EUROPEAN COMMISSION

DG Research and Innovation

Researchers' Report 2012

Deloitte.

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

French and German versions of the report will shortly be available.

Acknowledgements

The Researchers Report 2012 was prepared by Deloitte under the leadership of Richard Doherty and Luc Chalsège, and with the support of Benoît Vandresse, Michael Ulrich, Vilma Zotou and two external experts Marion Bywater and Emmanuel Boudard. The production of this report would not have been possible without the continuous efforts and valuable input of many other people involved in the project. The authors would like to express their deep gratitude to all who have contributed to the production of this report.

We would like to thank especially:

- The members of the ERA Steering Group on Human Resources and Mobility (SGHRM) for their cooperation and valuable contributions;
- The members of the SGHRM Working Group on Monitoring and Indicators for their valuable analytical and statistical contributions;
- Our contacts at the European Commission, Directorate-General for Research and Innovation, Unit B2 Skills, and especially Peter Whitten and Peter van der Hijden for their continuous support and critical advice.

Table of contents

Table of figures

Table of tables

Executive summary

Introduction

Europe needs more researchers if it is to meet its target of devoting 3% of GDP to R&D by 2020, to keep up with its main economic competitors and thus to be a knowledge-based economy. Recent estimates indicate that a net increase of one million researchers is needed over this decade, an increase of more than 60%.

Achieving these goals implies that women have equal opportunities, working conditions are attractive and that recruitment is open and merit-based. It is also critical that cross-border mobility is facilitated, that young people see research as an attractive career, that Europe is an internationally attractive place to study and work for both Europeans and others, and therefore offers quality doctoral and post-doctoral training. Optimising European research also means increasing the number of researchers in the private sector and greater movement between the public and private sector – in both directions, rather than largely from public to private as at present.

The Researchers Report

The 2012 *Researchers Report* prepared by Deloitte Consulting for the European Commission's Directorate-General for Research and Innovation looks at the extent to which those prerequisites are already met, since a full understanding of the researcher profession in its complexity is indispensable for sound decision and policy-making.

The report focuses in particular on indicators which relate to Innovation Union Commitments Nos 1, 4 and 30[1]. These cover research training and employment conditions, removal of obstacles to mobility and cross-border cooperation, and ensuring that leading academics, researchers and innovators reside and work in Europe and attracting a sufficient number of highly skilled third country nationals to stay in Europe.

The Report establishes the baseline for annual updates and for monitoring the European Research Area (ERA). It is based on qualitative and quantitative data. It also provides the basis for further analysis on the observed correlation between a lower degree of openness in terms of some of the indicators for the research profession used in this report and low performance on the Innovation Union Scoreboard[2], and for identifying clusters of low-performing countries.

The qualitative data comes primarily from the answers to a questionnaire sent to the 38 countries covered by the Report, i.e. the EU-27 and the countries with associate status in the Seventh Framework Programme. This was supplemented by desk research. The quantitative data comes from a variety of official sources and earlier studies for DG Research and Innovation.

The Report as such is complemented by Issue Sheets, which can be read stand-alone or as an introduction to the chapters in the report, by data Annexes, and by detailed Country Files of around 10-15 pages and by 49 examples of Good Practice.

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

[2] Available at: http://ec.europa.eu/enterprise/policies/innovation/files/ius-2011_en.pdf

All are presented in accordance with the same seven themes:

- The stock of researchers in Europe
- Women in the research profession
- Open, transparent and merit-based recruitment
- Education and training
- Working conditions
- Collaboration between academia and industry
- Mobility and international attractiveness.

The Issue Sheets, the report, the Country Files and the Good Practice examples are complemented by scorecards which provide a quick visual presentation of where countries stand in relation to the main themes.

Each chapter of this 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. The data often highlights 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 many new Member States have to make up in many (but by no means all) categories.

The issues

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

Stock of researchers: While Europe has many talented and skilled researchers, their number as a share of the labour force is nearly 50% higher in the US and 60% more in Japan. Moreover, both countries have more than one-and-a half times as many researchers per thousand in the private sector than does the EU. Closing these gaps will be one of the main challenges facing European education, research and innovation systems in the years ahead.

Member States and Associated Countries have reported a range of measures aimed at ensuring they train enough researchers to meet their national R&D targets in their respective countries: National Action Plans, programmes, strategies and legislative acts. In many cases, it is too early to measure the direct or indirect impact of these measures. A key step will be to move from addressing aspects of human resources in the research profession by means of a single (national) strategy, whereas the tendency at present is to have issues-based policies and action plans, which do not necessarily form a coherent whole.

Women in the research profession: Women still face a glass ceiling. They outnumber men at the first two levels of tertiary education, but are less likely to take a PhD, to occupy a senior academic position, or to sit on decision-making bodies – they are even less likely to head a higher education institution: women account for only 13% of the total. And there is still a pay gap.

Working conditions are often still not gender-neutral by failing, for example, to make adequate provision to safeguard the research posts and projects of women during maternity leave or to facilitate ‘dual career’ opportunities for men and women researchers who are life partners. Gender stereotypes remain and women still do not have the same access to research networks or

encouragement to become researchers as do men. The European Research Area cannot fulfil its potential if the remaining gender imbalances are not better addressed.

Open, transparent and merit-based recruitment procedures: High academic performance and teaching excellence are the result of optimal allocation of human resources. That presupposes recruitment based on merit and academic excellence from the very earliest stages and throughout a research career. That recruitment must also be seen to be fair, i.e. it must be transparent. But while the vast majority of national authorities consider the recruitment system in their countries to be largely fair and transparent, researchers see this very differently.

There is more progress to be made in advertising positions more widely, e.g. through EURAXESS jobs. Currently there is a ratio of more than 100 to 1 between the country with the best record on publication relative to public sector opportunities and those with the worst. It is also important to do more to ensure that selection processes are transparent, that unsuccessful candidates are able to obtain feedback and/or appeal against selection decisions. Unwillingness to make public sector research opportunities open to nationals of other countries is still an issue in a number of countries.

Education and training: The first step in increasing the stock of researchers is to ensure that enough young people study science. Progress is being made: the rate at which the EU-27 has been increasing the number of tertiary graduates in Science, Technology, Engineering and Mathematics (STEM) and the number of women graduating in these subjects has been increasing faster than in the US and Japan. Nevertheless, the number per thousand is still below the figure for both these countries.

If tertiary graduates are to go on to take doctorates, then Europe's educational institutions need to offer high-quality doctoral training. If the most is to be made of the researchers subsequently, then there needs to be greater osmosis between academia and the world of business to ensure that Europe has an environment of open innovation where research results are commercialised and ideas are exploited.

Much has been done in many countries in all these areas. There are mentoring programmes, science communication action plans, implementation of the Principles for Innovative Doctoral Training[3] and programmes to provide post-doctoral career paths in business and to encourage academia-industry partnerships in line with the Charter and Code[4]. However, the picture is varied across Europe and additional efforts are needed.

Working conditions: It is self-evident that working conditions are important in making any career attractive, but research careers present a particular challenge, since many researchers work on fixed-term projects or indeed have no contract at all, as is the case for many doctoral candidates. These offer uncertain career paths and either do not provide any social security provision or this provision is not on a par in terms of health, and in particular maternity, unemployment and old-age benefits with what is available to those on permanent contracts.

[3] Available at: http://ec.europa.eu/euraxess/pdf/research_policies/Principles_for_Innovative_Doctoral_Training.pdf
[4] European Charter for Researchers and Code of Conduct for the recruitment of researchers.

Combined in many case with poor remuneration, uncertain funding for public sector research entities, and insufficient cooperation with the private sector in many cases, this makes research careers in the public sector in Europe relatively unattractive. More still needs to be done to encourage life-long learning, e.g. via dedicated career programmes, and to improve working conditions by applying the principles for the European Charter for Researchers and the Code of Conduct for the Recruitment of Researchers[5].

Collaboration between academia and industry: There is a striking difference between the extent to which researchers in Europe are employed in the private or the public sector compared to the US and Japan. In Europe, only 44% are in the private sector, in the US, the figure is 80%, in Japan, it is 74%. There is not necessarily an optimal figure, but what is critical and where Europe often appears to fall short compared to these competitors is in collaboration between research, education and innovation, i.e. mobility across all sectors and the translation of research results into applications which will stimulate growth and jobs.

Figures for cross-sector scientific co-publication per million inhabitants are considerably higher in the US and Japan than in the EU, for example. Cross-sectoral mobility is also low in the EU. Researchers that do move tend to do so from the public sector to the private sector, but the flow in the other direction is marginal, as is any flow back and forth.

Moreover, an environment of open innovation presupposes equipping researchers with the requisite skills to operate as entrepreneurs, e.g. an understanding of industrial property rules and knowledge transfer principles, but a recent survey indicates that less than a quarter of EU researchers are currently equipped in this way despite the efforts in many countries to boost partnerships between universities, research institutions and private companies.

Mobility and international attractiveness: Mobility is a core concept of the European Research Area. This in turn is fundamental to the EU's Growth and Jobs Strategy and Vision for 2020, which aims to improve the dynamism and competitiveness of the EU economy. Mobility is strongly 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.

Levels of mobility are already relatively high since more than half the EU's researchers have spent three months in another country at least once in their career and more than one quarter have been mobile on this definition within the last three years. Furthermore, nearly one quarter of the doctoral candidates in the EU are from another country. Nevertheless, US public research institutions appear more attractive on a number of indicators to which researchers may look. For example, the US outranks the EU in the production of international scientific co-publications and scientific publications in the top 10% most-cited publications worldwide, and the country of residence of Nobel Prize winners. Researchers asked to compare the US and EU reported that working as a

[5] Available at: http://ec.europa.eu/euraxess/index.cfm/rights/europeanCharter

researcher in the US gave, among other things, better opportunities to collaborate with top-class researchers, better funding opportunities and more attractive remuneration packages[6].

Moreover, despite a number of programmes which have been put in place in Europe to promote mobility, there are still significant barriers to mobility. These range from administrative procedures (despite the existence of the scientific visa) to a recruitment system which is insufficiently transparent, open and merit-based, and the fact that grants are often not portable across frontiers.

Conclusion

This report provides a stocktaking of different dimensions of the researcher profession and the countries' measures to address them. It tries to highlight the key issues. It is necessarily a snapshot of what is a dynamic process. However, it is clear from the description of the measures in place or planned that the Member States are generally not standing still, but taking steps to meet the objectives of the Innovation Union and to the fundamental concepts of the European Research Area of opening up and connecting national research systems.

[6] MORE study available at http://ec.europa.eu/euraxess/index.cfm/general/researchPolicies

Introduction

Background

Well trained, creative and dynamic researchers are indispensable for building and sustaining a competitive knowledge-based economy. 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[7]. A full understanding of the researcher profession in its complexity is crucial for sound decision and policy-making.

Deloitte has received a mandate from the European Commission, DG Research & Innovation, to produce an annual integrated report on the research profession in Europe (*The Researchers Report*). The study aims at providing a reliable, complete and up-to-date picture of the research profession in 38 countries[8] (subsequently 'the countries'), taking into account country-specific (policy) contexts.

The report monitors the countries' progress towards realising the Europe 2020 Flagship Initiative "Innovation Union" [9] to improve conditions and access to finance for research and innovation, and to ensure that innovative ideas can be turned into products and services that create growth and jobs. According to recent estimates, 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[10].

Monitoring categories

The report takes stock of different dimensions of the researcher profession in Europe based on a set of reliable indicators[11]. The findings are supported by the most recently available statistical data and factual information offered by the countries' governments in response to a detailed questionnaire on issues within the scope of this report. Both sources of information provide the baseline material for the 2012 *Researchers Report*, and will subsequently serve as the basis for the 2013 and 2014 reports, respectively.

The report relates to Innovation Union Commitments Nos. 1[12], 4[13] and 30[14]. These set out objectives for Member States in the context of human resource policies and practices in research. In order to

[7] See for example: European Commission (2004a)

[8] EU-27 and countries associated to the Seventh Framework Programme for research and technological development: Norway, Iceland, Liechtenstein, Switzerland, Israel, Turkey, Croatia, the Former Yugoslav Republic of Macedonia, Serbia, Montenegro and Bosnia & Herzegovina.

[9] European Commission (2010a)

[10] Ibid

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

[12] "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)

[13] "In 2012, the Commission will propose a European Research Area framework and supporting measures to remove obstacles to mobility and to foster cross-border cooperation, aiming for them to be in force by end 2014. They will notably seek to ensure through a common approach:

- Quality of doctoral training, attractive employment conditions and gender balance in research careers;
- Mobility of researchers across countries and sectors, including through open recruitment in public research institutions and comparable research career structures and by facilitating the creation of European supplementary pension funds" (ibid).

provide a comprehensive picture of the research profession in Europe, the focus lies 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 addresses the countries' measures in response to a growing demand for top-level researchers;
2. **"Women in the researcher 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 and discusses the discrepancy between public authorities' and stakeholders' 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;
5. **"Working conditions in the researcher profession"** (Chapter 5): presents the most recent data on working conditions (employment contracts, remuneration and career prospects) in Europe as well as national measures to provide sufficient 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 also offers an overview of countries' measures to boost partnerships between universities, research institutions and private companies;
7. **"Mobility and international attractiveness"** (Chapter 7): presents the most recent figures on researchers' mobility (inward, outward and cross-sectoral) and discusses different factors influencing researchers' mobility such as career progression and personal/family factors. The chapter also provides information on the attractiveness of European countries and institutions by means of a number of useful indicators.

Definition of researchers

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"[15]. Furthermore, all doctoral candidates are considered to be researchers.

[14] "By 2012, the European Union and its Member States should put into place integrated policies to ensure that leading academics, researchers and innovators reside and work in Europe and to attract a sufficient number of highly skilled third country nationals to stay in Europe" (ibid).

[15] Frascati Manual (OECD 2002)

Annexes to the report

The 2012 *Researchers Report* is composed of the main report and a set of accompanying annexes:

1. **Country Files**: The 38 country files provide an overview of countries' measures in response to the Innovation Union Commitments Nos. 1, 4 and 30[16]. The information is grouped and presented in accordance with the chapters featured in the 2012 Researchers Report. It is based on the following sources:
   - The countries' individual responses to the Deloitte questionnaire (2011);
   - A number of key indicators;
   - Additional secondary sources.
2. **Issue Sheets**: Each chapter of the 2012 *Researchers Report* is accompanied by an Issue Sheet, providing a) a short introduction into the topic and b) a summary of the main findings per chapter. The Issue Sheets are presented in accordance with the individual chapters of the report. Each Issue Sheet is limited to a length of one to two pages to ensure readability. It can be used as a stand-alone document or in conjunction with the 2012 *Researchers Report*;
3. **Scorecards:** The multi-coloured scorecards allow for quick visualisation of the countries' individual progress between two different dates for a number of key indicators. 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. The scorecards presented in the scope of this report reflect progress (or the lack thereof) between two dates for each of the indicators. Scorecards serve as a means of monitoring progress (or the lack thereof) between different dates by showing if the value of an indicator has increased, decreased or remained stable;
4. **Good Practices:** For the purpose of this report, a Good Practice is defined as a measure and/or policy representing the most effective way of achieving a specific objective. To be considered a Good Practice, a measure and/or policy must be:
   - Well developed, implemented, and evaluated;
   - Successful (showing positive results in relation to a specific objective);
   - Verifiable (showing evidence of effectiveness and/or success achieved);
   - Have a possible multiplier effect or potential for transferability to other (policy) areas.

   In the framework of the 2012 Deloitte questionnaire, Deloitte asked the members of the ERA Steering Group on Human Resources and Mobility (SGHRM) to identify up to five Good Practice examples in a standardised format in a number of pre-defined categories. Deloitte received in total 70 Good Practices, covering all monitoring categories requested in the questionnaire.

   For the purpose of the 2012 *Researchers Report*, Deloitte selected 49 Good Practices, taking into account:
   - National context;
   - Geographical distribution;
   - Maturity of the country in the research profession; and
   - Potential exploitation of the example (application to other countries and contexts).

   The Good Practices are grouped and presented according to the topics of the 2012 *Researchers Report*.

[16] The 2012 *Researchers Report* and all its accompanying Annexes present information with a cut-off date of December 2011.

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 is lagging behind its main competitors in the share of researchers in the total labour force. In 2009, this stood at 6.63 per 1000, compared to 9.4 in the US and 10.32 in Japan. The Nordic countries and France do relatively better;
- In absolute terms, there were 1.58 million full time equivalent (FTE) researchers in the EU-27 in 2009 compared to 1.46 million in the United States, 0.68 million in Japan and 1.6 million in China. Between 2000 and 2009, the stock of researchers in the EU grew by an annual average of almost 4%. This was faster than in the US and Japan, but slower than in China.

The stock of researchers in the business sector:

- In the EU-27, less than half of the researchers (44%) work in the business sector, and 56% in the public sector. The share of researchers employed by the business sector is much higher, e.g. 80% in the United States, 74% in Japan and 68% in China;
- There were 2.94 full time equivalent researchers in the business sector per thousand active labour force in the EU-27 in 2009 compared to 7.51 in the US, 7.67 in Japan and 1.37 in China;
- The number of researchers in the business sector (FTE) per thousand active labour force is highest (>6) in a number of the Nordic countries (e.g. Finland, Denmark and Iceland) and lowest (<1) in some of the new Member States such as Latvia, Bulgaria, Poland, Slovakia, Romania and Lithuania.

Countries' measures to increase the stock of researchers:

- Member States and Associated Countries[17] have reported a range of measures aimed at ensuring they train enough researchers to meet their national R&D targets in their respective countries: National Action Plans, programmes, strategies and legislative acts. In many cases, however, it is too early to measure the direct or indirect impact of these measures;
- Member States and Associated Countries have established a number of awareness schemes to raise young people's interest in science and research in general. Dedicated programmes aim to make pursuing a researcher career attractive to specific groups, such as schoolchildren – and in particular girls. Member States have also set up measures to improve the quality and relevance of doctoral training[18].

1.2 Introduction

Well trained, creative and dynamic researchers are indispensable for building and sustaining a competitive knowledge-based economy. As the core producers of new knowledge and main agents in its transfer and exploitation, researchers and the institutions in which they perform research

[17] Countries associated with the Seventh Framework Programme for research and technological development: Norway, Iceland, Liechtenstein, Switzerland, Israel, Turkey, Croatia, the Former Yugoslav Republic of Macedonia, Serbia, Albania and Montenegro and Bosnia and Herzegovina.

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

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[19].

Europe hosts a large pool of talented and skilled researchers. However, their stock as a share of the active 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 in order to sustain Europe's position as a global economic leader. Recent estimates suggest that an additional one million researchers may be needed in Europe by 2020 to meet an R&D intensity target of 3% GDP[20]. The number of researchers required is significantly higher, as many researchers will retire over the next decade[21]. 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[22].

In order to remain competitive, Europe must invest in generating a sufficiently large pool of skilled human resources for research and innovation. From this backdrop, the Europe 2020 Flagship Initiative "Innovation Union"[23] called for Member States to put in place strategies by the end of 2011 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 Europe. First, it offers an overview of the key indicators showing the stock of researchers in Europe. Second, it discusses the state of play and evolution of the stock of researchers in Europe and in comparison with its main trading partners United States, China and Japan. It presents data on head counts, full time equivalents and the proportion of researchers in the business and public sector. Third, it provides an overview of the countries' measures aimed at training enough researchers to meet their national R&D targets.

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.

Figure 1: The stock of researchers in Europe - Key indicators

Indicators	Data source(s)	Year(s) of reference
Researchers (Full Time Equivalent), EU-27, US, China, Japan, 2000 and 2009 (in million)	Eurostat	2000, 2009
Researchers (Full Time Equivalent) per thousand active labour force,	Eurostat	2000, 2009

[19] See for example: European Commission (2004a)

[20] According to recent estimates, achieving the target of spending3% 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).

[21] This estimation does not include the additional need of researchers to substitute those leaving their employment for retirement.

[22] European Commission (2011a)

[23] European Commission (2010a)

Indicators	Data source(s)	Year(s) of reference
EU-27, US, China, Japan, 2000 and 2009		
Researchers (Full Time Equivalent) per thousand active labour force, Europe, 2000 and 2009	Eurostat	2000, 2009
Researchers (Full Time Equivalent) working in the business and public sector (in million), EU-27, US, China, Japan, 2009	Eurostat	2009
Researchers (Full Time Equivalent) by sector, EU- 27, 2000-2009 (in million)	Eurostat	2009
Share of Full Time Equivalent (FTE) researchers working in the business sector (as % of all researchers), EU-27, US, China, Japan, 2009	Eurostat	2009
Researchers in the business sector (Full Time Equivalent) per thousand active labour force, EU-27, US, China, Japan, 2000 and 2009	Eurostat	2000, 2009
Researchers in the business sector (Full Time Equivalent) per thousand active labour force, Europe, 2000 and 2009	Eurostat	2000, 2009
Researchers in the public sector (Full Time Equivalent) per thousand active labour force, EU-27, US, China, Japan, 2000 and 2009	Eurostat	2000, 2009
Researchers in the public sector (Full Time Equivalent) per thousand active labour force, Europe, 2000 and 2009	Eurostat	2000, 2009

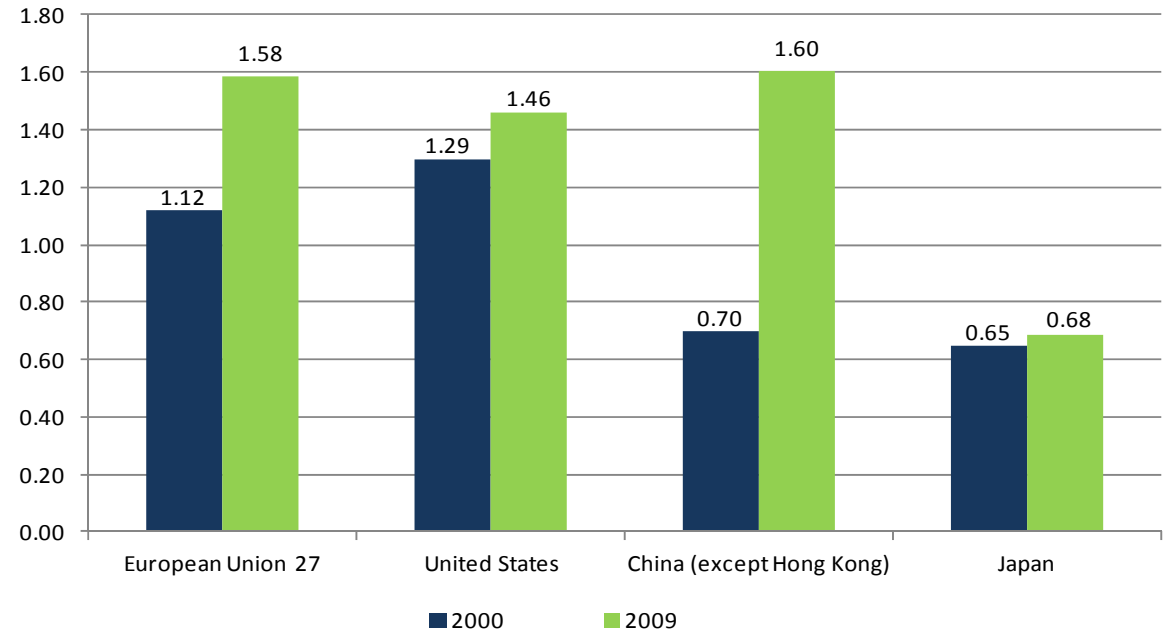
Source: Deloitte

1.4 Human resources in the research profession

In absolute terms, there were 1.58 million full time equivalent (FTE) researchers in the EU-27 in 2009 compared to 1.46 million in the United States, 0.68 million in Japan and 1.6 million in China. Between 2000 and 2009, the stock of researchers in the EU grew by an annual average of almost 4%. This was faster than in the US and Japan, but slower than in China.

Between 2000 and 2009, the stock of EU-27 researchers in FTE increased from 1.12 million to 1.58 million. The respective increase in the United States was from 1.29 million to 1.46 million. In Japan, the number of FTE researchers increased from 0.65 million to 0.68 million. China experienced the biggest increase in the number of researchers in FTE from 0.7 million to 1.6 million.

Figure 2: Researchers (Full Time Equivalent), EU-27, US, China, Japan, 2000 and 2009 (in million)



Source: Deloitte
Data: Eurostat Research and Development survey

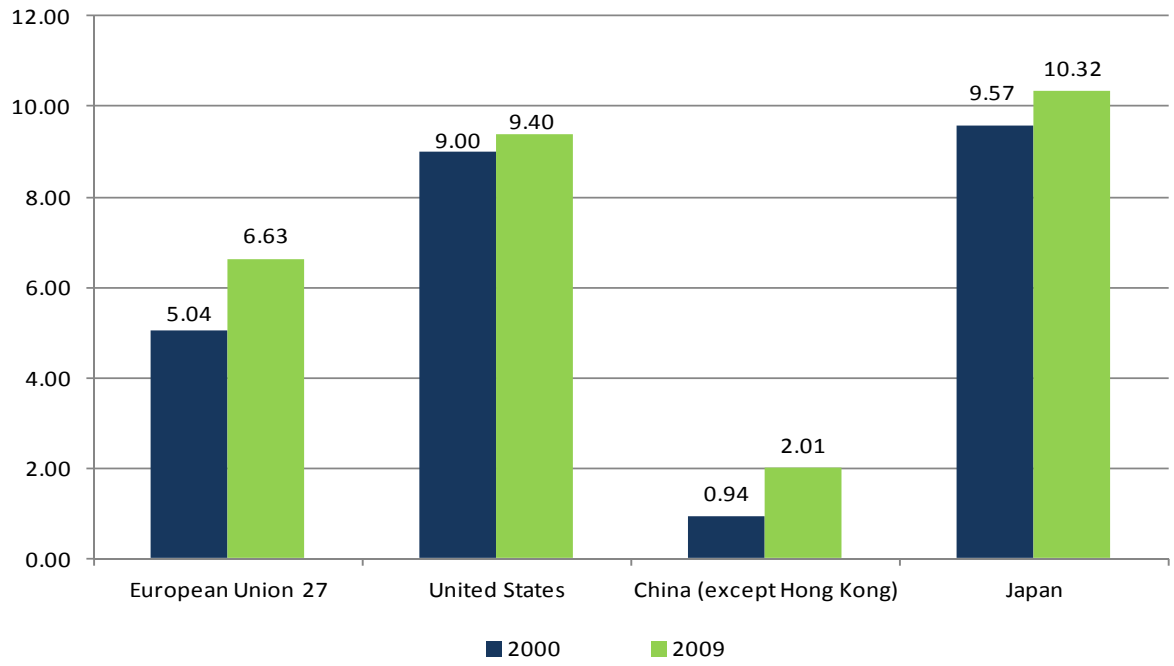
The EU is lagging behind its main competitors in the share of researchers in the total labour force. In 2009, this stood at 6.63 per 1 000, compared to 9.4 in the US and 10.32 in Japan. The Nordic countries and France do relatively better.

The labour force population (referring to the total labour force, which includes both employed and unemployed persons) was about 239 million in the EU-27 in 2009, compared to 155 million in the United States, 66 million in Japan and 780 million in China.

Between 2000 and 2009, the number of researchers (FTE) in relation to the active labour force increased by from 5.04 to 6.63 in the EU-27. The respective increase in the United States was from 9.0 to 9.4. In Japan, the number of FTE researchers per thousand active labour force increased from 9.57 to 10.32 while China reported an increase from 0.94 to 2.01.

Between 2008 and 2009, the number of researchers (FTE) per 1 000 labour force has increased in Europe and Japan by 4%, more than in the US (1%) and has remained relatively stable in China.

Figure 3: Researchers (Full Time Equivalent) per thousand active labour force, EU-27, US, China, Japan, 2000 and 2009

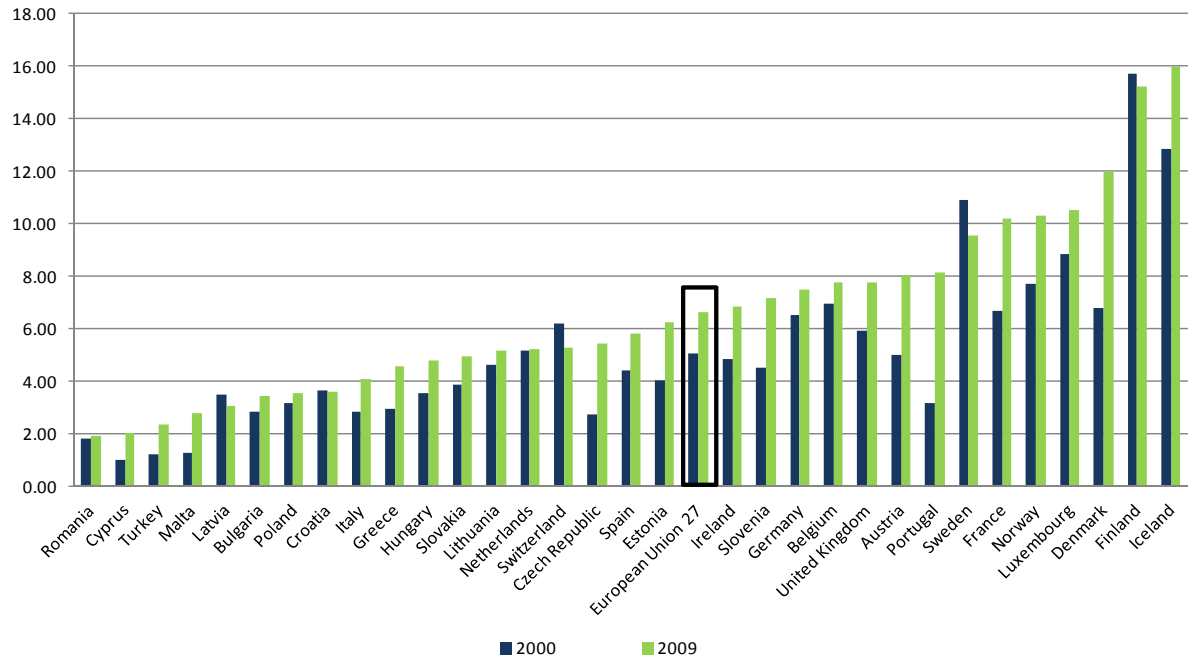


Source: Deloitte
Data: Eurostat Research and Development survey and Eurostat Labour Force survey

Sweden, France and Norway have a higher share of researchers (FTE) per thousand active labour force than the US. Denmark and Finland rank highest with more than ten researchers per thousand active labour force - higher than the US and Japan.

In 2009, the share of researchers per thousand active labour force was highest in the Nordic countries (Finland and Denmark) and lowest in a number of the Eastern European countries such as Romania, Bulgaria and Poland. In 2009, Iceland reported the highest penetration of researchers in the workforce with 16 researchers. Other Scandinavian countries (Finland, Denmark and Norway with around 10 researchers per thousand active labour force) rank among the top five countries together with and France. Romania and Bulgaria as well as the Mediterranean islands report the lowest numbers with three or less researchers per thousand active labour force.

Figure 4: Researchers (Full Time Equivalent) per thousand active labour force, Europe, 2000 and 2009



Source: Deloitte
Data: Eurostat Research and Development survey and Eurostat Labour Force survey

The table below shows the performance of the top seven European countries against the US and Japan in terms of the number of researchers (FTE) per thousand active labour force in 2000 and 2009.

Table 1: Researchers (Full Time Equivalent) per thousand active labour force, Europe, US, Japan, 2000 and 2009 for top performing European countries

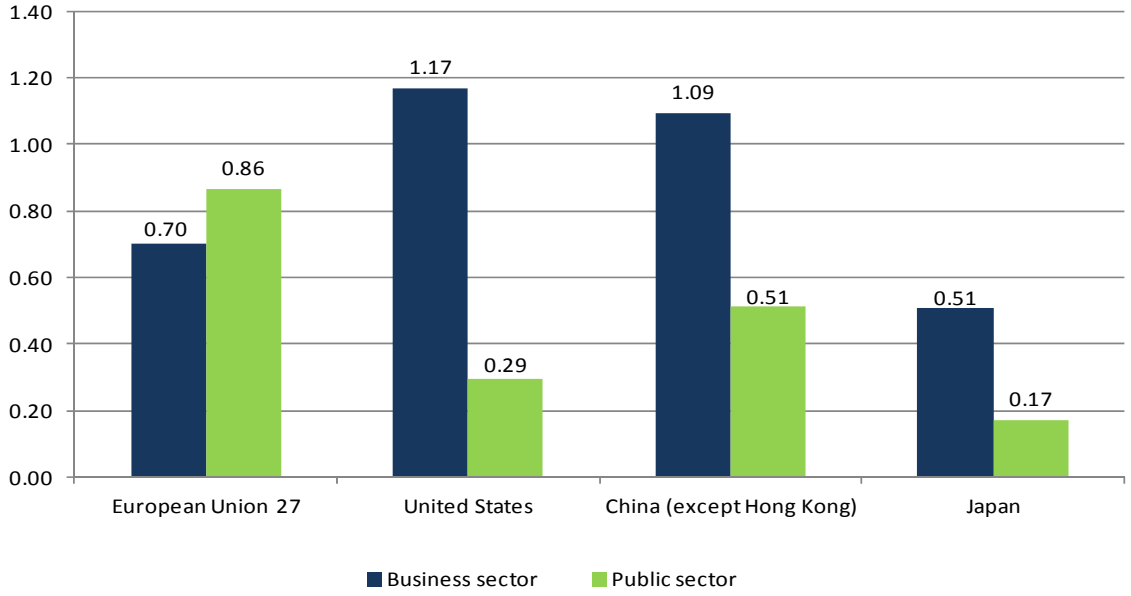
Country	2000	2009
United States	**9.00**	**9.40**
Sweden	10.89	9.53
France	6.69	10.19
Norway	7.73	10.31
Japan	**9.57**	**10.32**
Luxembourg	8.86	10.50
Denmark	6.80	11.96
Finland	15.71	15.25
Iceland	12.85	15.97

Source: Deloitte

The share of researchers employed in the business sector differs significantly between the EU and other major economies. In the EU-27, more than half of the researchers (56%) work in the public sector, and only 44%[24] (700 000) are in the business sector. The share of researchers employed by the business sector is much higher for the EU's main economic competitors, e.g. 1 117 000 (80%) in the United States, 1 109 000 (68%) in China and more than 500 000 (74%) in Japan.

[24] Compared to 46% in 2008 (European Commission, 2011b).

Figure 5: Researchers (Full Time Equivalent) working in the business and public sector (in million), EU-27, US, China, Japan, 2009



Source: Deloitte
Data: Eurostat Research and Development survey

The table below presents the number of researchers (FTE) by sector for the EU-27 for the period 2000-2009.

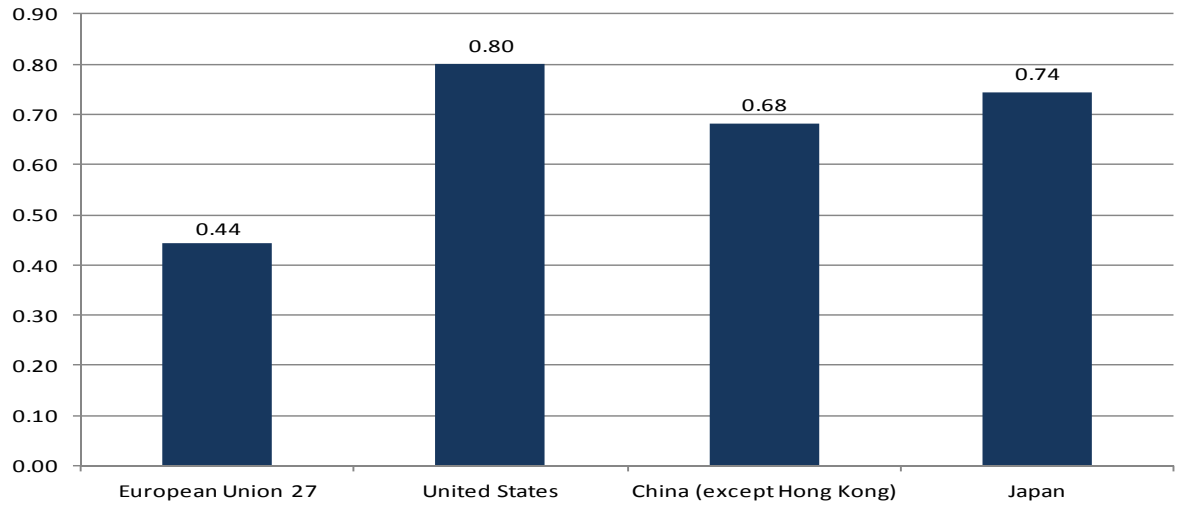
Table 2: Researchers (Full Time Equivalent) by sector, EU- 27, 2000-2009 (in million)

Year	FTE	Business enterprise sector	Government and higher education sectors
2000	1.12	0.52	0.58
2001	1.16	0.55	0.60
2002	1.21	0.57	0.63
2003	1.25	0.58	0.65
2004	1.30	0.60	0.68
2005	1.37	0.63	0.73
2006	1.42	0.65	0.75
2007	1.45	0.67	0.77
2008	1.52	0.70	0.80
2009	1.58	0.70	0.86

Source: Deloitte
Data: Eurostat Research and Development survey

The share of researchers employed in the business sector differs significantly between the EU and other major economies. The structural difference in the sector of employment is a European exception. The share of researchers (FTE) employed by the business sector is much higher within the EU's main economic competitors, e.g. 80% in the United States, 68% in China and 74% in Japan as demonstrated by the figure below.

