR 55 208 per year for postdocs (supplemented by EUR 4 386 for a PPP).

Country	Attract young people to science and the research profession	Quality of doctoral training and life-long learning	Collaboration between academia and industry
	covered by the AFR is three years, with a possibility of a one-year extension for finalisation of the PhD.		
MALTA	– Malta Government Scholarship Scheme (MGSS): A total of 397 scholarships for post-graduate studies were awarded between 2006 and 2013 (193 of which were for Doctoral studies); – Master It!: A total of 464 scholarships were awarded at Masters level during the first two calls. A total of 198 scholarships were awarded in STEM subjects. In April 2014, a third Call was launched; – Strategic Educational Pathways Scholarships (STEPS) Scheme: A total of 886 scholarships were awarded at Master and Doctoral levels. A total of 38 scholarships at doctoral level were awarded in STEM subjects, out of a total of 82 doctoral scholarships awarded. 220 scholarships were awarded in this area at Masters level.	– The Centre for Entrepreneurship and Business Incubation (CEBI): A total of around 50 students are following the Programme.	– Loan of Highly Qualified Personnel' Scheme: Scheme has been extended to June 2014. It is currently under review in anticipation of new State Aid guidelines; – National Research and Innovation Programme: As of 2013, the National R&I Programme was re-named as the Technology Development Programme.
NORWAY			– Research Council funds exceptional researchers and research centres under their leadership through the Centres of Excellence (SFF) scheme. In 2014, around NOK 300 million (some EUR 38 million) will be spent on top-up financing of 21 Centres which are affiliated with Norway's top universities and premier public research institutes; – 153 million (some EUR 18 million) were spent in 2013 on 11 Centres for Environmental-friendly Energy Research (FME); – The Norwegian contribution to the Top-level Research Initiative (TRI), the Nordic eScience Globalisation Initiative (NeGI), the Nordic eInfrastructure collaboration and the Education for Tomorrow initiatives was about NOK 18.5 million in 2013 (some EUR 2.5 million.)

Country	Attract young people to science and the research profession	Quality of doctoral training and life-long learning	Collaboration between academia and industry
POLAND	– MISTRZ Programme: Grants are awarded via a closed competition which covers a different field of science each year. In 2014, the competition is directed to scholars in the Life Sciences; – Increasing the number of graduates of degree programmes of key importance for a knowledge-based economy: An evaluation report was published in 2013.	–	– In July 2013, the Ministry of Science and Higher Education announced a competition a second batch of candidates, if they specialise in the sectors designated this time round, i.e. life sciences, agricultural sciences, forestry and veterinary sciences, to receive additional funding and National Leading Research Centres (KNOW) status. This is the second edition of the competition. The results of the competition were announced in May 2014.
SLOVENIA	– Young Researchers: The Slovenian Research Agency, which is in charge of this programme, devoted EUR 24 million to the programme and funded 1 300 Young Researchers in 2013. More than 60% of those funded by this measure in 2013 were STEM doctoral students. Some 20% of the mentors are women.	– Innovative Scholarship Scheme for Funding Doctoral Studies: In 2013, 1 633 doctoral candidates were funded for an annual amount of EUR 3.4 million.	– Young Researchers in the Economy: In 2013, the Agency devoted EUR 13.5 million to this programme and funded more than 400 young researchers in business; – The Slovenian Research Agency funds up to 75% of the cost of applied research projects: In 2013, the Agency spent EUR 8 million for the co-financing of 126 applied research projects.
SPAIN	– Ramón y Cajal programme: In 2012, the Ramón y Cajal programme increased the amount of each grant by 10%. In 2012, the number of Ramón y Cajal grants was 175. In 2013 provisions were introduced to allocate places by scientific discipline; – FPI programme (Ministry of the Economy and Competitiveness): In 2013, 940 candidates were successful. In addition, the Secretariat of State funds visiting fellowships for a period of between two and four months, including tuition fees.	– Grants for post-doc training and for incorporation of recent post-docs: these grants replaced the Juan de la Cierva programme in 2013.	– INNCORPORA programme: There were no calls in 2013.
SWEDEN	– The Swedish Council for Higher Education has been commissioned to compile, analyse and disseminate the results and experiences from the projects. The Council presented the report in April 2014 and the recommendations included reviewing the	–	– A Boost to Research and Innovation (Government Bill of 2008): The measure was continued in Research and Innovation (Gov. Bill 2012/2013:30) with an added EUR 1.8 million until 2016 targeting the establishment of transfer offices at more universities.

