European Commission

DG Research and Innovation

Researchers' Report 2013

Final Report

Deloitte.

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

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Executive summary

Introduction

A genuinely open and attractive European labour market for researchers is an essential factor for the successful completion of the European Research Area. Moreover, Europe needs more researchers if it is to meet its target of devoting 3% of GDP to R&D by 2020. It has been estimated that a net increase of one million researchers is needed over this decade, an increase of more than 60%. Without more researchers and an open labour market for researchers, Europe cannot remain globally competitive, and generate knowledge and innovation-based growth and jobs.

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 to facilitate cross-border mobility, 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. This implies offering quality doctoral and post-doctoral training and research opportunities. 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.

Significant progress has been made in recent years. Member States have introduced a range of measures, programmes, strategies and legislative acts to address the barriers and train researchers to create the conditions to meet their national R&D targets. A series of EU policy initiatives such as the development of the EURAXESS network, the 'Scientific Visa Directive', a Human Resources Strategy for Researchers based on the Charter and Code, and Principles of Innovative Doctoral Training have also contributed to this progress.

However, a number of challenges remain and a coordinated effort by the Commission, Member States and institutions is needed to remove remaining obstacles, in particular practices, to researcher mobility, training and attractive careers.

Researchers' Report 2013

The *Researchers' Report 2013* prepared by Deloitte Consulting for the European Commission's Directorate-General for Research and Innovation looks at the extent to which those prerequisites are being met, since a full understanding of the researcher landscape in its complexity is indispensable for sound decision- and policy-making.

The Report is the second of three annual reports, which measure the extent to which progress is being made on the various undertakings by the countries who participate in 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[1], and for identifying clusters of low-performing countries.

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

The qualitative data come 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 (including Croatia at the time of the research). This was supplemented by desk research. The qualitative data includes best practice examples, of which a selection is included in the relevant chapters of this report.

The quantitative data come from a variety of official sources and studies carried out for DG Research and Innovation. The past year has been particularly marked by the availability of data from the MORE2 study on researcher mobility and career paths[2] and of information gathered in the questionnaires on the impact of the measures taken to promote the profession of researcher.

The report focuses in particular on indicators which relate to Innovation Union Commitments[3] Nos. 1[4]and 30[5]. These deal with research training and employment conditions, gender and dual career considerations, and ensuring that leading academics, researchers and innovators reside and work in Europe and that a sufficient number of highly skilled third country nationals are attracted to Europe.

Innovation Commitment No. 4 on obstacles to mobility and cross-border cooperation, which was the starting point for the relevant sections of the first of these reports, has been superseded by the chapter on an open labour market for researchers in the reinforced European research area partnership for excellence and growth[6] agreed by the Council of Ministers in December 2012[7]. This reaffirms the commitment to completing the European Research Area and increasing the level of excellence of Europe's public research system and stresses the need to step up progress. This report takes this into account.

The Report as such is complemented by data Annexes, by 38 detailed Country Profiles of around 10-15 pages and by around 50 examples of Good Practice.

All the country profiles are presented in accordance with the same eight topics:

- Key data;
- National strategies;
- 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.

[2] Available at: www.more-2.eu

[3] European Commission (2010b)

[4] "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)

[5] "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)

[6] European Commission (2012c)

[7] Council of the European Union (2012)

The report, the Country Profiles 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.

The chapters of this report mirror the structure of the country profiles, except that the key data and national strategies topics are replaced by a single chapter on the stock of researchers. This report also benchmarks the EU-27 or the ERA countries against their main competitors, current and potential, and in particular the US, Japan and China.

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

The issues

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

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

Member States and Associated Countries[8] have reported a range of measures aimed at ensuring they train enough researchers to meet their national R&D targets in their respective countries. These include both regulatory or quasi-regulatory measures, such as national action plans and programmes, and new or updated legislation, and 'soft' measures, such as awareness-raising schemes about research careers, and improvements to the quality and relevance of doctoral training. There is a tendency for measures and policies to be issues-based, rather than based on a comprehensive strategy covering all issues. Information on the impact of the measures taken to date is still limited, but there are nevertheless examples of positive impacts from Belgium, Germany and Luxembourg.

Women in the research profession: Europe is far from having achieved gender equality in research and therefore from optimising its talent pool. Women still face a glass ceiling. They outnumber men at the first two levels of tertiary education, but are 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 or university: women account for only 16% of heads of these organisations. There is some improvement, based in some cases on specific policies and measures to introduce gender balance on boards and similar bodies, but the rate of progress is highly relative given the gap

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

that needs to be closed. 'Soft' measures include coaching and mentoring programmes (in Austria, for example), and awards for women for excellence in research, e.g. in Poland.

Open, transparent and merit-based recruitment procedures: Recruitment based on merit and academic excellence from the very earliest stages and throughout a research career are a prerequisite for research excellence and optimising research talent, and thus for realising the European Research Area. Both the authorities and research institutions report having taken steps to make the process more transparent. Publishing jobs on portals such as EURAXESS Jobs and meeting the conditions for obtaining the 'HR Excellence in Research' logo contribute to this.

Nevertheless, many researchers' perception is that there is still a long way to go. They believe that protectionism and nepotism are still widespread in a number of countries, that institutions lack human resource strategies and that there is an information deficit. The problem appears to be particularly acute in some Mediterranean countries.

There is more progress to be made in advertising positions more widely, e.g. through EURAXESS Jobs, but there have already been major advances. The number of jobs advertised on EURAXESS increased almost five-fold between 2010 and 2012, while several countries are making it compulsory to publish research job vacancies beyond national boundaries (e.g. Austria) or on EURAXESS (e.g. Poland). Countries making high use of EURAXESS include not only Poland, but also Greece, Sweden and Ireland.

Education and training: The first step in increasing the stock of researchers is to ensure that enough young people enter into tertiary education and that enough of these study science, technology, engineering and mathematics (STEM), and that a significant number then go on to receive quality doctoral training.

There has already been a 50% increase between 2000 and 2011 in the share of the 30-34 age group who have completed tertiary education (34.6%) and the EU-27 is well on its way to meeting its 2020 target of 40%.

The number of graduates in STEM per thousand in the 20-29 age group increased by almost 25% between 2000 and 2010 (and by 30% in the case of women). The increases were more rapid than in the US and Japan, but the ratios are still lower than in those countries, while the ratio of degrees in STEM subjects to all degrees is virtually unchanged.

There was an increase of almost 60% in the number of new doctoral graduates in the EU-27 over the last decade, slightly more than in the US but more than in Japan, while the number per thousand remains lower than in the US but higher than in Japan.

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

partnerships with and placements in the private sector. Examples include Austria's 'Talente' programme and the Fraunhofer industrial PhD programmes in Germany.

Working conditions: Attractive working conditions and career prospects are a key driver for attracting young people into a researcher career and ensuring top-quality research results in public research institutions. However, research careers present a particular challenge in the early career stages and during doctoral training when many researchers are on short, fixed-term contracts or indeed have no contract at all, and either do not have benefits from 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. Thus career paths appear uncertain.

The problems can be compounded by poor remuneration, although there are wide differences across the European Research Area. On average, as a percentage of the purchasing power adjusted salary of the best paying countries, non-European countries pay better than the EU-27 Member States in all career stages (R1-R4). The gap is 5 to 10 percentage points in R2, R3 and R4 and about 25 percentage points in R1. Amongst the best paying countries are the US (R2-R4), Brazil (R1-R4), Switzerland (R2-R4), Cyprus (R2-R4), the Netherlands (R3, R4), Ireland (R4), and Belgium (R1). Denmark pays the highest stipends for PhD candidates across all countries. US universities pay relatively low amounts for the R1 level researchers (both in terms of stipends but also to a lesser extent in terms of salaries for employed PhD candidates), but the higher the career level, the higher the PPP converted salaries are in the US in comparison to all other countries.

Where researchers have been able to spend time (measured as more than three months) in another country, this is generally perceived as having had a positive impact on career progression.

EU Member States and Associated Countries continue to support the implementation of the Charter & Code (C&C) which aim to improve researchers' working conditions. As of June 2013, more than 480 organisations from 35 countries in Europe and beyond have explicitly endorsed the principles underlying the C&C, many of them membership or umbrella organisations. Level of institutional endorsements of the C&C principles continues to grow.

The Commission's Human Resources Strategy for Researchers (HRS4R) focuses on the practical implementation of the C&C principles. Award of the "HR Excellence in Research" logo[9] recognises institutional progress in implementing C&C principles. Currently, some 230 organisations are members of the Strategy Group. So far 148 organisations have received the logo. Half of the logos awarded are within one country (the UK), reflecting the enabling framework provided by national authorities.

Collaboration between academia and industry: Research results have limited value if they are not exploited. Interaction with the private sector is therefore critical. However, moving out of public sector research into the private sector for a short period during doctoral studies or thereafter is still very much the exception, even though it is perceived as potentially beneficial for a researcher's

[9] Available at: http://ec.europa.eu/euraxess/index.cfm/rights/strategy4Researcher

career, access to funding and the exploitation of research results. Researchers appear to be held back by lack of preparation in the areas of intellectual property and knowledge transfer. As a result, levels of co-publication between the public and private sector are much lower than in the US or Japan.

Many countries acknowledge the problem and are promoting partnerships between universities, research institutions and private companies. These include the implementation of joint projects, exploitation programmes, research traineeships in companies, inter-sectoral mobility programmes, industrial PhD programmes, and the possibility to combine teaching and private sector research.

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 often associated with excellence, the creation of dynamic networks, improved scientific performance, improved knowledge and technology transfer, improved productivity, and ultimately enhanced economic and social welfare.

Around 15% of researchers who currently work in the EU are currently 'mobile', i.e. working in another country. Looking at mobility over a longer period, just under one third of all researchers have spent more than three months in another country in the last ten years, with men significantly more likely to have been internationally mobile than women; taking their careers as a whole, the figure of those who have been internationally mobile rises to almost half. EURAXESS is a key tool in supporting mobility.

Around 18% of current or recent doctoral candidates were mobile during their PhD, returning 'home' to obtain their PhD. In addition, 14% of R2-3-4 researchers moved to another country in order to obtain their PhD.

Mobility is driven by the benefits for researchers' careers, but also by the availability of funds, facilities and equipment, the availability of positions and the quality of training. Personal/family reasons appear to be barriers to mobility.

Measures to promote mobility range from financial incentives, such as special fellowships (e.g. in Poland) to support for dual careers (e.g. an initiative of the universities near the Franco-Swiss-German borders).

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

The extent to which research institutions co-publish and the extent to which their scientific publications are cited in the leading scientific journals are measures of the attractiveness of public research institutions. The EU, whose researchers primarily co-publish with other EU researchers and

who have a tendency to publish to a significant extent with researchers from neighbouring countries, still lags behind the US on both counts.

'Poles' or clusters, such as those in France and Germany, are another factor which can add to the visibility, attractiveness and performance of the European systems.

Conclusion

This report provides a stocktaking of different dimensions of the research profession which are critical to realisation of the European Research Area. It provides an overview of the measures being taken and possible remaining gaps. One year after the publication of the previous report, it is clear that countries participating in the ERA fully acknowledge its importance. Completion of the ERA may not be proceeding as rapidly as it has been hoped, but it is clear that the countries are generally not standing still, but are – with differences of degree – honouring the reaffirmation of the European Research Area contained in the December 2012 Council Conclusions on "A reinforced European research area partnership for excellence and growth", which emphasised the need to complement and step up the ERA-related actions in the context of the implementation of the Innovation Union.

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[10]. A full understanding of the research profession in its complexity is crucial for sound decision and policy-making.

In 2011, Deloitte received a mandate from the European Commission, DG Research & Innovation, to produce an integrated report on the research profession in Europe (*Researchers' Report*). The study aims to provide a reliable, complete and up-to-date picture of the research profession in 38 countries[11] (subsequently 'the countries'), taking into account country-specific (policy) contexts in the framework of a multi-annual reporting exercise. The *Researchers' Report* monitors the countries' progress towards realising the Europe 2020 Flagship Initiative 'Innovation Union' 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. It also establishes the baseline for annual updates and for monitoring the European Research Area (ERA)[12].

The *Researchers' Report 2012*[13] (the first of what will be three editions) provided information on the state of play of the countries' measures in response to Innovation Union Commitments[14] Nos. 1[15], 4[16] and 30[17]. The 2013 edition of the report provides an update on the countries' measures in response to the Innovation Union Commitments and takes into account the most recent (policy) developments in promoting an open labour market for researchers.

[10] See for example: "Communication from the European Commission, Europe 2020 A strategy for smart, sustainable and inclusive growth", European Commission (2010d)

[11] EU-27 and countries associated to the Seventh Framework Programme for research and technological development: Norway, Iceland, Liechtenstein, Switzerland, Israel, Turkey, the Former Yugoslav Republic of Macedonia, Serbia, Montenegro and Bosnia & Herzegovina whereas Croatia became member of the European Union in July 2013.

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

[13] The *Researchers' Report 2012* is available at: http://ec.europa.eu/euraxess/index.cfm/general/researchPolicies

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

[15] "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)

[16] "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)

[17] "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).

ERA is part of the Innovation Union, a Europe 2020 Initiative. In line with the Innovation Union commitments, the Commission proposed "A Reinforced European Research Area Partnership for Excellence and Growth"[18], which supersedes Innovation Union Commitment No. 4.