Figure 6: Share of Full Time Equivalent (FTE) researchers working in the business sector (as % of all researchers), EU-27, US, China, Japan, 2009

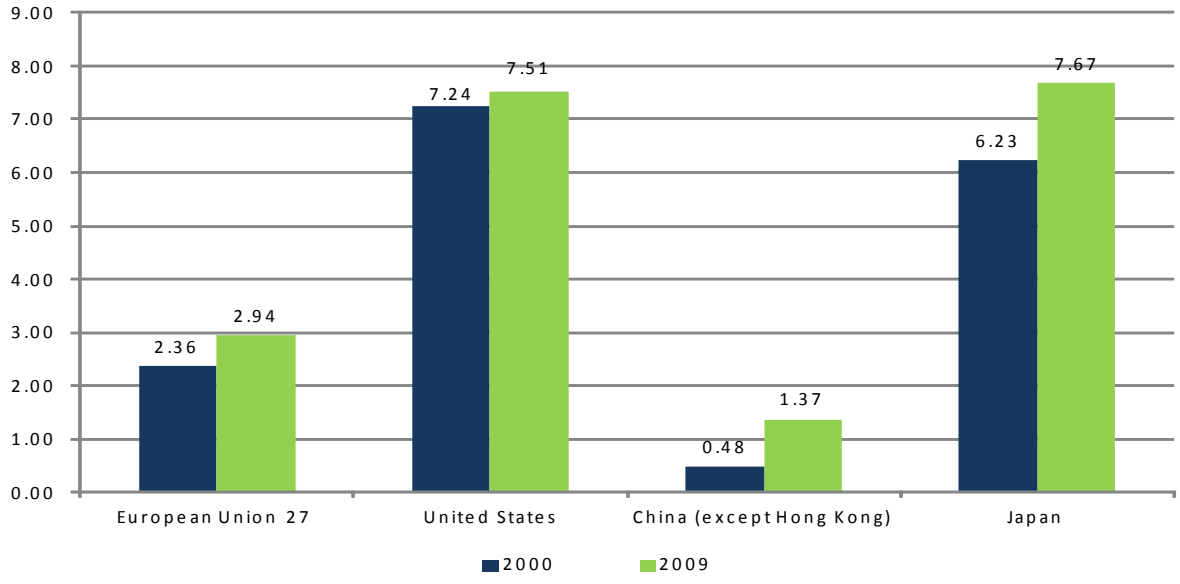


Source: Deloitte
Data: Eurostat Research and Development survey

There were 2.94 full time equivalent researchers in the business sector per thousand active labour force in the EU-27 in 2009 compared to 7.51 in the US, 7.67 in Japan and 1.37 in China.

Between 2000 and 2009, the stock of EU-27 researchers in the business sector per thousand active labour force increased from 2.36 to 2.94. The respective increase in the United States was from 7.24 to 7.51. In China, the number of FTE researchers in the business sector per thousand labour force increased from 0.48 to 1.37. In Japan, the respective increase was from 6.23 to 7.67 in the same period.

Figure 7: Researchers in the business sector (Full Time Equivalent) per thousand active labour force, EU-27, US, China, Japan, 2000 and 2009



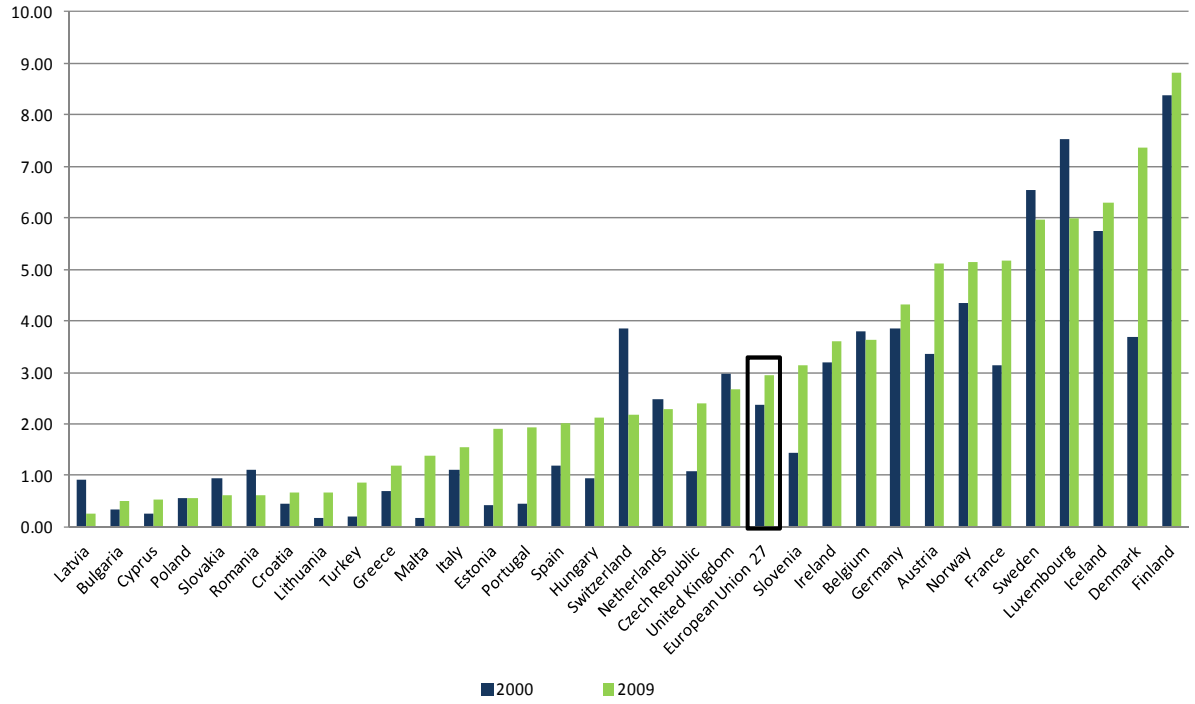
Source: Deloitte

Data: Eurostat

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

Between 2000 and 2009, some European countries more than doubled the number of researchers in the business sector per thousand active labour force: Denmark (+109%), France (+64%) and Austria (+51%). In the same period, the number of researchers in the business sector per thousand active labour force decreased by more than 25% in other countries: Latvia, Romania, Slovakia, Luxembourg and Switzerland.

Figure 8: Researchers in the business sector (Full Time Equivalent) per thousand active labour force, Europe, 2000 and 2009



Source: Deloitte
Data: Eurostat Research and Development survey

Table 3: Researchers in the business sector (Full Time Equivalent) per thousand active labour force, Europe, US, China, Japan 2000 and 2009

Country	2000	2009
Latvia	0.91	0.27
Bulgaria	0.34	0.49
Cyprus	0.25	0.52
Poland	0.57	0.57
Slovakia	0.94	0.61
Romania	1.11	0.62
Croatia	0.44	0.67
Lithuania	0.17	0.67
Turkey	0.19	0.86
Greece	0.70	1.19

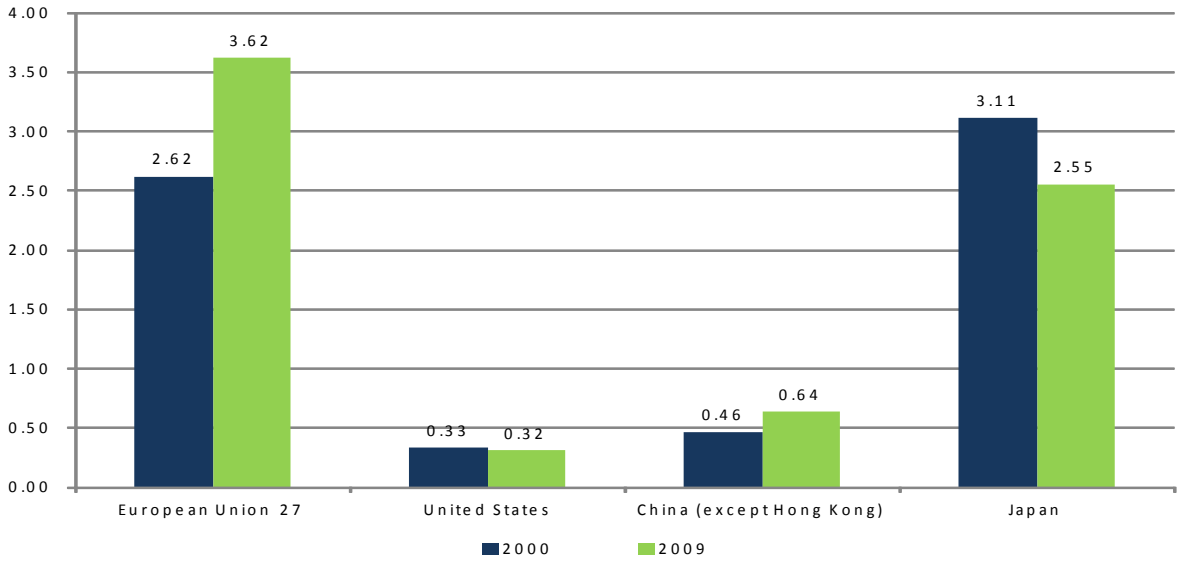
Country	2000	2009
China (except Hong Kong)	**0.48**	**1.37**
Malta	0.17	1.39
Italy	1.11	1.54
Estonia	0.41	1.89
Portugal	0.45	1.92
Spain	1.19	2.00
Hungary	0.95	2.13
Switzerland	3.85	2.17
Netherlands	2.47	2.28
Czech Republic	1.08	2.39
United Kingdom	2.96	2.66
European Union 27	**2.36**	**2.94**
Slovenia	1.43	3.15
Ireland	3.19	3.61
Belgium	3.80	3.63
Germany	3.86	4.32
Austria	3.37	5.10
Norway	4.34	5.14
France	3.15	5.17
Sweden	6.54	5.98
Luxembourg	7.53	5.99
Iceland	5.74	6.28
Denmark	3.69	7.37
United States	**7.24**	**7.51**
Japan	**6.23**	**7.67**
Finland	8.37	8.82

Source: Deloitte
Data: Eurostat Research and Development survey

In 2009, there were 3.62 FTE researchers in the public sector per thousand active labour force in the EU-27 compared to 0.32 in the US, 0.64 in China and 2.55 in Japan.

Between 2000 and 2009, the stock of researchers in the public sector per thousand active labour force increased from 2.62 to 3.62 in the EU-27 and from 0.46 to 0.64 in China. Both the US and Japan recorded a decrease in the number of researchers employed in the public sector per thousand active labour force. The numbers decreased marginally from 0.33 to 0.32 in the US and from 3.11 to 2.55 in Japan.

Figure 9: Researchers in the public sector (Full Time Equivalent) per thousand active labour force, EU-27, US, China, Japan, 2000 and 2009

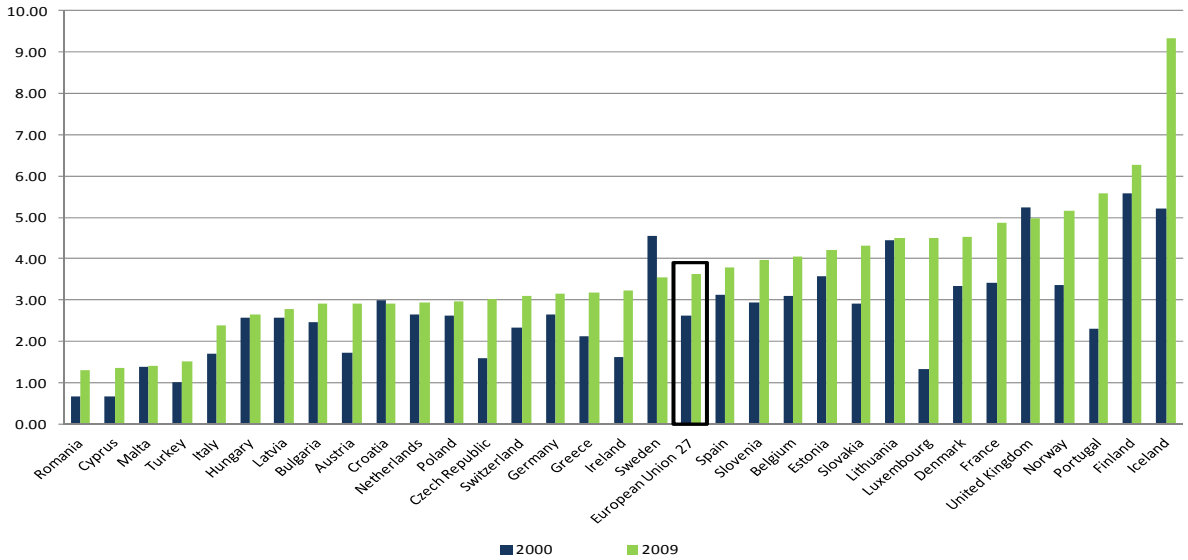


Source: Deloitte

Iceland, Finland, Portugal, Norway and the United Kingdom rank among the top five countries with around five researchers per thousand labour force employed in the public sector. Romania reports the lowest numbers with fewer than two researchers in the public sector per thousand labour force.

Between 2000 and 2009, Luxembourg (+70%) showed the most significant increase in the number of researchers in the public sector per thousand active labour force followed by Portugal (+58%) and Cyprus (+51%). Only three countries reported a decrease in the number of researchers employed in public research institutes in the same period: Sweden (-28%), Croatia (-3%) and the UK (-5%).

Figure 10: Researchers in the public sector (Full Time Equivalent) per thousand active labour force, Europe, 2000 and 2009



Source: Deloitte
Data: Eurostat Research and Development survey

Table 4: Researchers in the public sector (Full Time Equivalent) per thousand active labour force, Europe, US, China, Japan, 2000 and 2009

Country	2000	2009
United States	**0.33**	**0.32**
China (except Hong Kong)	**0.46**	**0.64**
Romania	0.68	1.32
Cyprus	0.67	1.37
Malta	1.38	1.42
Turkey	1.02	1.51
Italy	1.70	2.39
Japan	**3.11**	**2.55**
Hungary	2.57	2.64
Latvia	2.58	2.78
Bulgaria	2.47	2.92
Austria	1.72	2.93
Croatia	3.00	2.93
Netherlands	2.64	2.95
Poland	2.62	2.97
Czech Republic	1.60	3.01
Switzerland	2.33	3.11
Germany	2.64	3.15
Greece	2.12	3.18
Ireland	1.63	3.23
Sweden	4.54	3.54
European Union 27	**2.62**	**3.62**
Spain	3.13	3.79
Slovenia	2.94	3.98
Belgium	3.09	4.06
Estonia	3.57	4.21
Slovakia	2.91	4.33
Lithuania	4.46	4.50
Luxembourg	1.33	4.50
Denmark	3.33	4.52
France	3.41	4.87
United Kingdom	5.23	4.99
Norway	3.36	5.17
Portugal	2.31	5.58
Finland	5.58	6.28
Iceland	5.20	9.33

Source: Deloitte
Data: Eurostat Research and Development survey

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 global level. China has taken the world lead in the number of researchers (FTE), followed by Europe, the United States and Japan. Moreover, Europe is facing an innovation gap as 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 European Research Area "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"[25].

Against this backdrop, the Europe 2020 flagship Initiative "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 a great deal of innovation stems from research performed in higher education establishments and research institutes. More concretely, "by the end of 2011, Member States should have strategies in place to train enough researchers to meet its national R&D targets (...)"[26]. However, according to the 2010 Science and Technology Eurobarometer report[27], two-thirds (66%) of Europeans think that governments are doing too little to stimulate young people's interest in science.

A large number of EU-27 Member States and Associated Countries[28] have reported a range of measures aimed at training enough researchers to meet their national R&D targets in their respective countries. In many cases, however, it is too early to measure the direct or indirect impact of these measures. 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. The countries' measures in response to the Innovation Union Commitments Nos 1, 4 and 30 as a whole aim to increase the stock of researchers in Europe by addressing different dimensions of the researcher profession as discussed in the different chapters in this report.

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 to support women in particular in their career aspirations[29]. Women are the most obvious source of larger numbers of highly trained scientists, engineers and technologists, because this talent pool already exists and can be expanded[30].

National authorities have also put in place different measures to make the recruitment procedures in public research institutions more open, and transparent. Transparent recruitment procedures offer researchers equal opportunities at all stages of a researcher career by granting applicants fair access

[25] European Commission (2010a)
[26] Ibid
[27] European Commission (2010c)
[28] Countries associated to the Seventh Framework Programme for research and technological development: Norway, Iceland and Liechtenstein, Switzerland, Israel, Turkey, Croatia, the Former Yugoslav Republic of Macedonia, Serbia, Albania and Montenegro and Bosnia & Herzegovina.
[29] For information on specific measures to support women in top-level positions, see Chapter 2 "Women in the researcher profession".
[30] European Commission (2004b)

to competition-based research posts nationally and internationally. Fair access to attractive research positions can in turn have a positive impact on the attractiveness of the research career[31].

In order to secure an adequate science base, national governments and institutions have put in place measures to attract sufficient numbers of young people in taking science to an advanced (doctoral) level and thus, pursuing a researcher career. For example, governments have set up a number of awareness schemes to raise young people's interest in science and research in general. In addition, dedicated programmes aim to attract specific groups such as schoolchildren and in particular girls in pursuing a researcher career[32]. Such measures aim to secure an adequate supply of researchers in the long run. For the short and medium run, Member States have set up measures to improve the quality of doctoral training[33].

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[34]. Measures aimed to encourage life-long learning (e.g. via dedicated career programmes) and improve working conditions (e.g. via the European Charter and Code for Researchers) can have a positive impact on researchers' career development and job satisfaction. European countries have also put in place various measures to boost partnerships between universities, research institutions and private companies as to make the researcher profession more attractive[35].

Lastly, many countries have put in place measures to remove 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 the EU and non-EU countries, providing financial incentives for early stage researchers while others promote outbound mobility. By removing the remaining barriers to researchers' mobility, the countries aim to make the researcher profession attractive to young and experienced researchers across Europe[36].

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

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

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

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

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

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

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

2. Women in the research profession

2.1 Women in the research profession - Highlights

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

- Women researchers in all countries face difficulties in climbing the career ladder in the research profession (Glass Ceiling Index). 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); in the EU-27, women head only 13% of universities and HEIs (higher education institutions);
- Men outnumber women in the highest academic positions (Grade A positions) in the natural sciences, and engineering and technology. The proportion of women in Grade A positions is highest in the humanities and social sciences, but still lower than men in most cases;
- The ratio of women in top-level positions in research between 2004 and 2007 rose in every country at a different pace;
- The probability of women of reaching a top-level (Grade A) position in research is highest in Romania, Latvia, Turkey and Croatia and lowest in Ireland, Cyprus, Malta and Luxembourg;
- Women researchers are paid less than men at the same level (gender pay gap).

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

- The great majority of European countries have adopted measures to promote gender equality in the research profession. These include setting up special bodies dedicated to the issue of gender balance, the anchoring of the gender balance principle in national constitutions, charters, action plans, etc;
- Other 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 raise their chances of appointments and promotions to top-level research jobs. They encompass concrete gender targets and quotas, work-life balance provisions, advanced training, mentoring and empowerment as well as measures to enhance transparency in the appointment procedures;
- Several countries confer awards of excellence on women scientists to raise awareness of women in science and to reward outstanding women researchers for their contribution to research;
- A new edition of the 'She Figures' publication with more recent data from 2009 and 2010 is due for publication by the end of 2012.

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[37]. There is mounting evidence, however, that Europe does not make enough of its talent pool, especially of women.

[37] European Commission (2010a)

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. Men are over-represented in senior academic positions.

Despite a steady increase in the number of women researchers, women remain in a minority in scientific research. The ratio of women to men has been growing, but not enough to indicate that the gender imbalance in science is self-correcting[38]. On average in 2010, European universities had 30% of female staff but only 18% full professors[39]. In addition, the comparatively low representation of women in decision-making bodies and at prestigious public research institutions and the stark differences by gender in researchers' remuneration provide evidence of a gender imbalance in the research profession.

The implications of gender imbalances in the research profession are highly relevant for the European economy. According to recent estimates, 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. 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[40].

The reasons for the gender imbalance in the research profession are multifaceted[41]. 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' [42]), and unfair and opaque recruitment procedures favouring men above women researchers[43]. Resources, time, social networks, encouragement – unevenly distributed between the sexes – are necessary prerequisites for becoming a successful scientist[44].

The European Commission[45] and the Member States have put in place measures to reduce gender imbalances in science. 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.

[38] Ibid

[39] Ibid

[40] European Commission (2008a)

[41] 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)

[42] "(...) 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)

[43] "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)

[44] European Commission (2004c)

[45] "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).

Outline

This chapter presents the most recent data[46] on women researchers in science in Europe. Firstly, it offers an overview of the key indicators for monitoring the gender balance in research. Secondly, it sheds light on the proportion of female and male researchers by academic grades and in top-level positions by academic discipline. Thirdly, it presents statistics on the proportion of women 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. Fourthly, it provides an overview of Member States' and Associated Countries' measures to support women in top-level positions.

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 5: Women in the research profession - Key indicators

Indicators	Data source(s)	Reference year(s)
Proportion of academic staff by grade (A, B, C, ISCED 6 and ISCED 5A), EU-27, 2002 and 2006 (%)	WiS database/ SHE figures	2002, 2006
Glass Ceiling Index, Europe, 2004 and 2007	WiS database/ SHE figures	2004, 2007
Women Grade A academic staff, Europe, 2007 (%)	WiS database/ SHE figures	2007
Proportion of woman grade A academic staff by main field of science (natural sciences, engineering and technology, social sciences, and humanities), Europe, 2007 (%)	WiS database/ SHE figures	2007
Proportion of women heads (president/rector) of institutions in the Higher Education Sector, Europe, 2007 (%)	WiS database/ SHE figures	2007
Proportion of women on boards, Europe, 2007 (%)	WiS database/ SHE figures	2007

Source: Deloitte

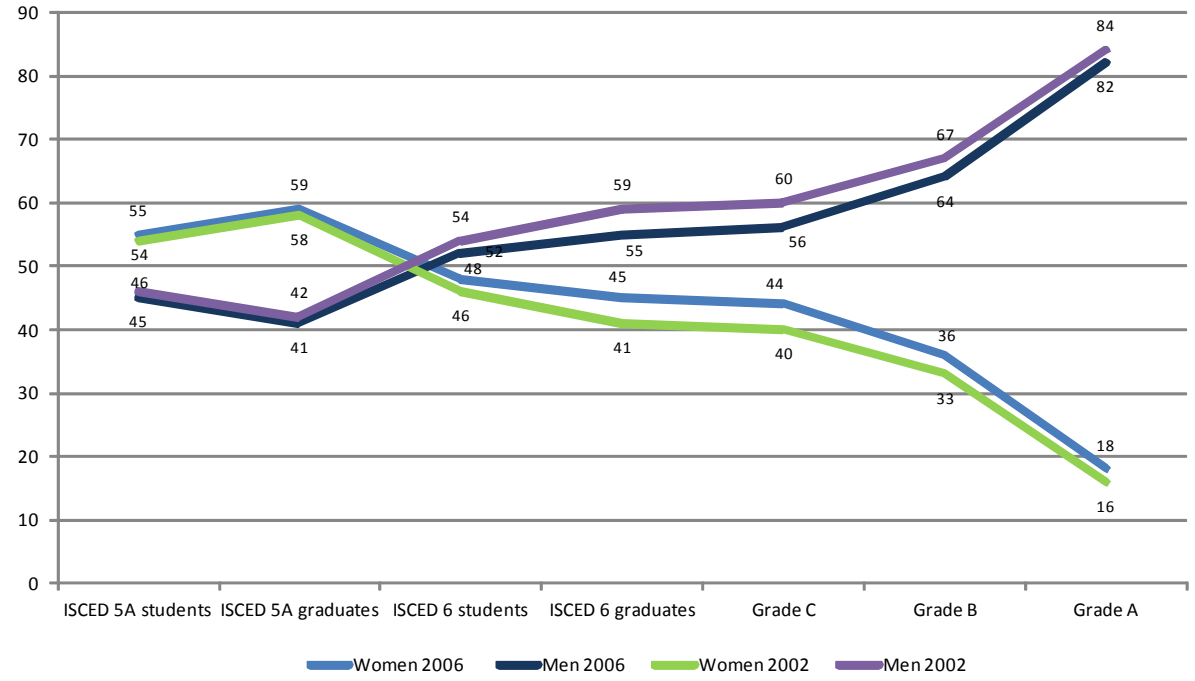
2.4 Women researchers in top-level positions – the evolution of a researcher career

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 that of a man. 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.

[46] A new edition of "She Figures" will be published later this year (2012) with more recent data on women researchers in Europe.

Figure 11: Proportion of academic staff by grade, EU-27, 2002 and 2006 (%)



Source: Deloitte
Data: WiS database/SHE figures

The proportion of women students (55%) and women graduates (59%) is higher at the first two levels of academic education (ISCED 5A)[47]. However, men outnumber women as of the third level (ISCED 6 students)[48], when the proportion of women drops back to 48% among PhD students. The gender gap widens further at the PhD level (ISCED 6 graduates), where the proportion of women drops to 45%.

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 women 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[49] and B[50]). The proportion of women is least at the top of the academic hierarchy, falling back to 18% of Grade A[51] academic staff.

A comparison of data between 2002 and 2006 shows an improvement. Women's relative position at PhD level and at the different levels of the academic career (Grades C, B and A) shows a positive

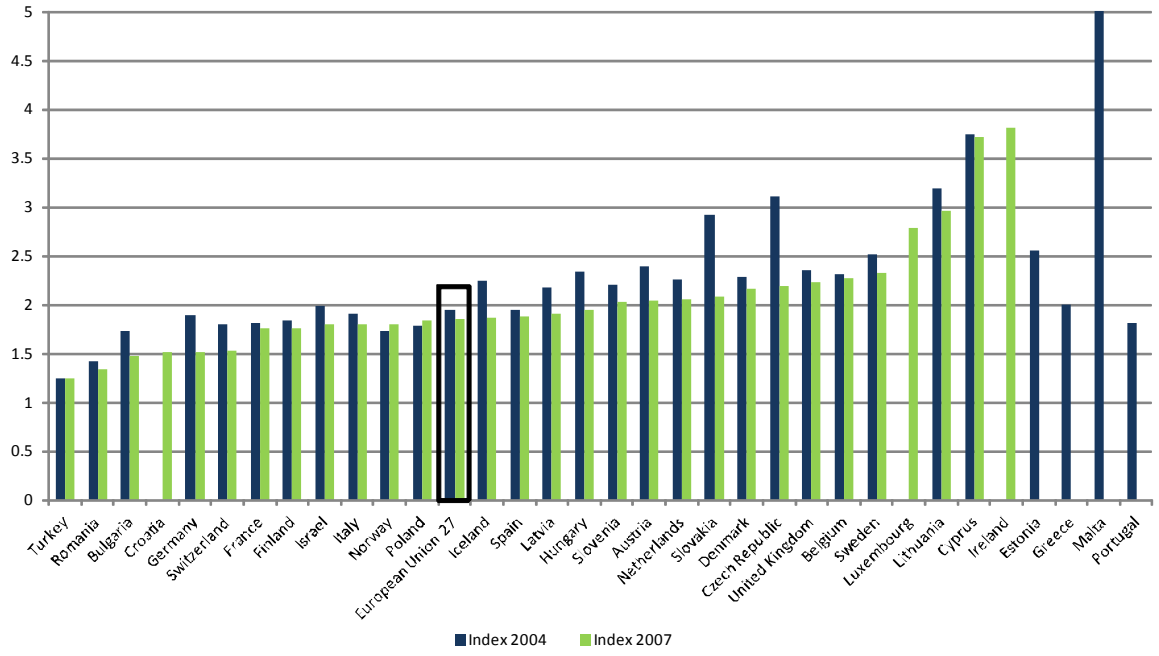
[47] ISCED 5A: Tertiary programmes to provide sufficient qualifications to enter into advanced research programmes & professions with high skills requirements.
[48] ISCED 6: Tertiary programmes which lead to an advanced research qualification (PhD).
[49] Grade C: The first grade/post into which a newly qualified PhD graduate would normally be recruited
[50] Grade B: Researchers working in positions not as senior as top position (A) but more senior than newly qualified PhD holders
[51] Grade A: The single highest grade/post at which research is normally conducted

trend towards more gender balance. The gender gap has been closing more markedly among scientists than in the labour market in general[52]. However, the relatively higher proportions of women at PhD level have not translated into greater equity at the top. Women researchers face a 'glass ceiling' stopping them from reaching high-level (prestigious) positions in research.

Women researchers in all countries face difficulties in climbing the career ladder in the research profession (Glass Ceiling Index).

The Glass Ceiling Index (GCI) illustrates the difficulties women have in gaining access to the highest hierarchical levels. 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. However, 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 12: Glass Ceiling Index, Europe, 2004 and 2007



Source: Deloitte
Data: WiS database/SHE figures
Data are unavailable for 2004 for: HR, LU, IE, and for 2007: EE, EL, MT and PT.
Exceptions to the reference year(s): 2007 HR: 2008; UK: 2007/2006; DK, IE (except for grade A: 2002-2003), FR, CY, LU, AT, IL: 2006; 2004 PT, NO: 2003; IL: 2001; EL: 2000
Data are unavailable for 2004: LU, IE, HR; 2007: EE, EL, MT, PT; Grade C unavailable for BG, RO
Break in series: CZ (2005)
Provisional data: ES
Data estimated: EU-27, (by DG Research) and SI
Others: def, specs: Some differences exist in coverage and definitions between countries; Countries with small numbers of academic staff: CY, MT, LU and IS; NO: before 2007 biannual data; Data for Ireland on Grade A professors does not include the Institutes of Technology; data are presented for the following Associated Countries: TR, HR (2007), CH, IL, NO and IS.

[52] European Commission (2011b)

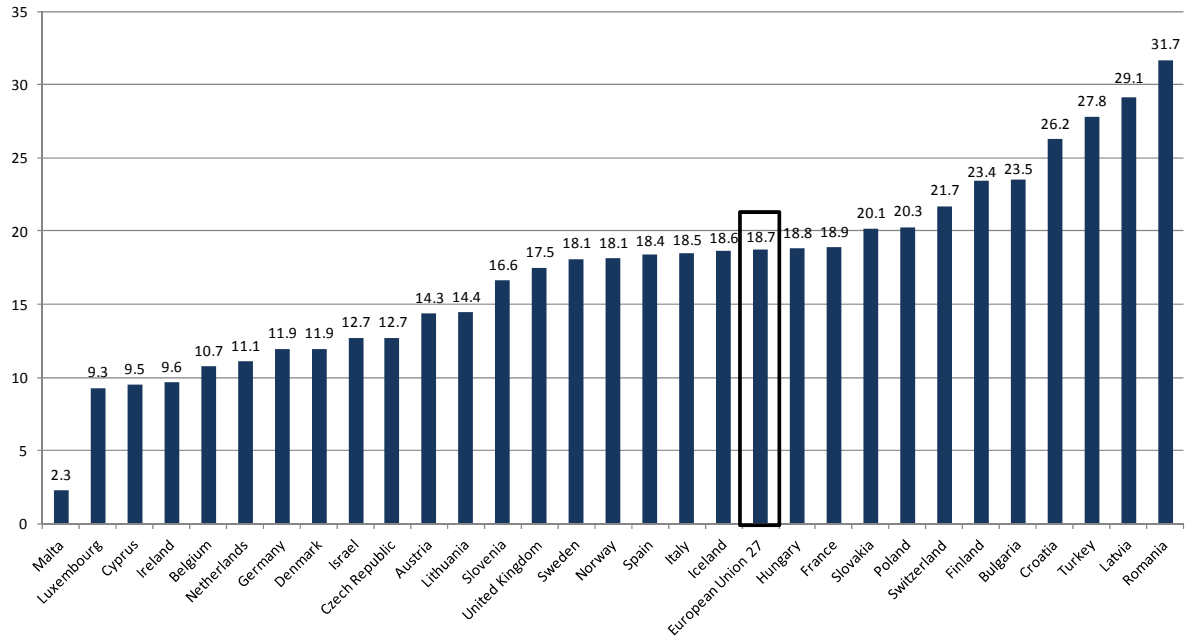
In 2007, the average GCI for the EU-27 was 1.8, with a range from 1.2 in Turkey (thinner glass ceiling) to 3.8 in Ireland (thick glass ceiling). No country reported a GCI equal to or below 1. The GCI was particularly high in Ireland, Lithuania, Sweden and Belgium. Thus, women researchers in these countries have the lowest degree of probability of reaching a top-level academic position. The probability of women being promoted to a higher academic position is relatively high in Romania, Bulgaria, Germany and Switzerland, which are all below or equal to 1.5 on the index. Nevertheless, the situation is far from optimal, leading to an over-representation of men in senior positions of academia.

Between 2004 and 2007, the index decreased or remained stable in most countries (except for Norway and Poland), leading to a lower GCI for the EU-27. However, the indicator provides evidence of the difficulty women researchers face in entering high-level positions in research.

The probability of women of reaching a top-level (Grade A) position in research is highest in Romania, Latvia, Turkey and Croatia and lowest in Ireland, Cyprus, Malta and Luxembourg.

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 2007, the EU-27 average of the share of women among Grade A academic staff was 18.7%. The proportion of women in top research positions was highest (>25%) in Romania (31.7%), followed by Latvia (29.1%), Turkey (27.8%) and Croatia (26.2%). Malta (2.3%), Luxembourg (9.3%), Cyprus (9.5%) and Ireland (9.6%) reported the lowest (<10%) figures for women in top-level academic positions.

Figure 13: Women Grade A academic staff, Europe, 2007 (%)



Source: Deloitte
Data: WiS database/SHE figures.
* Data are unavailable for EE, EL and PT.

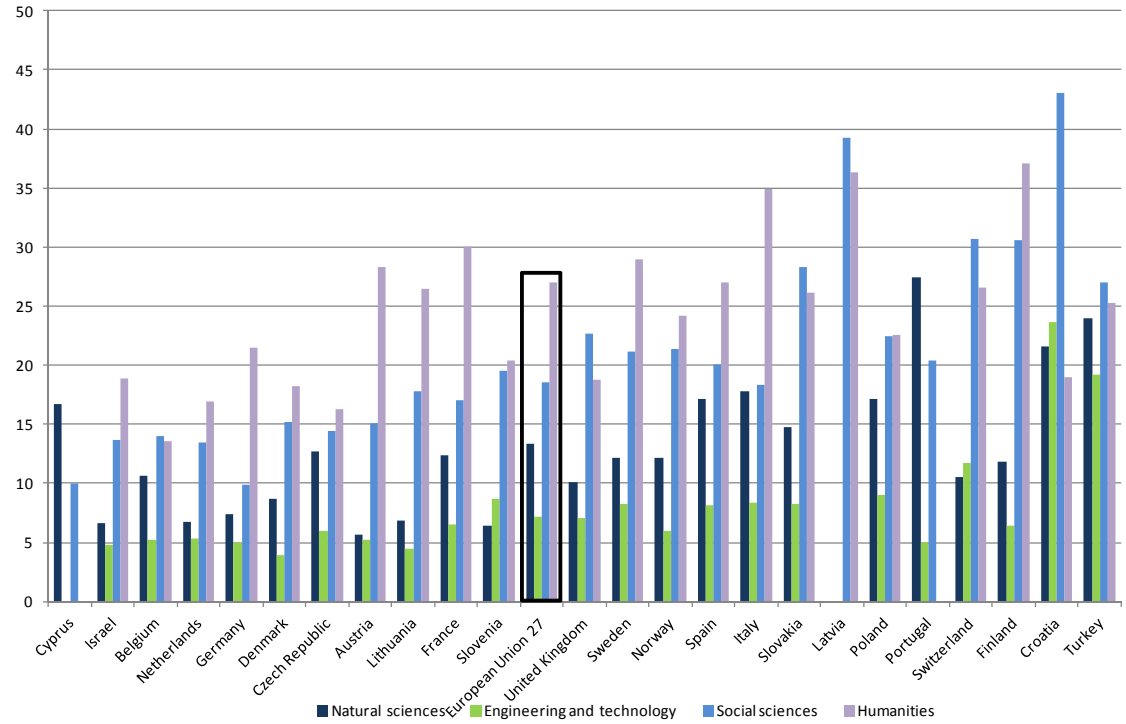
The ratio of women in top-level positions in research between 2004 and 2007 rose in every country at a different pace.

Between 2004 and 2007, the average percentage of women academic Grade A staff in the EU-27 increased from by two percentage points from 17% to 19%, and all countries in the scope of this report reported an increase in the ratio of women in high-ranking academic positions[53].

Men outnumber women in the highest academic positions (Grade A positions) in the natural sciences, and engineering and technology. The proportion of women in Grade A positions is highest 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 women researchers in top-level positions in the fields of science and engineering (see figure below). An analysis of the differences in the representation of women in scientific fields in the EU-27 reveals that women in Grade A positions are disproportionately under-represented in the fields of natural sciences (13.4%), and engineering and technology (7.2%), compared to figures of 18.6% for the social sciences and 27% for the humanities. In most of the countries monitored, there are more women researchers in top-level positions in the humanities than in the other disciplines.

Figure 14: Proportion of woman academic Grade A staff by main field of science (natural sciences, engineering and technology, social sciences, and humanities), Europe, 2007 (%)



Source: Deloitte
Data: WiS database/SHE figures
* Data are unavailable for BG, EE, EL, HU, IE, IS, LU, MT and RO.

[53] For a detailed analysis on the countries' performance, see Scorecard: "Proportion of women Grade A academic staff, 2004 and 2007" in Annex "Scorecards".