Country	Attract young people to science and the research profession	Quality of doctoral training and life-long learning	Collaboration between academia and industry
	decision paths in academia – with clear guidelines and routines to contribute to transparency within all decision-making processes.		
UNITED KINGDOM		– Centres for Doctoral Training (CDT): 90 Centres since 2009. Natural Environment Research Council (NERC) in January 2014 announced a Centre in Oil and Gas at a consortium of universities led by Heriot-Watt; – UK Research Councils have allocated GBP 120 million (some EUR 141 million) in ring-fenced funding to skills agendas for researchers since 2003. Since March 2011, funding has been embedded in normal funding (PhD fees and indirect costs on research grants). The most recent survey, in 2013, shows significant progress has been made towards embedding implementation of the Researcher Development agenda and its funding into HEI processes.	– The RCUK School-University Partnerships Initiative (SUPI): this is worth GBP £3.5 million (EUR 4.3 million), with half the funding from RCUK and matched funding from universities and their partners; it supports 12 SUPI partnerships at Imperial College London, Queen's University Belfast, and the universities of Aberystwyth, Bristol, Cardiff, East Anglia, Exeter, Lancaster, Manchester, Southampton, Strathclyde, and the Open University, with coordination, support and dissemination provided by the National Coordinating Centre for Public Engagement (NCCPE).

Source: Deloitte, 2012 and 2013 reporting exercise

12.3 Mobility and international attractiveness

The table below provides an overview of the impacts of measures supporting mobility and international attractiveness. The information is based on the 2012 and 2013 reporting exercise with the participating countries within the scope of this study. An update of information was not available this year for Bulgaria, Portugal, the Slovak Republic nor for Iceland, Israel and Liechtenstein.

Table 38: Mobility and international attractiveness (Impact reported)

Country	Measures to attract and retain 'leading' national, EU and third country researchers	Measures supporting researchers' inward mobility	Measures supporting researchers' outbound mobility	Promotion of 'dual careers'	Portability of national grants	Access to cross-border grants
AUSTRIA			– The APART Programme: In 2012, about 30% of the fellows conducted research at universities or research institutions abroad; – DOC Programme: PhD studies can be conducted at universities or research institutions both in Austria and abroad. In 2011 and 2012, 15% of the fellows conducted research at universities or research institutions abroad; – ROM Programme: Nine stipends were awarded in 2013.			
BELGIUM		– BEWARE FELLOWSHIPS Industry: The Industry programme will grant 57 mandates over 5 years. The first call for proposals was launched on January 21st, 2014; – BEWARE FELLOWSHIPS Academia: A total of 80				

Country	Measures to attract and retain 'leading' national, EU and third country researchers	Measures supporting researchers' inward mobility	Measures supporting researchers' outbound mobility	Promotion of 'dual careers'	Portability of national grants	Access to cross-border grants
		mandates will be available for researchers. The first call for proposals was launched in March 2014.				
BOSNIA AND HERZEGOVINA	– Cooperation Agreement with Slovenia: Through competitive grants in 2012-2013, 28 projects were supported, whilst for period 2014-2015 the number of projects was 38; – Cooperation Agreement with Montenegro (2009): A total of 15 projects were supported for the period 2012-2013 whereas for 2014-2015, 13 projects were selected.		– Exchange programme in 2012-13 for research assistants and students: 16 individual exchanges (12 outward and four arrivals); – CEEPPUS (Central European Exchange Programme for University Studies) in 2012-13: 37 individual exchanges (16 outward and 21 arrivals) for university professors, university assistants and students; – The Federal Ministry of Education and Science regularly publishes a public call for researchers within which there is a programme to support research, scientific training and study visits abroad with a view to raising the level of scientific competence and promoting scientific careers. In 2013 a total of 35 candidates were			