In its Conclusions on "A reinforced European research area partnership for excellence and growth"[19], the Council of the European Union emphasised the need to complement and step up the ERA related actions in the context of the implementation of the Innovation Union and recalled the need to realise a genuine European research labour market. The Member States also emphasised the need to improve human resource policies within research organisations, and further promote innovative doctoral training, gender equality practices, academia-business cooperation, including mobility and fair recognition of academia degrees.

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

The *Researchers' Report 2013* monitors the implementation of the ERA and includes information on a number of impacts at national level from implementation of measures which the countries reported in some monitoring categories during the 2012 reporting exercise. The report also presents a full update of last year's indicators (see *Researchers' Report 2012*)[20] and includes additional indicators[21] in a number of monitoring categories.

Monitoring categories

The report takes stock of different dimensions of the research profession in Europe based on a set of reliable indicators[22]. 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 *Researchers' Report 2013*, and will serve as the basis for the 2014 report.

In order to 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 provides an overview of the countries' measures in response to a growing demand for top-level researchers together with some of the limited information available on the impact from the measures;
2. **"Women in the research profession"** (Chapter 2): discusses the remaining gender imbalance in science and provides an overview of countries' remedial measures to ensure equal opportunities for women and men in access to research funding, promotion and decision-making bodies;

[18] European Commission (2012c)
[19] Council of the European Union (2012)
[20] The report and its annexes are available at: http://ec.europa.eu/euraxess/index.cfm/general/researchPolicies
[21] Mainly benefiting from the results of the recent MORE2 survey (Idea Consult 2013)
[22] For a list of indicators in scope of this report, see Technical Annex "List of indicators"

3. **"Open, transparent and merit-based recruitment"** (Chapter 3): provides an assessment of the openness of public recruitment procedures in public research institutions across Europe, in particular with reference to the number of openings published on the EURAXESS Jobs portal, and discusses the discrepancy between stakeholders' and public authorities' perceptions of the degree of openness, fairness and transparency of those procedures;
4. **"Education and training"** (Chapter 4): discusses the pivotal role education and training play in generating a sufficiently large pool of skilled researchers to promote a knowledge-based economy. The chapter provides an overview of the countries' measures to attract people to a researcher career, to upgrade the quality of doctoral training and post-doctoral career paths, and to encourage academia-industry partnerships in line with the European Charter for Researchers and Code of Conduct for the Recruitment of Researchers (Charter & Code) [23];
5. **"Working conditions in the research profession"** (Chapter 5): presents the most recent data on working conditions (employment contracts and remuneration), measures to improve and the impact of mobility on career prospects, as well as discussing the issues relating to social security provision for researchers;
6. **"Collaboration between academia and industry"** (Chapter 6): provides the most recent statistics on collaboration between academia and industry in Europe, and in comparison with its main economic competitors (US, Japan and China). It provides information on the extent to which researchers have spent time in the private sector (cross-sectoral mobility), and the motivation, and on co-publication with the private sector;
7. **"Mobility and international attractiveness"** (Chapter 7): presents the most recent figures on researchers' mobility (inward and outward) and discusses different factors influencing researchers' mobility, such as career progression, availability of funding or facilities, and personal/family factors. The chapter also presents information on scientific co-publications and provides an overview of the countries' measures to remove the remaining barriers to researchers' mobility.

Definition of researchers

In accordance with the new European Framework for Research Careers (2011)[24], research career stages are divided into four broad research profiles:

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

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

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

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

[25] Frascati Manual (OECD 2002)

Annexes to the report

The *Researchers' Report 2013* consists of the main report and a set of accompanying annexes[26]:

1. **Country Files**: The 38 country files provide an overview of countries' measures in response to Innovation Union Commitments Nos. 1, 4 and 30 and in particular to the issues identified in the ERA priority area "An open labour market for researchers"[27]. The information is presented in accordance with the chapters featured in the *Researchers' Report 2012*. It is based on the following sources:
   - The countries' individual responses to the Deloitte questionnaire (2011) and the 2012 reporting exercise. For the 2012 reporting exercise, the countries were requested to report on their individual progress towards meeting the 'Innovation Union' Commitments since the last reporting exercise (2011) in relation to:
     - (New) policy measure(s) (strategies, programmes, initiatives, etc.) in response to the Innovation Union Commitments in each of the monitoring categories;
     - The (likely) impacts resulting from the measure(s) implemented/foreseen by providing factual evidence;
     - The magnitude of the measures implemented/foreseen;
     - A number of key indicators;
     - Additional secondary sources.

2. **Scorecards:** The multi-coloured scorecards allow for quick visualisation of the countries' individual progress (or lack thereof) between two different dates for a number of key indicators[28]. The indicators were selected on the basis of their a) relevance for the issue to be monitored, b) comparability between dates (availability of data) and c) robustness of the data set. Scorecards serve as a means of monitoring change between different dates by showing if the value of an indicator has increased, decreased or remained stable.

   Each scorecard refers to two dimensions:
   1. **Score**: the value of the indicator for the latest year available is summarised in four value ranges (from 4 to 1) represented by colours, from 4 (green) to 1 (orange);
   2. **Progress**: the value of the indicator against its value from the previous year (or latest year available). This makes it possible to monitor progress (or lack thereof) by showing if the value of the indicator has increased (↑), decreased (↓) or remained stable (↔).

The countries (and in some cases the EU-27, US, Japan and China) are placed in four performance groups[29]:

[26] The *Researchers' Report 2013* and all its accompanying Annexes present information with a cut-off date of March 2013.

[27] European Commission (2012c)

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

[29] Based on the methodology applied in the "Innovation Union Scoreboard 2013", European Commission (2013a)

Table 1: Scorecards - Methodology

Category	Calculation
Green (4)	The country's/region's performance is at least 20% above the EU-27 average.
Light green (3)	The country's/region's performance is between -10% and +20% of the EU-27 average.
Yellow (2)	The country's/region's performance is between -50% and -10% of the EU-27 average.
Orange (1)	The country's/region's performance is below 50% of the EU-27 average.

Source: Deloitte based on the methodology applied in the "Innovation Union Scoreboard 2013"

In most cases, we observe a positive trend in the EU-27 performance between two different dates:

- Between 2009 and 2010, the number of researchers (FTE) per 1 000 labour force increased in the EU-27 by 2.3%, less than in Japan (3.7%), but more than in the US (1.3%);
- Between 2002 and 2010, the average percentage of women Grade A academic staff in the EU-27 increased from 15.3% to 19.8% (+29%);
- Between 2011 and 2012, 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 33.3% to 40.8% (+23%);
- The number of new doctoral graduates (ISCED 6) per thousand population aged 25-34 in the EU-27 increased from 1.5 in 2009 to 1.6 in 2010 (+7%);
- Between 2009 and 2010, the EU-27 share of non-EU doctoral candidates as a percentage of all doctoral candidates decreased slightly from 20.5% to 20.0% (-2%);
- Between 2009 and 2010, the proportion of doctoral candidates (ISCED 6) in the EU-27 with a citizenship of another EU-27 Member State remained unchanged and stood at 7.8%;
- Between 2010 and 2011, the number of international scientific co-publications per million population in the EU-27 remained almost unchanged. The EU-27 average was around 300 co-publications per million population in comparison with around 450 in the United States, 211 in Japan and 43 in China;
- Between 2007 and 2008, EU-27 scientific publications in the top 10% most-cited publications worldwide as a percentage of all scientific publications increased from 10.7% to 10.9% (+2%).

The table below presents the performance of the EU-27 (and in some cases of the US, Japan and China) for a number of indicators, showing the name of the indicator(s), the values per year of reference and the long- and short-term trend for each indicator (where data are available).

Table 2: Scorecards, long- and short-term trend per key indicator for the EU-27, US, China and Japan[30]

Name of the indicator	Values/ progress	Years of reference	EU-27		United States		China (except Hong Kong)		Japan	
Researchers (Full Time Equivalent) per thousand labour force, EU-27, US, China, Japan, 2000, 2009 and 2010	*Values*	*2000*	4.9		9.0		1		9.6	
		2009	6.5		9.4		1.4		9.9	
		2010	6.6		9.5		1.9		10.3	
	Progress	*2000-2010*	↑	**35%**	↑	**6%**	↑	**101%**	↑	**7%**
		2009-2010	↑	**2%**	↑	**1%**	↑	**32%**	↑	**4%**
Women as Grade A academic staff, Europe, 2002 and 2010, EU-27	*Values* (%)	*2002*	15.3		:		:		:	
		2010	19.8							
	Progress	*2002-2010*	↑	**29%**						
Researcher posts advertised through the EURAXESS Jobs portal per thousand researchers in the public sector, EU-27, 2011 and 2012	*Values*	*2011*	33.3		:		:		:	
		2012	40.8							
	Progress	*2011-2012*	↑	**23%**						
New doctoral graduates (ISCED 6) per thousand population aged 25-34, EU-27, US, China, Japan, 2000, 2009 and 2010	*Values*	*2000*	1.1		1.1		:		0.7	
		2009	1.5		1.6		2.4		1.1	
		2010	1.6		1.7		2.4		1.1	
	Progress	*2000-2010*	↑	**45%**	↑	**55%**	:	:	↑	**52%**
		2009-2010	↑	**7%**	↑	**6%**	↔	**0%**	↓	**-4%**
Non-EU doctoral candidates as a percentage of all doctoral candidates, EU-27, 2004, 2009 and 2010	*Values* (%)	*2004*	17.1		:		:		:	
		2009	20.5							
		2010	20.0							
	Progress	*2004-2010*	↑	**17%**						
		2009-2010	↓	**-2%**						
Doctoral candidates (ISCED 6) with citizenship of another EU-27 Member State, EU-27, 2004, 2009 and 2010	*Values* (%)	*2004*	5.8		:		:		:	
		2009	7.8							
		2010	7.8							
	Progress	*2004-2010*	↑	**34%**						
		2009-2010	↔	**0%**						
International scientific co-publications per million population, EU-27, US, China, Japan, 2002, 2010 and 2011	*Values*	*2002*	129		:		:		:	
		2010	301		441		38		204	
		2011	300		450		43		211	
	Progress	*2002-2011*	↑	**133%**	:		:		:	
		2010-2011	↔	**0%**	↑	**2%**	↑	**12%**	↑	**4%**
Scientific publications in the top 10% most-cited publications worldwide as a percentage of total scientific publications, EU-27, US, China, Japan, 2004, 2007 and 2008	*Values* (%)	*2004*	10.2		14.31		6.6		7.2	
		2007	10.7		14.4		6.6		7.2	
		2008	10.9		14.3		6.8		7.3	
	Progress	*2004-2008*	↑	**7%**	↔	**0%**	↑	**15%**	↓	**-2%**
		2007-2008	↑	**2%**	↓	**-1%**	↑	**4%**	↑	**1%**

[30] Data per Member State for each of the ten key indicators are available in the "Scorecards". This includes two key indicators (share of mobile researchers and share of fixed-term contracts) which were excluded from this table as there is no information on progress in the EU nor any comparable data for the US, China and Japan. Source: Deloitte.

3. **Good Practices:** In 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 70 Good Practices in total, covering all monitoring categories in the questionnaire.

   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.

   For the purpose of the *Researchers' Report 2012*, Deloitte selected around 50 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 *Researchers' Report 2013* includes an updated selection of the Good Practices based on the countries' response to the 2012 reporting exercise. The Good Practices are presented according to the topics of the Report.

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 despite a moderate increase between 2009 and 2010. In 2010, the ratio was 6.64 per 1 000 in the EU-27, compared to 9.51 in the US and 10.27 in Japan. The Nordic countries and Luxembourg do better than the EU average;
- In absolute terms, there were 2.44 million (head count) researchers in the EU-27 in 2010. This amounts to 1.59 million full time equivalent (FTE) researchers in the EU-27 compared to 1.48 million in the United States, 0.68 million in Japan and 1.53 million in China. Between 2000 and 2010, the stock of researchers in the EU-27 grew by an annual average of almost 4%.

The stock of researchers in the business sector:

- In the EU-27, more than half the researchers (55%) work in the public sector, and only 45% (710 000) are in the business sector[31]. The share of researchers employed by the business sector is much higher for the EU's main economic competitors, e.g. 1 150 000 (78%) in the United States, 940 000 (62%) in China and more than 500 000 (74%) in Japan;
- There were 2.98 Full Time Equivalent researchers in the business sector per thousand labour force in the EU-27 in 2010 compared to 7.40 in the US, 7.63 in Japan and 1.38 in China;
- The number of researchers in the business sector (FTE) per thousand labour force is highest (>6) in a number of the Nordic countries (Finland, Denmark, Iceland and Sweden) and lowest (<1) in some of the new Member States, such as Bulgaria, Latvia, Romania, Poland, Slovakia and Lithuania.

Countries' measures to increase the stock of researchers:

- Member States and Associated Countries have reported a range of measures aimed to ensure 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[32];
- Very few countries reported impacts resulting from national measures to increase the stock of researchers at national level. One exception was the Belgian 'Action Plan for Researchers (2010)', which has been evaluated. It was considered that most of its actions have been completed successfully[33]. Other examples came from Germany and Luxembourg;

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

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

[33] E.g. the Research Foundation – Flanders and all Flemish universities have been acknowledged in the HR Excellence in Research process, or are working towards it; the Convention on the Recognition of Qualifications concerning Higher Education in the European Region (ETS no. 165) was ratified by Belgium and Flanders in 2009; language legislation at the universities was made more flexible; the Research Foundation – Flanders analysed how to evaluate foreign candidates in an objective and accurate way; workshops were organised on

– For a detailed overview of countries' measures in each of the monitoring categories, please see the individual chapters in this report which highlight some best practice examples.