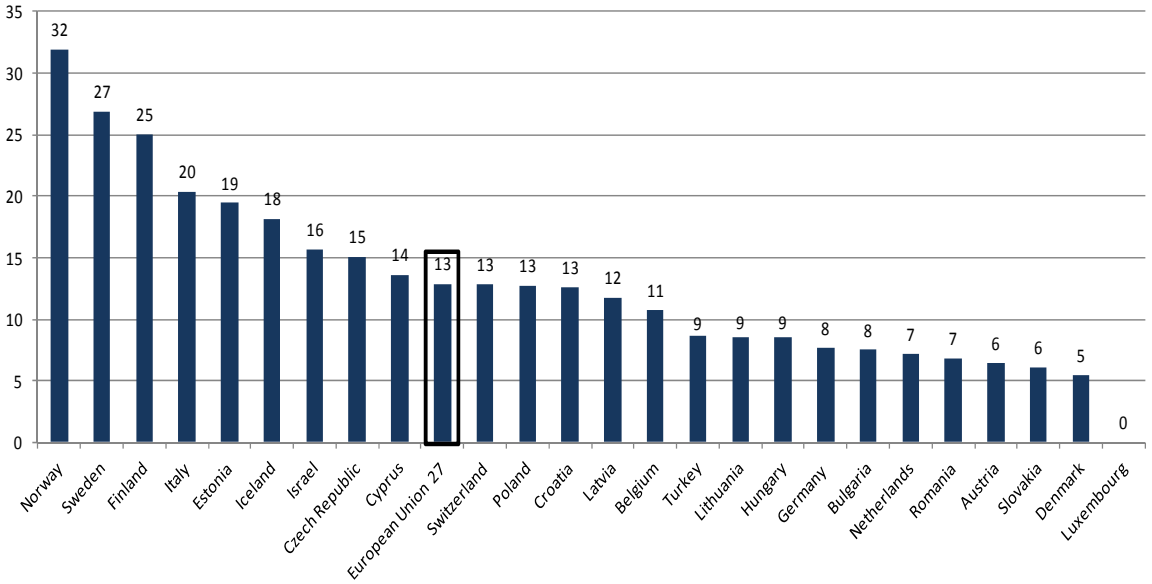
Women are under-represented at the highest levels of academia – in the EU-27, women head only 13% of universities and HEIs (higher education institutions).

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-27 in 2007, women headed only 13% of institutions in the Higher Education Sector. The actual proportion in individual countries in the sample varied between 32% in Norway[54] and 5% in Denmark. The lowest figures (<10%) were reported in Denmark (5%), Slovakia (6%), Austria (6%), Romania (7%), the Netherlands (7%), Bulgaria (8%), Germany (8%), Hungary (9%), Lithuania (9%) and Turkey (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 5%. Countries such as Germany (8%), the Netherlands (7%) and Austria (6%) show relatively low figures (<10%) of women in top-level positions in the Higher Education Sector.

Figure 15: Proportion of women heads (president/rector) of institutions in the Higher Education Sector, Europe, 2007 (%)



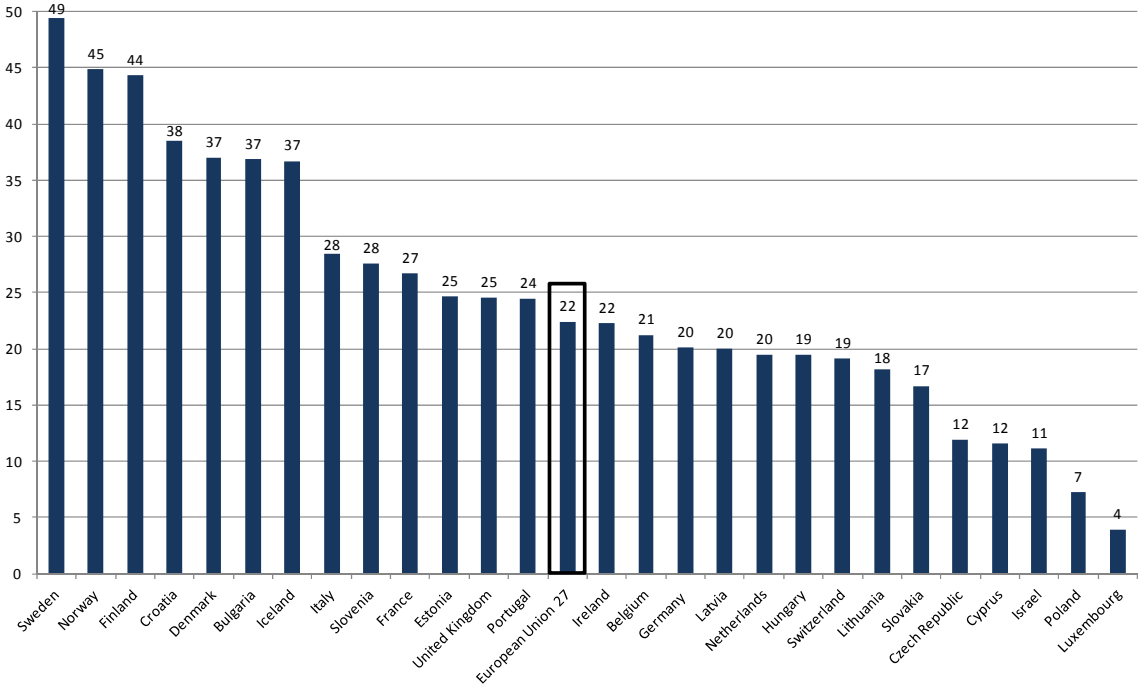
Source: Deloitte
Data: WiS database/SHE figures
* Data are unavailable for EL, ES, FR, IE, MT, PT, SI and UK.
Exceptions to the reference year: IT: 2009; BE (Dutch-speaking community), DE, EE, HU, AT, PL, SK, FI, SE, HR, CH, IL: 2008; DK, CY: 2008/2007; RO: 2007/2006 Data unavailable: BE (French-speaking community), IE, EL, ES, FR, MT, PT, SI, UK
Data estimated: EU-27 (by DG Research)

[54] Between 2004 and 2007, the Glass Ceiling Index increased in Norway (from 1.7 to 1.8), making it more difficult for women to gain access to the highest hierarchical levels in the research profession.

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-27, only 22% of board members[55] are women. The figure tops 40% only in Sweden (49%), Norway (45%) and Finland (44%). The participation of women on boards is lowest (<10%) in Luxembourg (4%) and Poland (7%). The UK (25%), France (27%) show figures slightly above EU-27 average whereas Germany (20%) and the Netherlands (20%) have ratios slightly below the EU-27 average.

Figure 16: Proportion of women on boards, Europe, 2007 (%)



Source: Deloitte
Data: WiS database/SHE figures
* Data are unavailable for AT, EL, ES, MT and RO.

Women researchers are paid less than men at the same level (gender pay gap).

Despite limited data on researchers' remuneration, the statistics available show striking differences in researchers' remuneration between men and women. The overall gender pay gap for the entire economy was 25% in the EU-27 in 2006 – a slight improvement from 2002 when it stood at 26% (European Commission, 2009c). According to the Remuneration Study,[56] the difference between the remuneration of a woman researcher and a male researcher was significant in most of the countries monitored. The Commission's ongoing MORE2 Study on mobility patterns and career paths of researchers includes an in-depth case study on researchers' remuneration in more than 40 countries. Results are expected in early 2013.

[55] 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.

[56] European Commission (2007a)

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.

The scarcity of women in senior positions inevitably means that 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 of future development of research careers. In addition, if women scientists are not visible and not seen to be succeeding in their careers, they cannot serve as role models to attract and train young women in scientific professions[57]. The countries in the 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 the countries' different measures[58] aiming at promoting (more) women to top-level academic positions. For a comprehensive overview of the countries' measures aimed at promoting women in top-level positions, see Annex III "Women in the research profession".

Table 6: Support women in top-level positions – countries' measures overview

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						✓✓✓✓✓✓✓
CROATIA						✓✓✓✓✓✓✓
CYPRUS	✓✓✓					
CZECH REPUBLIC			✓✓			✓✓✓✓
DENMARK		✓		✓		✓
ESTONIA						✓✓
FINLAND		✓			✓	✓✓✓✓
FRANCE		✓	✓	✓✓✓	✓	✓✓✓✓✓✓✓✓
GERMANY	✓			✓✓✓✓✓		✓✓
GREECE		✓				✓✓
HUNGARY		✓				✓✓
IRELAND		✓				✓✓✓✓✓✓
ITALY	✓	✓		✓	✓	✓✓
LATVIA	✓					
LITHUANIA				✓		✓
LUXEMBOURG					✓	
MALTA						✓✓✓
NETHERLANDS				✓		
NORWAY	✓	✓			✓✓✓	
POLAND	✓✓	✓	✓			✓
SLOVAK REPUBLIC						✓✓✓
SLOVENIA	✓	✓				✓✓
SPAIN		✓✓				✓✓
SWEDEN		✓				
SWITZERLAND	✓	✓✓✓	✓✓	✓		✓✓✓✓
UNITED KINGDOM					✓	✓✓✓✓

Source: Deloitte, "Researchers' Report 2012", Annex 'Country files'.
No information available for BG, BiH, FYROM, IL, IS, LI, ME, PT, RO, RS and TR.
Information presented in this table is limited to the input provided by individual countries in their response to the Deloitte questionnaire (2011).

[57] European Commission (2008a)

[58] 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).

The measures are grouped into three overarching categories[59]. The first group is composed of measures to improve (junior) women 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, coaching activities and special funding schemes dedicated to women to bonus points to gender-balanced project teams. For example, the fForte Coaching Programme (Austria) supports women in writing successful grant proposals. In addition, it provides information on sources of funding and personal (professional) development to increase the ratio of women in research funding programmes.

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 are addressed particularly at women researchers at an advanced level of their academic career. 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[60] designed to produce the effect that women will not be discriminated against. For example, the Swiss Federal Equal Opportunity Programme 2008-11/12 aims to increase the proportion of women category I Professors from 14% in 2006 to 25% by the end of 2012. In Poland, the recently amended Law on higher education calls for the Minister for higher education to ensure that at least 30% of the members of the Polish Accreditation Committee are women.

The third group refers to 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. It 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 the 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.

The great majority of 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, etc. The majority of countries have appointed special bodies, such as Units/Offices within Ministries, Committees/Councils, Equality Centres, and Ombudsmen for Equality or Equality Boards responsible for monitoring the equal representation of both sexes, covering, amongst others, the researcher profession.

[59] Based on European Commission (2008a)

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

In addition, several countries confer awards of excellence on women scientists to raise awareness of women in science and to reward outstanding women 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 women researchers and promote their scientific achievements. In the 2011 edition of competition, almost 100 students in maths, science, natural sciences and technology from all over Poland submitted their papers. The winner, a fifth year biology student at the Jagiellonian University, received PLN 20 000 (some EUR 4 700) as well as the opportunity to participate in the European scientific conference of her choice.

Further analysis is needed to assess the direct and indirect effects of these measures on raising the share of women 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.

3. Open, transparent and merit-based recruitment

3.1 Open, transparent and merit-based recruitment – Highlights

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

- Most countries report having taken concrete steps to encourage or require institutions 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;
- The vast majority of national authorities consider the recruitment system in their country to be largely open and transparent. They widely acknowledge the positive impact of open recruitment on scientific quality and productivity, researchers' international mobility, the attractiveness of research careers, and equal access to job opportunities for women and men;
- They consider explicit recruitment policies on the part of the hiring institution, a legislative framework, and awareness on the part of the institution of large job portals as very influential factors in the degree to which vacancies are advertised, and selection criteria/procedures are transparent.

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

- Many researchers perceive the public institutions' recruitment rules and procedures to be neither open nor transparent. The lack of open and transparent recruitment procedures is regarded by the majority of stakeholders as one of the main factors hindering researchers' international mobility. Protectionism/nepotism (85%) is considered to be the main reason, followed by the lack of a human resources strategy in institutions (77%). Information is also felt to be critical, with 67% citing the lack of awareness of job portals such as EURAXESS Jobs as a key factor inhibiting open and fair recruitment procedures;
- Stakeholders emphasise the importance of an open, transparent and merit-based recruitment system as a precondition for excellence and innovation in research. They believe policy makers need to take concrete actions to remove the remaining bottlenecks to guarantee an attractive and efficient research career.

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

- The share of research posts advertised on the EURAXESS Jobs portal (per thousand researchers in the public sector) is relatively high in the United Kingdom, the Netherlands, Ireland and Norway;
- The length of time for which researchers in the higher education sector have been employed by their principal employer provides an indication as to the opportunities for and extent of mobility within a country. Many factors are at play but there appears to be a link with the degree of openness of recruitment structures in institutions in the EU-27. The share of researchers employed by their principal employer for more than 10 years is 42% in the EU-27. It is highest (>50%) in Bulgaria, Portugal, Hungary, Lithuania, Romania, Spain and Greece and lowest (<30%) in the Netherlands, the UK, Austria and Finland.

3.2 Introduction

Open, transparent and merit-based recruitment procedures in public research institutions across Europe are a prerequisite for the realisation of the European Research Area (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 and Code[61].

Table 7: 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.

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

Mobility is a core of the concept of the ERA. This in turn is fundamental to the EU's Growth and Jobs Strategy [62]and Vision for 2020[63], which aim to improve the dynamism and competitiveness of the EU economy. Mobility is strongly associated with the creation of dynamic networks, improved scientific performance, improved knowledge and technology transfer, improved productivity and ultimately enhanced economic and social welfare[64]. 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.

The countries in the scope of this report widely acknowledge the importance of an open, transparent and merit-based recruitment system for the benefit of a functioning research system in their respective countries. National authorities overwhelmingly acknowledge the positive impact of an

[61] European Commission (2005a)
[62] European Commission (2010b)
[63] Council of the European Union (2008a)
[64] European Commission (2010b)

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 who perceive the public institutions' recruitment rules and procedures as 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[65].

Despite the progress reported[66] in improving the functioning of national public recruitment systems, there is an apparent discrepancy between the public authorities' and stakeholders' perceptions of the degree of openness, fairness and transparency. This discrepancy is partly due to a lack of clear evidence on the degree of openness of national recruitment systems. This chapter provides an assessment of the openness of public recruitment systems in Europe on the basis of a number of reliable indicators. In addition, it takes into account the findings and opinions of national authorities on the degree of openness and transparency of research systems at national and European level.

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. Firstly, 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, it sheds light on the number of non-national and external researchers recruited by institutions as an indicator for the openness of national recruitment systems. Fourth, it presents statistics on the percentage of researchers trained and recruited by the institution at which they study as an indicator of the degree of protectionism/nepotism in public research institutions. Fifth, the report presents an overview of the countries' perceptions of the level of openness and transparency of their national research systems.

[65] European Commission (2008b)
[66] European Commission (2009c)

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.

Table 8: Open, transparent and merit-based recruitment - Key indicators

Indicators	Data source(s)	Reference year
Researcher posts advertised through the EURAXESS Jobs portal, Europe, January to August 2011	EURAXESS JOBS	January to August 2011
Research posts advertised through the EURAXESS Jobs portal per thousand researchers in the public sector, Europe, January to August 2011	EURAXESS JOBS	January to August 2011
Estimated share of researchers in the higher education sector employed by their principal employer by years and country of affiliation, EU-27, 2009 (%)	MORE study[67]	2009

Source: Deloitte

3.4 The EURAXESS Jobs Portal

In 2003, the European Commission launched the European Researcher's Mobility Portal[68] to provide researchers with up-to-date information about jobs and funding opportunities. As of 2008 this portal became part of the broader EURAXESS – Researchers in Motion portal[69], which offers practical information on job vacancies, fellowship programmes, entry conditions, social security and tax schemes across Europe, cultural/intercultural and family-related issues, information about working conditions (i.e. Charter and Code, and the HRS4R mechanism) and e-networking tool for European researchers abroad. The EURAXESS portal is complemented by the national EURAXESS portals of member countries.

The job market for researcher positions must be open and transparent 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 a European Research Area. Researchers across Europe must have equal access to competition-based research posts as to ensure an optimal allocation of human resources in research. The number of research posts advertised via the EURAXESS Jobs portal serves as a rough indication for assessing the degree of openness and transparency of national public recruitment systems in the EU. It provides information on the number of research-related positions posted by employers. A positive correlation exists between the number of job postings on international job platforms such as EURAXESS Jobs and the openness of a recruitment system. The higher the number of job postings shown by the indicators, the more open and transparent the recruitment system can be assumed to be.

Between 2005 and 2011[70], the total number of research-related jobs posted on the EURAXESS Jobs increased continuously, from 781 to 22 129, including information from other national job portals. This was due to concerted efforts by the Commission and several Member States to ensure that a

[67] IDEA Consult (2010)

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

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

[70] Data available for the period January-August 2011

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. However, in the Public Consultation on the ERA Framework, 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.

Table 9: Researcher posts advertised through the EURAXESS Jobs portal, Europe, January to August 2011

Year	Job Vacancies total
2005	781
2006	1 707
2007	2 063
2008	3 898
2009	4 731
2010	7 329
2011 (January to August)	22 129

Source: Deloitte
Data: EURAXESS JOBS 2011

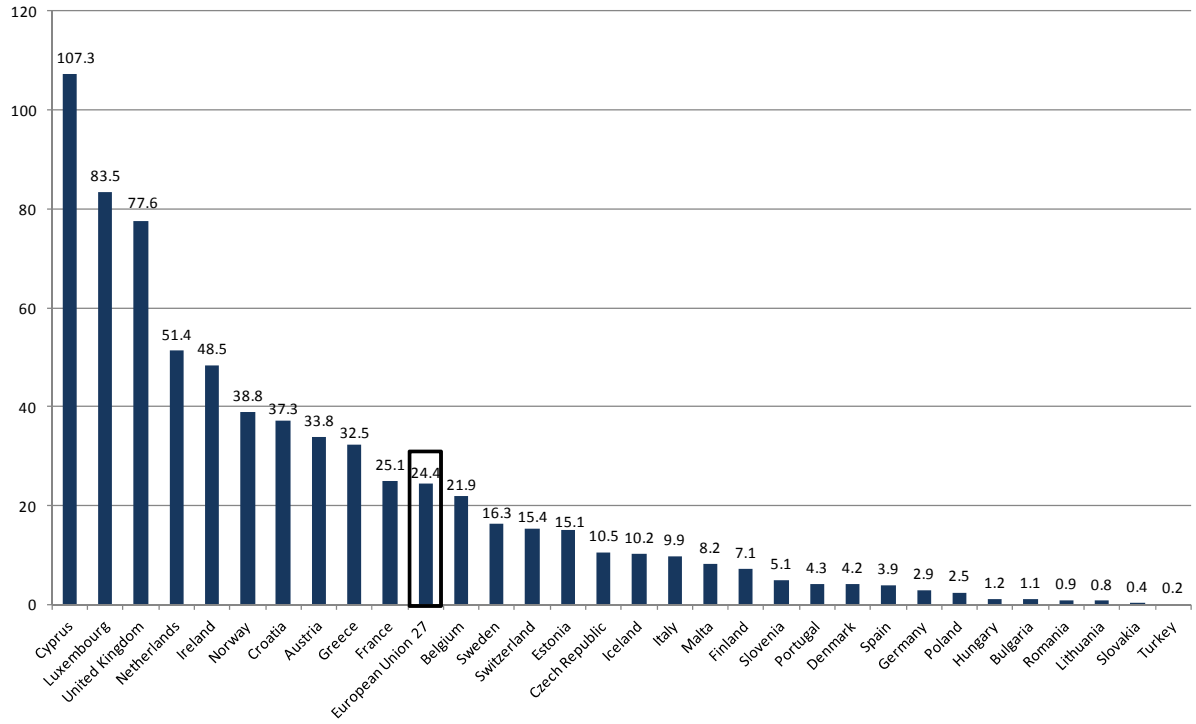
The share of research posts advertised on the EURAXESS Jobs portal per thousand researchers in the public sector provides a rough indication of the openness of a recruitment system. The United Kingdom, the Netherlands, Ireland and Norway have among the highest shares of jobs posted on the EURAXESS Jobs portal.

Between January and August 2011, the average number of job postings on the EURAXESS Jobs portal per thousand researchers in the public sector for the EU-27 was 24, with a range from 107 in Cyprus to five or fewer in several countries. The number of jobs advertised via the online platform was high notably in the United Kingdom, the Netherlands, Ireland and Norway. Thus, researchers across Europe benefit from a more open and transparent access to research-related jobs in these countries.

We observe a low share of researchers posts advertised on the EURAXESS Jobs portal per thousand researchers in the public sector in countries such as such as Slovakia, Lithuania, Romania, Bulgaria, Hungary and Poland. Germany, Spain, Portugal and Denmark also report relatively low (<10) numbers of job postings on EURAXESS per thousand researchers in the public sector. Generally speaking, if job positions are not advertised publicly and widely, the chances of recruiting the best possible talent are more limited.

This indicator should however be treated with caution. 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 to advertise national postings. The indicator provides a general trend of a certain level of openness of recruitment practices in European countries. However, it is not possible to calculate with precision the level of openness in each country due to its (methodological) limitations. The publication of job vacancies on relevant European-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 7).

Figure 17: Research posts advertised through the EURAXESS Jobs portal per thousand researchers in the public sector, Europe, January to August 2011



Source: Deloitte
Data: EURAXESS JOBS 2011
* Figures are rounded to the nearest 10.
** Data are unavailable for LV as well as for CH, HR, IS, NO, TR.

The number of research posts advertised on via the EURAXESS Jobs portal per thousand researchers in the public sector rose significantly in the vast majority of European countries between 2010 and 2011, but not equally rapidly everywhere[71].

Between 2010 and 2011, the average number of research posts advertised via the EURAXESS Jobs portal per thousand researchers in the public sector in the EU-27 increased from 4.8 to 24.4 (+80%), and the vast majority of countries within the scope of this report reported an increase in the number of research posts advertised on the portal.

[71] For a detailed analysis on the countries' performance, see Scorecard: "Ressearch posts advertised through the EURAXESS Jobs portal per thousand researchers in the public sector" in Annex "Scorecards"

3.5 Non-national researchers recruited by institutions

The proportion of non-national researchers serves as a useful indicator of the degree of openness of national recruitment systems.

France, the UK and Norway have a relatively high proportion of non-EU doctoral candidates as a percentage of all doctoral candidates[72] whereas the UK, Austria and Belgium have a relatively high proportion of doctoral candidates with a citizenship of another EU-27 Member State. For more information on the proportion of non-national (foreign) doctoral candidates in different Member States, see Chapter 7 "Mobility and international attractiveness".

3.6 Researchers trained and recruited by institutions

The high share of researchers in the higher education sector employed by their principal employer in countries such as Bulgaria, Portugal, Hungary, Lithuania and Romanian indicates a relatively low level of openness of these public institutions to external researchers.

European universities and research institutions often recruit their own students to research posts. Doctoral candidates are usually hired by the institution just after having obtained their PhD, hindering the possibility of extra-institutional doctoral graduates competing for the same job. Nepotism/protectionism - which refers to selection processes based on personal relationships rather than standardised evaluation of applicants or a thorough analysis of individual skills - is widely perceived as the main barrier to international mobility. It may also have negative effects on academic performance and research/teaching excellence[73]. It does not support mobility. Research shows that countries without sufficiently open, transparent, merit-based recruitment procedures coupled with relatively closed and unattractive research systems, high levels of endogamy and low levels of staffing autonomy are more likely to underperform in terms of research outcomes[74].

Evidence shows a positive correlation between research excellence and open research systems of which open, transparent and merit-based recruitment is a key component. The Innovation Scoreboard 2011[75] shows that the leading EU Member States in terms of 'open, excellent and attractive research systems' are all "Innovation Leaders or Followers". In contrast, those countries with relatively low scores in terms of open systems are "Moderate or Modest innovators".

Evidence from ERAWATCH also suggests that countries with a strong research system appear to be more open and promote the mobility of researchers more actively. They advertise internationally more often, offer more equal opportunities for foreigners to get a research position, have more institutions that have signed the Charter for Researchers, and so on. By offering more attractive

[72] "Non-EU doctoral candidates" refers to foreign doctoral candidates in case of non-EU countries.
[73] Technopolis group (2010a)
[74] European Commission (2011c)
[75] European Commission (2011c)

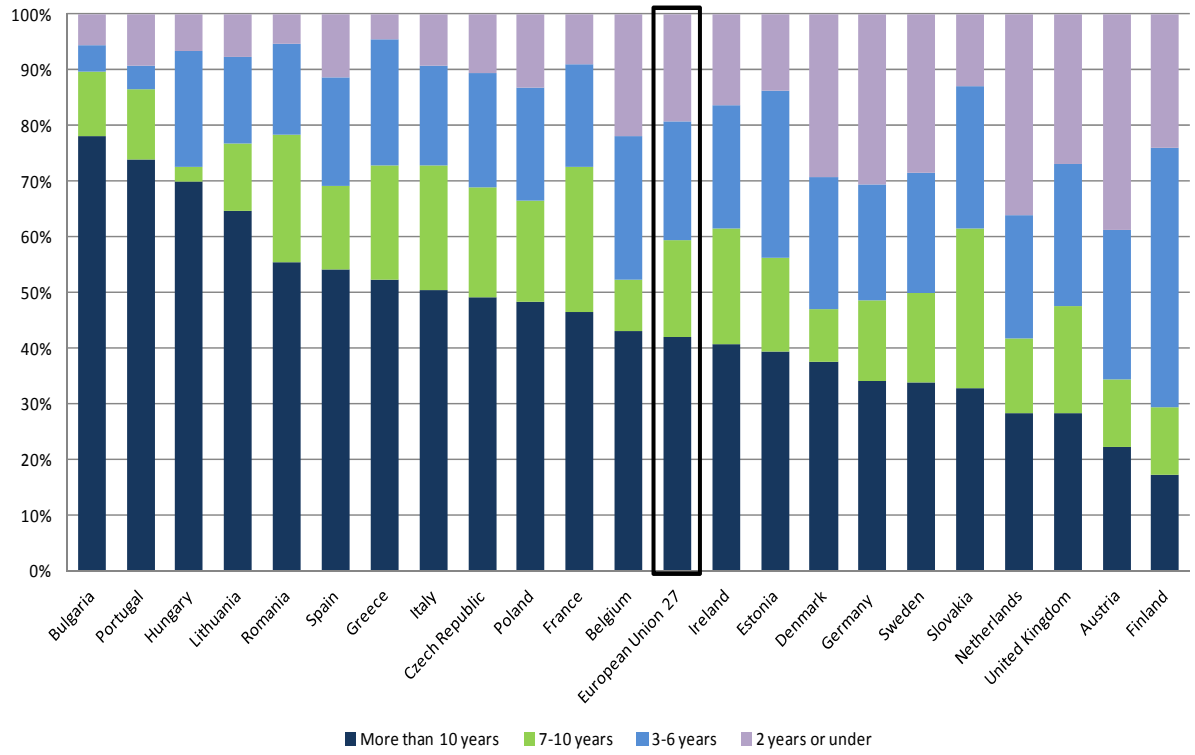
salaries, research communities and infrastructures, these countries appear to experience nothing but benefits from opening up to foreign researchers[76].

The estimated share of researchers in the higher education sector employed by their principal employer can be used to indicate the degree of openness of recruitment structures in institutions in the EU-27. In the period 2009, the average ratio of researchers in the higher education sector employed by their principal employer for more than 10 years was 42% for the EU-27, with a range from 78% in Bulgaria (low level of openness) to 17% in Finland (high level of openness).

The ratio of researchers employed their principal employer for more than 10 years was more than 50% in Bulgaria (78%), Portugal (74%), Hungary (70%), Lithuania (65%), Romania (55%), Spain (54%) and Greece (52%). Thus, institutions in these countries favour the recruitment of their own (national and internal) personnel over the recruitment of researchers from other institutions.

Conversely, external (non-national) researchers may face difficulties in entering the research systems of those countries[77]. A lower percentage (<30%) of researchers employed by their principal employer for more than 10 years serves as an indicator of institutions' degree of openness to external staff. There are four countries in this category: Finland (17%), Austria (22%), the United Kingdom (28%) and the Netherlands (28%).

Figure 18: Estimated share of researchers in the higher education sector employed by their principal employer by years and country of affiliation, EU-27, 2009 (%)



Source: Deloitte
Data: MORE study, question: "How long (years) have you been employed by this principal employer"?
* Data are unavailable for CY, LU, LV, MT and SI.

[76] Fernandez-Zubieta and Guy (2009)
[77] Other reasons may be language, unattractive working conditions, low remuneration levels, etc.

**The realised sample of respondents to this question was as follows: 12% of the population were doctoral/PhD students, 34% were post-doctoral researchers and 54% were in the residual "other researcher category"[78]. For 2007, there were 525 809 PhD students in the EU-27 (excluding Germany and Luxembourg, since there were missing values for these two countries), including foreign doctoral candidates in each EU MS. For the same year, there were 116 698 foreign doctoral candidates in the EU-27, with missing values for Germany, Ireland, Greece, Luxembourg and Netherlands. This implies that in 2007 there were about 42% PhD students among all EU-27 researchers in the higher education sector (excluding Germany, Ireland, Greece, Luxembourg and Netherlands). Evidently, not all PhD students had been counted as researchers in the EU-27 and consequently, the group of PhD students in the Mobility Survey is smaller (under-represented) compared with the share of PhDs in the EU-27 population of researchers in the higher education sector. In addition, MORE HEI survey showed that Italy (2%) and Greece (3%) had the lowest shares of doctoral/PhD students in the realised survey sample, while Finland (41%) and Austria (37%) has the highest shares. Romania (58%) and Poland (56%) had the highest shares of postdoctoral researchers, and Estonia (13%) and Greece (14%) had the lowest shares. Greece (84%) and Italy (77%) had the highest shares of researchers in "other researcher" categories, while this share was lowest in Slovakia (28%) and Finland (30%).

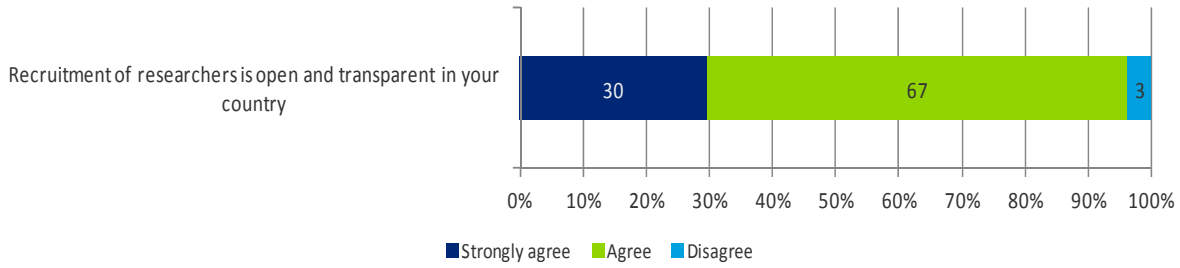
3.7 Open recruitment in institutions

The vast majority of national authorities consider the recruitment system in their country to be largely open and transparent. This is in sharp contrast to the perceptions of researchers who perceive the public institutions' recruitment rules and procedures as neither open nor transparent.

The contributions by countries within the scope of this report revealed that national authorities consider their national recruitment systems to be open and transparent. This is in sharp contrast to the perceptions of researchers who perceive the public institutions' recruitment rules and procedures to be opaque and unfair[79]. It is therefore important to assess the countries' and public institutions' measures aimed at making European researchers' recruitment systems more open and transparent.

As presented in the figure below[80], the vast majority of countries consider their national recruitment system to be open and transparent.

Figure 19: Considering the situation in your country, do you agree with the following statement?



Source: Deloitte questionnaire (2011)

In contrast, many researchers perceive the public institutions' recruitment rules and procedures to be neither open nor transparent. According to the Public Consultation on the European Research Area Framework[81], the lack of open and transparent recruitment procedures is regarded by more than 59% of respondents (and up to 78% if those who rate it as of 'medium importance' are

[78] The category "other" stands for: (i) researchers who have moved between public and private sectors at various stages and (ii) researchers who are employed in the public sector, but at the same time work in the private sector (for example, a part-time job or they have their own firm).

[79] "(...) the lack of open and transparent recruitment procedures is regarded as one of the main barriers to internationally mobile researchers", European Commission (2012a).

[80] See Annex I "Open, transparent and merit-based recruitment" for a detailed overview of answers provided by country.

[81] European Commission (2012a)

included) as one of the main factors hindering researchers' international mobility. Protectionism/nepotism (85%) is considered to be the main reason followed by the lack of human resources strategy in institutions (77%). Information is also felt to be a key factor, with 67% citing the lack of awareness of job portals such as EURAXESS Jobs as a key factor inhibiting open and fair recruitment procedures.

Stakeholders widely acknowledge the importance of an open, transparent and merit-based recruitment system as a precondition to excellence and innovation in research. 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"*.[82]

This line is supported by the League of European Research Universities (LERU): "*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*."[83]

Institutional, legal and cultural barriers are the main remaining obstacles to an open and transparent recruitment system for higher education and public research institutions in the EU-27.

When asked about the remaining barriers to an open and transparent recruitment system for higher education and public research institutions, the ranking of the categories is: institutional, legal and cultural. The table below provides examples of remaining barriers (legal, institutional and cultural) to an open and transparent recruitment system for higher education and public research institutions.

Table 10: Remaining barriers (institutional, legal and cultural) to an open and transparent recruitment system for higher education and public research institutions

– National citizenship as a prerequisite prescribed by majority of calls for publicly funded research jobs (e.g. Croatia); – Strong institutional sense of attachment of doctorates to their Alma Mater (e.g. Portugal); – Tendency to protect/favour internal candidates, claiming that they are 'the best possible' for the available position (e.g. Italy).	– Absence of a legal instrument to influence the autonomy of the institution (e.g. Czech Republic); – Long procedure to enter a country for third country researchers (e.g. Estonia); – Low salaries for researchers (e.g. Estonia); – Knowledge of the national language (e.g. Estonia).	– Recruitment in laboratories performing research related to the interests of the nation is considered as "sensitive'' or "protected'' and thus oppose hosting foreign scientists (e.g. France); – Language and tradition of the host country (e.g. Greece).

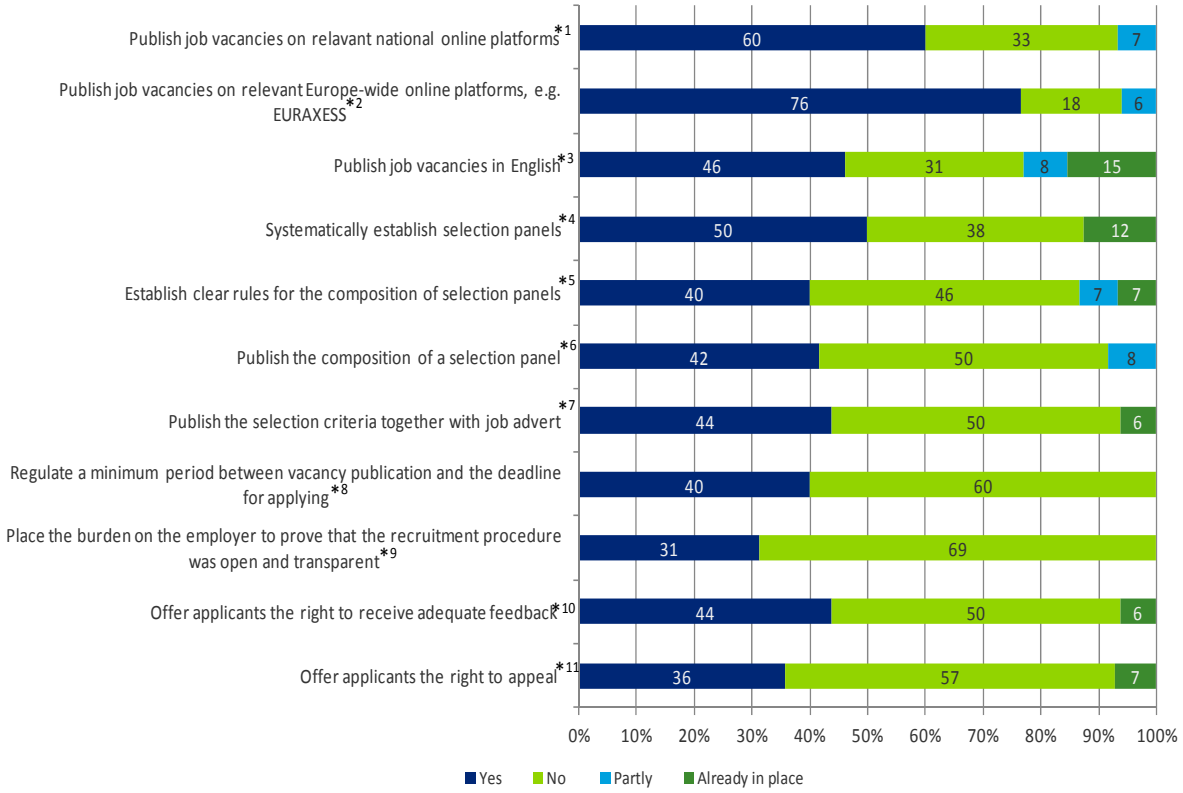
Source: Deloitte questionnaire (2011)

[82] European Science Foundation (2009)
[83] League of European Research Universities (2011)

Most countries report having taken concrete steps to encourage or require institutions 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.

Public authorities have put in place a number of measures to make national recruitment systems more open, transparent and merit-based. The majority of countries reported that public authorities are taking steps to encourage institutions to publish vacancies on relevant national (60%) and European-wide (76%) online platforms (e.g. EURAXESS Jobs). Austrian Universities, for example, must advertise research job vacancies (for scientific and research staff) internationally, at least EU-wide (Amendment to the University Act). 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, according to Law no. 240/2010, all (fixed-term) positions should be made publicly available on the national and EU websites.

Figure 20: Are public authorities in your country taking steps to encourage or require institutions to…?



Source: Deloitte questionnaire (2011)

4. Education and training

4.1 Education and training – Highlights

Tertiary graduates in Europe:

- The Europe 2020 growth strategy has 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 2010, the average was 33.6%, a significant increase of 11.2 percentage points since 2000 (22.4%);
- The number of new tertiary graduates per thousand population aged 20-29 climbed from 39.3 in 2000 to 61.8 in 2008 in the EU-27, but this is still less than in the United States (65.5) and Japan (68.8);
- The number of new tertiary graduates in Science, Technology, Engineering and Mathematics (STEM) subjects per thousand population aged 20-29 in the EU-27 increased from 10.1 (in 2000) to 14.3 (in 2009), a higher growth rate than in the US and Japan, but is still less in absolute terms;
- The number of women graduates in STEM subjects per thousand women population aged 20-29 increased from 6.3 (in 2000) to 9.4 (in 2009), significantly outstripping the increase in the US and Japan, but is still less in absolute terms.