Country	Measures to attract and retain 'leading' national, EU and third country researchers	Measures supporting researchers' inward mobility	Measures supporting researchers' outbound mobility	Promotion of 'dual careers'	Portability of national grants	Access to cross-border grants
			supported under this programme.			
CROATIA	– Return of Croatian scientists to the country project: Its total value is EUR 7 million, of which 60% is financed from national sources.					
CYRPUS	– - New Infrastructure Programme: A programme for "Upgrading of Existing Infrastructure" was launched in 2009, through which seven projects are being financed with a total grant of the order of EUR 2 million. A further programme to fund public infrastructure was launched in 2011 with a total grant of the order of EUR 2 million and a maximum grant per project of EUR 0.5 million. Implementation of four projects started before the end of 2011.					
CZECH REPUBLIC		– ERC CZ (2012-2019) by the Ministry of Education, Youth and Sports: In 2014, the programme has so far supported eight projects;	– KONTAKT II – (2011-2017) Programmes: In 2013, the programme supported 126 projects. Since 1 January 2014, 55 new projects have			

Country	Measures to attract and retain 'leading' national, EU and third country researchers	Measures supporting researchers' inward mobility	Measures supporting researchers' outbound mobility	Promotion of 'dual careers'	Portability of national grants	Access to cross-border grants
		– Installation grants within EMBC via the Ministry of Education, Youth and Sports: In 2014, the MEYS has so far supported six projects; – Mobility Support Activity funded by the Ministry of Education, Youth and Sports: Annually, the programme supports more than 100 new projects; – SoMoPro programme of South Moravian Region: The total budget was EUR 3 887 158. SoMoProII is planned for the period 2012-2017. The total budget is EUR 4 766 562.	started under the Programme; – Mobility Support activity (2011-2018): In total, more than 200 projects have been funded so far.			
DENMARK	- Getting Settled in Denmark Programme: As of 2014, an interministerial working group was looking at how to improve the information centres for incoming researchers.					
FRANCE		– In 2013, the proportion of young foreign researchers recruited by Public Scientific and Technological Institutions was				

Country	Measures to attract and retain 'leading' national, EU and third country researchers	Measures supporting researchers' inward mobility	Measures supporting researchers' outbound mobility	Promotion of 'dual careers'	Portability of national grants	Access to cross-border grants
		approximately 1/5 and by universities 1/6.				
GERMANY	– Humboldt Professorship (AvH): Since its launch in 2008, 41 Humboldt professors have taken up their cutting-edge research in Germany; – Recruiting Initiative (HGF): The programme will run until 2015 and encompasses 40 extra positions.	– Leibniz-DAAD Research Fellowships: the fellowships offer highly qualified recent foreign postdocs the opportunity to conduct special research at one of the 94 Leibniz Association participating institutions in Germany for up to one year.	– German Research Foundation Programmes (DFG): the DFG provides about 700 Research Fellowships enabling post-docs to conduct research abroad for up to 2 years.			
HUNGARY	– Albert Szent-Györgyi Fellowships for Returning Post-Doc and Experienced Researchers: seven postdoctoral fellows and six experienced researchers were awarded scholarships in 2013; – Andrássy Europe Fellowships for excellent early-stage and experienced researchers/lecturers: In 2013, four candidates were granted fellowships; – János Neumann Fellowships for Early-stage and Experienced Foreign: twelve early-stage and nine experienced	– Momentum (Lendület) Programme of the Hungarian Academy of Sciences: in 2013, 14 young scholars from among the 104 candidates were able to set up an independent research team using the total sum of HUF 633.7 million (some EUR 2.1 million) provided for the first years by the Academy. Consequently, together with the scholars who have previously received awards, 79 research teams have since the summer of 2013 been able to conduct research into promising internationally		– A Ministerial Commissioner responsible for the improvement of the women's position in the labour market was appointed in 2013 and promotion of dual careers can be considered part of the remit.		

Country	Measures to attract and retain 'leading' national, EU and third country researchers	Measures supporting researchers' inward mobility	Measures supporting researchers' outbound mobility	Promotion of 'dual careers'	Portability of national grants	Access to cross-border grants
	researchers were funded in 2013; – János Szentágothai Fellowship Programme for Experienced Researchers: seventy-one researchers were awarded this fellowship in 2013; – New Central Europe Fellowships: In 2013, six fellowships were awarded; – *Zoltán Magyary* Postdoctoral Fellowship Programme (under National Excellence Programme): in 2012, the total number of beneficiaries was 33.	significant achievements of a total funding of nearly HUF 3 billion (some EUR 10 million).				
LITHUANIA	– Brain Retain and Gain Strategy (2008-2013): Follow-up actions are being included under the 2014-2020 Multiannual Financial Framework with the aim of attracting world-class researchers and post docs, and providing funding for short-term visits; – Global Grant Measure (2009-2015): The programme-based activities will be continued or the new ones will be carried out	– Implementation of Postdoctoral internships in Lithuania (2009-2015): The programme will be continued under the Multiannual Financial Framework 2014-2020; – As part of the Short Period Visits Programme, institutions can invite third-country researchers to Lithuania. The total budget for inbound mobility in this	– As part of the Short Period Visits Programme, institutions can send national researchers abroad. The total budget for the outbound mobility in this programme is around EUR 724 000.			