1.2 Introduction

As previously stated, well-trained, creative and dynamic researchers are indispensable for building and sustaining a competitive knowledge-based economy. Europe hosts a large pool of talented and skilled researchers. However, the stock as a share of the labour force is well below that of its main trading competitors (United States, China and Japan). In addition, the proportion of researchers employed in the business sector is insufficient to sustain Europe's position as a global economic leader. It has been estimated that an additional one million researchers may be needed in Europe by 2020 to meet an R&D intensity target of 3% GDP[34]. The actual number of researchers required is significantly higher, as many researchers will retire over the next decade[35]. 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[36]. Demand in Europe for highly qualified people is predicted to rise by almost 16 million in the period up to 2020[37].

In order to remain competitive, Europe must, therefore, invest in generating a sufficiently large pool of skilled human resources for research and innovation. Against this backdrop, the Europe 2020 Flagship Initiative "Innovation Union"[38] 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 research in Europe and presents a comparison of data between last year's report and the most recent quantitative data available. First, it offers an overview of the key indicators showing the stock of researchers in Europe. Second, it discusses the position and trends in the stock of researchers in Europe, and in comparison with its main trading partners: United States, China and Japan. It presents data on Full Time Equivalents (FTE), Head Counts (HC) and the proportion of researchers in the business and public sector. Third, it provides an overview of the measures the countries are taking with a view to training enough researchers to meet their national R&D targets. It then looks at some of the impacts of the countries' measures which it is already possible to discern.

1.3 The stock of researchers in Europe – Key indicators

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

several topics related to the action plan; an interuniversity initiative was taken to promote the recruitment of doctorate holders on the private labour market; gender-friendly measures were taken in the new legislation on research funding for the Special Research Funds at the universities; and the doctoral schools received funding for the support of young researchers.

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

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

[36] European Commission (2011a)

[37] European Commission (2011f)

[38] European Commission (2010a)

Table 3: The stock of researchers in Europe - key indicators

Indicators	Data source(s)
Researchers (Full Time Equivalent), EU-27, US, China, Japan, 2000, 2009 and 2010 (in million)	Eurostat
Researchers (Full Time Equivalent) per thousand labour force, EU-27, US, China, Japan, 2000, 2009 and 2010	Eurostat
Researchers (Full Time Equivalent) per thousand labour force, Europe, 2000 and 2010	Eurostat
Researchers (Full Time Equivalent) working in the business and public sectors (in million), EU-27, US, China, Japan, 2010	Eurostat
Researchers (Full Time Equivalent) by sector, EU- 27, 2000-2010 (in million)	Eurostat
Share of Full Time Equivalent (FTE) researchers working in the business sector (as % of all researchers), EU-27, US, China, Japan, 2010	Eurostat
Researchers in the business sector (Full Time Equivalent) per thousand labour force, EU-27, US, China, Japan, 2000 and 2010	Eurostat
Researchers in the business sector (Full Time Equivalent) per thousand labour force, Europe, 2000 and 2010	Eurostat
Researchers in the public sector (Full Time Equivalent) per thousand labour force, EU-27, US, China, Japan, 2000 and 2010	Eurostat
Researchers in the public sector (Full Time Equivalent) per thousand labour force, Europe, 2000 and 2010	Eurostat

1.4 Human resources in the research profession

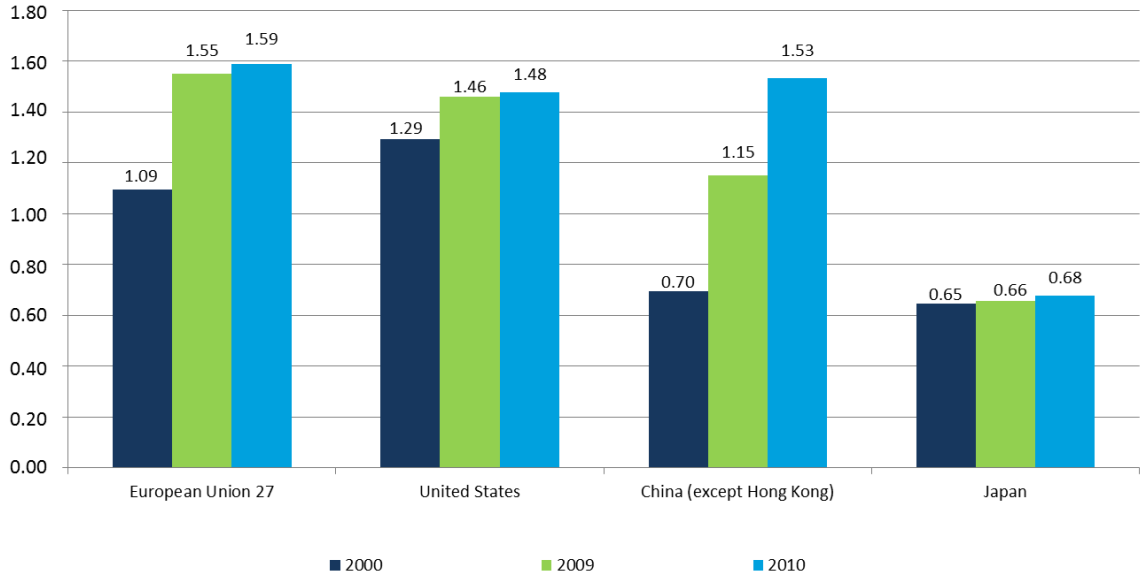
In absolute terms, there were 1.59 million full time equivalent (FTE) researchers in the EU-27 in 2010 compared to 1.48 million in the United States, 0.68 million in Japan and 1.53 million in China. Between 2000 and 2010, the stock of researchers in the EU-27 grew by an annual average of almost 4%. This was faster than in the US and Japan, but slower than in China. The corresponding head count figures[39] were 2.44 million, 2.2 million, 0.9 million and 1.9 million. The average annual increase (2000-2010) in the EU-27 was >4%.

Between 2000 and 2010, the stock of EU-27 researchers (in FTE) increased from 1.09 million to 1.59 million. The increase in the United States was from 1.29 million to 1.48 million. In Japan, the number of researchers increased from 0.65 million to 0.68 million. China experienced the biggest increase in the number of researchers from 0.7 million to 1.53 million.

Between 2009 and 2010, the number of researchers (in FTE) increased in Europe by 2.6%. The increase was 3.2% in Japan and 1.1% in the US.

[39] Recent data on HC for the US and China are not available. These numbers are based on the extrapolation of 2007 data.

Figure 1: Researchers (Full Time Equivalent), EU-27, US, China, Japan, 2000, 2009 and 2010 (in million)[40]



Source: Deloitte
Data: Eurostat

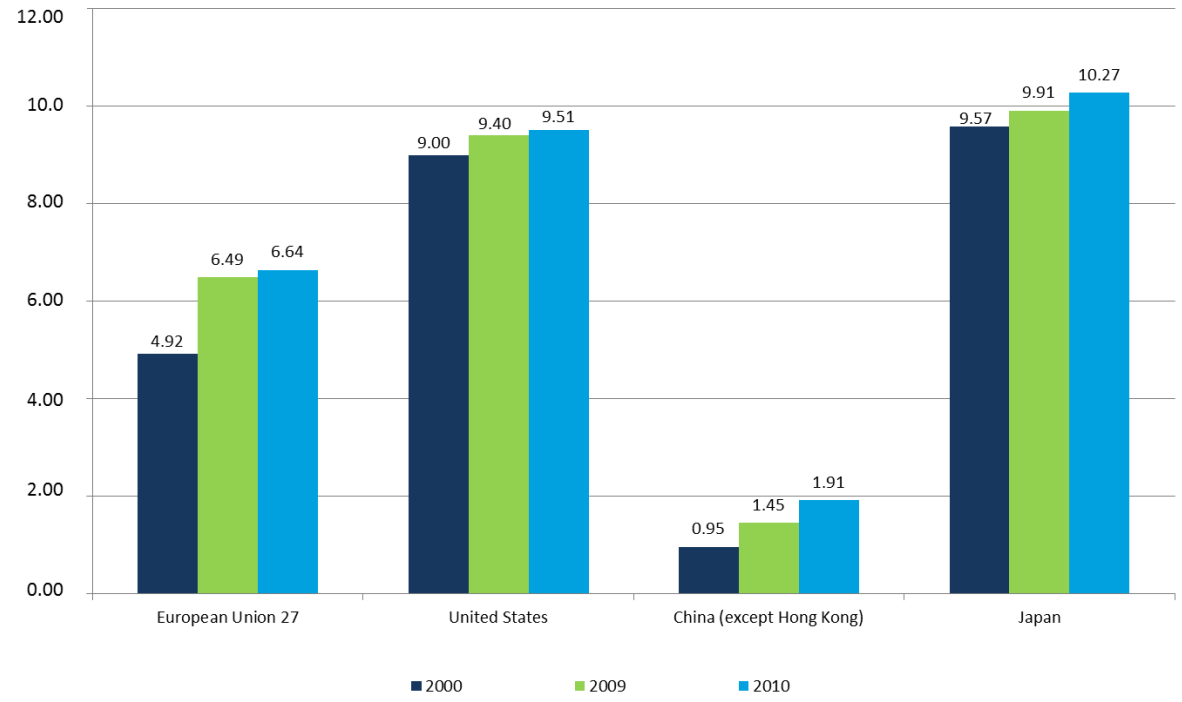
The EU is lagging behind its main competitors in the share of researchers in the total labour force, despite a moderate increase between 2009 and 2010. In 2010, the ratio was 6.64 per 1 000 in the EU-27, compared to 9.51 in the US and 10.27 in Japan. The Nordic countries and Luxembourg do better than the EU average.

Between 2000 and 2010, the number of researchers (FTE) in relation to the labour force increased from 4.92 to 6.64 in the EU-27, up from 6.49 in 2009. The increase in the United States between 2000 and 2010 was from 9.0 to 9.51. In Japan, it was from 9.57 to 10.27, while China reported an increase from 0.95 to 1.91, still below any European country. (The total labour force – i.e. including both the employed and unemployed – was some 239 million in the EU-27 in 2010, compared to 155 million in the United States, 66 million in Japan and 800 million in China.)

Between 2009 and 2010, the number of researchers (FTE) per 1 000 labour force increased in Europe by 2.3%, less than in Japan (3.7%), but more than in the US (1.3%).

[40] The stock of Chinese researchers in FTE in 2009 presented in the *Researchers' Report 2012* was 1.60 million. This was based on an estimate from Eurostat data up to 2008.

Figure 2: Researchers (Full Time Equivalent) per thousand labour force, EU-27, US, China, Japan, 2000, 2009 and 2010[41]



Source: Deloitte
Data: Eurostat

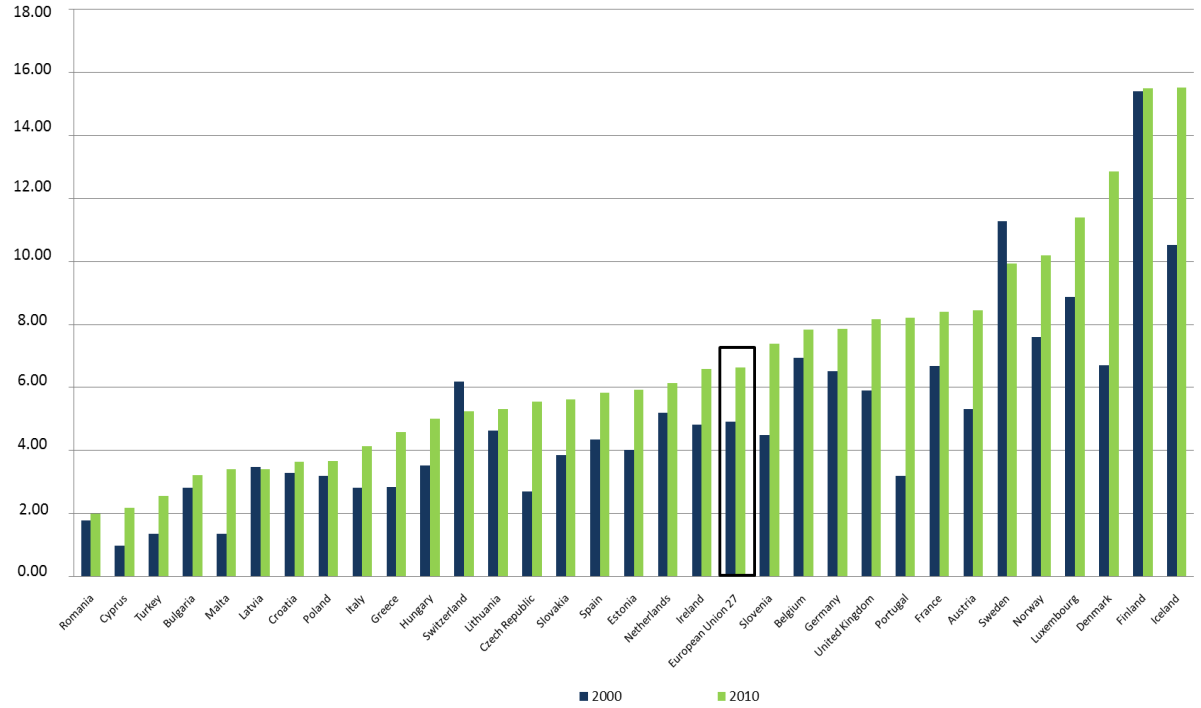
All Nordic countries have a higher share of researchers (FTE) per thousand labour force than the US. Finland and Denmark rank highest of EU-27 countries, with more than fifteen researchers per thousand labour force – higher also than Japan.