Doctoral graduates in Europe:

- The number of new doctoral graduates in the EU-27 increased from 83 000 (in 2001) to around 115 000 (in 2010). The increase for the US was from 44 904 in 2001 to 69 570 in 2010. In Japan, the number of new doctoral graduates increased from 13 179 in 2001 to 15 867 in 2010;
- The number of new doctoral graduates per thousand population aged 25-34 in the EU-27 stood at 1.6 per thousand in 2009. It was also 1.6 in the US and was 1.0 in Japan;
- The highest number of new doctoral graduates per thousand population aged 25-34 in Europe in 2009 was in Switzerland. The leading EU-27 countries were Sweden and Finland;
- The average number of new women doctoral graduates in the EU-27 increased from 0.9 to 1.4 per thousand women in the population aged 25-34 between 2000 and 2009. In 2009, Portugal reported the highest number of new women doctoral graduates; Cyprus the lowest.

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

- European countries are implementing various measures to attract people to a research career (e.g. via mentoring programmes, science communication action plans and financial support programmes for students (scholarships), to upgrade the quality of doctoral training (e.g. offering structured programmes in line with the Principles for Innovative Doctoral Training[84]), and post-doctoral career paths (e.g. in-company training programmes, professional development provision and tenure tracks) and to encourage academia-industry partnerships (e.g. via research traineeships in companies and inter-sectoral mobility programmes), in line with the Charter and Code[85].

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

[85] European Charter for Researchers and Code of Conduct for the Recruitment of Researchers

4.2 Introduction

According to recent estimates, Europe needs at least an additional one million researchers by 2020 to meet its R&D targets of 3% GDP[86] and remain competitive worldwide. In addition, Europe is facing a challenging increase in its ageing population that may lead to deterioration in the knowledge-intensity of its labour force and consequently considerable productivity losses[87]. As demonstrated in the first chapter of this report ("The stock of researchers in Europe"), 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 throughout meet the highest international standards 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" [88], where research results are commercialised 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.

In Europe, there is a significant shortage of people taking science to an advanced (doctoral) level and thus, pursuing a research career, albeit the basic education system is good compared with many parts of the world[89]. In the face of a substantial increase in the number of tertiary graduates (at ISCED levels 5[90] & 6[91]) in the EU-27, from around 40 per thousand population in 2000 to 62 in 2008, the European higher education system has weaknesses in science teaching[92]. The 2010 Science and Technology Eurobaro-meter[93] concluded that more than half of Europeans (66%) think that governments are doing too little to stimulate young people's interest in science. This appears to be happening due to the lack of concrete measures and initiatives taken by European countries (national authorities and institutions) to increase people's interest in the research profession, and attract national and foreign students to pursue a research career in Europe[94].

The research excellence of an institution is a key element in attracting future researchers. This is closely related, amongst others, to publication outputs. The higher the number of publications, such as books, journals or scientific articles in journals, the more distinguished and internationally

[86] European Commission (2010a)
[87] European Commission (2011a)
[88] European Commission (2008b)
[89] European Commission (2010a)
[90] ISCED 5A: Tertiary programmes to provide sufficient qualifications to enter into advanced research programmes & professions with high skills requirements.
[91] ISCED 6: Tertiary programmes which lead to an advanced research qualification (PhD).
[92] European Commission (2010b)
[93] European Commission (2010c)
[94] Ibid

recognised a university can be considered to be. However, the number of publications is only one plausible indication of excellence, while the quality itself in terms of usefulness of a publication depends on the citation scores[95]. Europe lags behind the United States in this, but is ahead of Japan and China. Relatively few European universities are in leading positions in the existing international rankings. There are, however, large differences between different EU institutions, some showing excellent results on an international scale.

Enhancing the quality of doctoral training serves as a precondition for excellence and innovation. Insufficient public expenditure on education (primary, secondary and tertiary) by EU Member States could result in a downgrade in the quality of the future labour force and modest innovation performance in Europe[96]. Moreover, the majority of researchers in Europe receive training in a traditional academic setting[97], and are not adequately prepared for the market, manage their intellectual property, obtain employment or set up their own company. Again, according to the Public Consultation on the European Research Area Framework[98], researchers are not well trained to meet business labour market prerequisites (78%), while the majority of respondents (67%) pointed out the importance of increasing researchers' awareness of intellectual property rules and knowledge transfer opportunities.

Against this backdrop, the Europe 2020 Flagship Initiative "Innovation Union"[99] called on Member States to put in place strategies by the end of 2011 aimed at training enough researchers to meet their national R&D targets and improving the quality of doctoral training in research careers. In addition, EU Member States have been urged to develop national skills agendas[100] to address innovation skills shortages while universities must ensure that future graduates are fully equipped with the skills necessary to meet modern knowledge economy challenges[101].

There are also calls for the business sector to be more involved in curricula development and doctoral training, so that entrepreneurial skills better match industry needs. As described in the first chapter of this report ("The stock of researchers in Europe"), in the European Union fewer than one in two researchers work in the private sector. This is largely due to insufficient collaboration between academia and industry. For a detailed discussion on the collaboration between industry and academia, see chapter "Collaboration between academia and industry" in this report.

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

[95] Technopolis Group (2010a)

[96] European Commission (2010a)

[97] European Commission (2008b)

[98] European Commission (2012a)

[99] European Commission (2010b)

[100] The EU-27Member States are requested to develop and support consistent "national skills agendas" to ensure that researchers are equipped with the necessary skills to contribute fully to a knowledge-based economy and society throughout their careers, ensure better links between academia and industry by supporting the placement of researchers in industry during their training and promoting industry financing of PhDs and involvement in curriculum development (European Commission, COM(2008b), p.11).

[101] European Commission (2010b)

proportion of new doctoral graduates in the EU-27, US and Japan, including women and non-EU doctoral graduates studying in Europe. Fourth, it presents statistics on scientific publications and co-publications. Fifth, 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 11: Education and training - Key indicators

Indicators	Data source(s)	Reference year(s)
Population aged 30-34 having completed tertiary education, Europe, 2000 and 2010 (%)	Eurostat Labour Force population survey	2000, 2010
Tertiary graduates (ISCED 5 & 6) per thousand population aged 20-29, EU-27, US and Japan, 2000 and 2008	Eurostat	2000, 2008
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 2009	UNESCO OECD Eurostat education survey	2000, 2009
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 2009	UNESCO OECD Eurostat education survey	2000, 2009
New doctoral graduates (ISCED 6) per thousand population aged 25-34, EU-27, US and Japan, 2000-2009	UNESCO OECD Eurostat education survey	2000, 2009
New doctoral graduates (ISCED 6) per thousand population aged 25-34, Europe, 2009	UNESCO OECD Eurostat education survey	2009
New women doctoral graduates (ISCED 6) per thousand population aged 25-34, Europe, 2000 and 2009	UNESCO OECD Eurostat education survey	2000, 2009
International scientific co-publications per million population, Europe, US, Japan and China, 2010	Science Metrix / Scopus	2010
Scientific publications in the top 10% most-cited publications worldwide as a percentage of total scientific publications, Europe, US, Japan and China, 2007	Science Metrix / Scopus	2007

Source: Deloitte

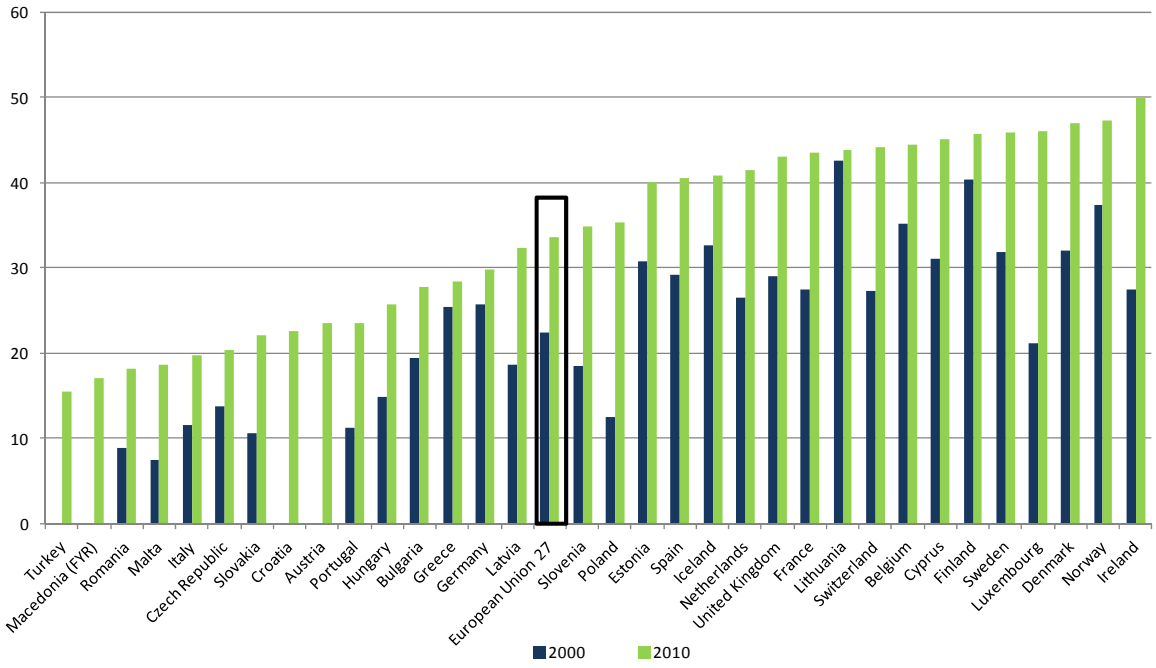
4.4 Tertiary graduates in Europe

The percentage of the EU-27 population aged 30-34 having completed tertiary education averaged 33.6% in 2010, a significant increase of 11.2 percentage points since 2000 (22.4%).

The Europe 2020 growth strategy[102] has 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 2010, the percentage averaged 33.6%, a significant increase of 11.2 percentage points since 2000 (22.4%).

In 2010, twelve EU Member States (along with Iceland, Norway and Switzerland) had achieved or exceeded the target of 40% or more. Ireland was at the top at around 50%. Conversely, eleven EU Member States (together with Croatia, FYROM and Turkey) are below 30%, whereas Estonia, Latvia, Poland and Slovenia reported figures of 30-35%.

Figure 21: Population aged 30-34 having completed tertiary education, Europe, 2000 and 2010 (%)



Source: Deloitte
Data: Eurostat Labour Force population survey.
*Data are unavailable for 2000 in AT, FYROM, HR, and TR.
**Data showing the average population aged 30-34 having completed tertiary education is not available for the US and Japan for 2000 and 2009.

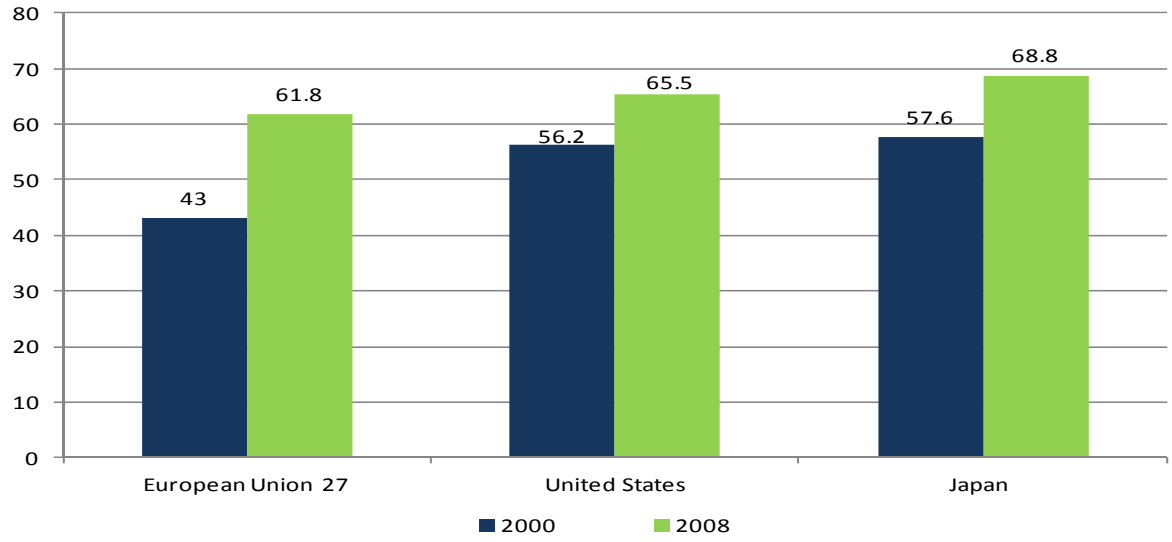
The number of tertiary graduates per thousand population aged 20-29 climbed from 39.3 in 2000 to 61.8 in 2008 (57.3%) in the EU-27, but this is still less than in the United States (65.5) and Japan (68.8).

Between 2000 and 2008, the number of tertiary graduates, both ISCED 5 and 6, increased in the EU-27 as well as in the United States and Japan. In the EU-27, the number of tertiary graduates per thousand population aged 20-29 climbed from 39.3 in 2000 to 61.8 in 2008 (57.3%). The increase in

[102] European Commission (2010d)

the United States was from 56.2 in 2000 to 65.5 in 2008 (16.5%). In Japan, the number of tertiary graduates per thousand population increased by approximately 19.4% from 57.6 in 2000 to 68.8 in 2008. Thus, Japan was in the leading position over the whole period, even if the gap with the other countries narrowed.

Figure 22: Tertiary graduates (ISCED 5 & 6) per thousand population aged 20-29, EU-27, US and Japan, 2000 and 2008



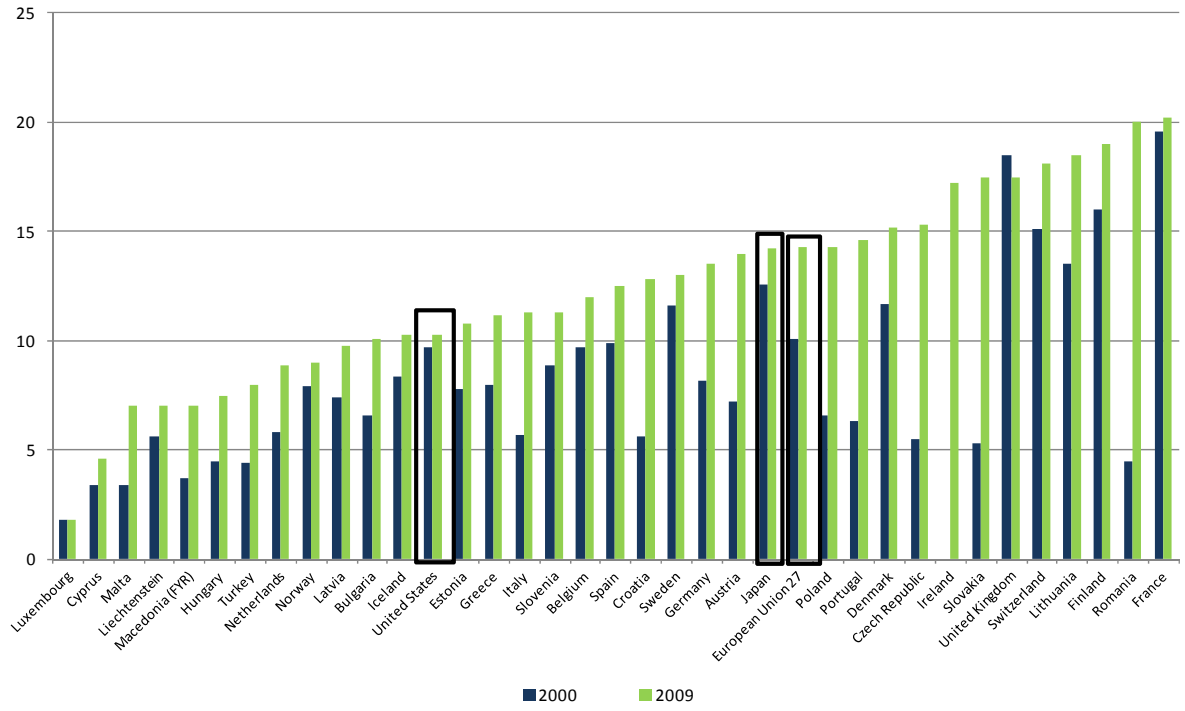
Source: Deloitte
Data: Deloitte, based on Eurostat (UOE).

The number of tertiary graduates in Science, Technology, Engineering and Mathematics (STEM) subjects per thousand population aged 20-29 in the EU-27 increased from 10.1 (in 2000) to 14.3 (in 2009), a higher growth rate than in the US and Japan, but is still less in absolute terms.

In 2009, the proportion of graduates (ISCED 5 & 6) in STEM subjects in the EU-27 was similar to the proportion in Japan (14.3 and 14.2 respectively), but higher than in the United States (10.3). The European countries which reported the highest number (>18) of graduates in STEM subjects were France (20.2), Romania (20), Finland (19), Lithuania (18.5) and Switzerland 18.1). Conversely, the lowest numbers (<8) were reported in Luxembourg (1.8), Cyprus (4.6), Malta (7), Liechtenstein (7), FYROM (7) and Hungary (7.5).

The number of STEM degrees awarded in the EU-27 increased from 10.1 per thousand population aged 20-29 in 2000 to 14.3 in 2009. The positive 2000-2009 trend in the EU-27 figure for tertiary STEM graduates per thousand population applied to almost all countries (with the exception of Ireland, Luxembourg and the UK), albeit with a variation in the extent of growth. Between 2000 and 2009, as demonstrated in the figure below, some considerably increased the number of graduates in STEM, such as (in descending order) Romania (from 4.5 to 20), Slovakia (from 5.3 to 17.5), the Czech Republic (from 5.5 to 15.3), Portugal (from 6.3 to 14.6) and Poland (from 6.6 to 14.3).

Figure 23: 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 2009



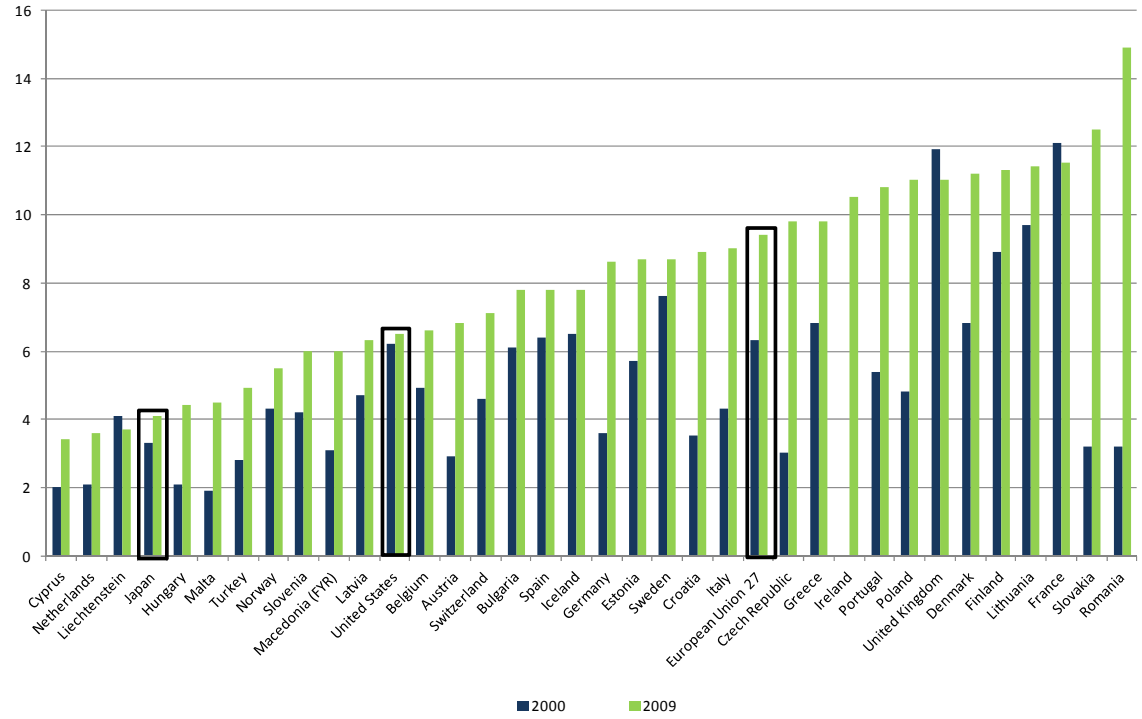
Source: Deloitte
Data: UNESCO OECD Eurostat education survey
*Data are unavailable for Ireland for 2000.

The number of women graduates in STEM subjects per thousand women population aged 20-29 increased from 6.3 (in 2000) to 9.4 (in 2009), significantly outstripping the increase in the US and Japan, but is still less in absolute terms.

In 2009, the proportion of women graduates in STEM subjects (ISCED 5 & 6) per thousand women aged 20-29 in the EU-27 was 9.4, more than in the United States (6.5) and Japan (4.1). The ratio was highest (>10) in a number of the new EU Member States such as Romania (14.9), Slovakia (12.5), Lithuania (11.4) and Poland (11) as well as in France (11.5), Finland (11.3), Denmark (11.2) and the UK (11). Conversely, the lowest numbers (<5) were in the following European countries: Cyprus (3.4), the Netherlands (3.6), Liechtenstein (3.7), Hungary (4.4), Malta (4.5) and Turkey (4.9).

The number of women graduates in STEM the EU-27 increased from 6.3 graduates per thousand women population aged 20-29 in 2000 to 9.4 in 2009. Although the vast majority of countries conformed to the increasing trend, the extent of their growth differs substantially. Between 2000 and 2009, a number of EU countries noticeably increased the number of women graduating in STEM, such as (in descending order) Romania (from 3.2 to 14.9), Slovakia (from 3.2 to 12.5), Czech Republic (from 3 to 9.8), Poland (from 4.8 to 11), Portugal (from 5.4 to 10.8) and Germany (from 3.6 to 8.6). Conversely, the figures for the United Kingdom, France and Liechtenstein decreased in the same time period.

Figure 24: 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 2009



Source: Deloitte
Data: UNESCO OECD Eurostat education survey.
* Data are unavailable for both 2000 and 2009 in LU.
** Data are unavailable for Ireland for 2000.

4.5 New doctoral graduates in Europe

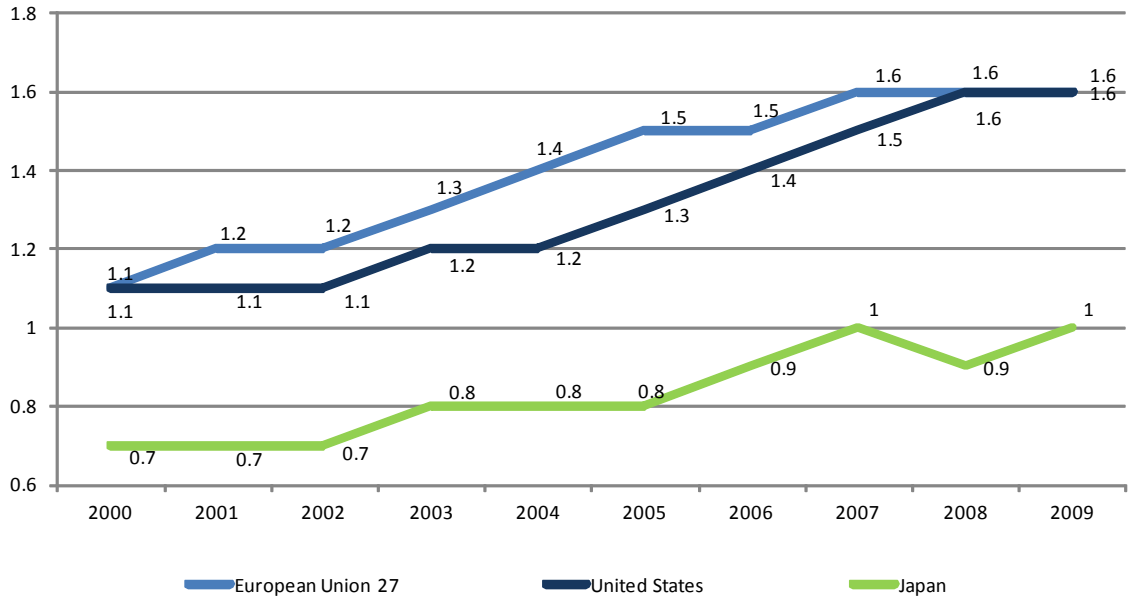
The number of new doctoral graduates in the EU-27 has risen signfiicantly in the past decade, increasing from 83 000 in 2001 to around 115 000 in 2010.

The number of new doctoral graduates in the EU-27 increased from 82 705 (in 2001) to around 115 000[103] (in 2010). The increase for the US was from 44 904 in 2001 to 69 570 in 2010. In Japan, the number of new doctoral graduates increased from 13 179 in 2001 to 15 867 in 2010.

The number of new doctoral graduates (ISCED 6) per thousand population aged 25-34 in the EU-27 increased from 1.1 in 2000 to 1.6 in 2010. The increase in the United States was from 1.1 in 2000 to 1.6 in 2009, while in Japan, it went from 0.7 in 2000 to 1.0 in 2009.

[103] European Commission estimate based on some provisional figures.

Figure 25: New doctoral graduates (ISCED 6) per thousand population aged 25-34, EU-27, US and Japan, 2000-2009



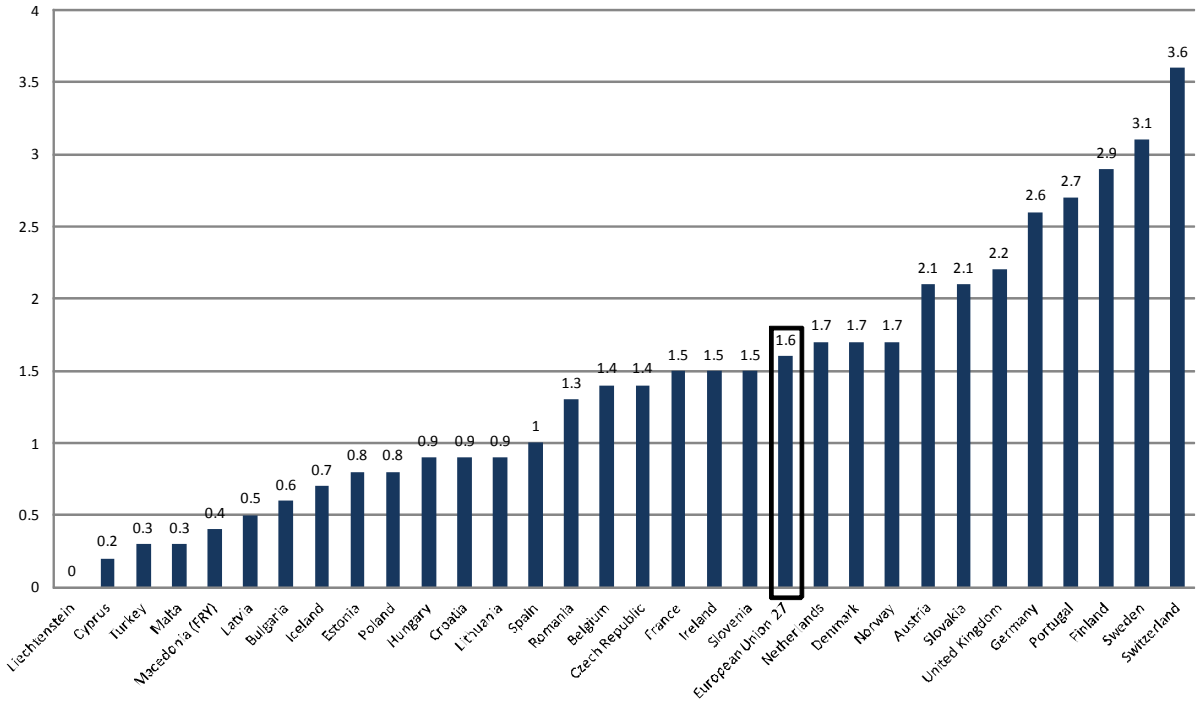
Source: Deloitte
Data: UNESCO OECD Eurostat education survey.

The highest number of new doctoral graduates per thousand population aged 25-34 in Europe in 2001 was in Switzerland. The leading EU-27 countries were Sweden and Finland.

In 2009[104], the average number of new doctoral graduates per thousand population aged 25-34 for the EU-27 was 1.5, with a range from 3.6 in Switzerland to 0.5 or less in several European countries. The countries can be grouped into three clusters: those countries with a number of new ISCED 6 graduates between 2.1 and 3.6 per thousand population, those with a range of 1.0-1.7 and those at below 1.0.

[104] While an estimate for the EU is available for 2010, the latest available data by Member State are for 2009.

Figure 26: New doctoral graduates (ISCED 6) per thousand population aged 25-34, Europe, 2009

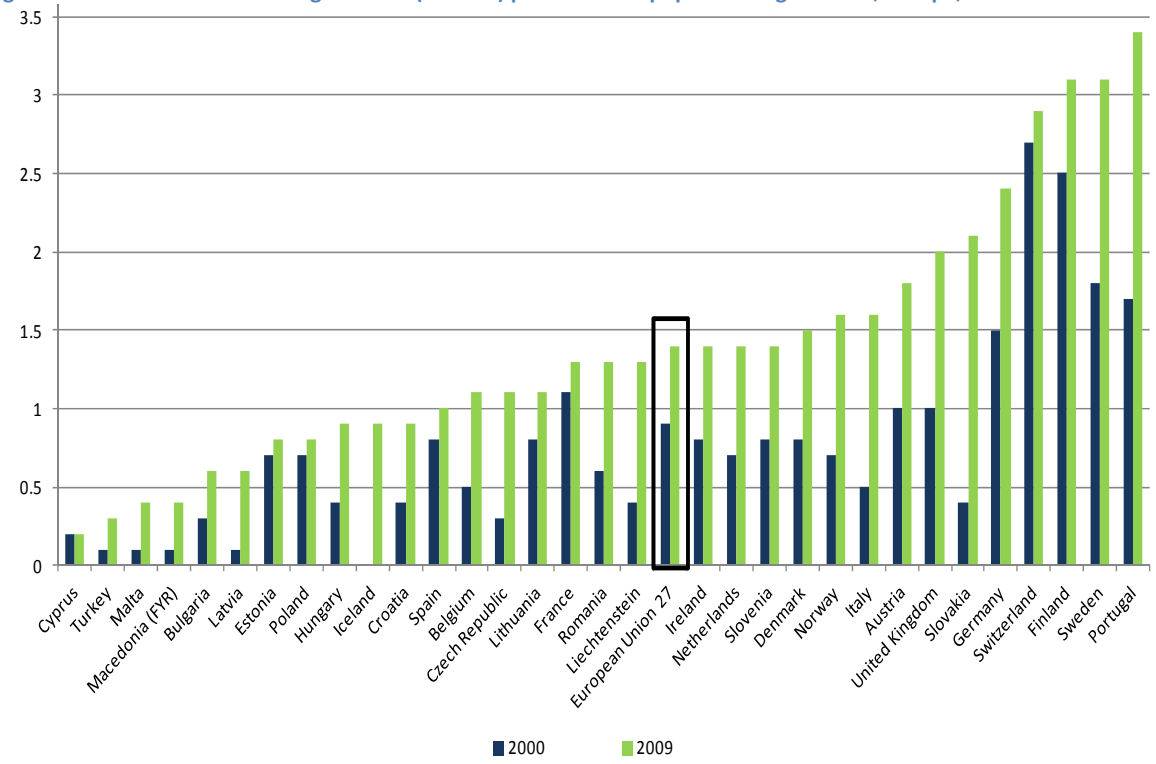


Source: Deloitte
Data: UNESCO OECD Eurostat education survey
* Data are unavailable for EL.

The average number of new women doctoral graduates in the EU-27 increased by from 0.9 to 1.4 per thousand women in the population aged 25-34 between 2000 and 2009. In 2009, Portugal reported the highest number of new women doctoral graduates; Cyprus the lowest.

Between 2000 and 2009, the number of new women doctoral graduates (ISCED 6) per thousand population aged 25-34 increased in all European countries (with the exception of Cyprus where the number did not change). Between 2000 and 2009, Slovakia, Liechtenstein and Italy reported the highest increase in the proportion of new women doctoral graduates. In France, Estonia, Poland, Spain and Switzerland the number increased only slightly, but from different baselines. Switzerland had the highest starting point, whereas Estonia was and remained below the EU average.

Figure 27: New women doctoral graduates (ISCED 6) per thousand population aged 25-34, Europe, 2000 and 2009



Source: Deloitte
Data: UNESCO OECD Eurostat education survey.
* Data are unavailable for both 2000 and 2009 in EL.
** Data are unavailable for 2000 in IS.

4.6 Attractiveness of institutions and research excellence

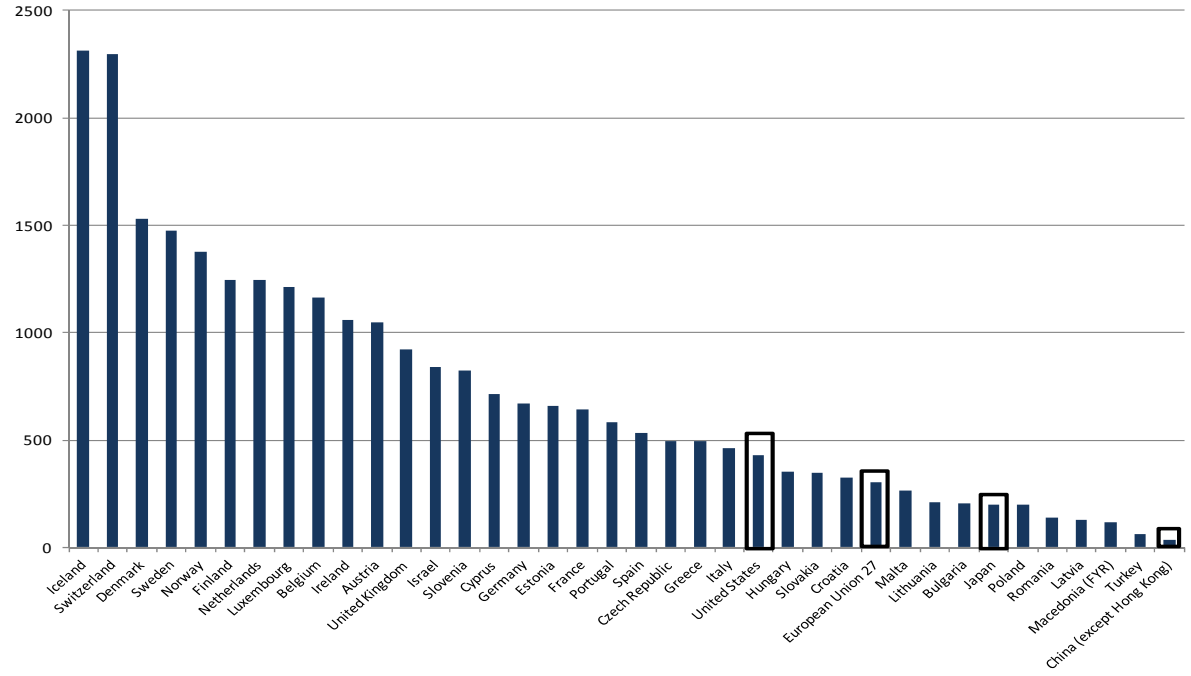
In 2010, the EU-27 was the runner-up in the production of international scientific co-publications behind the United States.

In 2010, the EU-27 lagged behind the United States in terms of international scientific co-publications per million population[105]. The EU-27 average was around 300 co-publications per million population in comparison with around 430 in the United States, 200 in Japan and 37 in China. The EU average is relatively low as here only co-publications with non-EU countries are included.

Iceland and Switzerland have very high levels, of more than 2 000 co-publications per million population followed by a number of Nordic countries such as Denmark, Sweden, Norway and Finland (in descending order) 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 Czech Republic, Hungary, Slovakia, Lithuania, Bulgaria, Poland and Romania (in descending order).

[105] 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).

Figure 28: International scientific co-publications per million population, Europe, US, Japan and China, 2010



Source: Deloitte
Data: Science Metrix/Scopus.
No data for Serbia. Statistical outliers: Denmark, Sweden.

In 2007, the EU-27 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, an indicator even more important than the sheer number of scientific co-publications is the 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. On average, a country is expected to have 10% of its publications among the top 10% most cited worldwide. A value higher than 10% means that the country tends to produce highly cited publications more often than the average.