Country	Measures to attract and retain 'leading' national, EU and third country researchers	Measures supporting researchers' inward mobility	Measures supporting researchers' outbound mobility	Promotion of 'dual careers'	Portability of national grants	Access to cross-border grants
	under the Multiannual Financial Framework 2014-2020; – Short Period Visits Programme (2009-2013 has been extended until May 2015. The total budget is around EUR 1.4 million.	programme is around EUR 724 000.				
LUXEMBOURG						– AFR grants are open to non-residents on condition that they have an employment contract at a Luxembourg-based research institution and spend at least 50% of their research time in this Luxembourg-based research institution. The AFR also funds PhDs and Postdocs abroad, but this is limited to Luxembourg nationals and Luxembourg residents (>5 years).
MALTA			– The Malta Government Scholarship Scheme (MGSS Scheme) allows awardees to pursue their studies abroad, in addition to supporting those students who opt to conduct part of their assignment at world-renowned research institutes. Sixty per cent			

Country	Measures to attract and retain 'leading' national, EU and third country researchers	Measures supporting researchers' inward mobility	Measures supporting researchers' outbound mobility	Promotion of 'dual careers'	Portability of national grants	Access to cross-border grants
			of the awardees opt to study abroad.			
POLAND	– The Foundation for Polish Science: In 2008-2012 the number of programmes was reduced from over 20 in 2008 to 15 in 2012. A review of its activities in 2008-2012 provided the basis for Programme Premises for 2013-2016.					
SERBIA	– The Ministry of Education, Science and Technological Development has programmes for co-financing researchers from abroad to come and work in Serbia. In 2013 the Ministry awarded 29 scholarships to foreign students and supported visits by 120 professors from abroad.					
SPAIN						
SWITZERLAND		– Ambizione Programme (SNSF): In the period 2008-13, 51% of the beneficiaries were "returning", i.e. they had received their doctorate in Switzerland or had an SNSF fellowship grant			– In 2013, 16 SNSF grants were transferred in this way (compared to 15 SNSF grants in 2011), with a total transferred amount of CHF 1.9 million (some EUR 1.54 million) (compared to	

Country	Measures to attract and retain 'leading' national, EU and third country researchers	Measures supporting researchers' inward mobility	Measures supporting researchers' outbound mobility	Promotion of 'dual careers'	Portability of national grants	Access to cross-border grants
		earlier in their career. Around 45% were incoming, i.e. not of Swiss nationality and without a PhD degree from Switzerland; – SNSF Professorship (SNSF): The proportion of researchers returning with an SNSF professorship in 2013 was 32%.			CHF 2.2 million in 2011).	

Source: Deloitte, 2012 and 2013 reporting exercise

13. Technical Annex

The technical annex presents information on:

- List of indicators and their availability (update for this year's report);
- Sources of indicators and years of reference;
- EU-coverage (EU-27 and/or EU-28);
- List of sources used during the desk research phase and production of the *Researchers' Report 2014;*
- Country abbreviations.