Within the EU-27 in 2010, the share of researchers per thousand labour force was highest in two Nordic countries (Finland and Denmark). It was lowest in a number of Eastern European countries, such as Romania, Bulgaria, Latvia and Poland.

Iceland reported the highest ratio of all the countries looked at, with 15.5 researchers per thousand labour force in 2010. Five countries had more than 10 researchers per thousand labour force, i.e. Luxembourg and all the Nordic countries except Sweden. Sweden is the sixth ranked country, with just below 10. The top four rank above Japan; the top six rank above the US. Of the EU-27 countries, Romania and Bulgaria, and the Mediterranean islands, report the lowest numbers, with four or fewer researchers per thousand labour force.

[41] The number of researchers in relation to the labour force in China in 2009 presented in the *Researchers' Report 2012* was 2.01 based on an estimation of Eurostat data up to 2008.

Figure 3: Researchers (Full Time Equivalent) per thousand labour force, Europe, 2000 and 2010



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

The table below shows the performance of the top six European countries (including the top four EU-27 countries) against the EU-27, US and Japan in terms of the number of researchers (FTE) per thousand labour force in 2000, 2009 and 2010.

Table 4: Researchers (Full Time Equivalent) per thousand labour force, top six European countries, EU-27, US, Japan, 2000, 2009 and 2010

Country	2000	2009	2010
Iceland	10.52	15.97	15.52
Finland	15.41	15.25	15.51
Denmark	6.71	12.48	12.86
Luxembourg	8.86	10.47	11.40
Japan	**9.57**	**9.91**	**10.27**
Norway	7.59	10.18	10.20
Sweden	11.29	9.57	9.94
United States	**9.00**	**9.40**	**9.51**
European Union 27	**4.92**	**6.49**	**6.64**

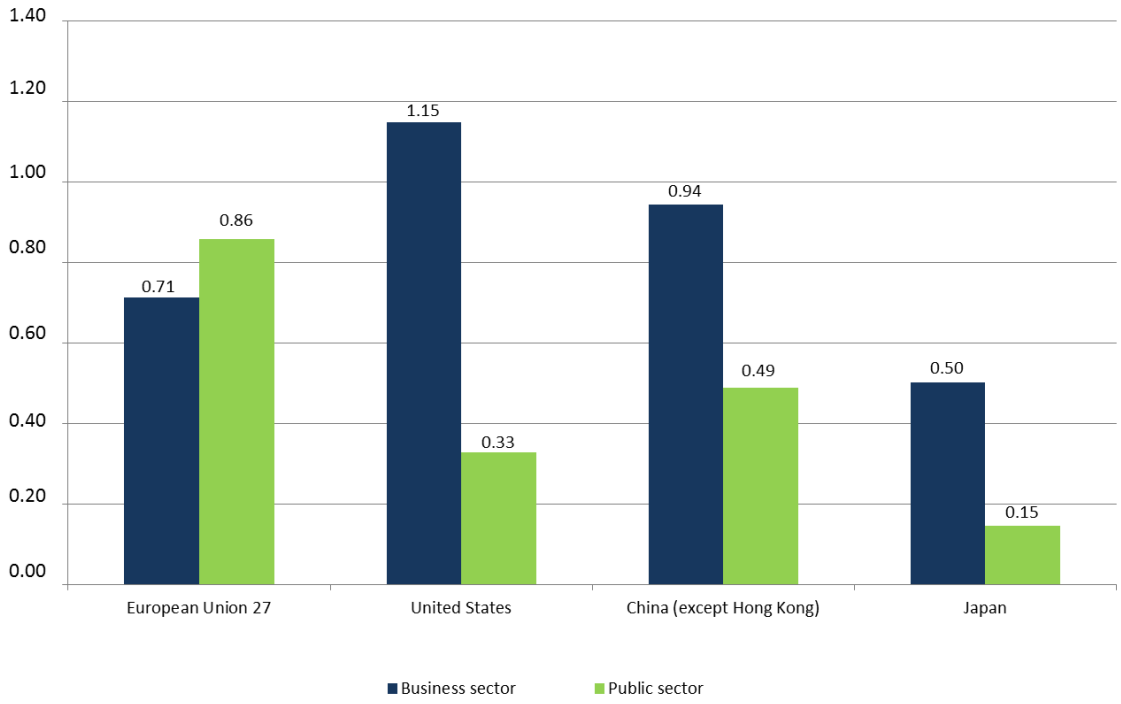
Source: Deloitte
Data: Eurostat

The share of researchers employed in the business sector differs significantly between the EU-27 and other major economies. In the EU-27, more than half the researchers (55%) work in the public sector, and only 45%[42] (710 000) are in the business sector. The share of

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

researchers employed by the business sector is much higher for the EU's main economic competitors, e.g. 78% (1 150 000) in the United States, 62% (940 000) in China, and 74% (500 000) in Japan.

Figure 4: Researchers (Full Time Equivalent) working in the business and public sectors (in million), EU-27, US, China, Japan, 2010



Source: Deloitte
Data: Eurostat

The table below presents the number of researchers (FTE) by sector for the EU-27 for the period 2000-2010.

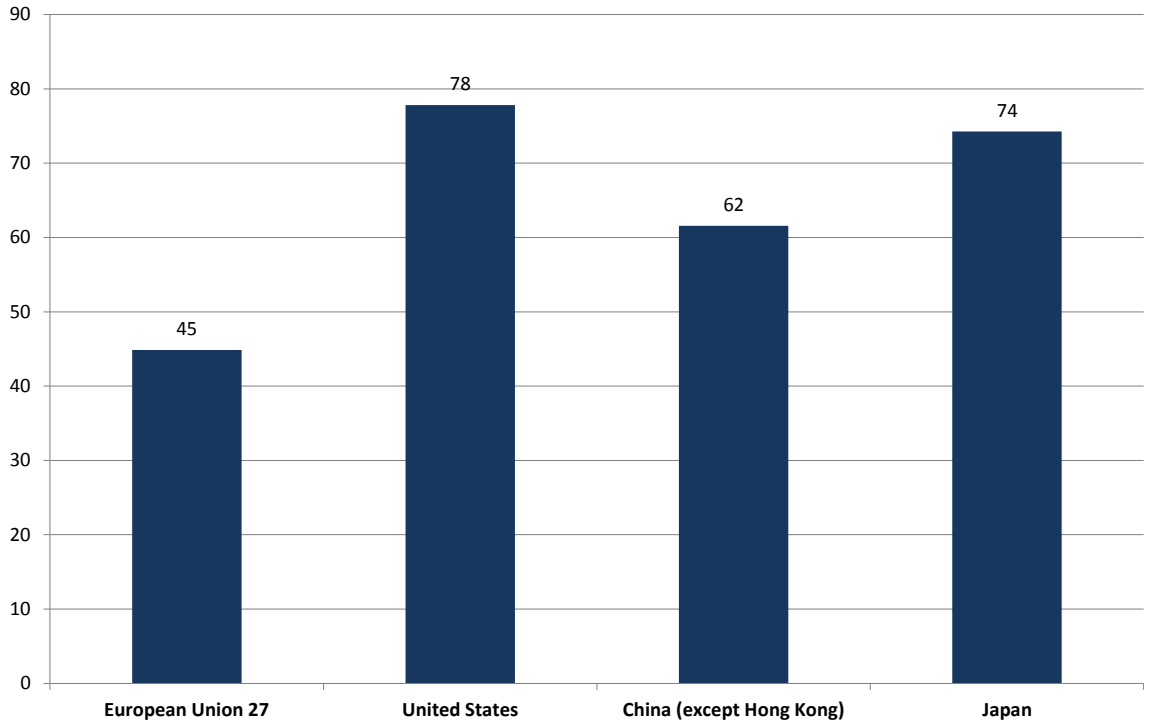
Table 5: Researchers (Full Time Equivalent) by sector, EU- 27, 2000-2010 (in million)

Year	Total	Business enterprise sector	Government and higher education sectors
2000	1.90	0.50	0.58
2001	1.12	0.53	0.58
2002	1.18	0.54	0.62
2003	1.22	0.56	0.64
2004	1.31	0.60	0.69
2005	1.37	0.63	0.73
2006	1.42	0.65	0.75
2007	1.45	0.67	0.77
2008	1.51	0.69	0.80
2009	1.55	0.69	0.84
2010	1.59	0.71	0.86

Source: Deloitte
Data: Eurostat

The share of researchers employed in the business sector differs significantly between the EU-27 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. 78% in the United States, 62% in China and 74% in Japan, as demonstrated by the figure below.

Figure 5: Share of Full Time Equivalent (FTE) researchers working in the business sector (as % of all researchers), EU-27, US, China, Japan, 2010

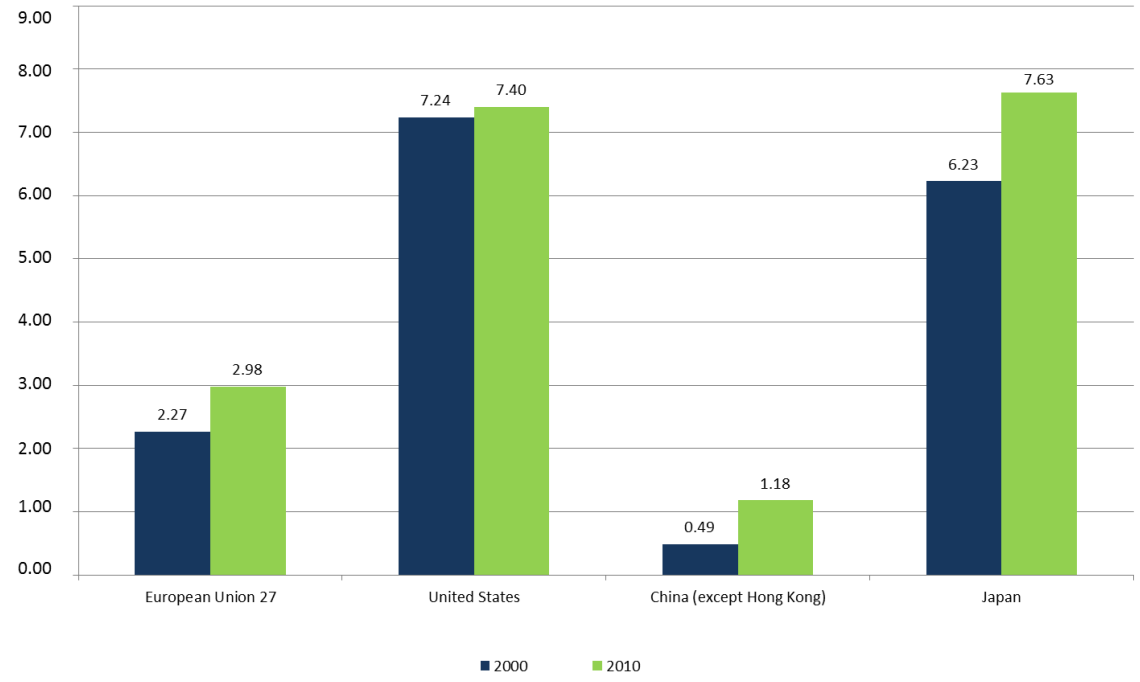


Source: Deloitte
Data: Eurostat

There were 2.98 full time equivalent researchers in the business sector per thousand labour force in the EU-27 in 2010 compared to 7.40 in the US, 7.63 in Japan and 1.38 in China.

Between 2000 and 2010, the stock of EU-27 researchers in the business sector per thousand labour force increased from 2.27 to 2.98. The increase in the United States was from 7.24 to 7.40. In China, the number of FTE researchers in the business sector per thousand labour force increased from 0.49 to 1.18. In Japan, the increase was from 6.23 to 7.63.

Figure 6: Researchers in the business sector (Full Time Equivalent) per thousand labour force, EU-27, US, China, Japan, 2000 and 2010



Source: Deloitte
Data: Eurostat

The table below shows the performance of the top five European countries (including the top four EU-27 countries) against the EU-27, US and Japan in terms of the number of researchers in the business sector (FTE) per thousand labour force in 2000, 2009 and 2010.