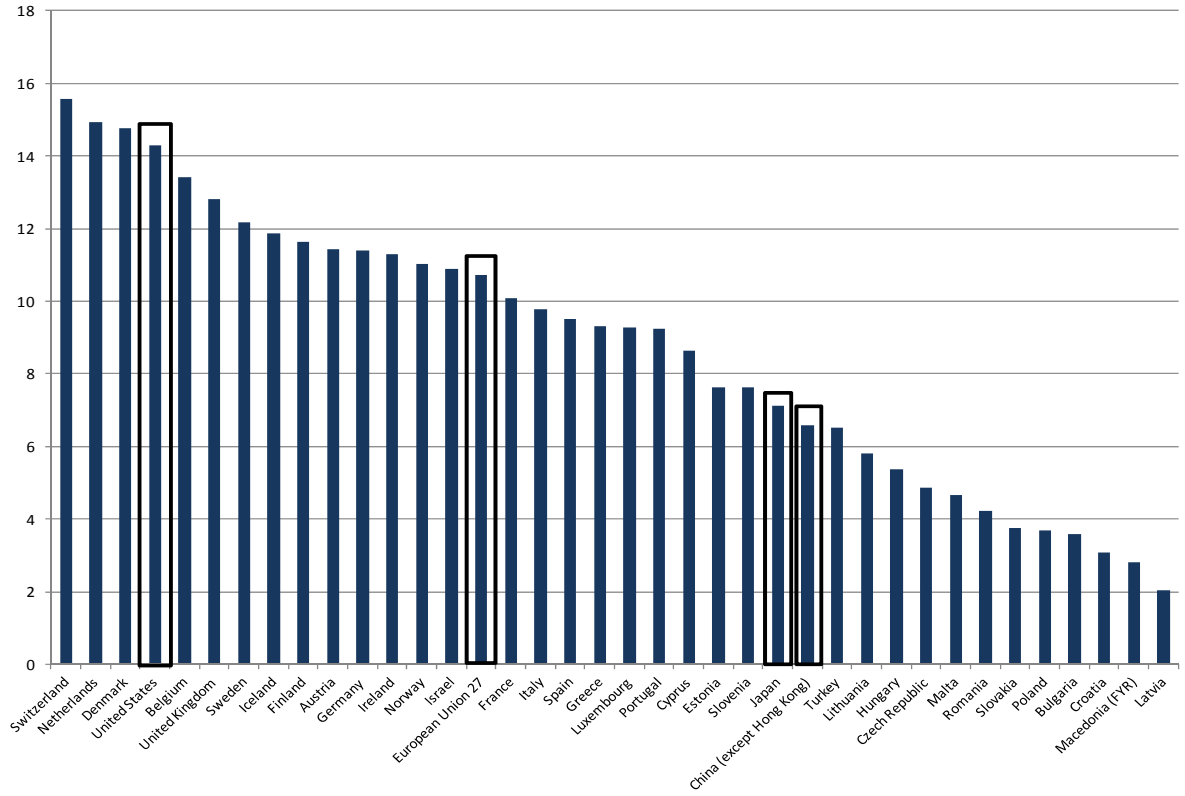
In 2007, the ratio of EU's contribution to the 10% most cited scientific publications was 1.16, lagging behind the United States with a ratio of 1.53, although well above the ratios of Japan and China[106]. The EU-27 produced 10.73 scientific publications in the top 10% most-cited publications worldwide in comparison with 14.31 scientific publications produced in the United States.

Individually, the best performance (>10%) in the EU-27 was shown (in descending order) by Netherlands, Denmark, Belgium, UK, Sweden, Finland, Austria, Germany, Ireland and France. Countries like France and Germany, where researchers publish relatively more in their own language, are more likely to underperform on this indicator as compared to their real academic excellence[107].

[106] European Commission (2011b)
[107] European Commission (2011c)

Performance in Latvia is poor, and to a lesser extent in Croatia, Bulgaria, Poland, Slovakia and Romania.

Figure 29: Scientific publications in the top 10% most-cited publications worldwide as a percentage of total scientific publications, Europe, US, Japan and China, 2007



Source: Deloitte
Data: Science Metrix/Scopus.

4.7 Attracting people to science and providing quality training for researchers

European countries are implementing various measures to attract people to a research career (e.g. via mentoring programmes, science communication action plans and financial support programmes for students (scholarships)), to upgrade the quality of doctoral training (e.g. offering structured programmes in line with the Principles for Innovative Doctoral Training [108]) and post-doctoral career paths (e.g. in-company training programmes, professional development provision and tenure tracks) and to encourage academia-industry partnerships (e.g. via research traineeships in companies and inter-sectoral mobility programmes), in line with the Charter and Code[109].

Europe needs to safeguard a sufficient supply of highly qualified researchers to both promote research and development, and accelerate the introduction of innovative business models by European enterprises[110]. In an attempt to increase research culture, many European countries have developed measures to attract students to the research world and systematically expose students to

[108] Available at: http://ec.europa.eu/euraxess/pdf/research_policies/Principles_for_Innovative_Doctoral_Training.pdf
[109] European Charter for Researchers and Code of Conduct for the recruitment of researchers
[110] European Commission (2010b)

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.

Universities increasingly offer doctoral training in structured programmes in line with the Principles for Innovative Doctoral Training[111], which reflect the Salzburg Principles and the Recommendations of EUA[112], Member States' good practice[113] 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[114].

The principles relate to:

1. Research Excellence
2. Attractive Institutional Environment (in line with the Charter and 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[115] 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.

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

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

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

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

[115] 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 12: 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	Collaboration between academia and industry
AUSTRIA	✓✓✓✓✓✓✓✓	✓✓✓✓✓✓✓✓	✓✓✓✓✓✓✓✓✓✓✓✓✓✓✓✓
BELGIUM	✓✓✓✓	✓✓✓✓✓✓	✓✓✓✓✓✓✓
BOSNIA AND HERZEGOVINA	✓✓✓✓✓	✓	✓
BULGARIA	✓✓✓✓✓✓✓	✓✓✓✓	✓✓✓✓
CROATIA			✓✓✓✓✓✓✓
CYPRUS	✓✓✓	✓✓✓✓✓✓✓✓	✓✓✓✓
CZECH REPUBLIC	✓	✓	✓
DENMARK	✓✓✓✓✓✓✓✓✓	✓	✓✓✓✓✓✓✓✓
ESTONIA	✓✓✓✓✓✓✓	✓✓✓✓	✓✓✓✓✓✓✓
FINLAND	✓✓✓✓	✓✓	✓✓✓✓
FRANCE	✓✓✓	✓✓✓✓✓	✓✓✓✓
MACEDONIA (F.Y.R.)	✓	✓	✓
GERMANY	✓✓✓✓✓✓✓✓✓	✓✓✓✓	✓✓
GREECE		✓✓	✓✓✓✓✓✓
HUNGARY	✓✓	✓	✓
ICELAND	✓	✓✓	✓✓✓
IRELAND	✓✓✓✓✓✓	✓✓✓✓✓✓	✓✓✓
ISRAEL		✓	✓
ITALY	✓✓	✓✓	✓✓✓
LATVIA		✓	✓✓✓
LIECHTENSTEIN			✓
LITHUANIA	✓✓✓✓✓✓	✓✓✓	✓✓✓✓
LUXEMBOURG	✓✓	✓	✓
MALTA	✓✓✓✓✓✓✓	✓	✓✓✓✓
MONTENEGRO	✓	✓	
NETHERLANDS	✓✓✓✓	✓	✓✓
NORWAY	✓✓✓✓✓✓✓✓✓✓✓	✓✓✓	✓✓✓✓✓
POLAND	✓✓✓✓✓✓		✓✓✓✓✓✓✓✓✓
PORTUGAL	✓	✓✓	✓
ROMANIA	✓	✓✓✓✓	✓✓
SERBIA	✓✓	✓✓✓	✓
SLOVAK REPUBLIC	✓✓✓✓✓✓✓	✓✓	✓✓✓
SLOVENIA	✓✓✓✓✓	✓✓✓✓	✓✓✓✓
SPAIN	✓✓✓	✓✓✓	✓✓✓✓✓✓
SWEDEN		✓✓	✓✓✓
SWITZERLAND	✓✓✓	✓✓✓✓✓✓✓	✓✓✓✓
TURKEY		✓	✓✓✓
UNITED KINGDOM	✓✓✓✓✓✓	✓✓✓✓✓✓	✓✓✓

Source: Deloitte, "Researchers' Report 2012", Annex 'Country files'.

* Information presented in the table is based on individual country responses to the Deloitte Questionnaire (2011).

The measures are grouped 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 to potentially 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 groups 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 [116] to improve researchers' employment skills and competencies at all career stages (from early career to star researchers). It

[116] European Commission (2009b)

also covers national qualifications frameworks, skill grids, doctoral studies curricula and other career 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[117]. 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 in place various measures in all three categories.

In relation to the first category, a significant majority of European countries have 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 recently 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 Initiative' (Austria) supports RTD talent (particularly women) by offering traineeships for pupils and providing financial support for (regional) education projects in schools in the field of mathematics, informatics, science and technology.

The České Hlavičky Contest (Czech Republic) aims to inspire, encourage and support talented young people to pursue a career in science, and, mainly in the fields of engineering and natural sciences. It targets children in their final years of primary school as well as high school students. In the context of the annual nationwide contest, prizes are awarded to the participants in five categories. A jury composed of representatives of associations, universities, and scientific institutions selects the winners. Each winner receives a financial prize, a diploma, and an original "České Hlavičky" award. The winners are also present at a press conference and a gala soirée.

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.

[117] Ibid

Finally, European countries' measures to boost partnerships between universities, research institutions and private companies include the implementation of joint projects, commercialisation programmes, 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 National Roadmap for Research Infrastructure (Bulgaria) supports networking and cooperation between academia and business by providing expertise and creates conditions for quick commercialisation of scientific products and services to enhance the dynamics of economic development.

5. Working conditions in the researcher profession

5.1 Working conditions in the researcher profession – Highlights

Researchers' contractual conditions and remuneration:

- The majority of EU researchers (59%) have an open-ended (permanent) contract while others have fixed-term contracts of varying duration (2009 data);
- Researchers' 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.

Researchers' career development – mobility, life-long learning and European Charter and Code:

- For the vast majority of EU researchers (80%), mobility has had a positive impact on their career progression across different employment sectors;
- Measures aimed at encouraging life-long learning (e.g. via dedicated career programmes) and improving working conditions (e.g. via the European Charter and Code) show a positive impact on researchers' career development and overall job satisfaction.

Social security in the researcher profession:

- 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, 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, 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 European Research Area. 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.

However, research careers in the public sector in Europe are relatively unattractive. According to the Public Consultation on the European Research Area Framework[118], more than 80% of respondents believe that the working conditions and career prospects of public sector researchers are less attractive than those of other professionals with similar qualifications. They consider unclear career prospects, a lack of (research) funding by universities and research institutions, relatively low wages in academia and insufficient cooperation between academia and the private sector as the main inhibiting factors for ensuring attractive careers in Europe.

[118] European Commission (2012a)

In many Member States, there is a two-tier workforce characterised by young researchers employed on temporary short-term contracts with limited job security and limited access to social security, and senior researchers on permanent contracts with progression based on seniority rather than performance[119]. There are significant variations between researchers' salary levels between the European Research Area 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. The vast majority (85%) of respondents to the ERA Public Consultation[120] consider a lack of career prospects and development opportunities as an 'important' or 'very important' inhibiting factor for an attractive career in research.

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. Firstly, it offers an overview of the key indicators for monitoring working conditions in research. Secondly, it sheds light on the contractual conditions of researchers in Europe. Thirdly, it presents statistics on the remuneration levels at different stages of a researcher career in Europe and at international level. Fourthly, 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 researcher 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 13: Working conditions in the researcher profession - Key indicators

Indicators	Data source(s)	Reference year(s)
Estimated shares of researchers in the higher education sector by employment contract status and by country of affiliation, EU-27, 2009 (%)	MORE study[121]	2009
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	2008 (US), 2009
Percentage of researchers indicating that their time as mobile researcher had positive, negative or no impact on career progression, EU-27, 2009	MORE study	2009

Source: Deloitte

5.4 Employment contracts in the researcher profession

In 2009, the majority of EU researchers in public institutions (59%) had an open-ended (permanent) contract while others had fixed-term contracts of varying duration.

[119] European Commission (2008b)
[120] European Commission (2012a)
[121] Idea Consult (2010)

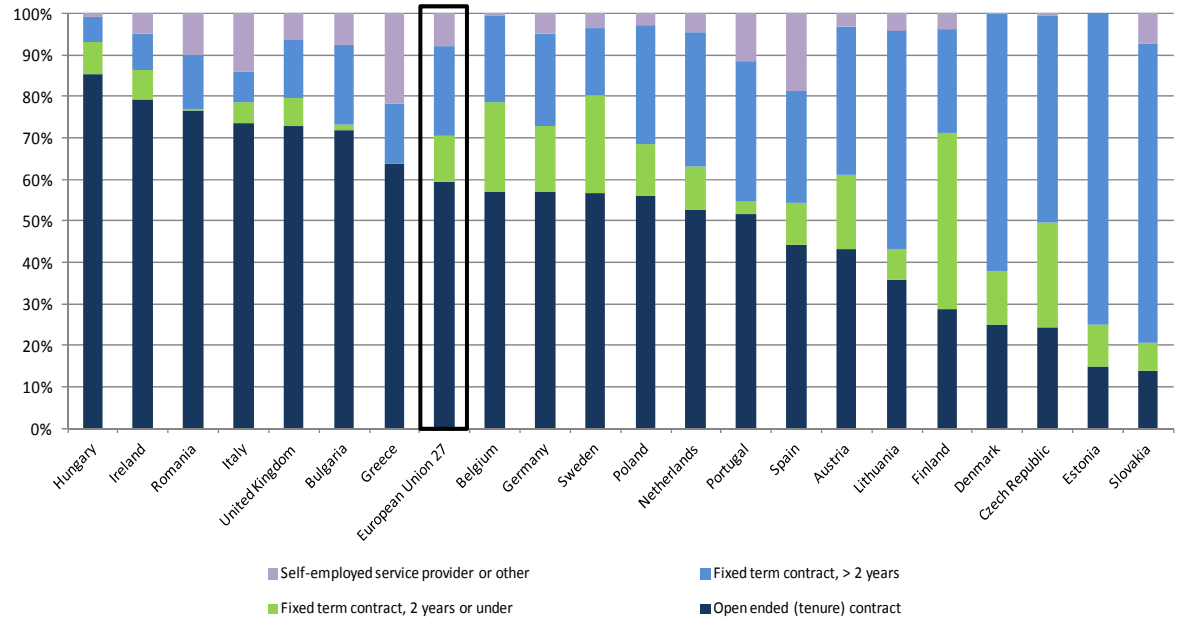
The type of employment contract has a significant impact on the attractiveness researchers' employment and working conditions. Young researchers are often employed on temporary short-term contracts to help carry out specific research projects to the detriment of academic independence, job security and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

In 2009, the majority of EU researchers (59%) had an open-ended (tenure) contract while others had fixed-term contracts of varying duration: more than two years (21%), between one and two years (7%), less than one year (4%) and 'other contracts' (8%). A small minority (<1%) of EU researchers had a contract as a self-employed service provider.

In 2009, the highest proportion of public sector researchers with an open-ended or fixed-term contract of more than two years was in a number of the new Member States.

In 2009, the highest proportion of researchers in the higher education sector employed on an open-ended contract (>70%) was in a number of the old Member States, e.g. Ireland (79%), Italy (73%) and the UK (73%). In the same year, the highest share of researchers with a fixed-term contract of more than two years (>50%) was in a number of new Member States, e.g. Estonia (75%), Slovakia (72%) and Lithuania (53%). Researchers with a fixed-term contract of two years or under ranged (in descending order) from 43% in Finland to less than 1% in Greece and Romania. 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.

Figure 30: Estimated shares of researchers in the higher education sector by employment contract status and by country of affiliation, EU-27, 2009 (%)



Source: Deloitte
*Data: MORE study, question: "What is your employment contract status"?
**Data are unavailable for CY, FR, LU, LV, MT and SI.

***The realised sample of respondents to this question was as follows: 12% of the population were doctoral/PhD students, 34% were post-doctoral researchers and 54% were in the residual "other researcher category"[122]. For 2007, there were 525 809 PhD students in the EU-27 (excluding Germany and Luxembourg, since there were missing values for these two countries), including foreign doctoral candidates in each EU MS. For the same year, there were 116 698 foreign doctoral candidates in the EU-27, with missing values for Germany, Ireland, Greece, Luxembourg and Netherlands. This implies that in 2007 there were about 42% PhD students among all EU-27 researchers in the higher education sector (excluding Germany, Ireland, Greece, Luxembourg and Netherlands). Evidently, not all PhD students had been counted as researchers in the EU-27 and consequently, the group of PhD students in the Mobility Survey is smaller (under-represented) compared with the share of PhDs in the EU-27 population of researchers in the higher education sector. In addition, MORE HEI survey showed that Italy (2%) and Greece (3%) had the lowest shares of doctoral/PhD students in the realised survey sample, while Finland (41%) and Austria (37%) has the highest shares. Romania (58%) and Poland (56%) had the highest shares of postdoctoral researchers, and Estonia (13%) and Greece (14%) had the lowest shares. Greece (84%) and Italy (77%) had the highest shares of researchers in "other researcher" categories, while this share was lowest in Slovakia (28%) and Finland (30%).

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 European Research Area 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[123]. The difference in median gross national earnings of doctorate holders[124] employed as researchers compared with those working as non-researchers in different sectors provides a useful indication of researchers' salary levels.

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: gross annual earnings of doctorate holders in the 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 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 countries such as Bulgaria, Croatia, Hungary, Lithuania, Romania, Spain and the Netherlands.

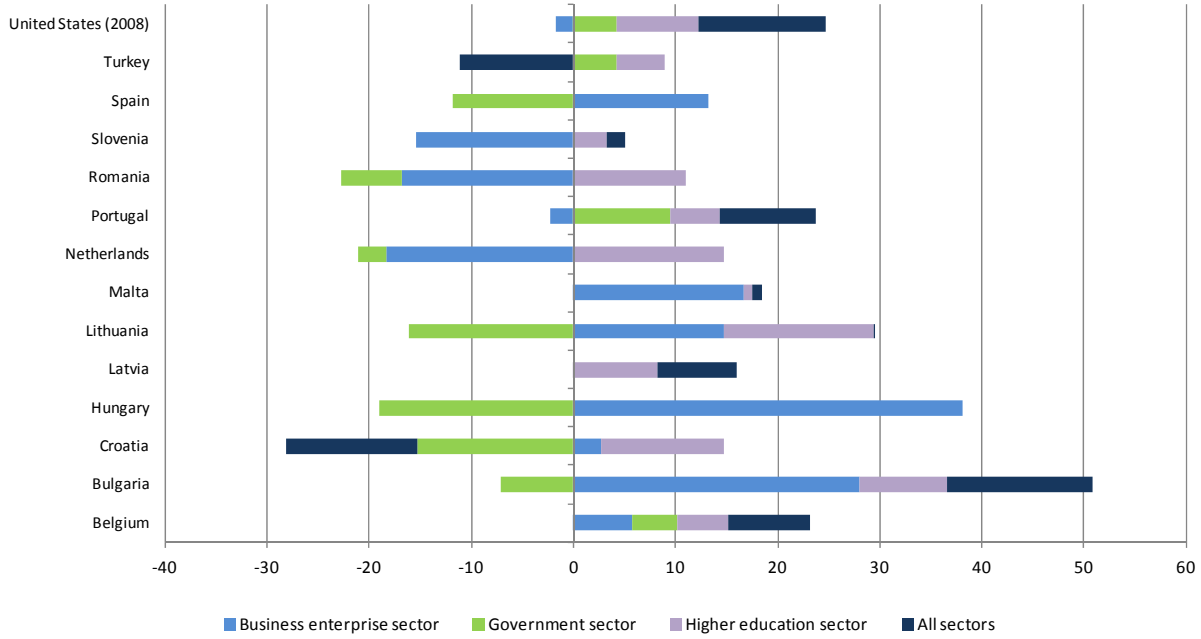
The MORE2 study will provide additional information on researchers' remuneration.

122 The category "other" refers to: (i) researchers who have moved between public and private sectors at various stages and (ii) researchers who are employed in the public sector, but at the same time work in the private sector (for example, a part-time job or they have their own firm).

123 European Commission (2008b)

124 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.

Figure 31: 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.

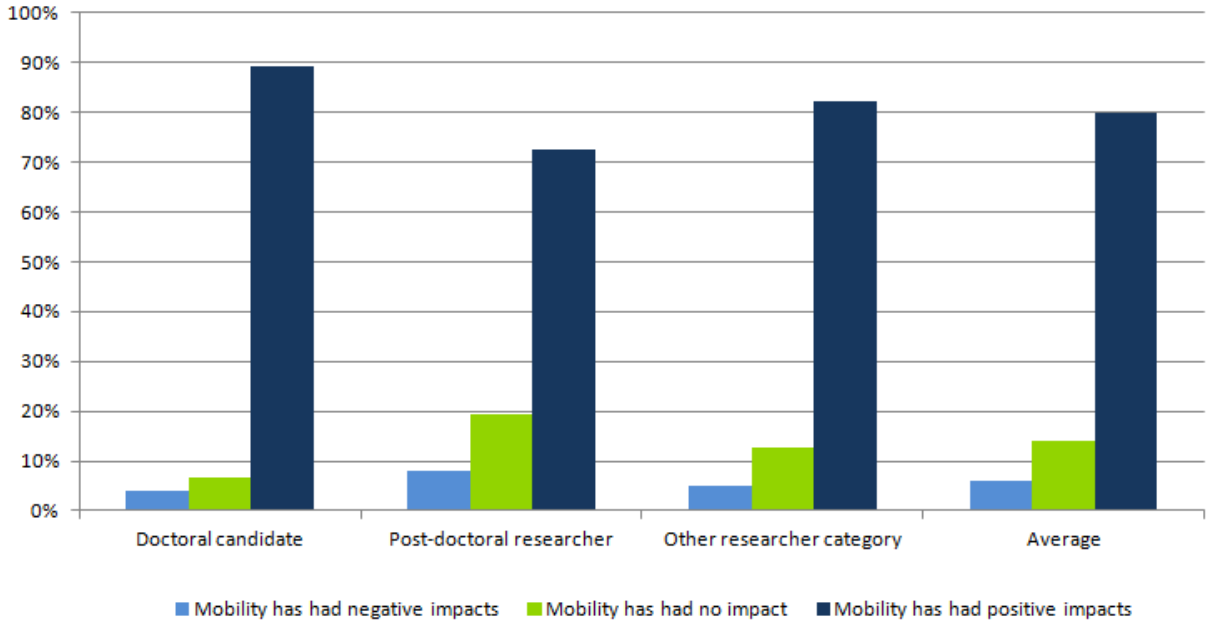
5.6 Researchers' career development – mobility, life-long learning and Charter and Code

For the vast majority of EU researchers (80%), 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. On average, 80% of internationally mobile researchers[125] in the EU-27 state that mobility had a positive impact on their career progression. The vast majority of doctoral candidates (89%) and post-docs (73%) underline the positive impact mobility had on their careers. Only a small minority of doctoral candidates (4%) and post-doctoral researchers (8%) state that mobility has had a negative impact on their career progression.

[125] Mobile researchers are defined as researchers in the higher education sector who have worked in a country other than the country where they attained their highest educational degree, including research visits of three months or more.

Figure 32: Percentage of researchers indicating that their time as mobile researcher had positive, negative or no impact on career progression, EU-27, 2009



Source: Deloitte
Data: MORE study

Measures aimed at encouraging life-long learning (e.g. via dedicated career programmes) and improving working conditions (e.g. via the European Charter and Code) show a positive impact on researchers' career development and overall job satisfaction.

Vitae, the UK organisation championing researchers and research staff, launched the new Researcher Development Framework (RDF). In this Framework, thirty major UK organisations (e.g. Funding Councils, Research Councils, 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[126].

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.

EU Member States support the implementation of the European Charter and Code for Researchers[127]. 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,

[126] Final Report forthcoming
[127] Council of the European Union (2008b)

transferring, sharing and disseminating knowledge and technological development, and to the career development of researchers. The objectives of promoting the Charter and Code principles are to improve researchers' working conditions in accordance with common European principles (as set in the Charter and Code).

For example, the promotion of the Charter and Code and broad implementation of their principles at Austrian universities is part of the negotiations for 2010-12 performance agreements with universities. The implementation of the Charter and Code is part of the National Action Plan for Researchers. In Austria, 18 universities have signed the Charter and Code. In addition, four funding organisations, three umbrella organisations, two research organisations and one university of applied sciences have signed the Charter and Code.

Over 1 000 universities, research institutes and funding agencies have signed up to the Charter and Code, directly or indirectly via their umbrella organisations[128]. Over 100 have received the "HR Excellence in Research" logo for their progress in implementing the Charter and Code[129].

5.7 Social security benefits (sickness, unemployment, old-age) [130]

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[131].

The EU ministers responsible for research (Competitiveness Council) met on 2 March 2010 to discuss European researchers' mobility and careers. In their Conclusions, they 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"*[132].

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[133].

[128] Available at: http://ec.europa.eu/euraxess/index.cfm/rights/charterAndCode
[129] Available at: http://ec.europa.eu/euraxess/index.cfm/rights/strategy4Researcher
[130] For a detailed overview of the countries' social security provisions for researchers (sickness, unemployment and old-age), see Annex II.
[131] European Commission (2005a)
[132] Available at: http://www.consilium.europa.eu/uedocs/cms_data/docs/pressdata/en/intm/113121.pdf
[133] European Commission (2005a)

6. Collaboration between academia and industry

6.1 Collaboration between academia and industry – Highlights

Collaboration between researchers from academia and industry:

- Only one in three public sector researchers in the EU-27 collaborates formally with researchers from the business sector and only one in five do so across borders (2009 data);
- The number of cross-sector scientific co-publications per million inhabitants is considerably higher in the US and Japan than in the EU;
- On average only 17% of EU researchers have been employed in both the public and private sector (2009 data);
- Cross-sectoral mobility is mostly from the public to the private sector, with low levels of movement in the other direction, or flows back and forth.
- Only 22% of respondents to the ERA public consultation felt that EU researchers are equipped for the business sector market. Three in four acknowledge lack of awareness of intellectual property rules and knowledge-transfer opportunities.

Countries' measures to increase collaboration between academia and industry:

- European countries have put in place various measures to boost partnerships between universities, research institutions and private companies. These include the implementation of joint projects, commercialisation programmes, research traineeships in companies, inter-sectoral mobility programmes and industrial PhD programmes. Some countries also encourage and sustain long-term cooperative partnerships (for instance, under a memorandum for cooperation), whereas other countries prefer to create networking platforms and innovation clusters to link universities and the business world.

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"[134]. Close collaboration between research, education and innovation is vital for the realisation of the European Research Area and for maintaining Europe's competitiveness vis-à-vis its main economic competitors (US, Japan and China). However, progress to date in concrete implementation of effective partnerships between business and academia has not been systematic[135].

As described in the first chapter of this report ("The stock of researchers in Europe"), the degree of researcher employment in the business sector differs significantly between the EU and other major economies. The business sector in Europe needs additional researchers to keep up with its international competitors. The comparatively lower share of EU researchers employed in the business sector is partly due to insufficient collaboration between academia and industry. There are other plausible reasons for the lower share of researchers employed in the business sector such as researchers' inadequate skills sets, training, a lack of entrepreneurial mind-set, etc.

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

[135] European Commission (2010a)

Individuals frequently prefer to be employees rather than employers, to the detriment of the development of innovative start-ups and SMEs[136]. It is important to note that Europe is not homogenous in this respect; there are stark differences between countries with regard to collaboration between academia and industry. Austria, Germany and Norway, for example, have introduced a plethora of measures aimed to encourage partnerships between academia and industry while Hungary, the Netherlands and Portugal report fewer measures in this respect[137].

Consequently, there is a need to develop a strong relationship between the academic world and the business sector with a view to attracting and absorbing more researchers as well as establishing "an environment of open innovation"[138], where research results are commercialised and ideas are exploited effectively. As described in the chapter on "Education and training" in this report, European countries have put in place various measures to boost partnerships between academia and industry[139]. A further analysis is needed to assess the direct and indirect effects of these measures on the collaboration between academia and industry. Especially for some of the more recent measures it is too early to assess the impact.

Outline

This chapter presents the most recent data on collaboration between academia and industry in Europe and in comparison with its main economic competitors (US, Japan and China). First, it offers an overview of the key indicators for monitoring collaboration between academia and the business sector. Second, it presents the most recent figures for the EU-27, 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. Third, it presents statistics on the proportion of public sector researchers with formal collaboration with the private sector in different EU Member States. Fourth, it offers information on the share of public sector researchers with formal collaboration with researchers from other countries by sector of employment.

6.3 Collaboration between academia and industry – Key indicators

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

[136] Ibid.

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

[138] European Commission (2008b)

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

Table 14: Collaboration between academia and industry - Key indicators

Indicators	Data source(s)	Reference year(s)
Researchers indicating they have been employed in both the public and private sector, EU-27, 2009 (%)	MORE study[140]	2009
Researchers indicating they have been employed in both the public and the private sector, by field of science (Social Science and Humanities, Natural Sciences and Technology, Medical Sciences and Agriculture) and by career stage (doctoral/PhD students, post-doctoral researchers, 'other researcher' category), EU-27, 2009 (%)	MORE study	2009
Public sector researchers with formal collaboration with business sector researchers from the country where they principally work, EU-27, 2009 (%)	MORE study	2009
Public sector researchers with formal collaboration with researchers from other countries, by sector (academia and business, business, academia) EU-27, 2009 (%)	MORE study	2009
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	2003, 2008

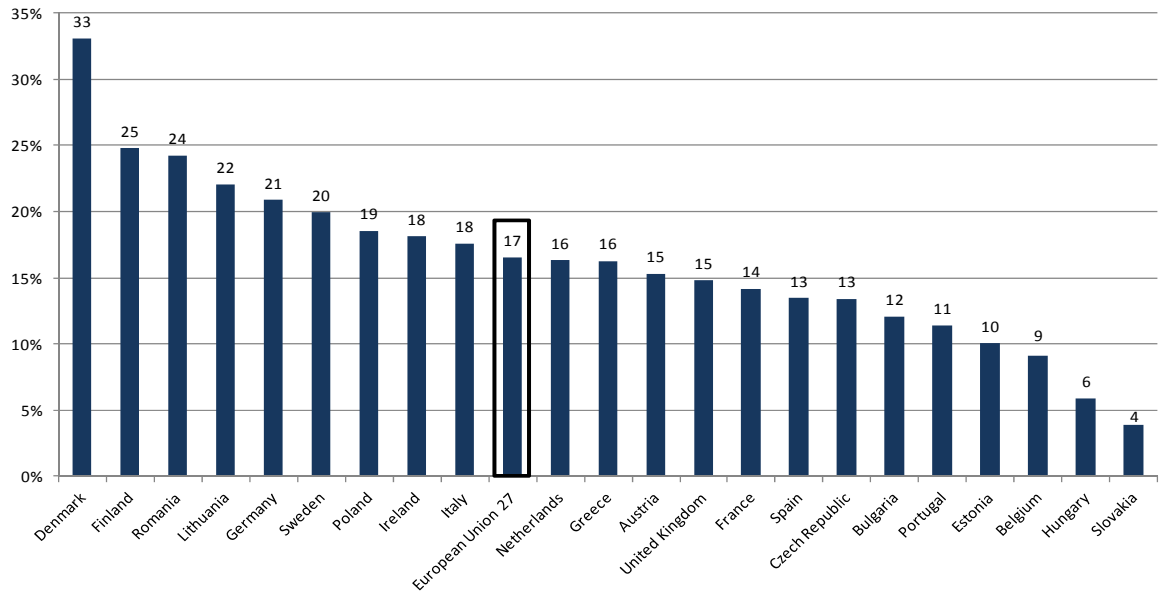
Source: Deloitte

6.4 Collaboration between the public and private sector

In 2009, on average 17% of EU researchers had been employed in both the public and private sector.

In 2009, the percentage of researchers who had been employed in both the public and the private sector was highest (≥25%) in a couple of Nordic countries, e.g. Denmark (33%) and Finland (24%), and lowest (≤10%) in a some of the new Member States, e.g. Estonia (10%), Hungary (6%) and Slovakia (4%).

Figure 33: Researchers indicating they have been employed in both the public and private sector, EU-27, 2009 (%)



Source: Deloitte
Data: MORE study
* Data unavailable for CY, LU, LV, MT and SI.

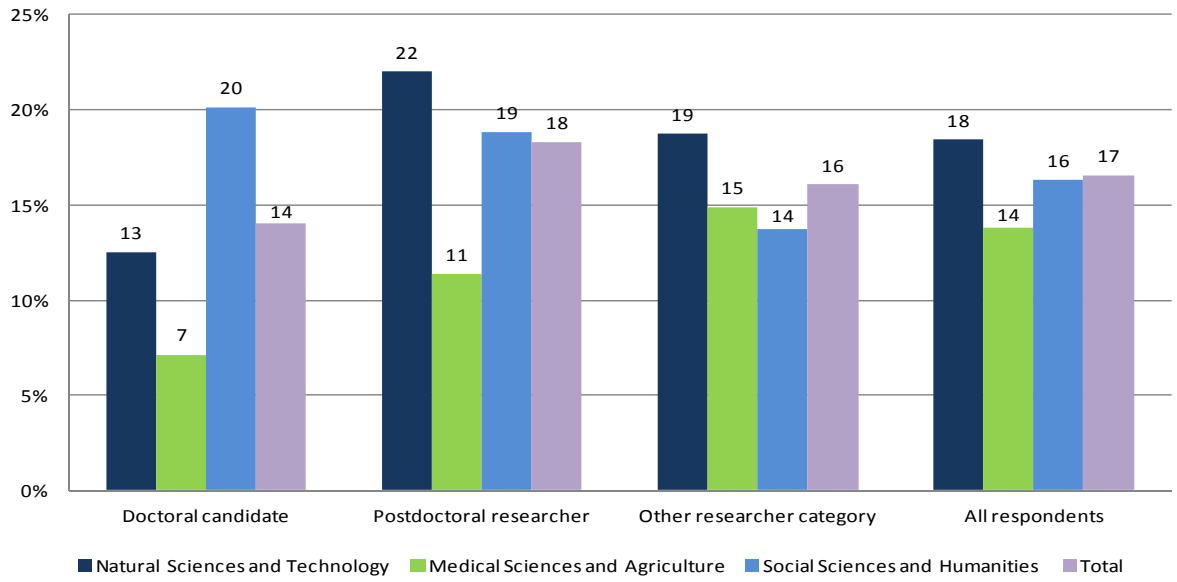
[140] Idea Consult (2010a)

In Norway, for example, professors and associate professors have the opportunity to hold a part time (20%) position (Professor II/ Associate professor II) in one institution in addition to their full-time permanent position in another institution. Qualified personnel from other sectors may also take up part time positions in the Higher Education Sector. This arrangement facilitates cooperation between the higher education sector and industry.

In general, post-doctoral researchers (18%) are more mobile than doctoral candidates (14%) with regard to cross-sectoral mobility.

The MORE study found[141] that 17% of EU-27 researchers in the higher education sector have worked in both the public and private sector. Researchers in Natural Sciences and Technology (18%) have been more mobile than researchers in Medical Sciences and Agriculture (14%). Overall, post-doctoral researchers in Natural Sciences and Technology (22%) have been the most mobile and doctoral candidates in Medical Sciences and Agriculture the least mobile (7%).

Figure 34: Researchers indicating they have been employed in both the public and the private sector, by field of science (Social Science and Humanities, Natural Sciences and Technology, Medical Sciences and Agriculture) and by career stage (doctoral/PhD students, post-doctoral researchers, 'other researcher' category), EU-27, 2009 (%)



Source: Deloitte
Data: MORE study

Cross-sectoral mobility is mostly from the public to the private sector, with low levels of movement in the other direction, or flows back and forth.

The MORE study also surveyed researchers working in industry. The circulation of researchers between the public and private sector serves as an indicator of inter-sectoral mobility. In 2010, 42% of the study population had at some time moved from the public to the private sector. The figure for

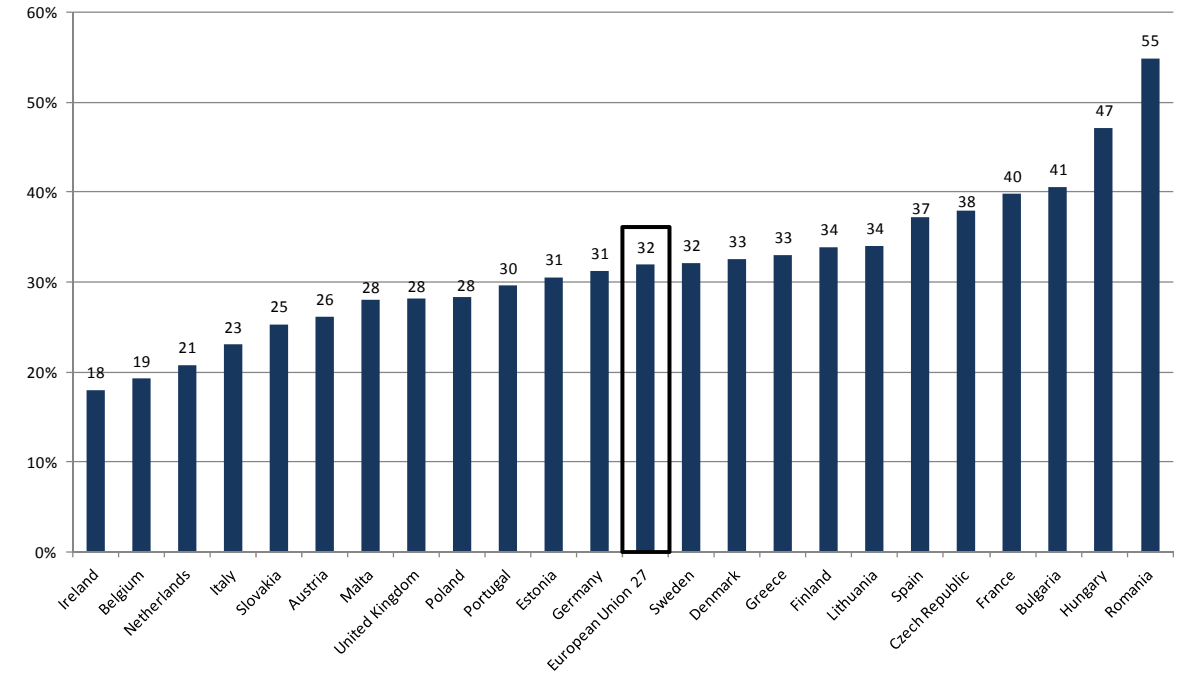
[141] Question: "Which of the following 'career paths' best describes your situation? (Please consider only changes of employer, not research visits)"? (Idea Consult, 2010a)

those always having worked in the private sector was 37%. The others had moved from the private sector to the public sector (and back) or from the public sector to the private sector (and back).

In 2009, only one in three public sector researchers in the EU-27 collaborated formally with researchers from the business sector and only one in five did so across borders.