13.1 List of indicators

Table 39: *Researchers' Report 2014* - List of indicators

Indicators	Data source(s)	Update available[189]	Latest year available	EU coverage
Chapter 1 - The stock of researchers in Europe				
Researchers (Full Time Equivalent), EU-28, US, China, Japan, 2000, 2010 and 2011 (in million)	Eurostat	Yes	2011	EU-28
Researchers (Full Time Equivalent) per thousand labour force, EU-28, US, China, Japan, 2000, 2010 and 2011	Eurostat	Yes	2011	EU-28
Researchers (Full Time Equivalent) per thousand labour force, Europe, 2000 and 2011	Eurostat	Yes	2011	EU-28
Researchers (Full Time Equivalent) per thousand labour force, top six European countries, EU-28, US, Japan, 2000, 2010 and 2011	Eurostat	Yes	2011	EU-28
Researchers (Full Time Equivalent) working in the business and public sectors (in million), EU-28, US, China, Japan, 2011	Eurostat	Yes	2011	EU-28
Researchers (Full Time Equivalent) by sector, EU-28, 2000-2011 (in million)	Eurostat	Yes	2011	EU-28
Share of Full Time Equivalent (FTE) researchers working in the business sector (as % of all researchers), EU-28, US, China, Japan, 2011	Eurostat	Yes	2011	EU-28
Researchers in the business sector (Full Time Equivalent) per thousand labour force, EU-28, US, China, Japan, 2000 and 2011	Eurostat	Yes	2011	EU-28
Researchers (Full Time Equivalent) in the business sector, top five European countries, EU-28, Japan, US, 2000, 2010 and 2011 (in million)	Eurostat	Yes	2011	EU-28
Researchers in the business sector (Full Time Equivalent) per thousand labour force, Europe, 2000 and 2011	Eurostat	Yes	2011	EU-28
Researchers in the business sector (Full Time Equivalent) per thousand labour force, EU-28, US, China, Japan 2000, 2010 and 2011	Eurostat	Yes	2011	EU-28
Researchers in the public sector (Full Time Equivalent) per thousand labour force, EU-28, US, China, Japan, 2000 and 2011	Eurostat	Yes	2011	EU-28
Researchers in the public sector (Full Time Equivalent) per thousand labour force, Europe, 2000 and 2011	Eurostat	Yes	2011	EU-28

[189] Compared with the previous year (*Researchers' Report 2013*).

Indicators	Data source(s)	Update available[189]	Latest year available	EU coverage
Researchers in the public sector (Full Time Equivalent) per thousand labour force, EU-28, US, Japan, China 2000, 2010 and 2011	Eurostat	Yes	2011	EU-28
Chapter 2 - Women in the research profession				
Proportion of academic staff by grade and gender, EU-27, 2002 and 2010 (%)	WiS database/ SHE figures	No	2010	EU-27
Glass Ceiling Index, Europe, 2004 and 2010	WiS database/ SHE figures	No	2010	EU-27
Women as Grade A academic staff, Europe, 2010 (%)	WiS database/ SHE figures	No	2010	EU-27
Proportion of woman as Grade A academic staff by main field of science (natural sciences, engineering and technology, medical sciences, agricultural sciences, social sciences, and humanities), Europe, 2010 (%)	WiS database/ SHE figures	No	2010	EU-27
Proportion of women heads (president/rector) of institutions in the Higher Education Sector, Europe, 2010 (%)	WiS database/ SHE figures	No	2010	EU-27
Proportion of women on boards, Europe, 2010 (%)	WiS database/ SHE figures	No	2010	EU-27
Chapter 3 – Open, transparent and merit-based recruitment				
Researcher posts advertised through the EURAXESS Jobs portal, Europe, 2009-2013	EURAXESS JOBS	Yes	2013	EU-28
Researcher posts advertised through the EURAXESS Jobs portal per thousand researchers in the public sector, Europe, 2013	EURAXESS JOBS	Yes	2013	EU-28
Share of researchers in the public sector satisfied with the extent to which research job vacancies are advertised externally by their institution, Europe, 2012 (%)	MORE2 study	No	2012	EU-27
Share of researchers in the public sector satisfied with the extent to which research job vacancies are advertised externally by their institution, by career stages, Europe, 2012 (%)	MORE2 study	No	2012	EU-27
Chapter 4 - Education and training				
Population aged 30-34 having completed tertiary education, Europe, 2000 and 2013 (%)	Eurostat Labour Force population survey/IUS	Yes	2013	EU-28
Population aged 25-64 having completed tertiary education, EU-27 and main competitors, 2004 and 2011 (%)	Eurostat, OECD	Yes	2011	EU-27
Tertiary graduates in Science, Technology, Engineering and Mathematics (STEM) studies (ISCED 5 & 6) per thousand population aged 20-29, Europe, US and Japan, 2000 and 2011	UNESCO OECD Eurostat education survey	Yes	2011	EU-27
Women tertiary graduates in Science, Technology, Engineering and Mathematics (STEM) studies (ISCED 5 & 6) per thousand women aged 20-29, Europe, US and Japan, 2000 and 2011	UNESCO OECD Eurostat education survey	Yes	2011	EU-27
New doctoral graduates (ISCED 6) per thousand population aged 25-34, EU-27, US and Japan, 2000-2011	UNESCO OECD Eurostat education survey/IUS	Yes	2011	EU-27
New doctoral graduates (ISCED 6) per thousand population aged 25-34, Europe, 2000 and 2011	UNESCO OECD Eurostat education survey/IUS	Yes	2011	EU-27