Table 6: Researchers (Full Time Equivalent) in the business sector, top five European countries, EU-27, Japan, US, 2000, 2009 and 2010 (in million)

Country	2000	2009	2010
Finland	8.65	8.82	8.57
Denmark	3.85	7.97	7.85
Japan	**6.23**	**7.41**	**7.63**
United States	**7.24**	**7.36**	**7.40**
Iceland	5.39	6.28	6.44
Luxembourg	7.53	5.99	6.31
Sweden	6.85	5.93	6.13
European Union 27	**2.27**	**2.91**	**2.98**

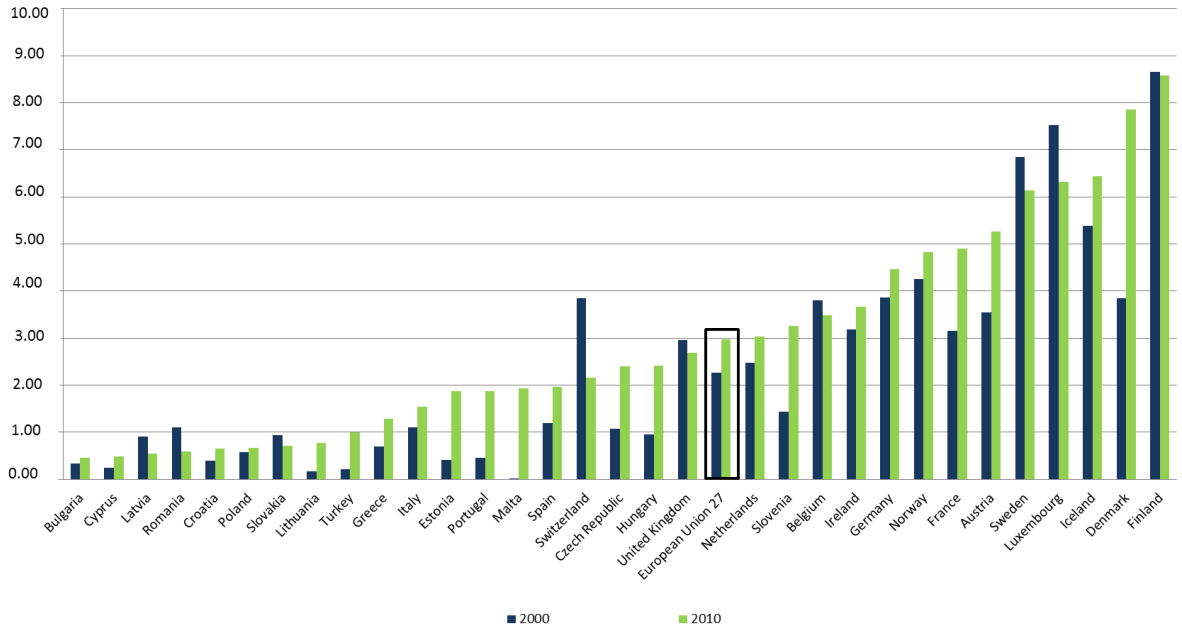
Source: Deloitte
Data: Eurostat

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

The five leading countries are the same as in the case of the overall number of researchers per thousand labour force (in a different order). Finland and Denmark have higher numbers than either Japan or the United States.

Between 2000 and 2010, some European countries more than doubled the ratio of researchers in the business sector per thousand labour force: Denmark (+104%), Slovenia (+128%), Czech Republic (+123%) and Hungary (+153%). A number of smaller countries even quadrupled this figure, i.e. Portugal (+320%), Lithuania (+347%), Turkey (+364%) and Estonia (+352%), while in Malta the jump was thirtyfold, from a very low base. In the same period, the number of researchers in the business sector per thousand labour force decreased by more than 25% in other countries: Latvia, Romania, and (according to the data available from Eurostat) Switzerland as well.

Figure 7: Researchers in the business sector (Full Time Equivalent) per thousand labour force, Europe, 2000 and 2010



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

Table 7: Researchers in the business sector (Full Time Equivalent) per thousand labour force, EU-27, US, China, Japan 2000, 2009 and 2010

Country	2000	2009	2010
Bulgaria	0.34	0.49	0.45
Cyprus	0.25	0.52	0.48
Latvia	0.91	0.27	0.55
Romania	1.11	0.62	0.59
Croatia	0.40	0.67	0.66
Poland	0.57	0.57	0.67
Slovakia	0.94	0.61	0.71
Lithuania	0.17	0.68	0.77
Turkey	0.22	0.86	1.00
China (except Hong Kong)	**0.49**	**0.89**	**1.18**
Greece	0.70	1.26	1.28
Italy	1.11	1.53	1.53
Estonia	0.41	1.90	1.87
Portugal	0.45	1.80	1.88
Malta	0.01	1.48	1.93

Country	2000	2009	2010
Spain	1.19	2.00	1.97
Switzerland	3.85	2.17	2.15
Czech Republic	1.08	2.40	2.40
Hungary	0.95	2.13	2.41
United Kingdom	2.96	2.70	2.68
European Union 27	**2.27**	**2.91**	**2.98**
Netherlands	2.47	2.29	3.04
Slovenia	1.43	3.15	3.25
Belgium	3.80	3.72	3.48
Ireland	3.19	3.52	3.67
Germany	3.86	4.39	4.46
Norway	4.25	4.91	4.82
France	3.15	4.71	4.90
Austria	3.54	5.04	5.27
Sweden	6.85	5.93	6.13
Luxembourg	7.53	5.99	6.31
Iceland	5.39	6.28	6.44
United States	**7.24**	**7.36**	**7.40**
Japan	**6.23**	**7.41**	**7.63**
Denmark	3.85	7.97	7.85
Finland	8.65	8.82	8.57

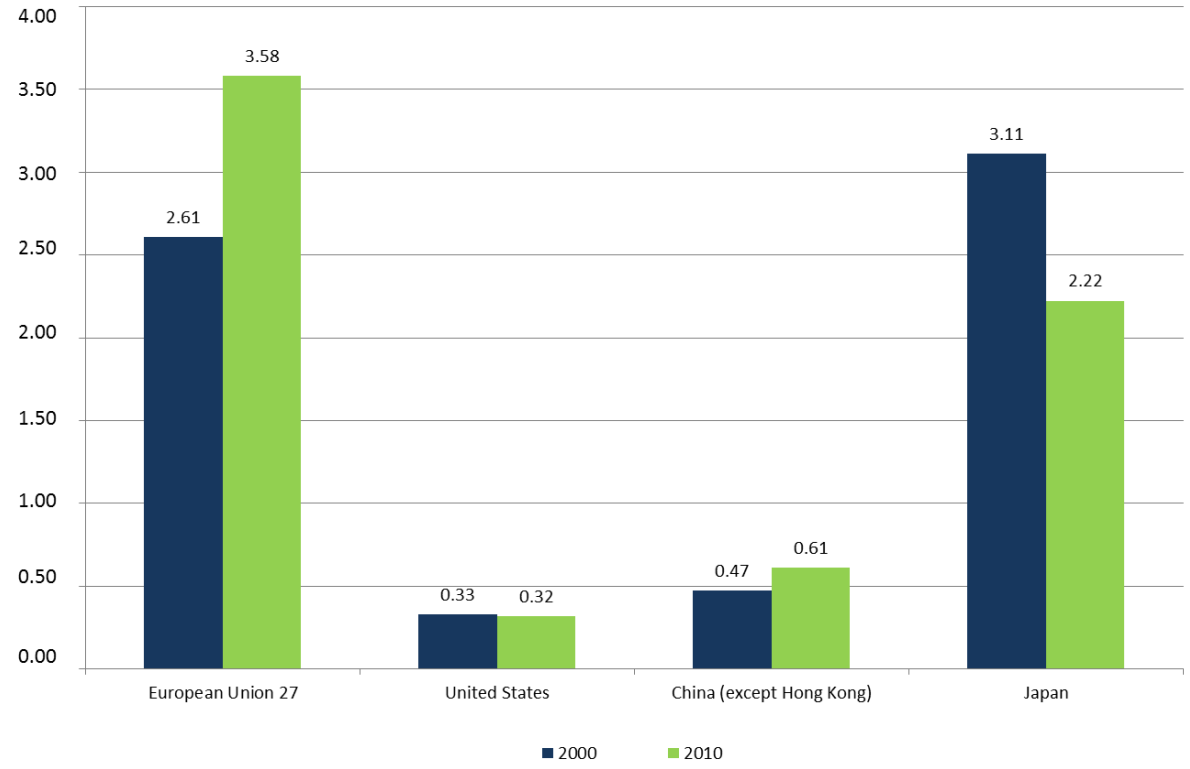
Source: Deloitte
Data: Eurostat

In 2010, there were 3.58 FTE researchers in the public sector per thousand labour force in the EU-27 compared to 0.32 in the US, 0.61 in China and 2.22 in Japan.

Between 2000 and 2010, the number of researchers in the public sector per thousand labour force increased from 2.61 to 3.58 in the EU-27 and from 0.47 to 0.61 in China. Both the US and Japan recorded a decrease in the number of researchers employed in the public sector per thousand labour force. The numbers decreased marginally from 0.33 to 0.32 in the US, and from 3.11 to 2.22 in Japan.

Between 2009 and 2010, the number of researchers (FTE) in the public sector per thousand labour force increased only slightly from 3.5 to 3.58 in the EU-27. It went up rather more in China, from 0.56 to 0.61, while remaining stable in the United States (0.32), and declining from 2.37 to 2.22 in Japan.

Figure 8: Researchers in the public sector (Full Time Equivalent) per thousand labour force, EU-27, US, China, Japan, 2000 and 2010

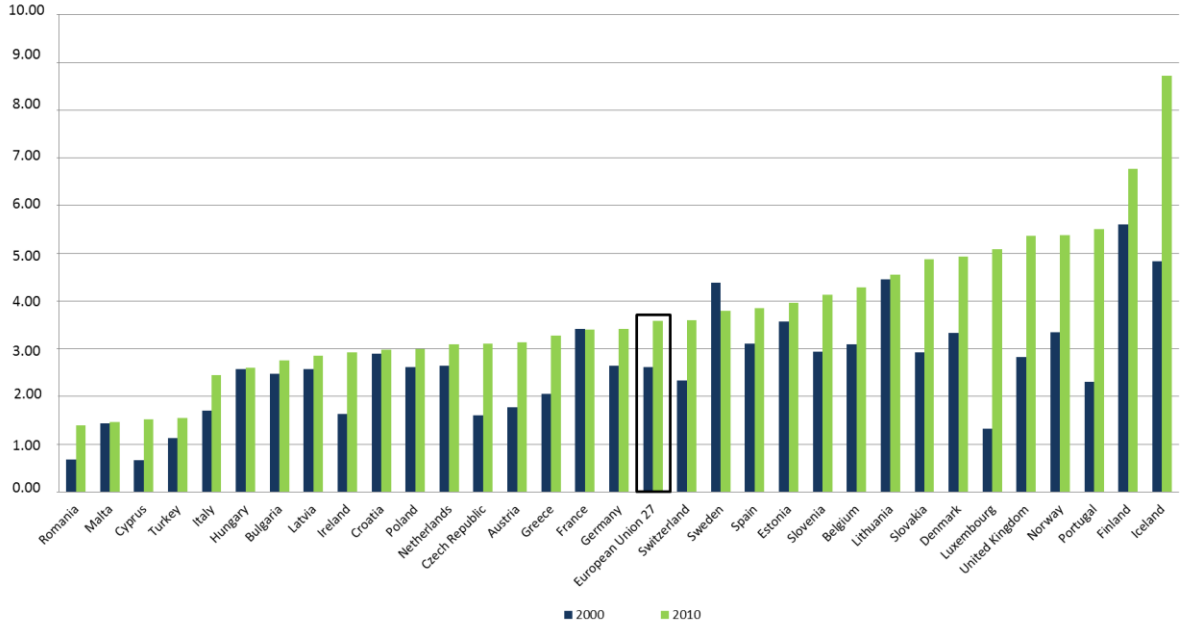


Source: Deloitte
Data: Eurostat

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

Between 2000 and 2010, Luxembourg (+283%) showed the most significant increase in the number of researchers in the public sector per thousand labour force followed by Portugal (+138%), Cyprus (+125%) and Romania (+105%).

Figure 9: Researchers in the public sector (Full Time Equivalent) per thousand labour force, Europe, 2000 and 2010



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

Table 8: Researchers in the public sector (Full Time Equivalent) per thousand labour force, Europe, US, China, Japan, 2000, 2009 and 2010

Country	2000	2009	2010
United States	**0.33**	**0.32**	**0.32**
China (except Hong Kong)	**0.47**	**0.56**	**0.61**
Romania	0.68	1.32	1.39
Malta	1.44	1.38	1.46
Cyprus	0.67	1.46	1.52
Turkey	1.13	1.51	1.54
Japan	**3.11**	**2.37**	**2.22**
Italy	1.70	2.39	2.44
Hungary	2.57	2.64	2.60
Bulgaria	2.47	2.92	2.75
Latvia	2.58	2.81	2.85
Ireland	1.63	3.09	2.93
Croatia	2.89	2.93	2.98
Poland	2.62	2.98	3.00
Netherlands	2.65	2.97	3.10
Czech Republic	1.60	3.02	3.11
Austria	1.77	2.99	3.13
Greece	2.06	3.18	3.27
France	3.41	3.43	3.40
Germany	2.64	3.21	3.41
European Union 27	**2.61**	**3.50**	**3.58**
Switzerland	2.33	3.37	3.60

Country	2000	2009	2010
Sweden	4.38	3.62	3.80
Spain	3.11	3.79	3.85
Estonia	3.57	4.21	3.97
Slovenia	2.94	3.98	4.13
Belgium	3.09	4.18	4.29
Lithuania	4.46	4.54	4.55
Slovakia	2.92	4.33	4.88
Denmark	3.33	4.45	4.94
Luxembourg	1.33	4.48	5.08
United Kingdom	2.82	5.33	5.37
Norway	3.34	5.27	5.38
Portugal	2.31	5.37	5.51
Finland	5.60	6.28	6.77
Iceland	4.83	9.33	8.72

Source: Deloitte
Data: Eurostat

1.5 Increasing the stock of researchers

Europe needs to invest substantially in its science base in order to remain a relevant economic player at a global level. China has taken the world lead in the number of researchers (FTE) (though not in head count). It is followed by the EU-27, the United States and Japan. Moreover, Europe is facing an innovation gap because the majority of researchers are employed in the public sector. Europe therefore needs to focus on generating a talent pool and strengthening its science base in order to create a genuinely unified 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"[43].