The share of public sector researchers collaborating formally with researchers from the business sector was highest (>40%) in a number of the new Member States, e.g. Romania (55%), Hungary (47%) and Bulgaria (41%). Fewer than one in four public sector researchers actively collaborated with business sector researchers in a number of the old Member States: Italy (23%), the Netherlands (21%), Belgium (19%) and Ireland (18%).

Figure 35: Public sector researchers with formal collaboration with business sector researchers from the country where they principally work, EU-27, 2009 (%)[142]



Source: Deloitte
Data: MORE study
*Data are unavailable for CY, LU, LV and SI.
** Differences in the share of public sector researchers indicating formal collaboration with business sector researchers from the country they principally work can partly be explained by differences in the interpretation of the term "formal collaboration" by respondents in different countries.

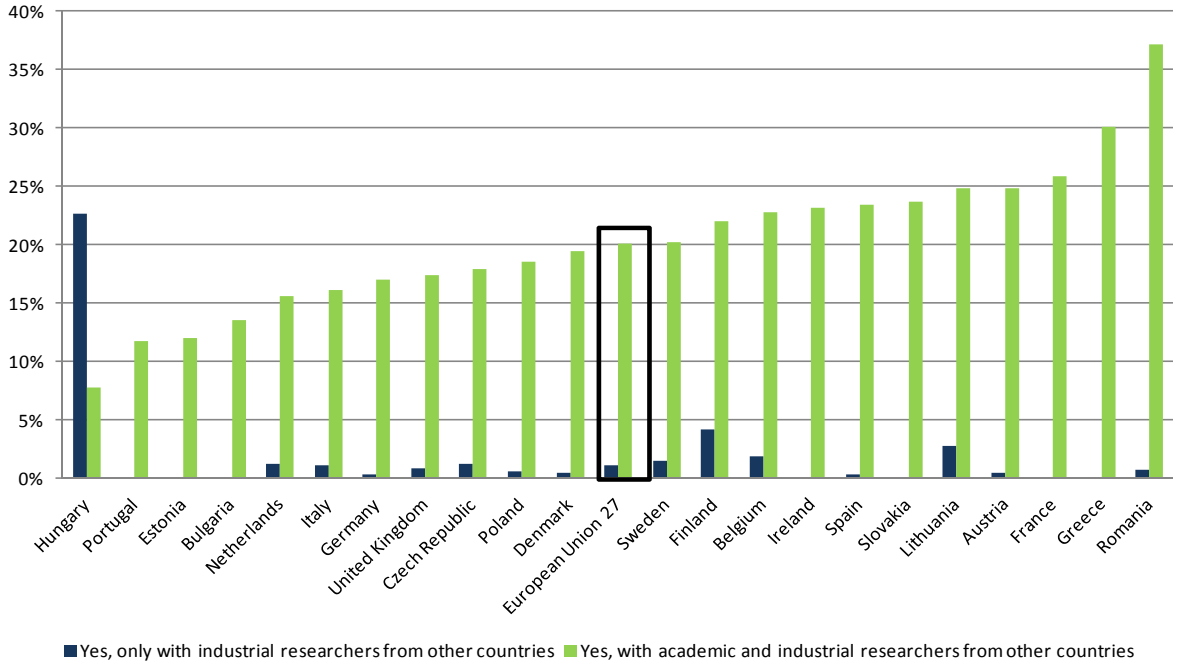
In 2009, on average, only 20% of EU-27 public sector researchers had a formal collaboration with researchers from both academia and business from other countries.

The formal collaboration of public sector researchers with researchers from EU-27 countries (in business and/or academia) serves as an indicator of the level of cooperation between academia and industry. The highest ratio of public sector researchers collaborating formally with researchers from other countries in business and academia (>30%) was in Romania (37%) and Greece (30%). It was lowest in Hungary (8%), Portugal (12%), Estonia (12%) and Bulgaria (14%) (<15%). Compared with

[142] Question: "Does your current work as a researcher involve some form of formal collaboration (i.e. contractually based collaboration) with business sector researchers from the country where you principally work as researcher"? (Idea Consult, 2010a)

other EU-27 Member States, Hungary has an extremely high proportion of public sector researchers with formal cooperation with foreign researchers from the business sector only (23%).

Figure 36: Public sector researchers with formal collaboration with researchers from other countries, by sector (academia and business, business) EU-27, 2009 (%)[143]



Source: Deloitte
Data: MORE study
*Data are unavailable for CY, LU, LV, MT and SI.
** Differences in the shares of public sector researchers indicating formal collaboration with researchers from other countries by sector (business, academia and business) can partly be explained by differences in the interpretation of the term "formal collaboration" by respondents in different countries.

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 indicates the degree of collaboration between academia and industry. Only a limited number of European researchers collaborate formally with the business sector. The number of scientific co-publications per million population is considerably higher in the US and Japan than in the EU.

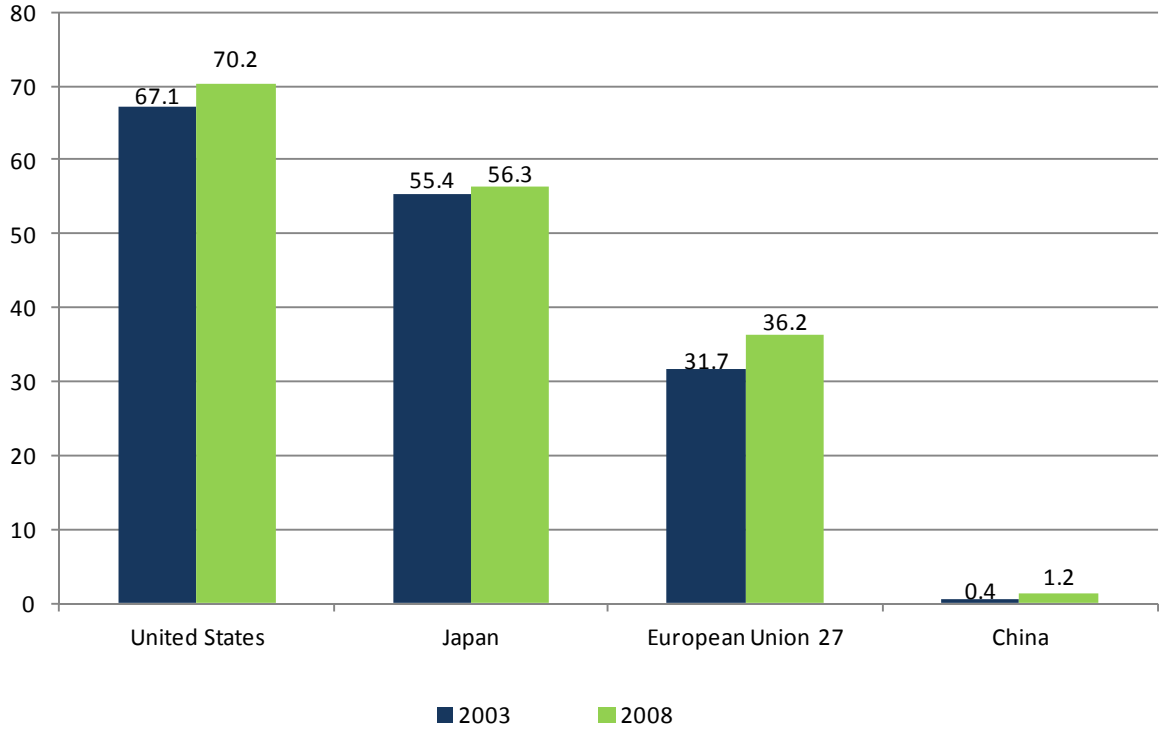
The number of public-private co-publications between different sectors (universities, research institutes, industry) per million population provides an indication of the degree of collaboration between academia and industry. In 2008, the figures for the US were 70.2, followed by Japan (56.3), EU-27 (36.2) and China (1.2). There seems to be a link between the number of scientific co-publications between the public and business sector and the number of researchers employed by the business sector. In 2009, only 700 000 EU researchers worked in the business sector compared with 1 117 000 in the US, 1 109 000 in China and more than 500 000 in Japan[144].

[143] Question: "Does your current work as a researcher involve some form of formal collaboration (i.e. contractually based collaboration) with academic or business sector researchers from other countries?" (Idea Consult, 2010a)
[144] For a detailed discussion on the stock of researchers, see Chapter "The stock of researchers in Europe" in this report.

Between 2003 and 2008, the number of public-private co-publications between different sectors per million population increased marginally 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 by approximately 1.6% from 55.4 in 2003 to 56.3 in 2008. China reported a substantial increase of 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"[145].

Figure 37: 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

[145] European Commission (2011b)

7. Mobility and international attractiveness

7.1 Mobility and international attractiveness – Highlights

Mobility of researchers in Europe:

- More than half of EU researchers (56%) have been 'internationally mobile' (outward mobility for at least three months) at least once in their career and more than one quarter (29%) in the last three years (2009);
- Around half the recently mobile (some 14% of EU researchers) moved to a new employer in a different country. This compares with around 1.5% of the EU workforce[146] (2009).

Mobility of doctoral candidates:

- EU-wide, there are around 600 000 doctoral candidates: 76% are EU nationals studying in their own country. Of these, 7% (around 40 000) are EU nationals studying in another EU country. The remaining 17% (around 110 000) are from outside the EU. The highest number of foreign (non-EU) doctoral candidates in the EU-27 came from China (2007);
- The proportion of non-national researchers serves as a useful indicator of the degree of openness of national recruitment systems. France, the UK and Norway have a relatively high proportion of non-EU doctoral candidates as a percentage of all doctoral candidates[147] whereas the UK, Austria and Belgium have a relatively high proportion of doctoral candidates who are citizens of another EU-27 Member State;
- Compared to the EU average (7%), the UK (15%) is the EU country most likely to be chosen by other Europeans to do their doctorate in, followed by Austria (13%) and Belgium (12%). Member States with the lowest inflows of other EU doctoral candidates are the new Member States, Italy and Portugal.

Factors influencing and motivations for mobility:

- The most important factors influencing researchers' mobility are 'personal education and/or research agenda', 'career progression goals & possibility of evolving further', 'the prospect to work with leading experts in your field' and 'getting access to the facilities/equipment necessary to your research'. Conversely, 'personal/family factors' are the most important factors dissuading researchers from becoming mobile.

Barriers to mobility:

- The most important factor inhibiting researchers' international mobility is the lack of transparent, open and merit-based recruitment (78% of respondents, see chapter 3);
- A majority of respondents (66%) also point to the lack of portability of publicly funded grants as an inhibiting factor, while 58% of respondents report that burdensome and complicated immigration rules and procedures are important obstacles to mobility. In addition, a majority of researchers report facing difficulties in moving from the public to the private sector and vice versa[148].

[146] Percentage of the EU workforce that lives and works in a different Member State from their country of origin

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

[148] European Commission (2012a)

Countries' measures to remove the remaining barriers to mobility:

- European countries have put in place various measures 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 types of researcher mobility (inward, outward and cross-sectoral). Many of these schemes promote inward mobility from both EU and non-EU countries providing financial incentives for early stage researchers while others promote outbound mobility. Non-financial incentives include measures promoting 'dual careers'[149]. Some countries provide tax incentives to facilitate researchers' mobility in Europe.

Attractiveness of public research institutions:

- In 2010, the EU-27 was the runner-up in the production of international scientific co-publications behind the United States;
- 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%) but a growing number of co-publications are produced in collaboration with at least one author from a country outside of the EU. Within Europe, researchers from most countries collaborate intensively with colleagues from large countries in particular (i.e. Germany, France, Italy and the UK);
- The EU-27 lagged behind the US in terms of scientific publications in the top 10% most-cited publications worldwide (in 2007). The indicator is a proxy for the excellence of the research system as highly cited publications are assumed to be of higher quality;
- The residence of Nobel Prize winners by continent serves as an indication of the attractiveness of countries and institutions for performing research. Far more Nobel Prize winners have been from the US (70%) than from Europe (22.5%);
- The 'Leiden Ranking' indicates that Europe has 171 top research universities. This provides an indication of which European universities are attractive for third-country researchers;
- Several excellence initiatives, such as 'poles' or clusters, as in France and Germany, may add to the visibility, attractiveness and performance of the European systems.

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

7.2 Introduction

Mobility is a core concept of the ERA. This in turn is fundamental to the EU's Growth and Jobs Strategy [150]and Vision for 2020[151], which aim to improve the dynamism and competitiveness of the EU economy. Mobility is strongly 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[152]. According to the European Commission, "the benefits of mobility across institutions, disciplines, countries and sectors are becoming increasingly recognised"[153].

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)[154]. 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.

There are many factors affecting each individual researcher's motivation, 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[155], portability of publicly funded grants[156], transparent transfer conditions, clear immigration rules and procedures, attractive employment and working conditions[157] – 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 plethora of initiatives to facilitate researchers' mobility. These include measures to facilitate access to information on mobility (via the EURAXESS portals[158]), a "Scientific Visa" package[159] facilitating administrative 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[160] to improve researchers' rights across Europe, a "European Partnership for

[150] European Commission (2010a)
[151] Council of the European Union (2008a)
[152] European Commission (2010a)
[153] Ibid
[154] For more information on collaboration between academia and industry, see chapter "Collaboration between academia and industry" in this report.
[155] 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. .
[156] 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
[157] 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 researcher profession" in this report.
[158] Euraxess Researchers in Motion. Available at: http://ec.europa.eu/euraxess/
[159] 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.
[160] European Commission (2005a)

Researchers"[161] to create a genuine labour market for researchers and the Europe 2020 "Innovation Union"[162] initiative to remove obstacles to researchers' mobility. In 2012, the European Commission will propose a European Research Area framework to further strengthen the ERA partnership with Member States and to ensure removal of barriers to researchers' mobility, training and attractive careers.

The EU-27 Member States have put in place various measures 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. 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 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. European countries also support researchers' cross-sectoral mobility. In Belgium, for example, the Flemish community (e.g. Baekeland Programme, IWT Innovation mandates) and the Wallonia-Brussels Federation (e.g. PRODOC Programme, FIRST Spin-off Programme) encourage researchers to move from the public to the business sector and vice-versa.

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.

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.

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 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.

[161] European Commission (2008b)
[162] European Commission (2010b)

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 15: Mobility and international attractiveness - Key indicators

Indicators	Data source(s)	Reference year(s)
Foreign (non-EU) doctoral candidates (ISCED 6) in the EU-27 by the top 30 countries of origin, 2007	UNESCO OECD Eurostat education survey.	2007
Non-EU doctoral candidates as a percentage of all doctoral candidates, Europe, 2009	Innovation Union Scoreboard database (2011)	2011
Doctoral candidates (ISCED 6) with a citizenship of another EU-27 Member State, EU-27, 2007 (%)	EUROSTAT OECD UNESCO survey	2007
Researchers having spent a period of at least three months as researchers in another country, EU-27, 2009 (%)	MORE study[163]	2010
Women researchers having spent a period of at least three months as researchers in another country, EU-27, 2009 (%)	MORE study	2010
Factors motivating European researchers to become mobile or not, EU-27, 2010 (average scores)	MORE study	2010
Personal motivation of EU-27 researchers to become mobile, Europe, 2009 (%)	MORE study	2010
Professional motivation of researchers to become mobile (1/2), EU-27, 2009 (%)	MORE study	2010
Professional motivation of researchers to become mobile (2/2), EU-27, 2009 (%)	MORE study	2010
Main producers of scientific publications, EU, 2000 and 2008	Innovation Union Competitiveness Report 2011[164]	2000, 2008
Co-publications with an author from another European country by five main partners in Europe, other countries, 2010 (%)	Science Metrix / Scopus	2010
Residence of Nobel Prize winners by continent, Europe, US, Asia/Pacific, 1990-2011	www.nobelprize.org	1990-2011
Most active research universities by normalised citation impact ('Leiden Ranking'), Europe, 1997-2006	Innovation Union Competitiveness Report 2011	1997-2004

Source: Deloitte

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

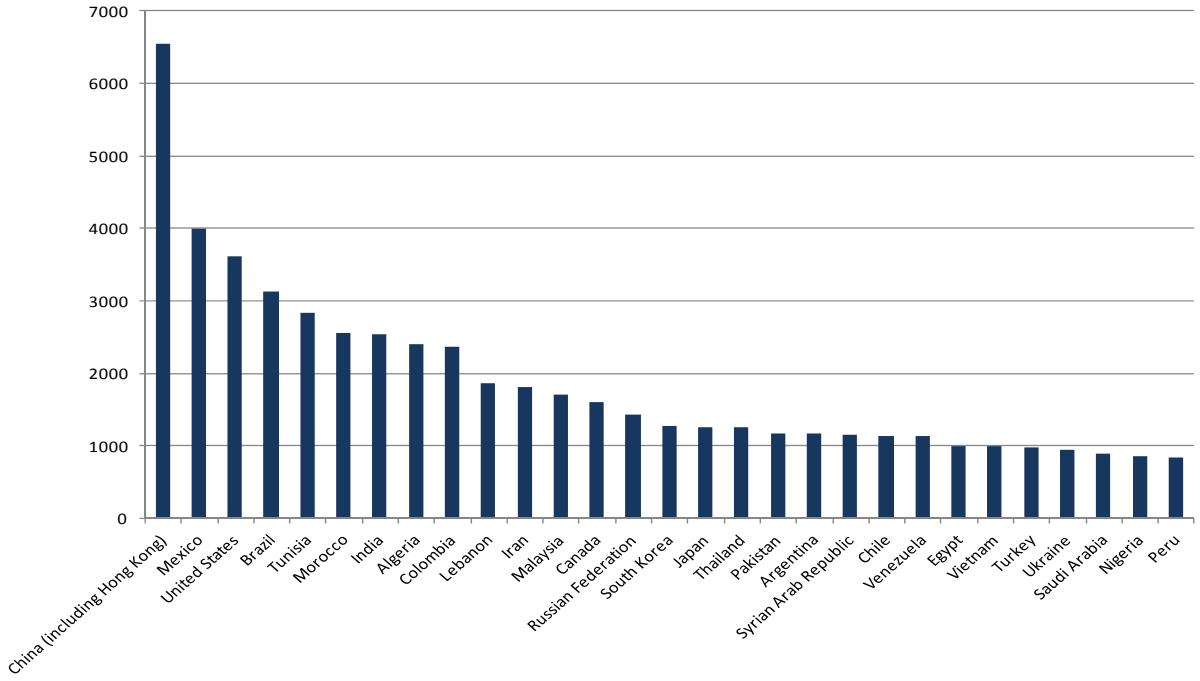
In 2007, the highest number of foreign (non-EU) doctoral candidates in the EU-27 came from China.

Almost 20% of all doctoral candidates in the EU-27 come from outside the EU. According to 2007 data, the most important country of origin is China with 6 545 doctoral candidates, followed by Mexico (4 008), the United States (3 613), and Brazil (3 134). Between 2 000 and 3 000 doctoral candidates came (in descending order) from Tunisia, Morocco, India, Algeria and Colombia each, while fewer than 1 000 non-EU doctoral students came from (in descending order) Lebanon, Iran, Malaysia, Canada, Russia, South Korea, Japan, Thailand, Pakistan, Argentina, Syria, Chile, Venezuela, Egypt, Vietnam, Turkey, Ukraine, Saudi Arabia, Nigeria and Peru.

[163] Idea Consult (2010a)

[164] European Commission (2011a)

Figure 38: Foreign (non-EU) doctoral candidates (ISCED 6) in the EU-27 by the top 30 countries of origin, 2007



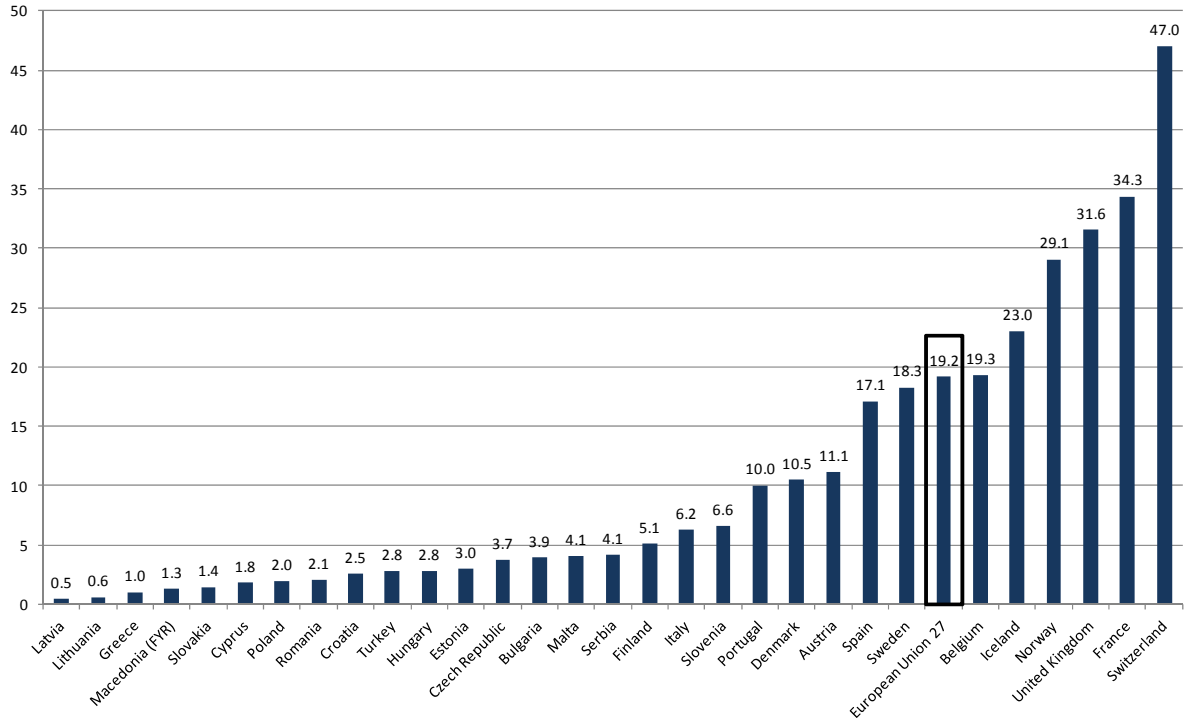
Source: Deloitte
Data: UNESCO OECD Eurostat education survey.

The share of non-EU doctoral candidates[165] as a percentage of all doctoral candidates serves as an indication of the mobility of candidates as an effective way of diffusing knowledge. The average share for the EU-27 is around 20%. Those above the EU average are Belgium (19.3%), the UK (31.6%) and France (34.3%).

The share of non-doctoral candidates reflects the mobility of candidates as an effective way of diffusing knowledge. The average share of non-EU doctoral candidates is almost 20%. In France and the UK, the share is between 30% and 35%. A relatively high share (<20% and >10%) of non-EU doctoral candidates is to be found in a number of the old Member States, e.g. Belgium (19.3%) and Spain (17.1%) while 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 3.9% in Bulgaria and 0.5% in Latvia. In Switzerland, almost one in two doctoral candidates is not Swiss.

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

Figure 39: Non-EU doctoral candidates as a percentage of all doctoral candidates, Europe, 2009

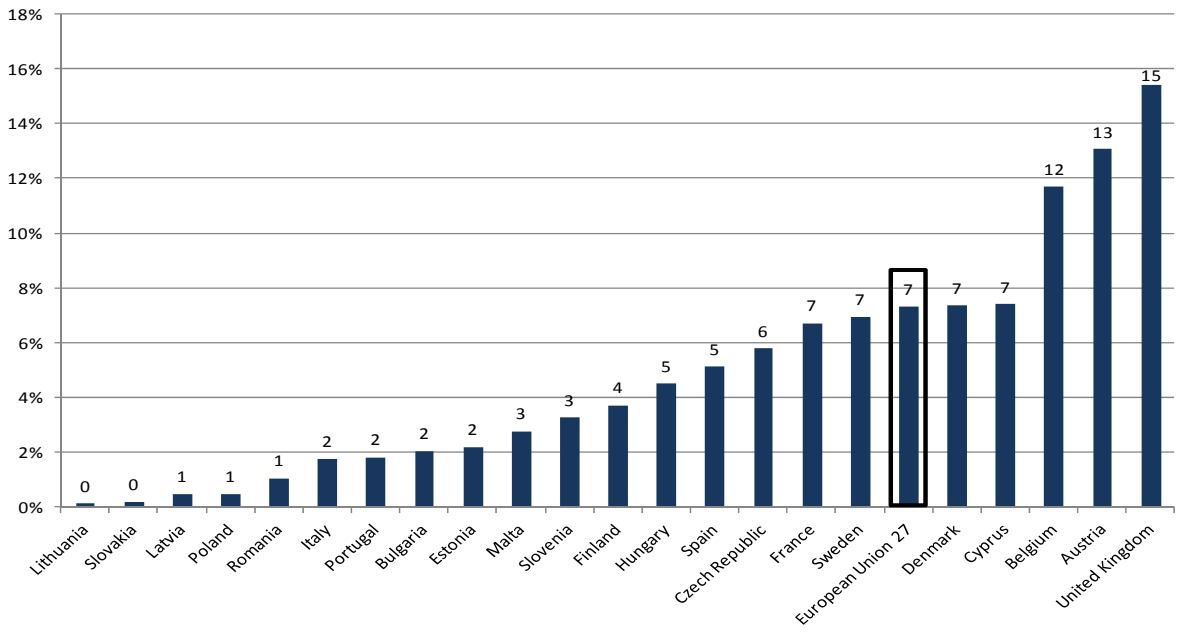


Source: Deloitte
Data: Innovation Union Scoreboard database (2011)
* Data unavailable for DE, IE, LU and NL.

Around 40 000 (or 7% of all doctoral candidates) are EU nationals studying in another EU country. Compared to the EU average (7%), the UK (15%) is the EU country most likely to be chosen by other Europeans to do their doctorate in, followed by Austria (13%) and Belgium (12%). Member States with the lowest inflows of other EU doctoral candidates are the new Member States, Italy and Portugal.

The highest level of doctoral candidates with citizenship of another EU-27 Member State (>10%) was in a number of the old Member States, e.g. the UK (15%), Austria (13%) and Belgium (12%). Conversely, the lowest share (<5%) was in a number of the new Member States, ranging from 3% in Slovenia to 0% in Lithuania.

Figure 40: Doctoral candidates (ISCED 6) with a citizenship of another EU-27 Member State, EU-27, 2007 (%)



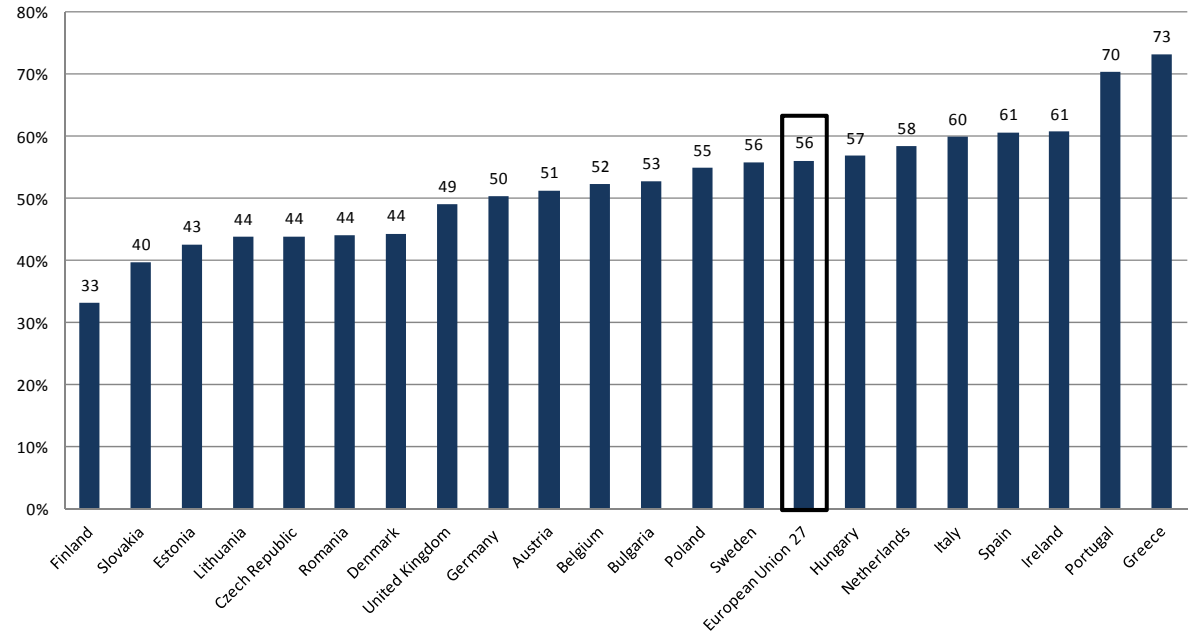
Source: Deloitte
Data: EUROSTAT OECD UNESCO survey
* Data unavailable for DE, EL, IE, LU and NL.

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

Mobility is a feature of the career path of many researchers. More than half of EU researchers (56%) have been 'internationally mobile' (outward mobility for at least three months) at least once in their career and more than one quarter (29%) in the last three years.

Greece, Portugal, Ireland, Spain and Italy have the highest levels of mobile researchers (≥60%). Conversely, researchers from Finland, Slovakia, Estonia, Lithuania, Czech Republic, Romania and Denmark were the least mobile of those in the study population.

Figure 41: Researchers having spent a period of at least three months as researchers in another country, EU-27, 2009 (%)



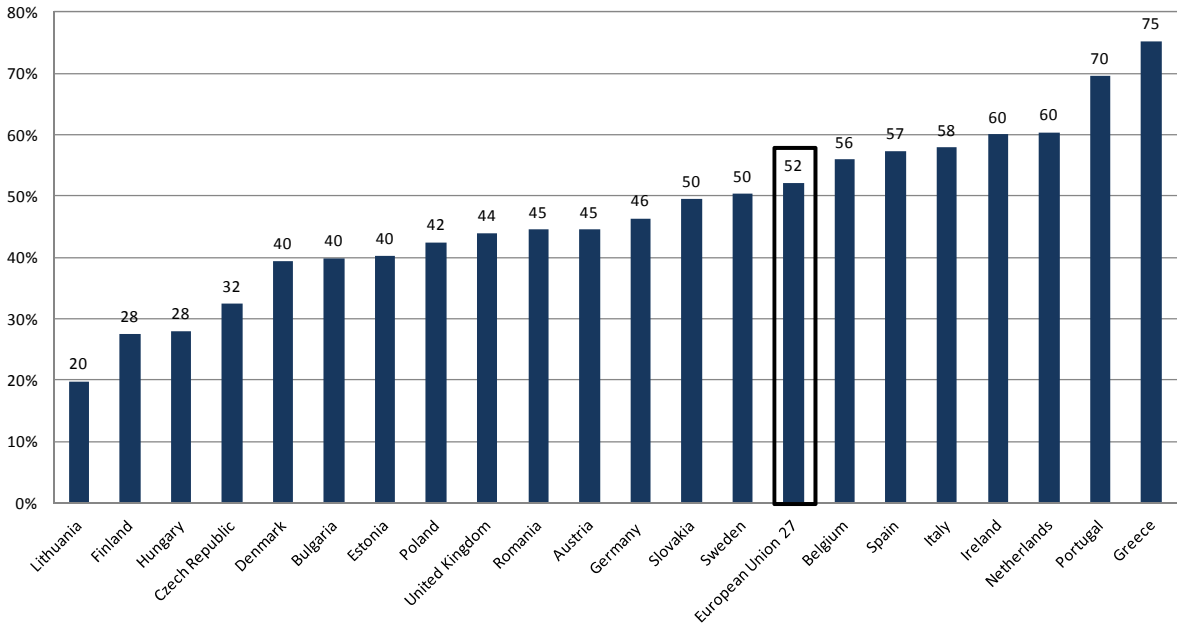
Source: Deloitte
Data: MORE study
* Data unavailable for CY, FR, LU, LV, MT and SI.

The ratio of men having spent a period of at least three months as a researcher in another country (59%) is slightly higher than for women researchers (52%).

The MORE study[166] revealed a difference between mobility patterns when looking at the proportion of female and male researchers. The ratio of men researchers indicating that they have spent a period of at least three months as a researcher in another country was higher (59%) than that of women (52%). While this holds true across all scientific domains, the difference was greater in the social sciences and humanities (64% compared to just over 50%). Data for international mobility over the last three years suggest that this gap is getting smaller, but is still statistically significant.

[166] Idea Consult (2010a)

Figure 42: Women researchers having spent a period of at least three months as researchers in another country, EU-27, 2009 (%)



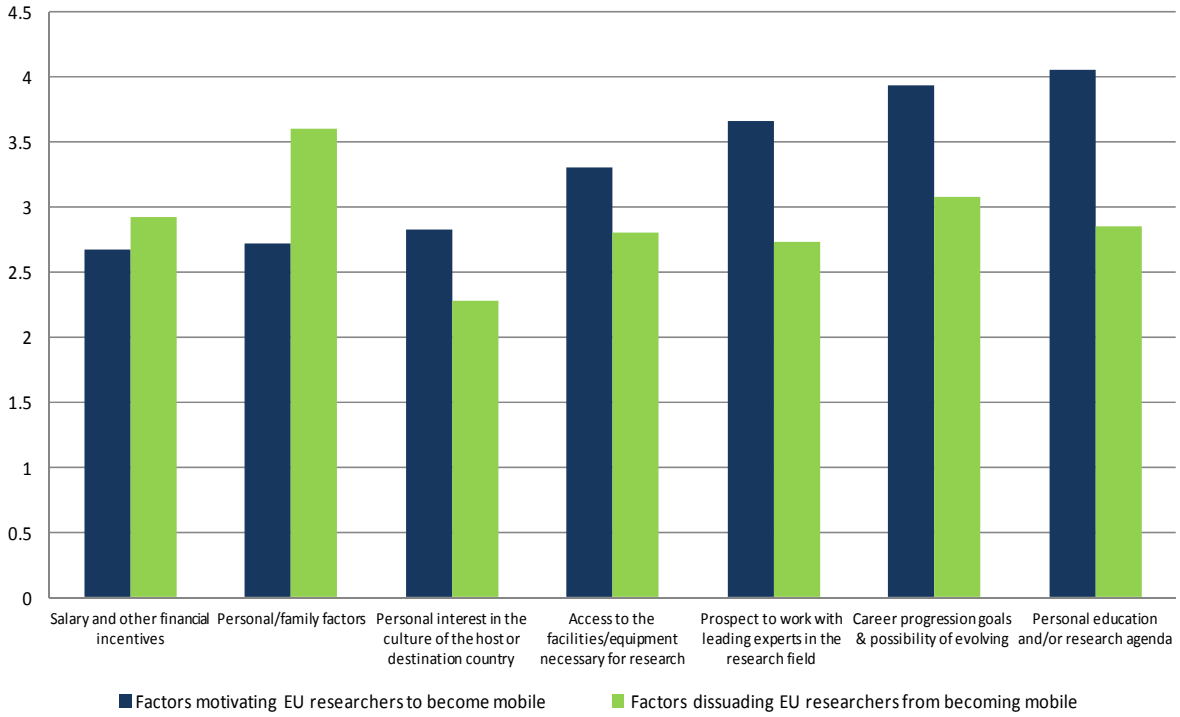
Source: Deloitte
Data: MORE study
* Data unavailable for CY, FR, LU, LV, MT and SI.

7.6 Factors influencing and motivations for mobility

The most important factors influencing researchers' mobility are 'personal education and/or research agenda', 'career progression goals & possibility of evolving further', 'the prospect to work with leading experts in your field' and 'getting access to the facilities/equipment necessary to your research'. Conversely, 'personal/family factors' are the most important factors dissuading researchers from becoming mobile.

There are many factors practical motivating European researchers to become mobile or dissuading them from taking such a decision. The Figure below shows the average scores of motivating factors ranging from 1 (unimportant) to 5 (extremely important).

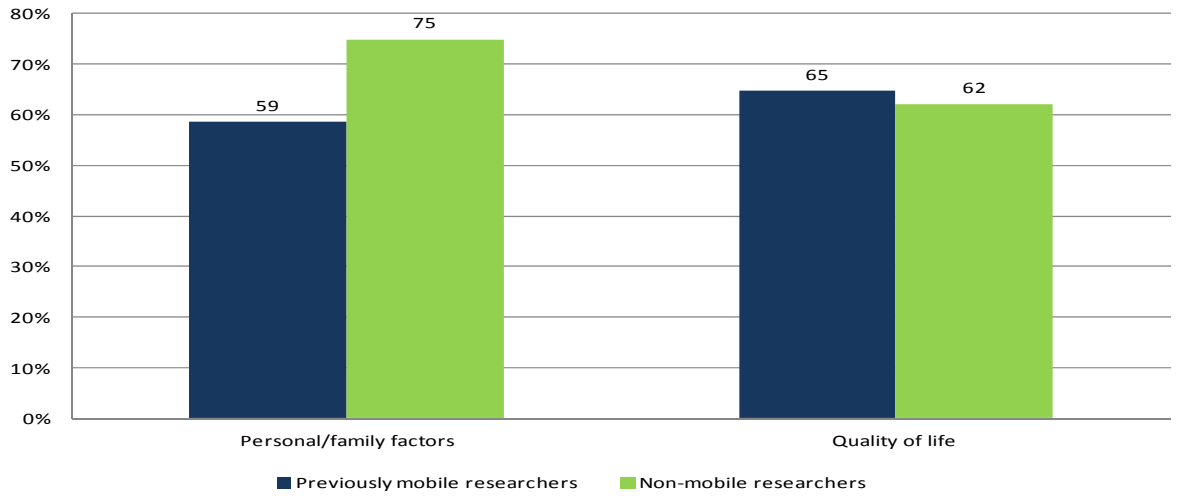
Figure 43: Factors motivating European researchers to become mobile or not, EU-27, 2010 (average scores)



Source: Deloitte
Data: MORE study
The results are based on the surveys' scoring systems, including a range of 1= Unimportant/Not important at all; 2= Not very important; 3= Important; 4= Highly important and 5= Extremely important.