Indicators	Data source(s)	Update available[189]	Latest year available	EU coverage
New women doctoral graduates (ISCED 6) per thousand population aged 25-34, Europe, 2000 and 2011	UNESCO OECD Eurostat education survey	Yes	2011	EU-27
Doctorate graduates in S&E per 1 000 population aged 25-34, R&D intensity, Europe, US, China and Japan, 2011	Eurostat, OECD, China Statistical Yearbook 2012	New	2011	EU-27
Chapter 5 – Working conditions in the research profession				
Researchers employed on fixed-term contracts, Europe, 2012 (%)	MORE2 study	No	2012	EU-27
Estimated shares of researchers in the higher education sector by employment contract status and by country of affiliation, Europe, 2012 (%)	MORE2 study	No	2012	EU-27
Remuneration of doctorate holders working as researchers compared to doctorate holders working as non-researchers (difference in median gross annual earnings), Europe (2009), US (2008) (%)	OECD, Science, Technology and Industry Scoreboard, 2011	No	2008 (US), 2009	-
Gross annual salaries and PhD stipends of university researchers as percentage of the best paying country within career stages, EU, the rest of Europe, and selected competitors and emerging economies	MORE2 study	No	2012	EU-27
Post-PhD researchers indicating that their time as mobile researcher had positive, negative or no impact on career progression, EU-27, 2012 (%)	MORE2 study	No	2012	EU-27
Chapter 6 - Collaboration between academia and industry				
Work placement or internship in the non-academic sector during PhD (per country of PhD), Europe, 2012 (%)	MORE2 study	No	2012	EU-27
Post-PhD researchers indicating inter-sectoral mobility >3 months in private industry, Europe, 2012 (%)	MORE2 study	No	2012	EU-27
Motives for private sector employment, EU-27, 2012 (%)	MORE2 study	No	2012	EU-27
Public-private co-publications between two or more sectors (universities, research institutes, industry) per million population, EU, US, China, and Japan, 2003 and 2008	CWTS/Thomson Reuters /IUS 2014	No	2008	-
Composite indicator of research excellence, Europe, 2007 and 2012	JRC calculations using data from Science-Metrix (highly cited publications), OECD (PCT patent applications), CWTS Leiden Ranking (world class universities) and Scimago (research institutes), and ERC/DG RTD CORDIS (ERC grants data). Population and R&D data are from Eurostat and OECD, GDP data from World Bank World Development Indicators	New	2012	EU-28
Chapter 7 - Mobility and international attractiveness				

Indicators	Data source(s)	Update available[189]	Latest year available	EU coverage
Foreign (non-EU) doctoral candidates (ISCED 6) in the EU-27 by the top 30 countries of origin, 2011	UNESCO OECD Eurostat education survey	Yes	2011	EU-27
Non-EU doctoral candidates as a percentage of all doctoral candidates, Europe, 2011	Eurostat/Innovation Union Scoreboard 2014	Yes	2011	EU-27
Doctoral candidates (ISCED 6) with a citizenship of another EU-27 Member State, Europe, 2008 and 2011 (%)	EUROSTAT OECD UNESCO survey	Yes	2011	EU-27
Researchers (post-PhD) having spent a period of at least three months as a researcher in another country in the last 10 years, Europe, 2012 (%)	MORE2 study	No	2012	EU-27
Differences in gender for researchers (post-PhD) having spent a period of at least three months as researchers in another country in the last 10 years, Europe, 2012 (%)	MORE2 study	No	2012	EU-27
Factors motivating EU researchers (post-PhD) to spend a period of at least three months as researchers in another country in the last 10 years, EU-27, 2012 (%)	MORE2 study	No	2012	EU-27
Factors motivating EU researchers (post-PhD) to spend a period of at least three months as researchers in another country in the last 10 years, by career stages, EU-27, 2012 (%)	MORE2 study	No	2012	EU-27
Importance of barriers as reasons for international non-mobility in post-PhD career, EU-27, 2012 (%)	MORE2 study	No	2012	EU-27
International scientific co-publications per million population, Europe, US, Japan and China, 2012	Science-Metrix/ Scopus/Innovation Union Scoreboard 2014	Yes	2012	EU-28
Scientific publications in the top 10% most-cited publications worldwide as a percentage of all scientific publications, Europe, US, Japan and China, 2009 (%)	Science-Metrix/Scopus /Innovation Union Scoreboard 2014	Yes	2009	EU-28
Main producers of scientific publications, EU, 2000 and 2008	Innovation Union Competitiveness Report 2011	No	2008	EU-27
Co-publications with an author from another EU-27 Member State by five main partners in Europe, other countries, 2010 (%)	Science-Metrix/Scopus	No	2010	EU-27
Scientific publications in the top 10% most-cited publications by sector, Europe, US and Asia (Japan, China, Republic of Korea and India)	Science-Metrix	New	2008	EU-27
Scientific collaboration pattern for all scientific priorities in Europe, other countries, 2000-2011	Science-Metrix using Scopus	New	2011	EU-27
Composite indicator of research excellence, Europe, 2007 and 2012	JRC calculations using data from Science-Metrix (highly cited publications), OECD (PCT patent applications), CWTS Leiden Ranking (world class universities) and Scimago (research institutes), and	New	2012	EU-28