Against this backdrop, the Communication on 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 much 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 their national R&D targets (...)"[44].

In their reporting for this report, the vast majority of EU-27 Member States provided information on new measures aimed at training enough researchers to meet their national R&D targets in their respective countries. They are addressing aspects of human resources in the research profession mainly by means of a diverse set of (policy) measures, such as national action plans, programmes and legislative acts, and not by means of one coherent (national) strategy[45].

[43] European Commission (2010a)
[44] Ibid
[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 in these strategies" (European Commission, 2010b)

In order to secure an adequate science base, national governments and institutions have put in place measures to attract sufficient numbers of young people to take science to an advanced (doctoral) level and thus pursue a researcher career. For example, governments have set up a number of awareness schemes to raise young people's interest in science, and in research in general. In addition, dedicated programmes aim to attract specific groups, such as schoolchildren – and girls in particular, to pursue a researcher career[46]. Such measures aim to secure an adequate supply of researchers in the long run. For the short and medium term, Member States have established measures to improve the quality of doctoral training[47].

The countries in the scope of this report have put in place a plethora of measures to address the gender imbalance in research decision-making and in particular to support women in their career aspirations[48]. However, as recent research shows, Europe is far from achieving gender quality in research[49]. In spite of national and EU-level strategies on gender equality, European research still suffers from a considerable drain of and inefficient use of women. The annual increase in the number of women researchers is less than half the annual number of female PhD graduates and too few women are in leadership positions or involved in decision-making[50].

National authorities have also put in place different measures to make the recruitment procedures in public research institutions more open and transparent. Open, transparent and merit-based recruitment procedures in public research institutions across Europe are a prerequisite for the realisation of ERA. They are a precondition of high academic performance and teaching excellence by ensuring optimal allocation of human resources based on merit and academic excellence[51]. Speaking at the Irish Presidency Conference on Researcher Careers and Mobility in Dublin Castle[52], European Commissioner for Research, Innovation and Science, Máire Geoghegan-Quinn said that one of the most important problems which still needs to be tackled in certain areas is the lack of transparent, open and merit-based recruitment: "A lack of open recruitment is simply unfair to people, women in particular. It also prevents universities from putting together the best possible research teams. That's bad for the quality of research, and in the long run, bad for a knowledge society." [53]

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[54]. Measures aimed at encouraging life-long learning (e.g. via dedicated career programmes) and improving working conditions (e.g. via the Charter & Code) can have a positive impact on researchers' career development and job satisfaction. European countries have also put various

[46] For information on specific measures aimed to attract people to become researchers see Chapter 4 "Education and training"
[47] For information on specific measures aimed to improve the quality of doctoral training see Chapter 4 "Education and training"
[48] For information on specific measures to support women in top-level positions, see Chapter 2 "Women in the research profession".
[49] European Commission (2013b)
[50] European Commission (2012c)
[51] For information on specific measures to make the national recruitment systems more open and transparent, see Chapter 3 "Open, transparent and merit-based recruitment"
[52] Available at: http://www.iua.ie/research-innovation/rcm/
[53] European Commission (2013d)
[54] For information on specific measures to improve researchers' employment and working conditions, see Chapter 5 "Working conditions in the research profession"

measures in place to boost partnerships between universities, research institutions and private companies so as to make the research profession more attractive[55].

Lastly, many countries have put in place measures to remove the remaining barriers to mobility and increase the attractiveness of public research institutions as an employer. Different national mobility schemes aim to boost researchers' mobility (inward, outward and cross-sectoral). Many of these schemes promote inward mobility from both EU-27 and non-EU countries, providing financial incentives for early stage researchers. Others promote outbound mobility. By removing the remaining barriers to researchers' mobility, the countries aim to make the research profession attractive to young and experienced researchers across Europe[56].

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

For the 2012 reporting exercise, the countries were requested not only to report on their individual progress since the previous reporting exercise (2011) towards meeting the 'Innovation Union' Commitments, but were also asked to provide information on the (likely) impacts of measure(s) implemented or foreseen by providing factual evidence and data on the magnitude of the measures implemented. The countries' measures in response to Innovation Union Commitments Nos 1, 4 and 30, and in particular the issues identified in the ERA priority area "An open labour market for researchers"[57], aim as a whole to increase the stock of researchers in Europe by addressing different dimensions of the research profession as discussed in the different chapters in this report. In many cases, however, it is too early to measure the direct or indirect impact of these measures, since all in all, very few countries reported (likely) impacts resulting from the measure(s) implemented/foreseen at national and regional level.

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

In terms of measures aiming to increase the stock of researchers, very few countries reported impacts from national measures already in place. One exception was the Belgian 'Action Plan for Researchers (2010)', which has been evaluated. It was considered that most of its actions have been completed successfully. Three other examples came from Germany: first, the extension of the Federal government/*Länder* 'Excellence Initiative' until 2017 with a total budget of EUR 2.7 billion;

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

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

[57] European Commission (2012c)

second, the follow-up report (BuWiN II) to the Federal Government 'Report on the Promotion of Young Researchers' ('BuWin'), which aimed to cover statistical data and research findings on training, career paths and employment prospects for PhD holders in Germany; third, updated statistical data on the Federal government/*Länder* 'Higher Education Pact 2020'. This envisages adding 300 000 new entrants to higher education by 2015 compared to the 2005 figure, while the Federal Government will increase its contribution to the Pact by EUR 2.2 billion to more than EUR 7 billion. Finally, Luxembourg reported that a follow-up study on Performance Contracts (2008) will be undertaken in 2013, focusing on the implementation of the 2005 recommendations and the remaining gaps to be filled in the policy aspects of the Luxembourg research system.

Finally, a significant number of countries reported an update in the number of universities/research institutions having signed the Charter & Code during 2012 (e.g. the *CEITEC* (the Central European Institute of Technology) in Brno (CZ), the universities of *Freiburg*, *Erlangen-Nürnberg* and the *Cologne University of Applied Sciences* (DE)). Others mentioned the expansion of the EURAXESS national network (e.g. EURAXESS Jobs & Performance Agreements 2010-2012 and 2013-2015 with universities (AT)). In 2012, the EURAXESS Czech Republic network staff assisted 680 researchers, finding solutions for over 5 500 queries. Two institutions (the *Semmelweis University* and the *Óbuda University*) joined the EURAXESS Hungarian network in 2012.

2. Women in the research profession

2.1 Women in the research profession - Highlights

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

- Female researchers in all countries face difficulties in climbing the career ladder in the research profession. 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 (showing a scissors effect); in the EU-27, women head only 16% of universities and HEIs (higher education institutions);
- Men always outnumber women in the highest academic positions (Grade A[58] positions) regardless of the field of science;
- The ratio of women in top-level positions in research between 2007 and 2010 rose in nearly every country but unevenly;
- The probability of women reaching a top-level (Grade A) position in research is low and progress is slow. In relative terms, the probability is highest in Turkey, Romania, Switzerland, Bulgaria and Germany, and lowest in Cyprus, Lithuania, Luxembourg and Belgium.

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

- The great majority of European countries have introduced general support measures to promote equal opportunities for men and women. There do not yet appear to be enough measures addressing work-life balance, transparency and appointment procedures. The majority of countries have reported new measures to facilitate women's access to top-level positions, such as supporting gender parity on boards and the introduction of quotas;
- European countries have also 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. For example, the Flemish Government Act of 13.07.2007 includes provisions aimed at safeguarding gender balance in advisory bodies and steering committees. In the Agency for Innovation by Science and Technology, for example, 30% of the internal scientific advisors are women;
- Other measures encompass 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 promotion to top-level research jobs. These include concrete gender targets and quotas, work-life balance provisions, advanced training, mentoring and empowerment programmes as well as measures to enhance transparency in the appointment procedures. For example, the fForte Coaching Programme (Austria) supported women in writing successful grant proposals. In addition, it provided information on sources of funding and personal (professional) development to increase the ratio of women in research funding programmes. Between 2003 and 2012, 297 women took part in the fForte Coaching Programme. The total budget was EUR 572 587;
- Several countries confer awards of excellence on female scientists to raise awareness of women in science and to reward outstanding female researchers for their contribution to

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

research. For example, the "Girls of the Future – in the footsteps of *Maria Skłodowska-Curie*" competition (Poland) aims to support talented young female researchers and promote their scientific achievements. In the 2011 edition of the competition, almost 100 students in maths, science, natural sciences and technology from all over Poland submitted 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.

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

As recent research[60] shows, the EU-27 is far from achieving gender equality in research. While the proportion of women at the first two levels of tertiary education is higher than that of men, the proportion of women at PhD level is lower. It diverges even more in academic positions, and is greatest in the higher (more prestigious) academic positions. The participation rate of women in science and technology, especially in top-level positions and decision-making bodies, is well below that of men.

Despite a steady increase in the number of female researchers, women are still 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. In 2010, in the EU-27, 16% of institutions in the Higher Education Sector were headed by women, and just 10% of universities had a female rector[61].

The implications of gender imbalances in the research profession are highly relevant for the European economy. It has been estimated that the EU will need at least one million new research jobs if it is to reach the R&D expenditure target of 3% of GDP[62]. 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[63].

The reasons for the gender imbalance in the research profession are multifaceted[64]. 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' [65]), and unfair and opaque recruitment procedures favouring men above female

[59] European Commission (2010a)
[60] European Commission (2013b)
[61] Ibid
[62] European Commission (2010a)
[63] European Commission (2008a)
[64] 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)
[65] "(...) 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)

researchers[66]. Resources, time, social networks, encouragement – unevenly distributed between the sexes – are necessary prerequisites for becoming a successful scientist[67].

The European Commission[68] 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.

To this end, the ERA priority area 'Gender equality and gender mainstreaming in research' calls on Member States, research stakeholder organisations and the Commission to "end the waste of talent and to diversify views and approaches in research and to foster excellence" [69].

Outline

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

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 9: Women in the research profession - Key indicators

Indicators	Data source(s)
Proportion of academic staff by grade and gender, EU-27, 2002 and 2010 (%)	WiS[70] database/ SHE figures
Glass Ceiling Index, Europe, 2004 and 2010	WiS database/ SHE figures
Women as Grade A academic staff, Europe, 2010 (%)	WiS database/ SHE figures
Proportion of woman as Grade A academic staff by main field of science (natural sciences, engineering and technology, medical sciences, agricultural sciences, social sciences, and humanities), Europe, 2010 (%)	WiS database/ SHE figures
Proportion of female heads (president/rector) of institutions in the Higher Education Sector, Europe, 2010 (%)	WiS database/ SHE figures

[66] "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)

[67] European Commission (2004c)

[68] "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)

[69] European Commission (2012c)

[70] Women in Science (WiS)

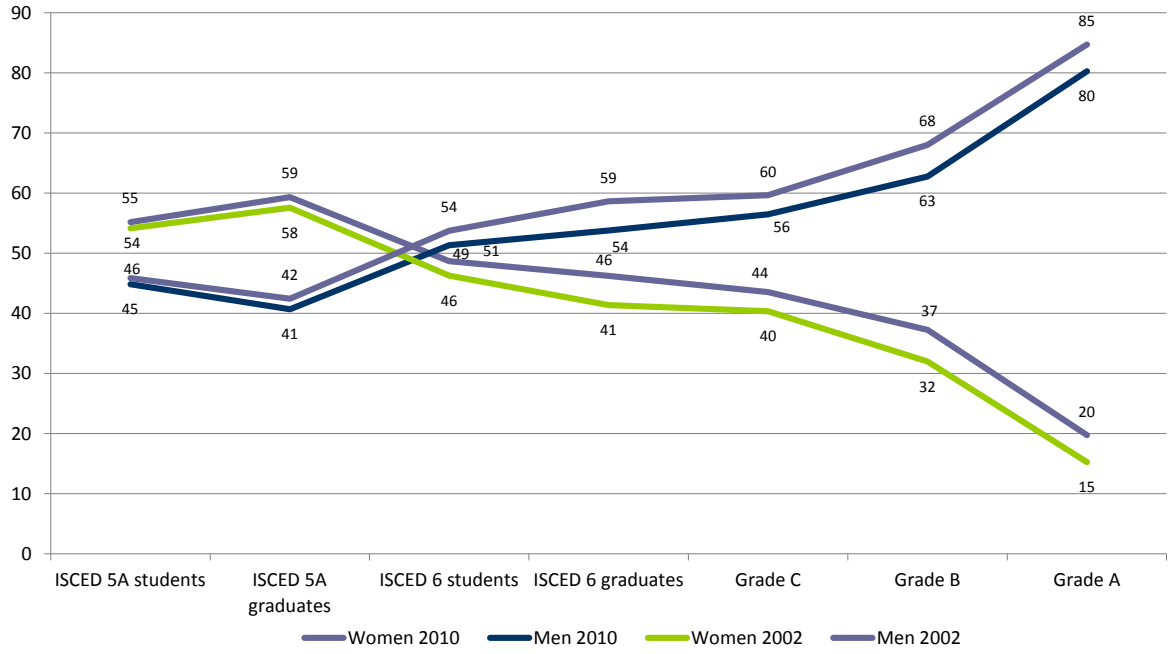
Indicators	Data source(s)
Proportion of women on boards, Europe, 2010 (%)	WiS database/ SHE figures

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

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

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

Figure 10: Proportion of academic staff by grade and gender, EU-27, 2002 and 2010 (%)



Source: Deloitte

Data: WiS database/SHE figures

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

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

Data estimated: EU-27 (by DG Research and Innovation) for WiS, ISCED 6 students and ISCED 5A-6 graduates

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

The proportion of female students (55%) and female graduates (59%) is higher at the first two levels of academic education (ISCED 5A) [71]. However, men outnumber women as of the third level (ISCED 6

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

students)[72], when the proportion of women drops back to 49% among PhD students. The gender gap widens further at the PhD level (ISCED 6 graduates), where the proportion of women drops to 46%.