'Looking more closely at factors relating to personal circumstances, e.g. 'my quality of life (or that of my family)' and 'personal/family factors (e.g. personal relationships and family ties)', the percentage of personal motivation factors ranked as "important" or "highly important" varies between 59% and 65% for previously mobile researchers. Researchers with previous mobility experience consider 'quality of life' (65%) as the most important factor in the decision to become mobile. Three in four non-mobile researchers consider 'personal/family factors' (75%) as a key motivational factor for becoming mobile.

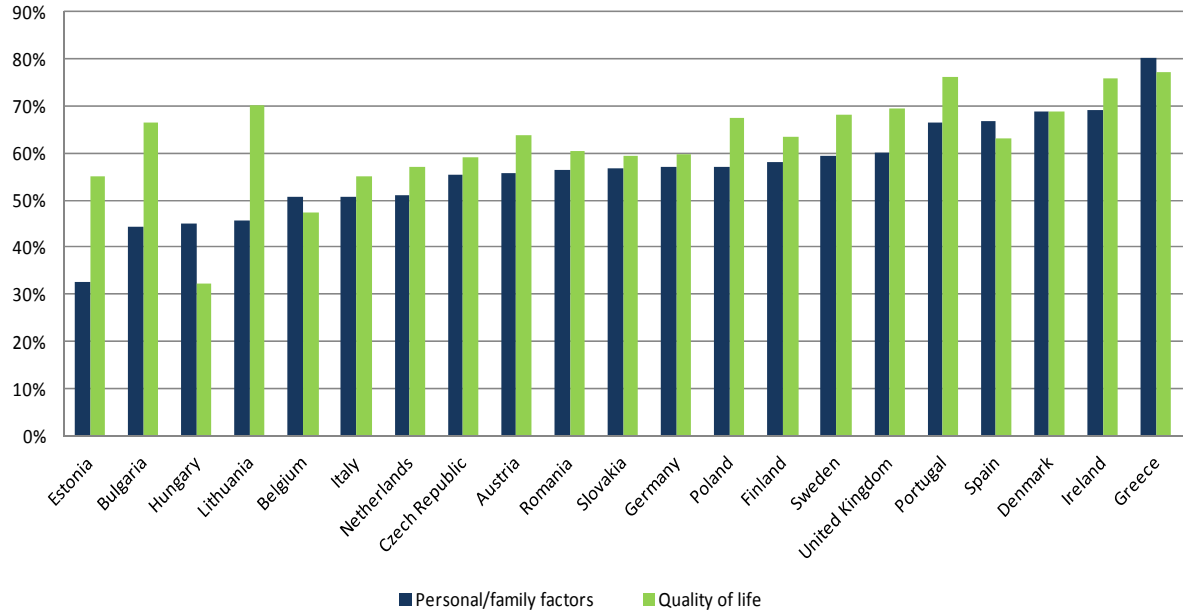
Figure 44: Personal motivation of EU-27 researchers to become mobile, 2009 (%)



Source: Deloitte
Data: MORE study

A number of Southern European countries, such as Greece (80%), Spain (67%) and Portugal (67%) had the highest share of researchers (>65%) indicating 'personal/family factors' as their motivation for becoming mobile. A number of the new Member States report lower figures for researchers considering 'personal/family factors' as a personal motivation for becoming mobile, e.g. Lithuania (46%), Hungary (45%), Bulgaria (44%) and Estonia (33%). In those countries, the majority of researchers consider the 'quality of life' as the main motivational factor for becoming mobile, e.g. Lithuania (70%), Bulgaria (66%) and Estonia (55%). However, researchers' interpretation of the survey questions may have resulted in the differences.

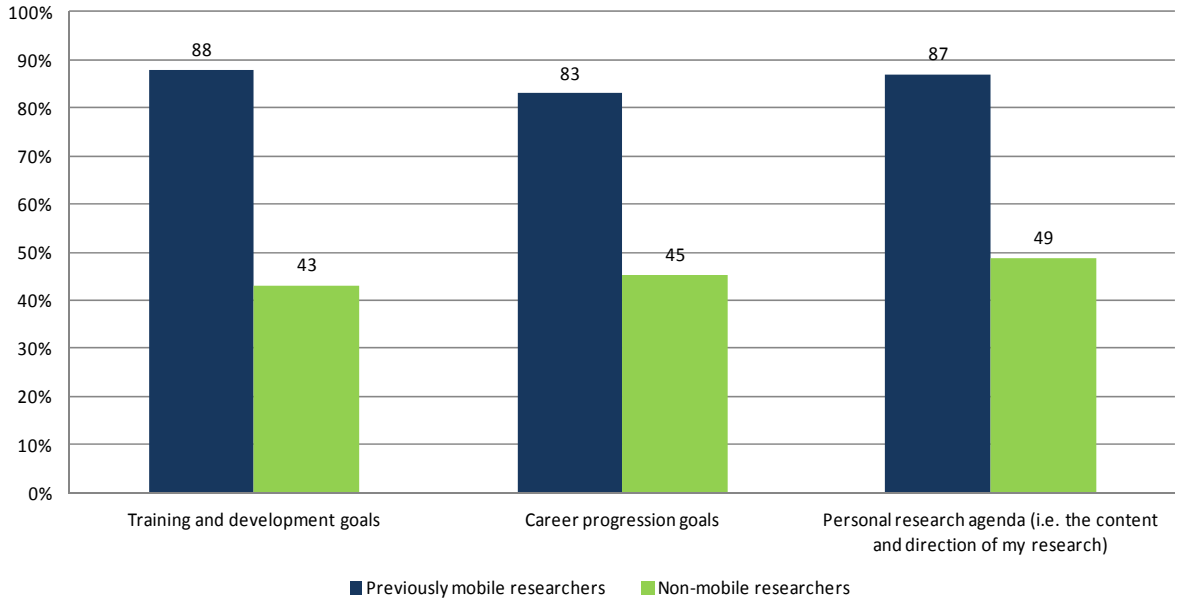
Figure 45: Personal motivation of researchers to become mobile, EU-27, 2009 (%)



Source: Deloitte
Data: MORE study
* Data unavailable for EU-27, CY, FR, LU, LV, MT and SI.

Researchers' professional motivation for becoming mobile serves as another indicator for assessing researchers' mobility. The vast majority of previously mobile researchers consider 'training and development goals' (88%), 'career progression goals' (83%) and their 'personal research agenda' (87%) as key professional motivational factors for mobility. For non-mobile researchers, the figure is much lower. Less than half of non-mobile researchers perceive 'training and development goals' (43%), 'career progression goals' (45%) and their 'personal research agenda' (49%) as important motivational factors for becoming mobile.

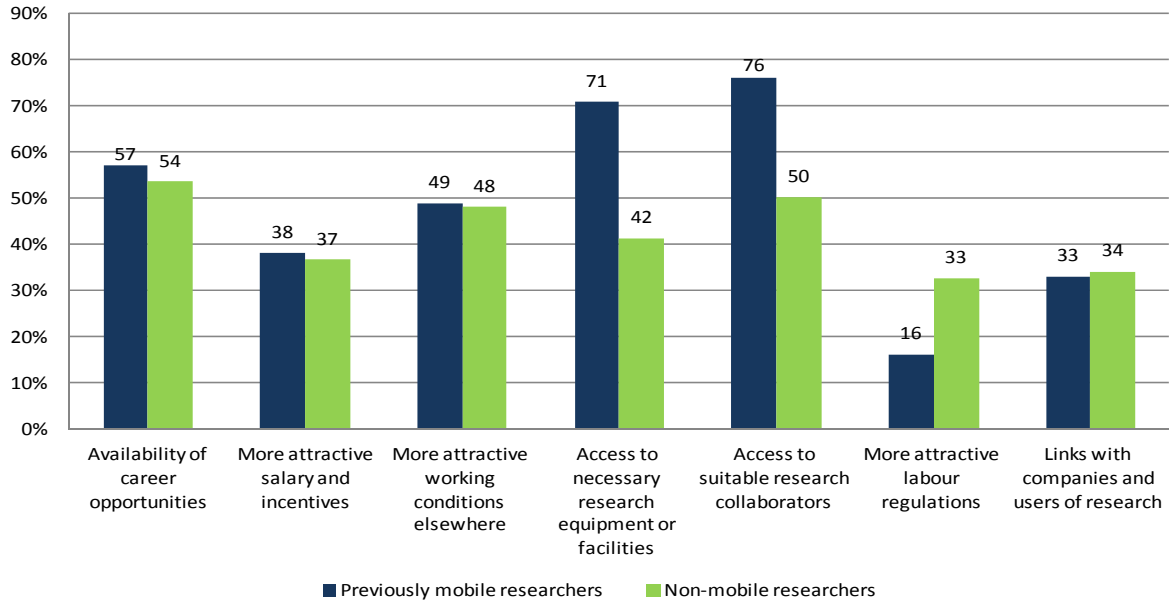
Figure 46: Professional motivation of researchers to become mobile (1/2), EU-27, 2009 (%)



Source: MORE study

When looking at other professional factors impacting a researcher's decision to become mobile, the majority of the study population of 'previously mobile researchers' consider 'access to suitable research collaborators' (76%), 'access to necessary research equipment or facilities' (71%) and 'availability of career opportunities' (57%) as key factors. A significant number of non-mobile researchers (>40%) perceive the 'availability of career opportunities' (54%), 'access to suitable research collaborators' (50%), 'more attractive working conditions elsewhere' (48%) and 'access to necessary research equipment or facilities' (42%) as the most important professional motivation factors. The least important factor influencing researchers' decision to become mobile (again) is 'more attractive labour regulations'.

Figure 47: Professional motivation of researchers to become mobile (2/2), EU-27, 2009 (%)



Source: Deloitte
Data: MORE study

7.7 Scientific co-publications with an author from another country

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%) but a growing number of co-publications are produced in collaboration with at least one author from a country outside of the EU. Within Europe, researchers from most countries collaborate intensively with colleagues from large countries in particular (i.e. Germany, France, Italy and the 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 (21.9% of the total EU-27 publications), Germany (20.8%), France (15.1%), Italy (11.3%) and Spain (8.7%).

Table 16: Main producers of scientific publications, EU, 2000 and 2008

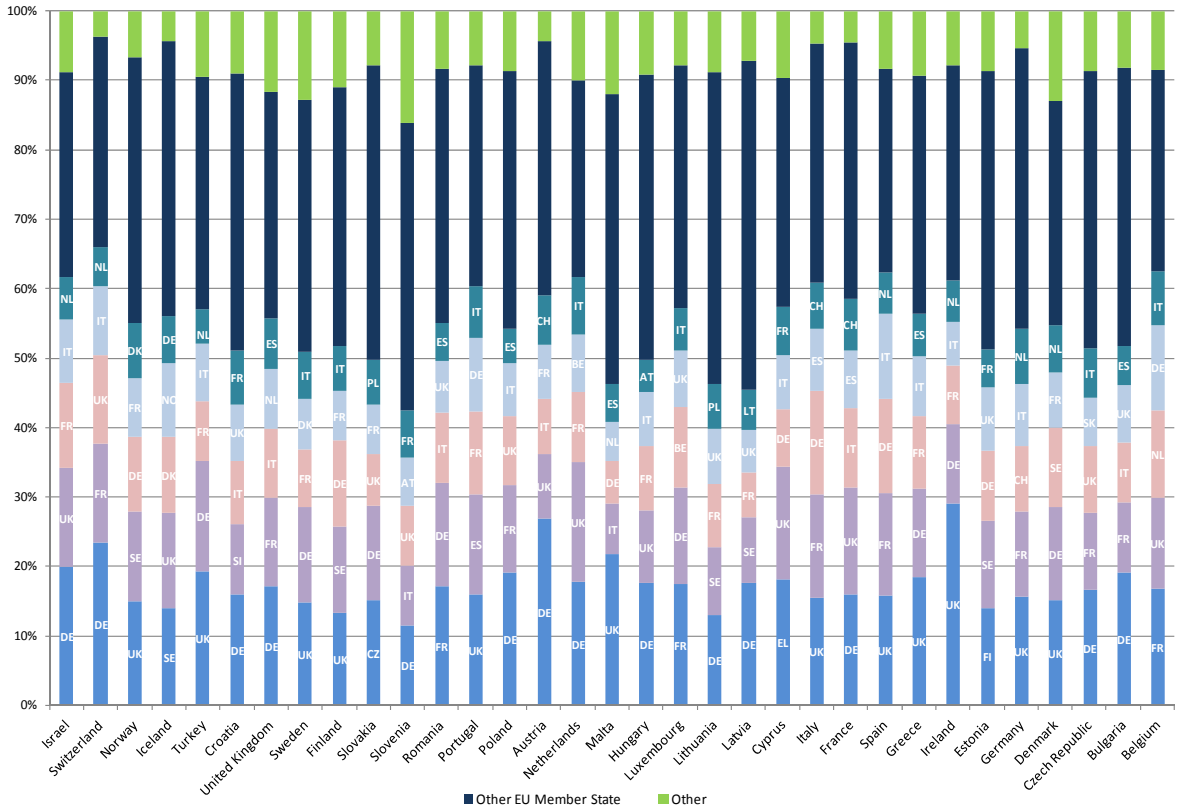
	2000	2008	Average annual growth (%)
European Union	367 207	546 837	5.1
United Kingdom	84 422	117 742	4.2
Germany	77 958	111 288	4.5
France	57 081	81 911	4.6
Italy	38 708	63 408	6.4
Spain	27 089	52 664	8.7

Source: Deloitte
Data: Innovation Union Competitiveness Report

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 European countries (85-95%). Researchers from Germany, France, Italy, and the UK are the main partners for co-publications, which 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 preferential collaboration between Belgium and the Netherlands, the Czech Republic and Slovakia[167].

[167] European Commission (2011b)

Figure 48: Co-publications with an author from another European country by five main partners in Europe, other countries, 2010 (%)



Source: Deloitte
Data: Science Metrix / Scopus

7.8 Attractiveness of research institutions

The residence of Nobel Prize winners by continent serves as an indication of the attractiveness of countries and institutions for performing research. Far more Nobel Prize winners have been from the US (70%) than from Europe (22.5%).

There seems to be a positive correlation between the attractiveness of countries and institutions for performing research, and the performance of institutions and their research teams[168]. The best-recognised research teams often include researchers who have received a Nobel Prize[169] for their achievements in physics, chemistry, physiology or medicine, and the economic sciences. The table below shows that 70% of the Nobel Prizewinners were (at the time of the Nobel Prize announcement) located in the United States, ranging from 63% in physics to 86% in the economic sciences. Europe had 22.5% of winners overall, and has performed best in physiology or medicine with 29% and Physics with 28%.

[168] The residence of Nobel Prize winners by continent is only one measure of university performance. The European Commission feasibility study "U-Multirank – Design and Testing the Feasibility of a Multidimensional Global University Ranking" (2011) provides a multi-dimensional university ranking. Available at: http://ec.europa.eu/education/higher-education/doc/multirank_en.pdf

[169] The Nobel Prize is an international award administered since 1901 (1968 for economics), consisting of a medal, personal diploma and a cash award.

Table 17: Residence of Nobel Prize winners by continent, Europe, US, Asia/Pacific, 1990-2011

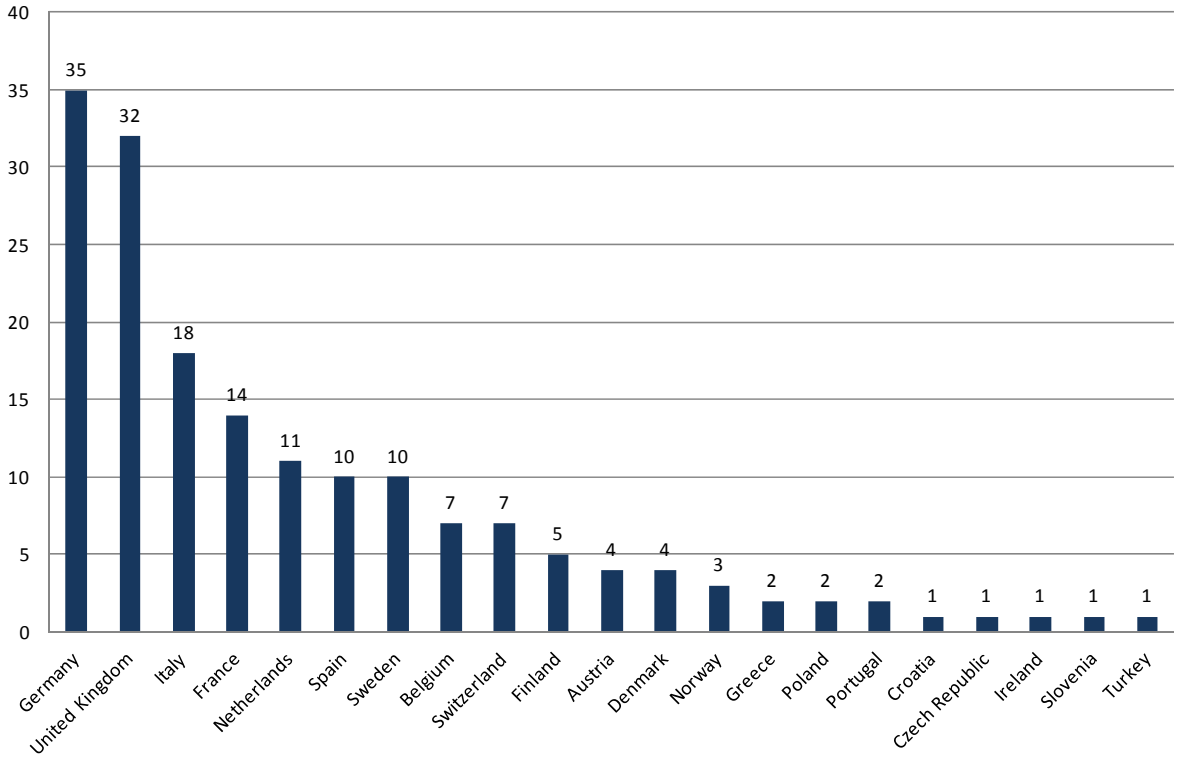
Region/ domains	Physics	%	Chemistry	%	Physiology or Medicine	%	Economic Sciences	%	Total	%
United States	38	63.3	32	66.7	32	66.7	38	86.4	140	70.0
Europe	17	28.3	9	18.8	14	29.2	5	11.4	45	22.5
Asia/Pacific	5	8.3	7	14.6	2	4.2	1	2.3	15	7.5
TOTAL	***60***		***48***		***48***		***44***		***200***	

Source: Deloitte
Data: www.nobelprize.org

The 'Leiden Ranking' indicates that Europe has 171 top research universities; this provides an indication of which European universities are attractive for third-country researchers.

The 'Leiden Ranking' serves as an indicator of a university's performance. It looks at the total production of articles by universities in a country and provides an overview of the main centres of academic production in Europe. The figure below displays the volume and visibility of scientific production, i.e. the normalised citation impact, over a nine-year period (1997-2006). The ranking indicates that Europe has 171 top research universities or research-intensive universities. Most of these universities are located in EU-15 Member States; very few EU-12 Member States have universities on the lists, and the absolute numbers are low compared to some other European countries of similar size.

Figure 49: Most active research universities by normalised citation impact ('Leiden Ranking'), Europe, 1997-2006



Source: Deloitte
Data: Innovation Union Competitiveness Report 2011
Data: Europe's top research universities in FP6 based on Leiden Ranking. The Leiden Ranking provides an overview of the top European research universities over the period 1997-2006 according to their performance, which is based on the total number of articles produced in these universities and published in reference journals.

8. Bibliography

Council of the European Union (2008a), "Council conclusions on the definition of a "2020 Vision for the European Research Area", 16767/08

Council of the European Union (2008b), "Council Conclusions on better careers and more mobility: a European partnership for researchers", 2891st Competitiveness (Internal Market, Industry and Research) Council meeting. Brussels, 26 September 2008

European Commission (2004a), "Communication from the Commission, Science and technology, the key to Europe's future – Guidelines for future European Union policy to support research", COM (2004) 353 final, Brussels, 16.6.2004

European Commission (2004b), "Europe needs more scientists. Increasing Human Resources for Science and Technology in Europe. Report of the High Level Group on Human Resources for Science and Technology in Europe", Science and Society

European Commission (2004c), "Gender and Excellence in the making", Study, Science and Society, EUR 21222

European Commission, (2005a) "The European Charter for Researchers and The Code of Conduct for the Recruitment of Researchers", EUR 21620.

European Commission (2007a), "Remuneration of Researchers in the Public and Private Sectors", Service Contract REM 01, Final report by Carsa, April 2007

European Commission (2008a), "Mapping the Maze - Getting More Women to the Top in Research", Study, EUR 23311 EN

European Commission (2008b), "Communication from the Commission to the Council and the European Parliament. Better Careers and More Mobility: A European Partnership for Researchers", COM (2008)317 Final

European Commission (2009a), "SHE Figures 2009. Statistics and Indicators on Gender Equality in Science", General Information, EUR 23856 EN

European Commission (2009b), "Report by the ERA Steering Group on Human Resources and Mobility (SGHRM) (2009), 'Report on the Implementation of the European Partnership for Researchers (EPR) by Member States and countries associated to FP7'".

European Commission (2009c), "Feasibility Study for Creating a European University Data Collection". Final Study Report of EUMIDA consortium for Directorate General for Education and Culture (DG EAC), of the European Commission, Contract No. RTD/C/C4/2009/0233402

European Commission (2010a), Commission Staff Working Document 'A Rationale For Action' accompanying document to the Communication from the Commission to the European Parliament, the Council, the European Economic and Social Committee and the Committee of the Regions "Europe 2020 Flagship Initiative. Innovation Union", SEC (2010)1161, Brussels, 6.10.2010

European Commission (2010b), Communication from the Commission to the European Parliament, the Council, the European Economic and Social Committee and the Committee of the Regions "Europe 2020 Flagship Initiative. Innovation Union", COM (2010) 546 final, Brussels, 6.10.2010

European Commission (2010c), "Science and Technology Report", Special Eurobarometer 340 / Wave 73.1 – TNS Opinion & Social, June 2010

European Commission (2010d), "Communication from the Commission. Europe 2020. A strategy for smart, sustainable and inclusive growth", COM (2010) 2020 Final

European Commission (2011a), "Proposal for a Regulation of the European Parliament and of the Council establishing Horizon 2020 – The Framework Programme for Research and Innovation (2014-2020)", COM(2011) 809 final, 2011/0401 (COD), Brussels, 30.11.2011

European Commission (2011b), "Innovation Union Competitiveness Report", 2011 edition, EUR 24211

European Commission (2011c), "Innovation Union Scoreboard, Research and Innovation Union scoreboard" 2011

European Commission (2012a), "Areas of untapped potential for the development of the European Research Area. Preliminary summary and analysis of the response to the ERA Framework Public Consultation"

European Parliament (2009a), "Cross-border Mobility of Young Researchers", October 2009

European Science Foundation (2009), "Research Careers in Europe Landscape and Horizons. A report by the ESF Member Organisation Forum on Research Careers", 2009.

Idea Consult (2010a), "Study on mobility patterns and career paths of EU researchers", April 2010

League of European Research Universities (2011), "The European Research Area: Priorities for research universities. LERU response to the European Commission consultation: The European Research Area Framework, untapped areas of potential", 30 November 2011

OECD (2006a), "Women in Scientific Careers: Unleashing the Potential", Complete Edition, pp. 1-209

OECD (2011a)," OECD Science, Technology and Industry Scoreboard 2011: Innovation and Growth in Knowledge Economies", September 2011

Sonnert, G. and Holton, G. (1996a), “Career patterns of women and men in the sciences”, American Scientist, 84: 67-71

Technopolis Group (2010a), “Study in support of an ex-ante impact assessment of post 2010 ERA policies”, Final Report, December 2010

Zuckerman, H. (1991a), “The careers of men and women scientists: a review of current research”, in Zuckerman, Cole and Bruer (eds.), The Outer Circle: Women in the Scientific Community. New York: Norton & Company, pp. 27-56.

9. Annex I: Data

9.1 "The stock of researchers in Europe"

Table 18: Researchers (Full Time Equivalent) per thousand active labour force, EU-27, US, China, Japan, 2000 and 2009

Country	2000	2009
Romania	1.79	1.94
China	**0.94**	**2.01**
Cyprus	0.98	2.04
Turkey	1.21	2.38
Malta	1.25	2.81
Latvia	3.49	3.05
Bulgaria	2.82	3.43
Poland	3.19	3.54
Croatia	3.65	3.60
Italy	2.82	4.08
Greece	2.96	4.58
Hungary	3.52	4.77
Slovakia	3.85	4.94
Lithuania	4.63	5.17
Netherlands	5.19	5.23
Switzerland	6.18	5.28
Czech Republic	2.70	5.44
Spain	4.38	5.81
Estonia	4.02	6.23
European Union 27	**5.04**	**6.63**
Ireland	4.82	6.84
Slovenia	4.49	7.15
Germany	6.50	7.47
Belgium	6.95	7.75
United Kingdom	5.90	7.78
Austria	4.98	8.06
Portugal	3.19	8.15
Unites States	**9.00**	**9.40**
Sweden	10.89	9.53
France	6.69	10.19
Norway	7.73	10.31
Japan	**9.57**	**10.32**
Luxembourg	8.86	10.50
Denmark	6.80	11.96
Finland	15.71	15.25
Iceland	12.85	15.97

Source: Deloitte
Data: Eurostat Research and Development survey and Eurostat Labour Force survey

Table 19: Researchers in the business sector (Full Time Equivalent) per thousand active labour force, Europe, 2000 and 2009

Country	2000	2009
Latvia	0.91	0.27
Bulgaria	0.34	0.49
Cyprus	0.25	0.52
Poland	0.57	0.57
Slovakia	0.94	0.61
Romania	1.11	0.62
Croatia	0.44	0.67
Lithuania	0.17	0.67
Turkey	0.19	0.86
Greece	0.70	1.19
Malta	0.17	1.39
Italy	1.11	1.54
Estonia	0.41	1.89
Portugal	0.45	1.92
Spain	1.19	2.00
Hungary	0.95	2.13
Switzerland	3.85	2.17
Netherlands	2.47	2.28
Czech Republic	1.08	2.39
United Kingdom	2.96	2.66
European Union 27	**2.36**	**2.94**
Slovenia	1.43	3.15
Ireland	3.19	3.61
Belgium	3.80	3.63
Germany	3.86	4.32
Austria	3.37	5.10
Norway	4.34	5.14
France	3.15	5.17
Sweden	6.54	5.98
Luxembourg	7.53	5.99
Iceland	5.74	6.28
Denmark	3.69	7.37
Finland	8.37	8.82

Source: Deloitte
Data: Eurostat Research and Development survey

Table 20: Researchers in the public sector (Full Time Equivalent) per thousand active labour force, Europe, 2000 and 2009

Country	2000	2009
Romania	0.68	1.32
Cyprus	0.67	1.37
Malta	1.38	1.42
Turkey	1.02	1.51

Country	2000	2009
Italy	1.70	2.39
Hungary	2.57	2.64
Latvia	2.58	2.78
Bulgaria	2.47	2.92
Austria	1.72	2.93
Croatia	3.00	2.93
Netherlands	2.64	2.95
Poland	2.62	2.97
Czech Republic	1.60	3.01
Switzerland	2.33	3.11
Germany	2.64	3.15
Greece	2.12	3.18
Ireland	1.63	3.23
Sweden	4.54	3.54
European Union 27	**2.62**	**3.62**
Spain	3.13	3.79
Slovenia	2.94	3.98
Belgium	3.09	4.06
Estonia	3.57	4.21
Slovakia	2.91	4.33
Lithuania	4.46	4.50
Luxembourg	1.33	4.50
Denmark	3.33	4.52
France	3.41	4.87
United Kingdom	5.23	4.99
Norway	3.36	5.17
Portugal	2.31	5.58
Finland	5.58	6.28
Iceland	5.20	9.33

Source: Deloitte
Data: Eurostat Research and Development survey

9.2 "Women in the research profession"

Data for the chapter on "Women in the research profession" are largely based on the 2009 'SHE Figures' report (European Commission 2009a). A new edition of the 'She Figures' publication with more recent data from 2009 and 2010 is due for publication by the end of 2012.

9.3 "Education and training"

Table 21: Population aged 30-34 having completed tertiary education, Europe, 2000 and 2010 (%)

Country	2000	2010
Turkey	N/A	15.5
Macedonia (F.Y.R.)	N/A	17.1
Romania	8.9	18.1
Malta	7.4	18.6

Country	2000	2010
Italy	11.6	19.8
Czech Republic	13.7	20.4
Slovakia	10.6	22.1
Croatia	N/A	22.6
Austria	N/A	23.5
Portugal	11.3	23.5
Hungary	14.8	25.7
Bulgaria	19.5	27.7
Greece	25.4	28.4
Germany	25.7	29.8
Latvia	18.6	32.3
European Union 27	**22.4**	**33.6**
Slovenia	18.5	34.8
Poland	12.5	35.3
Estonia	30.8	40
Spain	29.2	40.6
Iceland	32.6	40.9
Netherlands	26.5	41.4
United Kingdom	29	43
France	27.4	43.5
Lithuania	42.6	43.8
Switzerland	27.3	44.2
Belgium	35.2	44.4
Cyprus	31.1	45.1
Finland	40.3	45.7
Sweden	31.8	45.8
Luxembourg	21.2	46.1
Denmark	32.1	47
Norway	37.3	47.3
Ireland	27.5	49.9

Source: Deloitte
Data: Eurostat (UOE).

Table 22: Tertiary graduates (ISCED 5 & 6) per thousand population aged 20-29, Europe, 2000 and 2009

Country	2000	2009
Luxembourg	12.1	N/A
Macedonia (F.Y.R.)	12.2	32.8
Cyprus	28.6	33.8
Turkey	14.7	38.3
Greece	23.2	44.9
Malta	36.9	46.6
Netherlands	36.1	47.1
Germany	31	47.2
Liechtenstein	13.8	47.6

Country	2000	2009
Austria	24.1	48.6
Spain	39.5	49.5
Hungary	37.5	49.6
Sweden	38	51.9
Croatia	27.8	52.4
Bulgaria	38.1	53.9
Portugal	30.5	55
Estonia	34	55.6
Norway	48.9	59.1
Italy	24.8	59.3
Slovenia	39	63.4
Czech Republic	22.4	64.5
Finland	56.3	64.6
Iceland	42.7	71
Switzerland	64.5	71.5
Latvia	46.7	73.6
Belgium	51.4	73.9
France	64.5	77.1
Denmark	54	77.6
Ireland	70.4	79.6
United Kingdom	66.4	80.6
Slovakia	25.4	84.8
Lithuania	51.8	87.8
Poland	58.1	91.1
Romania	18	92.3

Source: Deloitte
Data: UNESCO OECD Eurostat education survey.

Table 23: Women tertiary graduates (ISCED 6) per thousand women aged 25-34, Europe, US and Japan, 2000 and 2009

Country	2000	2009
Cyprus	0.2	0.2
Turkey	0.1	0.3
Malta	0.1	0.4
Macedonia (F.Y.R.)	0.1	0.4
Bulgaria	0.3	0.6
Latvia	0.1	0.6
Japan	0.3	0.6
Greece	0.6	0.7
Estonia	0.7	0.8
Poland	0.7	0.8
Hungary	0.4	0.9
Iceland	0	0.9
Croatia	0.4	0.9
Spain	0.8	1

Country	2000	2009
Belgium	0.5	1.1
Czech Republic	0.3	1.1
Lithuania	0.8	1.1
France	1.1	1.3
Romania	0.6	1.3
Liechtenstein	0.4	1.3
European Union 27	**0.9**	**1.4**
Ireland	0.8	1.4
Netherlands	0.7	1.4
Slovenia	0.8	1.4
Denmark	0.8	1.5
Italy	0.5	1.6
Norway	0.7	1.6
Austria	1	1.8
United States	1	1.8
United Kingdom	1	2
Slovakia	0.4	2.1
Germany	1.5	2.4
Switzerland	1.8	2.9
Finland	2.5	3.1
Sweden	1.8	3.1
Portugal	1.7	3.4

Source: Deloitte

Data: UNESCO OECD Eurostat education survey.

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 and 2009

Country	2000	2009
Luxembourg	1.8	1.8
Cyprus	3.4	4.6
Malta	3.4	7
Liechtenstein	5.6	7
Macedonia (F.Y.R.)	3.7	7
Hungary	4.5	7.5
Turkey	4.4	8
Netherlands	5.8	9.9
Norway	7.9	9
Latvia	7.4	9.8
Bulgaria	6.6	10.1
Iceland	8.4	10.3
United States	9.7	10.3
Estonia	7.8	10.8
Greece	8	11.2

Country	2000	2009
Italy	5.7	11.3
Slovenia	8.9	11.3
Belgium	9.7	12
Spain	9.9	12.5
Croatia	5.6	12.8
Sweden	11.6	13
Germany	8.2	13.5
Austria	7.2	14
Japan	12.6	14.2
European Union 27	**10.1**	**14.3**
Poland	6.6	14.3
Portugal	6.3	14.6
Denmark	11.7	15.2
Czech Republic	5.5	15.3
Ireland	24.2	17.2
Slovakia	5.3	17.5
United Kingdom	18.5	17.5
Switzerland	15.1	18.1
Lithuania	13.5	18.5
Finland	16	19
Romania	4.5	20
France	19.6	20.2

Source: Deloitte

Data: UNESCO OECD Eurostat education survey.

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 and 2009

Country	2000	2009
Cyprus	2.0	3.4
Netherlands	2.1	3.6
Liechtenstein	4.1	3.7
Japan	3.3	4.1
Hungary	2.1	4.4
Malta	1.9	4.5
Turkey	2.8	4.9
Norway	4.3	5.5
Slovenia	4.2	6
Macedonia (F.Y.R.)	3.1	6
Latvia	4.7	6.3
United States	6.2	6.5
Belgium	4.9	6.6
Austria	2.9	6.8
Switzerland	4.6	7.1
Bulgaria	6.1	7.8

Country	2000	2009
Spain	6.4	7.8
Iceland	6.5	7.8
Germany	3.6	8.6
Estonia	5.7	8.7
Sweden	7.6	8.7
Croatia	3.5	8.9
Italy	4.3	9
European Union 27	**6.3**	**9.4**
Czech Republic	3	9.8
Greece	6.8	9.8
Ireland	18.5	10.5
Portugal	5.4	10.8
Poland	4.8	11
United Kingdom	11.9	11
Denmark	6.8	11.2
Finland	8.9	11.3
Lithuania	9.7	11.4
France	12.1	11.5
Slovakia	3.2	12.5
Romania	3.2	14.9

Source: Deloitte

Data: UNESCO OECD Eurostat education survey.

Table 26: New women doctoral graduates (ISCED 6) per thousand population aged 25-34, Europe, 2000 and 2009

Country	2000	2009
Cyprus	0.2	0.2
Turkey	0.1	0.3
Malta	0.1	0.4
Macedonia (F.Y.R.)	0.1	0.4
Bulgaria	0.3	0.6
Latvia	0.1	0.6
Estonia	0.7	0.8
Poland	0.7	0.8
Hungary	0.4	0.9
Iceland	0	0.9
Croatia	0.4	0.9
Spain	0.8	1
Belgium	0.5	1.1
Czech Republic	0.3	1.1
Lithuania	0.8	1.1
France	1.1	1.3
Romania	0.6	1.3
Liechtenstein	0.4	1.3
European Union 27	**0.9**	**1.4**

Country	2000	2009
Ireland	0.8	1.4
Netherlands	0.7	1.4
Slovenia	0.8	1.4
Denmark	0.8	1.5
Norway	0.7	1.6
Italy	0.5	1.6
Austria	1	1.8
United Kingdom	1	2
Slovakia	0.4	2.1
Germany	1.5	2.4
Switzerland	2.7	2.9
Finland	2.5	3.1
Sweden	1.8	3.1
Portugal	1.7	3.4

Source: Deloitte

Data: UNESCO OECD Eurostat education survey.

Table 27: Foreign (non-EU) doctoral candidates (ISCED 6) in the EU-27 by top 30 countries of origin, 2007

Country	2007
China (including Hong Kong)	6 545
Mexico	4 008
United States	3 613
Brazil	3 134
Tunisia	2 833
Morocco	2 561
India	2 550
Algeria	2 410
Colombia	2 366
Lebanon	1 862
Iran	1 815
Malaysia	1 717
Canada	1 605
Russian Federation	1 438
South Korea	1 275
Japan	1 268
Thailand	1 264
Pakistan	1 170
Argentina	1 169
Syrian Arab Republic	1 157
Chile	1 133
Venezuela	1 130
Egypt	1 006
Vietnam	996

Country	2007
Turkey	981
Ukraine	947
Saudi Arabia	895
Nigeria	857
Peru	847

Source: Deloitte
Data: UNESCO OECD Eurostat education survey.

Table 28: International scientific co-publications per million population, Europe, US, Japan and China, 2010

Country	2010
Iceland	2 312.55
Switzerland	2 297.31
Denmark	1 530.26
Sweden	1 478.71
Norway	1 378.23
Finland	1 246.55
Netherlands	1 243.78
Luxembourg	1 211.87
Belgium	1 165.99
Ireland	1 062.38
Austria	1 048.93
United Kingdom	925.43
Israel	842.01
Slovenia	824.23
Cyprus	713.09
Germany	669.21
Estonia	660.62
France	643.68
Portugal	581.24
Spain	533.36
Czech Republic	496.62
Greece	495.45
Italy	464.24
United States	431.56
Hungary	352.29
Slovakia	347.48
Croatia	324.36
European Union 27	**304.07**
Malta	266.37
Lithuania	214.11
Bulgaria	206.67
Japan	199.55
Poland	198.23
Romania	140.01

Country	2010
Latvia	129.74
Macedonia (F.Y.R.)	116.96
Turkey	64.22
China (except Hong Kong)	37.04

Source: Deloitte
Data: Science Metrix/Scopus.