Indicators	Data source(s)	Update available[189]	Latest year available	EU coverage
	ERC/DG RTD CORDIS (ERC grants data). Population and R&D data are from Eurostat and OECD, GDP data from World Bank World Development Indicators			
Composite indicator for researcher excellence, Europe, US, China, Japan, Republic of Korea, India and Brazil, 2007 and 2012	JRC calculations using data from Science-Metrix (highly cited publications), OECD (PCT patent applications), CWTS Leiden Ranking (world class universities) and Scimago (research institutes), and ERC/DG RTD CORDIS (ERC grants data). Population and R&D data are from Eurostat and OECD, GDP data from World Bank World Development Indicators	New	2012	EU-28

Source: Deloitte

13.2 Sources of indicators and years of reference

Timing

The *Researchers' Report 2014* presents the most recent data to monitor the reseacher profession in Europe with a cut-off date of end of March 2014. It refers to a number of studies and combines several data sets in order to present a comprehensive and complete picture of the research profession in Europe. It is based on an update by the countries in scope of this report provided during this year's reporting exercise during which the countries updated their country profiles with new information.

Qualitative data

Deloitte collected and analysed a wealth of qualitative data for the production of the *Researchers' Report 2014* (for a full list, see "Desk research literature" below) and conducted a number of stakeholder interviews (in 2011-2012) to gain a deeper understanding of the subject matter.

In order to fill possible information gaps for the production of the report, Deloitte drew up a comprehensive questionnaire which was completed by the majority of countries' delegates of the ERA Steering Group on Human Resources and Mobility (SGHRM). The questionnaire also served as a means for the identification and selection of Good Practices (a separate Annex to this report). A literature review complemented the collection and analysis of the qualitative data. Also, for the 2014 edition of the *Researchers' Report*, the countries were asked to provide new information in each of the monitoring categories. All responses were carefully analysed and are reflected in the *Researchers' Report 2014*.

Quantitative data

The report draws upon quantitative data from several sources, including Eurostat Statistics, and other internationally-recognised sources such as OECD. In addition, it makes reference to a range of recent studies related to the research profession. For example:

- European Commission (2011), "Innovation Union Competitiveness Report", 2011 edition, EUR 24211;
- European Commission (2014), "Innovation Union Competitiveness Report, 2013 edition, EUR 25650;
- European Commission (2012), "Innovation Union Scoreboard 2011", Brussels;
- European Commission (2013), "Innovation Union Scoreboard 2013", Brussels;
- European Commission (2014), "Innovation Union Scoreboard 2014", Brussels;
- Idea Consult (2010), "Study on mobility patterns and career paths of EU researchers", April 2010;
- Idea Consult (2013), "Support for continued data collection and analysis concerning mobility patterns and career paths of researchers, February 2013;
- European Commission (2009), "Feasibility Study for Creating a European University Data Collection";
- European Commission (2013), "SHE Figures 2012. Gender in Research and Innovation";
- Science-Metrix/Scopus, European Commission (2010).