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

The gender gap starts to widen at PhD level; it continues to grow gradually during the research career (Grades C[73] and B[74]). The proportion of women is least at the top of the academic hierarchy, falling back to 20% of Grade A academic staff.

A comparison of data between 2002 and 2010 shows an improvement. Women's relative position at PhD level and at the different levels of the academic career (Grades B and A) shows a positive trend towards more gender balance. This positive long-term trend is reflected in the most recent findings[75], which show that more women are succeeding in climbing the career ladder, especially in the higher echelons of the academic career (Grades C, B and A).

The increase in the number of female researchers in top-level positions in research is nevertheless marginal, especially in light of Member States' objectives of attracting more female researchers into science and technology, and with the European Commission[76] and the Member States' ambitions of reducing gender imbalances in science.

The gender gap has been closing more markedly among scientists than in the labour market in general[77]. However, the relatively higher proportions of women at PhD level have not translated into greater equity at the top. Female researchers face a 'glass ceiling' stopping them from reaching high-level (prestigious) positions in research.

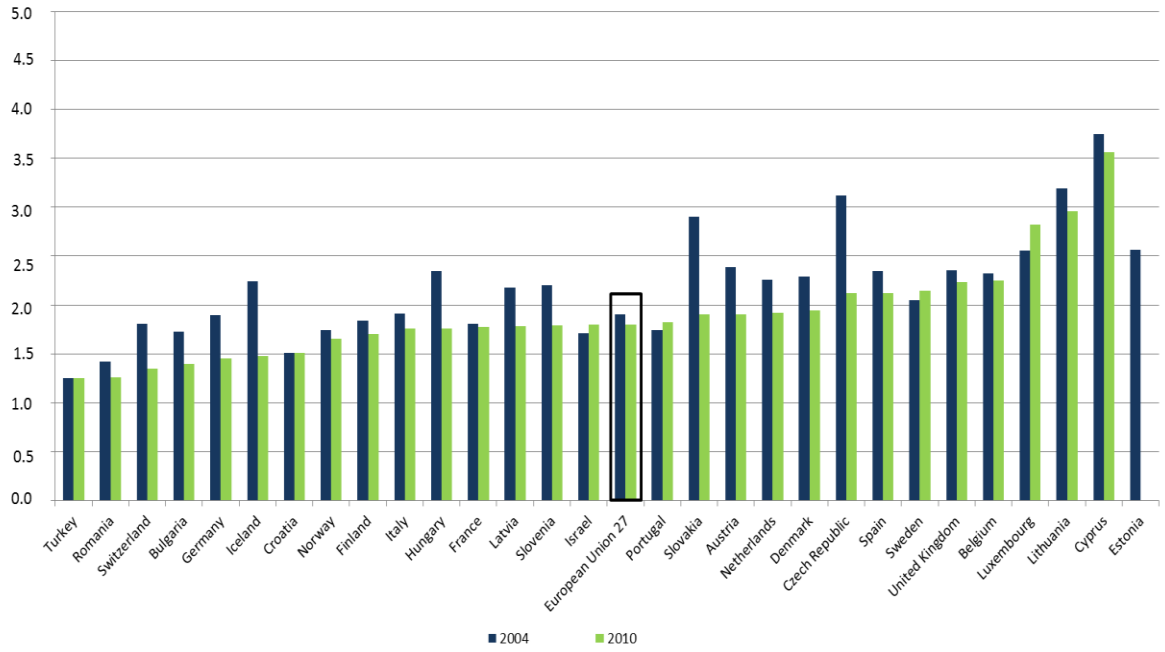
Female researchers in all countries face difficulties in climbing the career ladder in the research profession. The probability of women reaching a top-level (Grade A) position in research is highest in Turkey, Romania, Switzerland, Bulgaria and Germany and lowest in Cyprus, Lithuania, Luxembourg, Belgium,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

The Glass Ceiling Index (GCI) illustrates the difficulties women have in gaining access to the highest levels of the academic hierarchy. It measures the relative chance for women, as compared with men, of reaching a top-level position. The GCI compares the proportion of women holding Grade A positions (normally equivalent to Full Professorship) to the proportion of women in academia

[72] ISCED 6: Tertiary programmes which lead to an advanced research qualification (PhD)
[73] Grade C: The first grade/post into which a newly qualified PhD graduate would normally be recruited
[74] Grade B: Researchers working in positions not as senior as top position (A) but more senior than newly qualified PhD holders
[75] European Commission (2013b)
[76] "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)
[77] European Commission (2011b)

(Grades A, B and C). The GCI indicates the opportunity, or lack of it, for women to move upwards in their profession. A GCI of 1 indicates no difference in the promotion rate of women and men. The higher the value, the thicker the glass ceiling, and therefore the more difficult it is for women to move into a higher position.

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



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

In 2010, the average GCI for the EU-27 was 1.8, with a range from 1.3 in Turkey and Romania (thinner glass ceiling) to 3.6 in Cyprus (thick glass ceiling). Thus, no country reported a GCI equal to or below 1. The GCI was particularly high (>2) in Cyprus, Lithuania, Luxembourg, Belgium, the UK, Sweden, Spain and the Czech Republic[78]. The female researchers in these countries have the lowest degree of probability of reaching a top-level academic position.

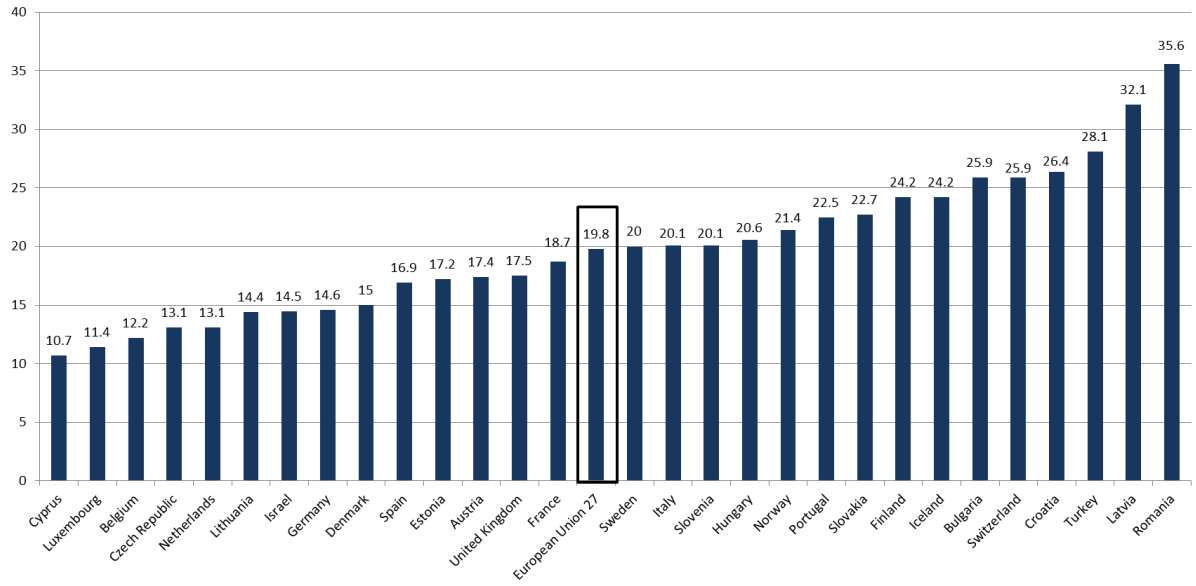
Between 2004 and 2010, the index decreased or remained stable in most countries (except for Portugal, Sweden and Luxembourg), leading to a lower GCI for the EU-27. However, the indicator still provides clear evidence of the difficulty female researchers still face in entering high-level positions in research.

The under-representation of women at the higher levels of the academic hierarchy is reflected in the share of women in Grade A academic positions. The culmination of a research career is reaching a top-level position. In 2010, the EU-27 average of the share of women among Grade A academics was 19.8%. The proportion of women in top research positions was highest (>25%) in Romania (35.6%), followed by Latvia (32.1%), Turkey (28.1%), Croatia (26.4%), Switzerland (25.9%) and Bulgaria

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

(25.9%). Cyprus (10.7%), Luxembourg (11.4%), Belgium (12.2%), the Czech Republic (13.1%), and the Netherlands (13.1%) reported lowest (<14%) figures for women in top-level academic positions.

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



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

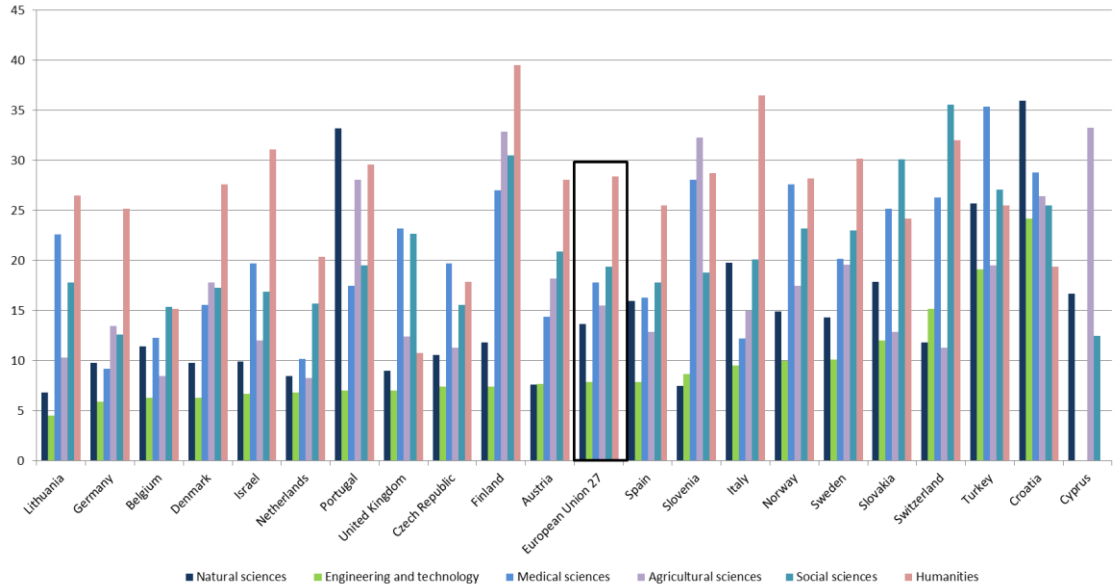
The ratio of women in top-level positions in research between 2007 and 2010 rose in nearly every country but unevenly.

Between 2007 and 2010, the average percentage of women academic Grade A staff in the EU-27 increased from 18.7% to 19.8%, and the majority of countries in the scope of this report reported an increase in the ratio of women in high-ranking academic positions.

Men always outnumber women in the highest academic positions (Grade A positions) in the natural sciences, and engineering and technology, and the differences are significant. The proportion of women in Grade A positions is higher in the humanities and social sciences, but still lower than men in most cases.

The gender imbalance becomes even more apparent when looking at the proportion of female researchers in top-level positions in the fields of the natural sciences, and engineering and technology (see figure below). An analysis of the differences in the representation of women in scientific fields in the EU-27 reveals that women in Grade A positions are disproportionately under-represented in the fields of natural sciences (13.7%), and engineering and technology (7.9%), compared to figures of 19.4% for the social sciences and 28.4% for the humanities. In most of the countries monitored, there are more female researchers in top-level positions in the humanities than in the other disciplines.

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



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

Women are under-represented at the highest levels of academia – in the EU-27, women head only 16% 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 2010, women headed only 16% of institutions in the Higher Education Sector. The actual proportion in individual countries in the countries for which statistics are available varied between 32% in Norway and 6% in France and Turkey. A figure of below 10% was also reported in Portugal (7%), Hungary (9%), Romania (9%) and Slovakia (9%).

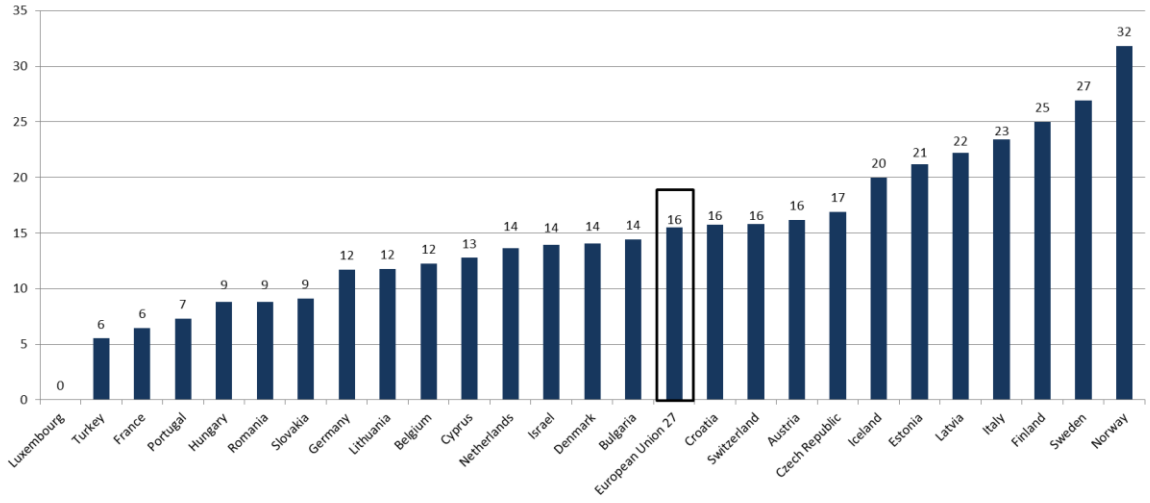
The countries show remarkable differences. Yet, it is difficult to detect a pattern. One striking difference is the position of Denmark as an outlier in the Nordic countries. While at least a quarter of the Higher Education Sector heads are women in Norway (32%), Sweden (27%) and Finland (25%), the figure for Denmark is only 14%[79]. At 23%, Italy compares well with the leaders and its position is in sharp contrast with that of France (6%). Austria and Switzerland do well in relative terms (16%), whereas Germany under-performs significantly (12%).