Table 29: Scientific publications in top 10% most-cited publications worldwide as percentage of total scientific publications, Europe, US, Japan and China, 2007

Country	2010
Switzerland	15.59
Netherlands	14.93
Denmark	14.78
United States	14.31
Belgium	13.42
United Kingdom	12.83
Sweden	12.19
Iceland	11.87
Finland	11.65
Austria	11.42
Germany	11.41
Ireland	11.31
Norway	11.03
Israel	10.9
European Union 27	**10.73**
France	10.09
Italy	9.8
Spain	9.52
Greece	9.32
Luxembourg	9.28
Portugal	9.26
Cyprus	8.63
Estonia	7.64
Slovenia	7.62
Japan	7.11
China (except Hong Kong)	6.59
Turkey	6.51
Lithuania	5.82
Hungary	5.38
Czech Republic	4.86
Malta	4.66
Romania	4.22
Slovakia	3.76
Poland	3.68

Country	2010
Bulgaria	3.59
Croatia	3.07
Macedonia (F.Y.R.)	2.82
Latvia	2.05

Source: Deloitte

Data: Science Metrix/Scopus.

9.4 "Working conditions in the researcher profession"

Table 30: Researchers employed on fixed-term versus permanent (open-ended) contracts by status: doctoral/PhD students, post-doctoral researchers, and other researcher category, Europe, 2009 (%)

	Doctoral candidate	Postdoctoral researcher	'Other researcher' category	Total
Fixed-term contract, less than 1 year	9	4	2	4
Fixed-term contract 1-2 years	15	11	4	7
Fixed-term contract, >2 years	33	31	13	21
Open-ended (tenure) contract	31	50	72	59
Self-employed service provider	1	0	0	0
Other	11	3	9	8

Source: Deloitte

Data: MORE study

Table 31: Researchers employed on fixed-term versus permanent (open-ended) contracts by status per country: doctoral/PhD students, post-doctoral researchers, and 'other researcher' category, EU-27, 2009

	Open-ended (tenure) contract	Fixed-term contract, 2 years or under	Fixed -term contract, > 2 years	Self-employed service provider or other
Hungary	85	8	6	1
Ireland	79	7	9	5
Romania	76	0	13	10
Italy	73	5	7	14
United Kingdom	73	7	14	6
Bulgaria	72	1	19	8
Greece	64	0	14	22
European Union 27	**59**	**11**	**21**	**8**
Belgium	57	22	21	1
Germany	57	16	22	5
Sweden	57	24	16	4
Poland	56	12	29	3
Netherlands	52	11	32	5
Portugal	51	3	34	12
Spain	44	10	27	19
Austria	43	18	36	3
Lithuania	36	7	53	4
Finland	29	43	25	4
Denmark	25	13	62	0

	Open-ended (tenure) contract	Fixed-term contract, 2 years or under	Fixed -term contract, > 2 years	Self-employed service provider or other
Czech Republic	24	26	50	1
Estonia	15	10	75	0
Slovakia	14	7	72	7

Source: Deloitte
Data: MORE study

Table 32: 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) (%)

Countries	Business enterprise sector	Government sector	Higher education sector	All sectors
United States (2008)	-1.7	4.2	8.1	12.4
Turkey	0	4.2	4.8	-11.1
Spain	13.3	-11.8	0	0
Slovenia	-15.4	N/A	3.3	1.8
Romania	-16.7	-6	11.1	0
Portugal	-2.2	9.5	4.8	9.5
Netherlands	-18.3	-2.8	14.7	0
Malta	16.7	0	0.9	0.9
Lithuania	14.8	-16.1	14.6	0.1
Latvia	N/A	N/A	8.3	7.7
Hungary	38.1	-19	0	0
Croatia	2.8	-15.2	12	-12.9
Bulgaria	28	-7.1	8.6	14.3
Belgium	5.8	4.4	5	8

Source: Deloitte
Data: OECD, Science, Technology and Industry Scoreboard, 2011

Table 33: Researchers indicating that their time as mobile researcher had positive, negative or no impact on career progression, EU-27, 2009 (%)

Internationally mobile researchers	Doctoral candidate	Post-doctoral researchers	'Other researcher' category	Average
Mobility has had negative impacts	4	8	5	6
Mobility has had no impact	7	19	13	14
Mobility has had positive impacts	89	73	82	80

Source: Deloitte
Data: MORE study

Table 34: Researchers indicating that their time as mobile researcher had positive, negative or no impact on career progression per research sector, EU-27, 2009 (%)

Internationally mobile researchers	Natural Sciences and Technology	Medical Sciences and Agriculture	Social Sciences and Humanities	Average
Mobility has had negative impacts	5	6	7	6
Mobility has had no impact	13	14	16	14
Mobility has had positive impacts	82	79	78	80

Source: Deloitte
Data: MORE study

9.5 "Mobility and international attractiveness"

Table 35: Researchers having spent a period of at least three months in another country at least once in their career by career stage (doctoral/PhD students, post-doctoral researchers, 'other researcher' category), EU-27, 2009 (%)

	Doctoral/PhD students	Post-doctoral researchers	Other
Greece	100	58	76
Portugal	69	42	86
Hungary	46	74	31
Netherlands	45	63	60
Spain	43	60	62
Bulgaria	42	28	80
Denmark	42	57	36
European Union 27	**31**	**56**	**61**
Czech Republic	29	45	52
Italy	28	56	61
Romania	27	49	40
Poland	25	55	59
Austria	23	63	74
Sweden	23	55	65
United Kingdom	21	50	54
Germany	20	53	57
Belgium	19	59	62
Lithuania	18	20	49
Estonia	18	94	49
Finland	15	31	63
Ireland	12	78	63
Slovakia	7	52	57

Source: Deloitte
Data: MORE study

Table 36: Researchers indicating they have been employed in both the public and the private sectors, by field of science (Social Science and Humanities, Natural Sciences and Technology, Medical Sciences and Agriculture) and by career stage (doctoral/PhD students, post-doctoral researchers, and 'other researcher' category), EU-27, 2009 (%)

	Social Science and Humanities	Natural Sciences and Technology	Medical Sciences and Agriculture	Total
Doctoral/PhD students	20	13	7	14
Post-doctoral researchers	19	22	11	18
Other	14	19	15	16
All respondents	16	18	14	17

Source: Deloitte
Data: MORE study

Table 37: Personal motivation of researchers to become mobile, EU-27, 2009 (%)

Country	Personal/family reasons	Quality of life
Greece	80	77
Ireland	69	76
Denmark	69	69
Spain	67	63
Portugal	67	76
United Kingdom	60	69
Sweden	59	68
Finland	58	63
Poland	57	68
Germany	57	60
Slovakia	57	59
Romania	56	60
Austria	56	64
Czech Republic	56	59
Netherlands	51	57
Italy	51	55
Belgium	51	47
Lithuania	46	70
Hungary	45	32
Bulgaria	44	66
Estonia	33	55

Source: Deloitte
Data: MORE study

Table 38: Professional motivation of researchers to become mobile (1/2), EU-27, 2009 (%)

Country	Training and development goals	Career progression goals	Personal research agenda (i.e. the content and direction of the research)
Portugal	100	82	87
Estonia	100	80	92
Romania	94	96	100
Spain	94	93	83
Slovakia	94	1°°	97
Italy	93	73	88
Poland	93	92	89
Austria	92	82	81
Hungary	91	95	91
Lithuania	91	77	57
Sweden	89	82	91
Netherlands	89	85	88
Czech Republic	87	89	87
Bulgaria	87	85	95
Greece	86	86	84
Finland	85	86	90
Belgium	84	82	85
Germany	83	76	88

Country	Training and development goals	Career progression goals	Personal research agenda (i.e. the content and direction of the research)
Ireland	81	73	82
United Kingdom	80	85	83
Denmark	73	76	84

Source: Deloitte
Data: MORE study

Table 39: Co-publications with an author from another European country by five main partners, Europe, 2010 (%)

	MS1	MS2	MS3	MS4	MS5	Other EU MS	Other country
Israel	20	14	12	9	6	29	9
Switzerland	23	14	13	10	6	30	4
Norway	15	13	11	9	8	38	7
Iceland	14	14	11	11	7	40	4
Turkey	19	16	9	8	5	34	9
Croatia	16	10	9	8	8	40	9
United Kingdom	17	13	10	9	7	33	12
Sweden	15	14	8	7	7	36	13
Finland	13	12	12	7	6	37	11
Slovakia	15	14	8	7	7	42	8
Slovenia	11	9	9	7	7	42	16
Romania	17	15	10	8	5	37	8
Portugal	16	15	12	11	7	32	8
Poland	19	13	10	8	5	37	9
Austria	27	9	8	8	7	37	4
Netherlands	18	17	10	8	8	28	10
Malta	22	7	6	6	5	42	12
Hungary	18	10	9	8	5	41	9
Luxembourg	17	14	12	8	6	35	8
Lithuania	13	10	9	8	6	45	9
Latvia	18	9	7	6	6	47	7
Cyprus	18	16	8	8	7	33	10
Italy	15	15	15	9	7	34	5
France	16	15	12	8	7	37	5
Spain	16	15	14	12	6	29	8
Greece	18	13	10	9	6	34	9
Ireland	29	11	8	6	6	31	8
Estonia	14	13	10	9	6	40	9
Germany	16	12	9	9	8	40	5
Denmark	15	14	11	8	7	32	13
Czech Republic	16	11	10	7	7	40	9
Bulgaria	19	10	9	8	6	40	8
Belgium	17	13	12	12	8	29	9

Source: Deloitte
Data: Science Metrix / Scopus

10. Annex II: Social security benefits (sickness, unemployment and old-age)

The table below provides an overview of the countries' social security provisions for researchers. The information is based on the countries' individual responses to the Deloitte questionnaire (2011) within the scope of this study. Information is not available for Bulgaria, FYROM, Iceland, Israel, Liechtenstein, Montenegro and Serbia.

Table 40: Social security benefits for researchers - To what extent do publicly-funded fellowships, stipends, grants or equivalent provide sickness, unemployment and old-age (pensions) benefits for researchers compared to researchers on more stable employment

Country	Social security benefits (sickness, unemployment and old-age)
AUSTRIA	In Austria, grant beneficiaries' access to social benefits (sickness, unemployment and old-age benefits) is based on the following provisions: – Grants offered by the main funding agencies provide social security coverage. Some programmes offer fixed-term contracts (grants) with full social coverage or with self-insurance; – Anyone receiving a grant from the Austrian Science Fund (FWF) is financed via an employment contract. This applies to doctoral students and incoming scholars as well. The FWF had already begun to avoid funding researchers by means of stipends even before it signed the European Charter for Researchers and the Code of Conduct for the Recruitment of Researchers in 2006. The FWF supports researchers with employment contracts, which include social insurance (contributions to pension funds, health and accident insurance, parental leave, etc.). Stipends for researchers going abroad are the only exception. In this case, there is no employment contract and only pension cover is provided; – Fellowship programmes for doctoral candidates and post-docs administered by the Austrian Academy of Sciences (APART, DOC, DOC-fForte, DOC-team programmes[170]) offer fixed-term contracts (fellowships) with full social coverage or with self-insurance.
BELGIUM	– Under the Belgian social security system, researchers (both doctoral candidates and post-doctorate researchers) are covered with full social security benefits, regardless of their nationality, as they are considered to be publicly funded researchers. Belgian general scheme of social security covers sickness, maternity, disability, pension insurance, unemployment, accidents, occupational diseases and family benefits. There is no difference whether the researcher has an employment contract or receives a stipend. The general scheme applies to nationals of countries of the European Economic Area (EEA) and Switzerland, or a country tied to Belgium by a bilateral agreement on social security[171]; – All scholarship recipients from a country that is not linked with Belgium by a bilateral agreement on social security or which is not part of the EEA are entitled to the Belgian limited scheme of social security[172].
BOSNIA AND HERZEGOVIA	– The Government of Bosnia and Herzegovina does not provide researchers with sickness, unemployment or pension benefits.
BULGARIA	–
CROATIA	– In Croatia, sickness benefits depend entirely on each institution's individual policies and not on the Croatian Science Foundation's fellowships and grants schemes; – The grants of the Croatian Science Foundation do not provide any old-age benefits (pensions) for researchers, regardless of their employment status; – Doctoral and postdoctoral grants from the Croatian Science Foundation only cover the short-term stay of researchers (3 to 12 months) in foreign academic institutions while employed at their home institutions.
CYPRUS	– In the Republic of Cyprus, researchers are entitled by law to receive fully paid sick leave for 42

[170] The APART and DOC Programmes offer fellowships to post-docs and doctoral candidates in all disciplines. Applicants must submit a career plan stipulating the fellowship's relevance for the development for their research career.

[171] Belgium has concluded agreements on social security with several countries. For more information, see: https://www.socialsecurity.be/CMS/en/coming_to_belgium/content/coming_to_belgium/themas/spfssfodsz/FODSZ_Convention.xml

[172] For more information, see: http://www.coming2belgium.be/

Country	Social security benefits (sickness, unemployment and old-age)
	calendar days for each year of continuous research work. When a researcher is on sick leave for a considerable period of time during the implementation of a nationally funded project, the project is put on hold and an extension of its duration is granted; – Employed researchers may apply for unemployment benefits, provided that they have worked for a minimum of 26 weeks and have contributed to the Social Insurance Fund during the previous year; – The self-employed are not entitled to unemployment benefits.
CZECH REPUBLIC	– In the Czech Republic, there is no legislation dealing exclusively with researchers' social security and supplementary old-age benefits; – Researchers receive social security benefits depending on the type of grant agreement. Generally speaking, if the contracts are defined as employment, social security and health insurance contributions are automatically taken off the wage, regardless of the nationality of the researcher.
DENMARK	– In Denmark, all publicly funded researchers (including employed PhD students) receive full pay when sick. This is governed by collective agreements. Universities may ask for a refund from municipalities of sums paid; – Unemployment insurance is voluntary and researchers are not automatically insured against unemployment. Similarly to all other employees, researchers must be a member of an unemployment fund (known as an "A-kasse") in order to gain access to unemployment insurance. These are private associations that are connected with trade unions and other professional organisations; – Under the Collective Agreement for Academics in the State (2008), a pension contribution of 17.1% of the salary is compulsory, split two thirds/one third between employer and employee. Publicly funded fellowships, stipends, grants and equivalent may provide old-age benefits depending on the specific collective agreement between the researcher and the employer.
ESTONIA	– In Estonia, all researchers are considered as employees and are entitled to full social security coverage, including health insurance and sickness benefits. The Estonian Health Insurance Fund pays the benefit to the insured person based on the certificate of incapacity for work. Benefits for temporary incapacity for work include sickness benefits, care allowance, maternity benefits and adoption allowance; – Doctoral candidates have access to health insurance, but are not eligible for sickness benefits. Only doctoral candidates covered by an employment contract enjoy full social security coverage; – Under the Universities Act, students (including doctoral candidates) have the right to take a sabbatical of up to one year once at each academic level. In addition, students are granted the right to take additional academic leave (of up to two years) for health reasons. Students can interrupt their academic career (by up to one year) to serve in the Defence Forces and can take parental leave at any time up to the child's third birthday.
FINLAND	– In Finland, publicly funded fellowships, stipends, grants or equivalent provide sickness, unemployment and old-age benefits for researchers.
FRANCE	– In France, all researchers with employment contracts have the right to receive full social security coverage (including sickness, unemployment and pension benefits); – All ANR (National Research Agency) fellows are recruited under doctoral contracts. Both doctoral and post-doctoral candidates working under doctoral contracts enjoy sickness and unemployment rights.
GERMANY	– In Germany, unlike employment contracts, which are subject to social insurance contributions, scholarships from German science organisations are flexible funding instruments; to a certain extent, they can be adapted by the scholarship provider and used to provide unbureaucratic support in unexpected (emergency) situations or in specific circumstances: i. Grants (scholarships/stipends) offered by the Alexander von Humboldt Foundation (AvH) are not considered as earned income and are therefore not subject to social insurance contributions. Social benefits are provided in the form of ancillary benefits. Health insurance has to be paid for from the fellowship grant; the AvH can provide a grant of EUR 50 per month for the duration of the funding period towards the costs of health and personal liability insurance for fellows, and their spouses and dependent children (up to the age of 18) who accompany them to Germany for a period of at least three months. Fellows are responsible for making sure that they have sufficient health coverage. Fellows and accompanying family members have to be covered by a health insurer

Country	Social security benefits (sickness, unemployment and old-age)
	providing sufficient coverage in Germany from the first day onwards and for the entire duration of their stay in Germany; ii. No health insurance grants are provided under the Feodor Lynen Research Fellowship Programme for German post-docs and experienced researchers going abroad to conduct research; iii. German Research Foundation (DFG) fellowship holders are responsible for their own health insurance; it has to be financed from the fellowship provided. Should the recipient fall seriously ill, and should a fellowship interruption or a part-time solution not be possible, the fellowship can – in individual cases and subject to the provision of medical proof – continue to be paid. In addition, the fellowship period can be extended so that the recipient can complete his or her work and remain in the science system; iv. Grants offered by the Max Planck Society (MPG) continue to be paid for six weeks if the recipient falls ill. Beyond this period, the Max Planck Institute in question decides whether and to what extent payments will continue. Funding is extended beyond the maximum funding period in case of illness. Grants also continue to be paid during maternity leave; any state benefits received are taken into account when calculating the grant payments; v. Funds offered by the German Academy of Sciences Leopoldina are provided in the form of full personal scholarships covering living expenses in the place of residence. Leopoldina does not provide contributions to (social) insurance. – Unemployment insurance in Germany is not provided under scholarship programmes. For instance, the AvH aims to balance out the existing social security disadvantages for research fellows by providing a suitable grant enabling recipients to make provision for the future (particularly in the form of pensions, care insurance and occupational disability insurance); – In principle, grant recipients are free to make voluntary payments into the statutory pension insurance scheme (DRV), foregoing the employer contribution (and taking into account the minimum limits). The German science organisations and funding agencies as well as the public and private funding providers offer additional pension insurance and other social benefits in order to maintain the attractiveness of funding instruments and reduce the risk of old-age poverty among researchers who start paying social security contributions at a later stage in life. Organisations promoting mobility are increasingly considering the provision of additional grants for post-docs to enable them to set up private pension schemes.
GREECE	– In Greece, researchers on stipends/grants are generally covered by social security even though provisions on social security coverage and supplementary pension benefits for researchers are not specifically included in national legislation. In practice, the type of benefits researchers receive depends on the type of grant agreement with the host institution; – Generally, researchers receiving stipends/grants are covered by social security.
HUNGARY	– In Hungary, researchers working under employment contracts or receiving fellowships are entitled to sickness benefits. If post-graduate students have not signed an employment contract with the host institution, they are not eligible for old-age benefits.
ICELAND	–
IRELAND	– In Ireland, the Fixed-term Workers Act ensures that researchers employed on fixed-term contracts are eligible for the same entitlements as comparable permanent employees in contrast to doctoral candidates who are regarded as students; – According to the Fixed-term Workers Act, post-doctorates (researchers) are treated as employees and therefore covered for Social Security purposes, whereas some pre-doctorates (PhD candidates) are treated as students and do not come under the Social (Welfare) Security code; – The Programme for Research in Third-Level Institutions (PRTLI), the Irish Research Council for Science, Engineering and Technology (IRCSET) and the Irish Research Council for Humanities and Social Sciences (IRCHSS) grants for experienced researchers include provision for an employer's Pay Related Social Insurance (PRSI) contribution, which can entitle employees to benefits such as maternity and illness benefits, and jobseekers (unemployment) allowance; – All funding awards for fixed-term researchers include an employer and employee pension contribution.
ISRAEL	–
ITALY	– In Italy, researchers under publicly funded fellowships/grants or under employment contracts are entitled to sickness benefits, but do not have an automatic right to maternity leave; – Old-age benefits are only foreseen for employees (permanent and fixed-term contracts), in

Country	Social security benefits (sickness, unemployment and old-age)
	the same way that pension contributions are collected in a separate track (*gestione separata*) of the National Social Security Institute.
LATVIA	– In Latvia, researchers employed under permanent or temporary contracts receive a salary, pay mandatory social security contributions, and are entitled to social security benefits (including sickness, unemployment and old-age benefits).
LIECHTENSTEIN	–
LITHUANIA	– In Lithuania, publicly-funded fellowships provide health insurance while pension contributions are not covered; – All PhD students working under employment contracts enjoy social security benefits; – The Law on Pensions for Researchers provides a pension scheme for researchers who have been employed in the researcher profession for at least ten years.
LUXEMBOURG	– In Luxembourg, all beneficiaries of an AFR Grant scheme from the National Research Fund (FNR) are taken on under work contracts with the host institution. These employment contracts offer researchers full social security coverage, including health and pension insurance, during the research training period.
MACEDONIA (F.Y.R.)	–
MALTA	– In Malta, all publicly funded fellowships, stipends, grants or equivalent provide sickness benefits (for temporary illness) for researchers in the case of normal employment[173]; – The Malta Government Scholarship Scheme (MGSS) and Strategic Educational Pathways Scholarships (STEPS) grant schemes provide funding for the beneficiary to enrol at a University as a student for a limited period (normally for a maximum of three years). However, they do not include explicit provision for contribution to social security (including unemployment and old-age benefits). Any unemployment benefits that a researcher qualifies for would depend on employment history rather than on the grant scheme.
MONTENEGRO	–
NETHERLANDS	– In the Netherlands, researchers with employment contracts are entitled to social security coverage, including health insurance, unemployment benefits and supplementary pensions, and old-age benefits. Contributions are automatically deducted from researchers' pay, regardless of their nationality; – PhD candidates receiving a grant have minimum or no social security rights (including no pension benefits).
NORWAY	– In Norway, researchers are on employment contracts (except the 5-7% PhD candidates on development grants) and receive full social security coverage; – The State Education Loan Fund provides sickness benefits for the 5-7% of PhD candidates receiving development grants. Research Council funding for short-term mobility (1-12 months) for doctoral candidates/post-docs/others does not carry sickness benefits. However, in both cases, health insurance is normally provided for through the Norwegian Labour and Welfare Service (NAV); – All employees in Norway, including researchers, enjoy the same right to unemployment benefit. The size of the benefit depends on their previous income level; – Researchers, like all employees in Norway, are entitled to old-age benefits.
POLAND	– In Poland there is no legislation dealing exclusively with the social security and supplementary pensions of researchers; – Social security benefits depend on the type of grant agreement, but in general, if the contract between a researcher and the host institution is defined as an employment contract, social security and health insurance contributions are automatically deducted from the wage of the researcher, regardless of nationality.
PORTUGAL	– In Portugal, researchers are eligible to receive sickness benefits only if they have signed employment contracts with the host institution; – Fellowship beneficiaries subscribe to old-age (pension) benefits on a voluntary basis. The common practice is for the host institution to pay the minimum contribution; the fellowship student tops this up at his/her own expense.
ROMANIA	– In Romania, researchers enjoy the same social security rights as any other worker.

[173] Normal employment has been defined and ruled by the 'Employment and Industrial Relations Act' and related legislation.

Country	Social security benefits (sickness, unemployment and old-age)
SERBIA	–
SLOVAK REPUBLIC	– In the Slovak Republic, social security coverage and health insurance are directly deducted from researchers' wages; – No legislation on extra social security schemes and/or pension provisions for researchers has so far been developed.
SLOVENIA	– In Slovenia, researchers (including young researchers, post-docs, and researchers at early career stages are considered as all other employees and enjoy all benefits related to sick leave or maternity. Contributions to pension and health insurance are normally automatic if the research work is supported by an employment contract; – The Young Researcher Programme provides beneficiaries with full social coverage; – Social benefits for other young researchers (i.e. those on stipends from different funds and foundations) are subject to conditions specified by each individual programme or project.
SPAIN	– In Spain, researchers under employment contracts or receiving funding are granted social security coverage, including sickness and unemployment benefits; – Old-age benefits are only available for PhD students under employment contracts, but not for pre-doctoral students receiving grants.
SWEDEN	– In Sweden, stipends and doctoral grants do not provide sickness benefits; – Unemployment benefits are only granted to employed researchers; – Old-age benefits are regulated by collective agreement between employers and unions. Stipends carry no pension benefits; – Doctoral grants carry entitlement to the national retirement pension and all kinds of employment carry an entitlement to an occupational pension.
SWITZERLAND	– In Switzerland, fellows (doctoral and post-doc) funded by SNFS or the Scientific Exchange NMS^{ch} Sciex Programme enjoy the same social security benefits (accident, unemployment, sickness, old-age) as researchers employed by universities under employment contracts; – Overall, in Switzerland health insurance is private, but compulsory.
TURKEY	– Turkey has bilateral social security agreements with 21 countries. Citizens of countries which have signed social security agreements with Turkey based on the principle of reciprocity can certify that they are subject to insurance in their own country.
UNITED KINGDOM	– In the UK, provisions on sickness benefits for researchers depend on the context of the grant agreement. Contractual arrangements defined as 'employment' provide researchers with sickness payments and other benefits, including maternity leave, paternity leave, adoptive leave**,** extended jury service and holidays; – Additional funding may be granted by the Research Councils UK (RCUK); – Each pension scheme includes different provisions.

Source: Deloitte Questionnaire (2011)

11. Technical Annex

Deloitte has received a mandate from the European Commission, DG Research & Innovation, to produce an annual integrated report on the research profession in Europe (*The Researchers Report*). The study aims at providing a reliable, complete and up-to-date picture of the research profession in 38 countries[174] (subsequently 'the countries'), taking into account country-specific (policy) contexts.

The technical annex presents information on:

- List of indicators;
- Sources of indicators and years of reference;
- Country abbreviations;
- List of sources used during the desk research phase and production of the 2012 *Researchers Report*.

11.1 List of indicators

Table 41: The Researchers Report 2012 - List of indicators

Indicators	Data source(s)	Year(s) of reference
The stock of researchers in Europe		
Researchers (Full Time Equivalent), EU-27, US, China, Japan, 2000 and 2009 (in million)	Eurostat	2000, 2009
Researchers (Full Time Equivalent) per thousand active labour force, EU-27, US, China, Japan, 2000 and 2009	Eurostat	2000, 2009
Researchers (Full Time Equivalent) per thousand active labour force, Europe, 2000 and 2009	Eurostat	2000, 2009
Researchers (Full Time Equivalent) working in the business and public sector (in million), EU-27, US, China, Japan, 2009	Eurostat	2009
Researchers (Full Time Equivalent) by sector, EU- 27, 2000-2009 (in million)	Eurostat	2009
Share of Full Time Equivalent (FTE) researchers working in the business sector (as % of all researchers), EU-27, US, China, Japan, 2009	Eurostat	2009
Researchers in the business sector (Full Time Equivalent) per thousand active labour force, EU-27, US, China, Japan, 2000 and 2009	Eurostat	2000, 2009
Researchers in the business sector (Full Time Equivalent) per thousand active labour force, Europe, 2000 and 2009	Eurostat	2000, 2009
Researchers in the public sector (Full Time Equivalent) per thousand active labour force, EU-27, US, China, Japan, 2000 and 2009	Eurostat	2000, 2009
Researchers in the public sector (Full Time Equivalent) per thousand active labour force, Europe, 2000 and 2009	Eurostat	2000, 2009
Women in the research profession		
Proportion of academic staff by grade (A, B, C, ISCED 6 and ISCED 5A), EU-27, 2002 and 2006 (%)	WiS database/ SHE figures	2002, 2006
Glass Ceiling Index, Europe, 2004 and 2007	WiS database/ SHE figures	2004, 2007
Women Grade A academic staff, Europe, 2007 (%)	WiS database/ SHE figures	2007
Proportion of woman academic staff grade A by main field of science (natural sciences, engineering and technology, social sciences, and	WiS database/ SHE figures	2007

[174] EU-27 and countries associated to the Seventh Framework Programme for research and technological development: Norway, Iceland, Liechtenstein, Switzerland, Israel, Turkey, Croatia, the Former Yugoslav Republic of Macedonia, Serbia, Montenegro and Bosnia & Herzegovina.

Indicators	Data source(s)	Year(s) of reference
humanities), Europe, 2007		
Proportion of women heads (president/rector) of institutions in the Higher Education Sector, Europe, 2007 (%)	WiS database/ SHE figures	2007
Proportion of women on boards, Europe, 2007 (%)	WiS database/ SHE figures	2007
Open, transparent and merit-based recruitment		
Researcher posts advertised through the EURAXESS Jobs portal, Europe, January to August 2011	EURAXESS JOBS	January to August 2011
Researcher posts advertised through the EURAXESS Jobs portal per thousand researchers in the public sector, Europe, January to August 2011	EURAXESS JOBS	January to August 2011
Estimated share of researchers in the higher education sector employed by their principal employer by years and country of affiliation, EU-27, 2009	MORE study[175]	2009
Education and training		
Population aged 30-34 having completed tertiary education, Europe, 2000 and 2010 (%)	Eurostat Labour Force population survey	2000, 2010
Tertiary graduates (ISCED 5 & 6) per thousand population aged 20-29, EU-27, US and Japan, 2000 and 2008	Eurostat	2000, 2008
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 2009	UNESCO OECD Eurostat education survey	2000, 2009
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 2009	UNESCO OECD Eurostat education survey	2000, 2009
New doctoral graduates (ISCED 6) per thousand population aged 25-34, EU-27, US and Japan, 2000-2009	UNESCO OECD Eurostat education survey	2000, 2009
New doctoral graduates (ISCED 6) per thousand population aged 25-34, Europe, 2009	UNESCO OECD Eurostat education survey	2009
New women doctoral graduates (ISCED 6) per thousand population aged 25-34, Europe, 2000 and 2009	UNESCO OECD Eurostat education survey	2000, 2009
International scientific co-publications per million population, Europe, US, Japan and China, 2010	Science Metrix / Scopus	2010
Scientific publications in the top 10% most-cited publications worldwide as a percentage of total scientific publications, Europe, US, Japan and China, 2007	Science Metrix / Scopus	2007
Working conditions		
Estimated shares of researchers in the higher education sector by employment contract status and by country of affiliation, EU-27, 2009 (%)	MORE study[176]	2009
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	2008 (US), 2009
Percentage of researchers indicating that their time as mobile researcher had positive, negative or no impact on career progression, EU-27, 2009	MORE study	2009
Collaboration between academia and industry		
Researchers indicating they have been employed in both the public and private sector, EU-27, 2009 (%)	MORE study	2009
Researchers indicating they have been employed in both the public and the private sector, by field of science (Social Science and Humanities, Natural Sciences and Technology, Medical Sciences and Agriculture) and by career stage (doctoral/PhD students, post-doctoral researchers, 'other researcher' category), EU-27, 2009 (%)	MORE study	2009
Public sector researchers with formal collaboration with business sector researchers from the country where they principally work, EU-27, 2009 (%)	MORE study	2009
Public sector researchers with formal collaboration with researchers from	MORE study	2009

[175] IDEA Consult (2010)

[176] Idea Consult (2010)

Indicators	Data source(s)	Year(s) of reference
other countries, by sector (academia and business, business, academia) EU-27, 2009 (%)		
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	2003, 2008
Mobility and international attractiveness		
Foreign (non-EU) doctoral candidates (ISCED 6) in the EU-27 by the top 30 countries of origin, 2007	UNESCO OECD Eurostat education survey.	2007
Non-EU doctoral students as a percentage of all doctoral students, Europe, 2009 (%)	Innovation Union Scoreboard database (2011)	2011
Doctoral candidates (ISCED 6) with a citizenship of another EU-27 Member State, EU-27, 2007 (%)	EUROSTAT OECD UNESCO survey	2007
Researchers having spent a period of at least three months as researchers in another country, EU-27, 2009 (%)	MORE study	2010
Women researchers having spent a period of at least three months as researchers in another country, EU-27, 2009 (%)	MORE study	2010
Factors motivating European researchers to become mobile or not, EU-27, 2010 (average scores)	MORE study	2010
Personal motivation of EU-27 researchers to become mobile, Europe, 2009 (%)	MORE study	2010
Professional motivation of researchers to become mobile (1/2), EU-27, 2009 (%)	MORE study	2010
Professional motivation of researchers to become mobile (2/2), EU-27, 2009 (%)	MORE study	2010
Main producers of scientific publications, EU, 2000 and 2008	Innovation Union Competitiveness Report 2011[177]	2000, 2008
Co-publications with an author from another European country by five main partners in Europe, other countries, 2010 (%)	Science Metrix / Scopus	2010
Residence of Nobel Prize winners by continent, Europe, US, Asia/Pacific, 1990-2011	www.nobelprize.org	1990-2011
Most active research universities by normalised citation impact ('Leiden Ranking'), Europe, 1997-2006	Innovation Union Competitiveness Report 2011	1997-2004

[177] European Commission (2011a)

11.2 Sources of indicators and years of reference

Timing

The 2012 *Researchers Report* presents the most recent data to monitor the reseacher profession in Europe with a cut-off date of end of November 2011. It refers to a number of studies and combines several data sets in order to present a comprehensive and complete picture of the researcher profession in Europe.

Qualitative data

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

In order to fill possible information gaps for the production of the report, Deloitte elaborated 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 seperate Annex to this report). A literature review complemented the collection and analysis of the qualitative data.

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 researcher profession. For example:

- European Commission (2011), "Innovation Union Competitiveness Report", 2011 edition, EUR 24211;
- European Commission (2011), "Innovation Union Scoreboard, Research and Innovation Union scoreboard" 2011;
- Idea Consult (2010a), "Study on mobility patterns and career paths of EU researchers", April 2010[178];
- European Commission (2009), "Feasibility Study for Creating a European University Data Collection";
- European Commission (2009), "SHE Figures 2009. Statistics and Indicators on Gender Equality in Science", General Information, EUR 23856 EN[179];
- Nobel Prizes, Nobel prize foundation (2011), available at: www.nobelprize.org;
- 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 researcher 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;

[178] A new study (MORE 2, to be published in June 2013) will provide information (case studies) on researchers' remuneration.
[179] A new SHE Figures report will be available in 2012/2013.

- 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[180] or EUMIDA[181]) or twice (such as the CDH survey[182]);
- 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.

11.3 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

Academic Cooperation Association (2006), "EURODATA: Student mobility in European higher education", Maria Kelo, Ulrich Teichler, Bernd Wächter (eds.), a study produced for Directorate General for Education and Culture (DG EAC), of the European Commission

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

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

[180] Idea Consult (2010a), "Study on mobility patterns and career paths of EU researchers", April 2010
[181] European Commission (2009), "Feasibility Study for Creating a European University Data Collection"
[182] OECD (2010), "Career of Doctorate Holders: Employment and Mobility Patterns", Science, Technology and Industry Working Paper 2010/4. DSTI/DOC(2010)4, Paris

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

European Commission (2008), "Communication from the Commission to the Council and the European Parliament. A Strategic European Framework for International Science and Technology Cooperation", COM (2008) 588 final, Brussels, 24.09.2008

European Commission (2008), "Benchmarking Policy Measures for Gender Equality in Science", EUR 23314, Luxembourg

European Commission (2009), "Euraxess-Links Abroad (ELA) Geographic Expansion- Feasibility study", Final Report by Deloitte & TEP, FRAMEWORK CONTRACT: RTD-C5-2005-I&C Lot 4: Assessment of the impact of information and communication policy products, for the European Commission Research Directorate General, , Brussels, 12 June 2009

European Commission (2009), "The Gender Challenge in Research Funding: Assessing the European national scenes", report by the Expert Group, EUR 23721 EN, Brussels

European Commission (2010), "Developing the European Research Area: Improving Knowledge Flows via Researcher Mobility", JRC Scientific and Technical report, Institute for Prospective Technological Studies (IPTS), EUR 24511 EN –2010, Spain

European Commission (2011), "Towards a European Framework for Research Careers", Directorate General For Research & Innovation, Brussels, 21 July 2011

European Commission (2011), "Progress Towards the Common European Objectives in Education and Training. Indicators and benchmarks 2010/2011", Commission staff working document, Brussels

European Commission (2011), "Report of Mapping Exercise on Doctoral Training in Europe. Towards a common approach", Directorate-General for Research & Innovation, 27 June 2011, Brussels

European Science Foundation and EUROHORCS (2008), "Vision on a Globally Competitive ERA and their Road Map for Actions", Strasbourg and Bern

European Science Foundation (2010), "Research Careers in Europe Landscape and Horizons", a report by the ESF Member Organisation Forum on Research Careers

European University Association (2009), "Collaborative Doctoral Education University-industry Partnerships for enhancing Knowledge exchange", Doc-Careers project by Lidia Borrell-Damian, Brussels

European University Association (2011), "University Autonomy in Europe II: The Scorecard", by Thomas Estermann, Terhi Nokkala & Monika Steinel, Brussels

OECD (2002), “Frascati Manual: Proposed Standard Practice for Surveys on Research and Experimental Development”, 6th edition, Paris

OECD (2007), “Labour Market Characteristics and International Mobility of Doctorate Holders: Results for Seven Countries”, Science, Technology and Industry Working Paper 2007/2. DSTI/DOC(2007)2, Paris

OECD (2008), “The Global Competition for Talent: Mobility of the highly skilled”, September 2008, Paris

OECD (2010), “OECD Science, Technology and Industry Outlook 2010”, December 2010, Paris

OECD (2010), “Career of Doctorate Holders: Employment and Mobility Patterns”, Science, Technology and Industry Working Paper 2010/4. DSTI/DOC(2010)4, Paris

OECD (2011), “Background note for the OECD RIHR Workshop on Transferable Skills Training for Researchers: Supporting career development and research”, Web Based Report / Working Paper DSTI/STP/RIHR(2011)7, Paris

11.4 Country abbreviations

Table 42: Country abbreviations

Monitored countries	Monitored regions
Austria - AT	European Union 27 – EU-27
Belgium – BE	China - CN
Bosnia & Herzegovina – BiH	Japan - JP
Bulgaria – BG	United States - US
Croatia - HR	
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	
Sweden - SE	
Switzerland - CH	
Turkey – TR	
United Kingdom – UK	

Source: Deloitte