Data limitation

The variety of data sources is useful for describing and qualifying a complex phenomenon such as the research profession. However, the usage of various data sources has certain drawbacks:

- Availability of comparable data for 38 countries: Many studies and Eurostat databases do not always cover all countries. As a result, a comparison of countries across all indicators may not be possible;
- Since Croatia joined the EU on 1 July 2013, not all EU averages have been adapted yet; some still present the EU average for 27 countries only. EU-27 and EU-28 are, of course, not strictly comparable, but the distortion from the addition of Croatia is not considered statistically significant;
- Variety of dates: some data are only available for 2007, 2008, 2009 or 2010 as the latest year available while others were collected only once (see for example the MORE survey[190], MORE2 study[191] WiS database/SHE figures[192] or EUMIDA[193]);
- Data methodology: The data collection method and treatment of data differ according to the source. Consequently, the sampling method (for representativeness of the researcher population) or data treatment (for exploitation) differ. Data sets used in this report were scrutinised on the basis of the methodology to ensure a sound interpretation of data.

13.3 Desk research literature

Academic Cooperation Association (2011), "Mapping mobility in European higher education. Volume I: Overview and trends", Eds. Ulrich Teichler, Irina Ferencz and Bernd Wächter, a study produced for the Directorate General for Education and Culture (DG EAC), of the European Commission, CONTRACT – 2009-3287/001-001 ERA-SHEPDE, Brussels, June 2011

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David, A. Paul and Metcalfe, Stan (2007), "Universities and Public Research Organisations in the ERA. Fulfilling universities' critical societal roles in the advancement of knowledge and the support of sustained innovation-driven economic growth in Europe", third draft of the report, prepared for the 8th June 2007 Brussels Meeting of the EC (DG-Research) Expert Group on Knowledge and Growth

EUROHORCs – European Heads of Research Councils (2009), "Creating the European Research Area (ERA): A bottom-up approach. Cross-border Research Cooperation in Europe -Contributions from National Research Organisations", June 2009, Bern

European Commission (2006), "Mobility of Researchers between Academia and Industry: 12 Practical Recommendations", EUR 22573, Brussels

[190] Idea Consult (2010)
[191] Idea Consult (2013)
[192] European Commission (2013), "She Figures 2012. Gender in Research and Innovation", Brussels
[193] European Commission (2009), "Feasibility Study for Creating a European University Data Collection"

European Commission (2006), “Creating an Innovative Europe”, report of the Independent Expert Group on R&D and Innovation appointed following the Hampton Court Summit and chaired by Mr. Esko Aho, Brussels, January 2006

European Commission (2007), “ERAWATCH: Collection and analysis of existing data on Researchers Careers (RESCAR) and implementation of new data collection activities”, JRC Institute for Prospective Technological Studies (IPTS), Brussels

European Commission (2008), “RINDICATE: Evidence on the main factors inhibiting mobility and career development of researcher”, Final Report, Contract DG-RTD-2005-M-02-01, Multiple Framework Service Contract for Expert Support with the Production and Analysis of R&D Policy Indicators, report by IDEA Consult, FRAUNHOFER-ISI, NIFU STEP, PREST, SPRU, TECHNOPOLIS, Brussels

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13.4 Country abbreviations

The study aims to provide a reliable, complete and up-to-date picture of the research profession in 38 countries[194].

Table 40: Country abbreviations

Countries monitored	'Regions' monitored
Austria - AT	European Union 27 – EU-27
Belgium – BE	European Union 28 – EU-28
Bosnia and Herzegovina – BiH	China – CN
Bulgaria – BG	Japan – JP
Croatia - HR	United States – US
Cyprus – CY	
Czech Republic - CZ	
Denmark – DK	
Estonia – EE	
Finland - FI	
France - FR	
Germany – DE	
Greece - EL	
Hungary – HU	
Iceland – IS	
Ireland - IE	
Israel - IL	
Italy – IT	
Latvia – LV	
Liechtenstein - LI	
Lithuania - LT	
Luxembourg – LU	
Former Yugoslav Republic of Macedonia - FYROM	
Malta – MT	
Montenegro - ME	
Netherlands - NL	
Norway – NO	
Poland – PL	
Portugal - PT	
Romania - RO	
Serbia - SR	
Slovak Republic – SK	
Slovenia – SI	
Spain – ES	

[194] EU-28 and countries associated to the Seventh Framework Programme for research and technological development: Norway, Iceland, Liechtenstein, Switzerland, Israel, Turkey, the Former Yugoslav Republic of Macedonia (FYROM), Serbia, Montenegro and Bosnia & Herzegovina.

Countries monitored	'Regions' monitored
Sweden - SE	
Switzerland - CH	
Turkey – TR	
United Kingdom – UK	