Between 2007 and 2010, the proportion of female heads of institutions in the Higher Education Sector in the EU-27 increased by 3 percentage points and rose in most countries, but at a different

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

pace. Latvia, Austria and Denmark reported a significant increase (>8 percentage points) in the proportion of female heads of HEI institutions during this period, while Cyprus and Israel reported a small decrease (<2 percentage points).

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



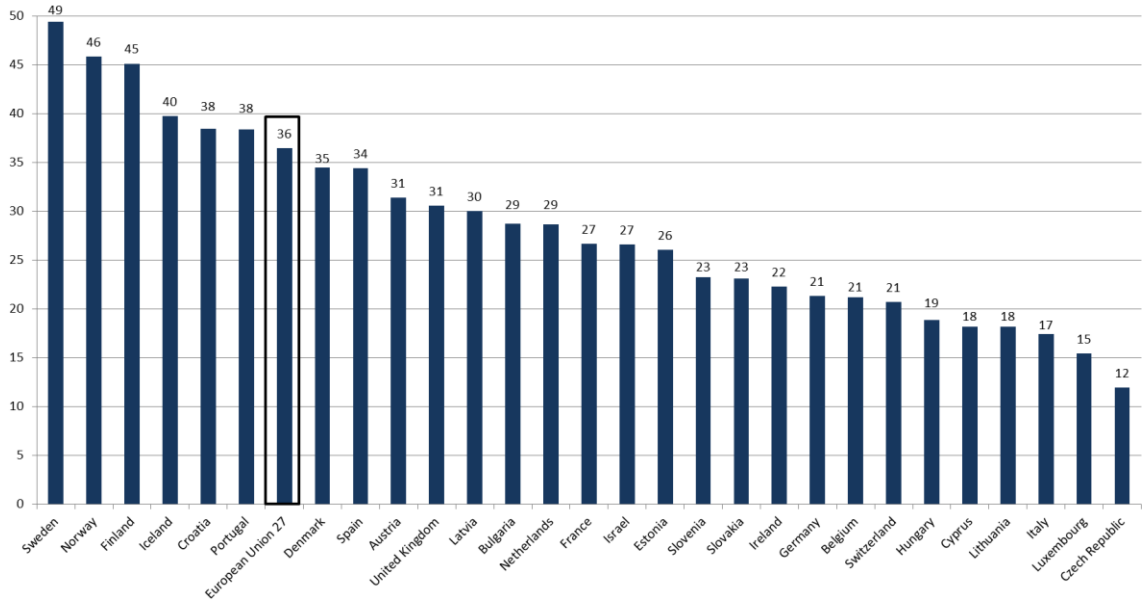
Source: Deloitte
Data: WiS database/SHE figures
*No information available for BiH, EL, ES, FYROM IE, LI, ME, MT, PL, SI, SR and UK
** Exceptions to the reference year: PT: 2012; SK: 2011; SE: 2008; HR: 2009.
***Data estimated: EU-27 (by DG Research and Innovation)

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 36% of board members[80] are women. In the EU-27, the figure tops 40% only in Sweden (49%), and Finland (45%). It is high in Norway as well (46%). The participation of women on boards is lowest (<20%) in the Czech Republic (12%), Luxembourg (15%), Italy (17%), Cyprus (18%), Lithuania (18%) and Hungary (19%). Portugal (38%) (and Croatia (38%)) show figures slightly above the EU-27 average, whereas Denmark (35%) and Spain (34%) have ratios slightly below the EU-27 average.

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

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



Source: Deloitte
Data: WiS database/SHE figures
*No information available for BiH, EL, FYROM IE, LI, ME, MT, PL, SI, SR
** Exceptions to the reference year: FR: 2002; IE: 2004; BE, LT, SE: 2007; CZ: 2008; PT, UK: 2009
*** Data estimated: EU-27, EU-25, EU-15 (by DG Research and Innovation)

2.5 Support for women in top-level positions

The great majority of European countries have introduced general support measures to promote equal opportunities for men and women. There do not yet appear to be enough measures addressing work-life balance, transparency and appointment procedures. The majority of countries have reported new measures to facilitate women's access to top-level positions, such as supporting gender parity on boards and the introduction of quotas.

The paucity of women in senior positions inevitably means that the individual and collective opinions of women are less likely to be voiced in policy-and decision-making processes. This may lead to biased decision-making on topics relating to the future development of research careers. In addition, if female scientists are not visible and not seen to be succeeding in their careers, they cannot serve as role models for attracting and training young women in scientific professions[81].

The countries in scope of this report have put in place a plethora of measures aiming to address the gender imbalance in research decision-making and to support women in their career aspirations. The table below provides an overview of different measures[82] the countries have taken to promote

[81] European Commission (2008a)

[82] 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)

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

Table 10: Support for women in rising to top-level positions – overview of national measures

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

Source: Deloitte, *Researchers' Report* 2013, Annex 'Country files'
No information available for IL, IS, LI, PT, 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) and to the 2012 reporting exercise (update of the country profiles).

The measures fall into three overarching categories[83]. The first group is composed of measures to improve (junior) female researchers' access to research funding. Fair access to funding, especially at an early stage of a researcher career, is a pre-condition for successful promotion to higher posts. The types of measure vary from training activities to improve women's (research) proposal writing capabilities, career development programmes, talent programmes, awards, coaching activities and special funding schemes dedicated to women to bonus points for gender-balanced project teams. For example, the fForte Coaching Programme (Austria) supported women in writing successful grant proposals. In addition, it provided information on sources of funding and personal (professional) development to increase the ratio of women in research funding programmes. Between 2003 and 2012, 297 women took part in the fForte Coaching Programme. The total budget was EUR 572 587.

The second group of measures encompasses activities and instruments to facilitate women's access to top-level positions (on boards, in the higher education sector and public research institutes) and ultimately raise their chances of appointments and promotions to top-level research jobs. These measures target female researchers at an advanced level of their academic career in particular. The

[83] Based on European Commission (2008a)

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[84] designed to produce the effect that women will not be discriminated against.

During the 2012 reporting exercise, the majority of countries reported new measures to facilitate women's access to top-level positions, such as gender targets and quotas to reach gender parity on boards. As another example, the Flemish Government Act of 13.07.2007 includes provisions aimed at safeguarding gender balance in advisory bodies and steering committees. For instance, in the Agency for Innovation by Science and Technology, 30% of the internal scientific advisors are women.

The Swiss Federal Equal Opportunities Programme 2008-11/12 aimed to increase the proportion of women category I Professors from 14% in 2006 to 25% by the end of 2012. For the period 2013-16, the Rectors' Conference of the Swiss Universities (CRUS) has set what are considered to be realistic targets per domain for newly nominated women Category I professors and assistant professors in the forthcoming Swiss University Conference sub-programme Equal Opportunity at Universities 2013-2016. The overall goal of the programme is for 25% of grade A professors and 40% of assistant professors (grade B) to be women by 2016.

The Female Professors Programme (Germany), which has been running since 2008, promotes outstanding female researchers. Since then, 262 additional female professors have been appointed at German Higher Education Institutions. Following a positive evaluation of the programme's contribution to developing equal opportunities in higher education institutions, the Joint Science Conference of the Federal Government and the Heads of Government of the Federal States (*Länder*) (GWK) decided in 2012 to continue the programme for a second period of five years until 2017.

The third group are different types of government measure to stimulate a discussion around the topic of gender balance and to provide leadership support for the principle of gender balance in research. This group encompasses national laws, action plans, the setting up of committees and working groups with the aim of reducing the gender imbalance in the research profession. For example, the Slovenian Ministry of Higher Education, Science and Technology in 2001 established a National Committee on Women in Science. The National Committee has an Annual Work Plan and reports annually to the Ministry. It is an advisory/expert body. It has 15 members from different institutions and scientific disciplines and its main focus is collecting data and raising awareness, networking of researchers from different scientific disciplines dealing with gender issues, and cooperation with other relevant organisations in Slovenia and the Helsinki Group on Women and Science[85].

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

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

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, Ombudsmen for Equality or Equality Boards responsible for monitoring the equal representation of both sexes, covering, amongst others, the research profession.

In addition, several countries confer awards of excellence on female scientists to raise awareness of women in science and to reward outstanding female researchers for their contribution to research. For example, the "Girls of the Future – in the footsteps of *Maria Skłodowska-Curie*" competition (Poland) aims to support talented young female researchers and promote their scientific achievements. In the 2011 edition of competition, almost 100 students in maths, science, natural sciences and technology from all over Poland submitted 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.

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

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

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

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:

- 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;
- Most countries report that public authorities and public research institutions have taken concrete steps to make the recruitment system more open, transparent and merit-based, by publishing vacancies on portals such as EURAXESS Jobs, establishing rules for the composition of selection panels and training staff on recruitment panels;
- Many public research institutions have taken steps to review their recruitment systems. A comprehensive review[86] of all universities or research institutes who have gained the HR Excellence in Research Award reveals that more than 90% had reviewed or were in the process of reviewing recruitment processes. Institutions were typically encouraging staff to involve at least three people in selection panels, including a representative from HR, having a gender balance on panels and creating a policy/guideline for recruitment panels, including external experts, to adhere to as well as training all staff involved in the process.

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;
- EU-wide, around 34-40% of researchers indicate that they are 'dissatisfied' with the levels of openness, transparency and the degree of merit-based recruitment at their institution. However, this average masks significant differences between countries, e.g. while the level of dissatisfaction is 22% in the UK, but 54% in Portugal, 55% in Greece and 69% in Italy;
- 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 action to remove the remaining bottlenecks in order to guarantee an attractive and efficient research career.

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

- Excellent progress has been made at EU level in publishing vacancies: while 7 500 job advertisements were published on EURAXESS Jobs in 2010, this increased almost five-fold to 36 500 in 2012. The share of research posts advertised on the EURAXESS Jobs portal (per thousand researchers in the public sector) is high relative to other countries in Poland, Greece,

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

Sweden and Ireland;

- Austrian Universities, for example, must advertise research job vacancies (for scientific and research staff) internationally, i.e. 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, Law no. 240/2010 requires all (fixed-term) positions to be made publicly available on the national and EU websites.

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. They are a precondition of high academic performance and teaching excellence by ensuring optimal allocation of human resources based on merit and academic excellence. Moreover, transparent recruitment procedures offer researchers equal opportunities at all stages of a researcher career by granting applicants fair access to competition-based research posts nationally and internationally. Fair access to attractive research positions in turn has a positive impact on the attractiveness of the research career. Transparent recruitment procedures are also indispensable for facilitating researchers' mobility. Research positions should be filled based on open, transparent and merit-based recruitment procedures proportionate to the level of the position in line with the basic principles of the Charter & Code[87].

Table 11: Open, transparent and merit-based recruitment – a definition

A recruitment system can be defined as open, transparent and merit-based if it meets all or some of the following criteria:

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

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

Mobility is a core of the concept of the ERA. This in turn is fundamental to the EU's Growth and Jobs Strategy[88] and the reinforced partnership[89] which aims to ensure the removal of barriers to

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

[88] European Commission (2010b)

[89] European Commission (2012c)

researcher mobility, training and attractive careers[90]. 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[91]. Transparent recruitment policies and procedures in all European countries have the potential to facilitate researchers' mobility by matching supply and demand for the best-suited research positions across Europe.

While researcher mobility contributes to excellence, several obstacles stand in the way of a genuine European research labour market. One of the most important is the lack of transparent, open and merit-based recruitment. This makes research careers less attractive and hampers mobility, gender equality and research performance. Against this background, the ERA priority area 'An open labour market for researchers'[92] aims to ensure the removal of legal and other barriers to the application of open, transparent and merit-based recruitment of researchers.

In its Conclusions on 'A reinforced European research area partnership for excellence and growth'[93], the Council of the European Union recalled the need to realise a genuine European research labour market, and noted that one of the most important remaining challenges across the EU is the realisation of transparent, open and merit-based recruitment where this is not available, since this would make research careers more attractive, and foster mobility and ultimately research quality.

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 open recruitment system on scientific quality and productivity, researchers' international mobility, the attractiveness of research careers, and equal access to job opportunities for women and men. The vast majority of national authorities consider the recruitment system in their countries to be largely fair and transparent. This is in sharp contrast to the perceptions of many researchers in certain countries who perceive the public institutions' recruitment rules and procedures to be neither fair nor transparent. Researchers frequently cite the absence of open access to job opportunities as a disincentive to starting or remaining in a research career in Europe[94].

Despite the progress reported[95] 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 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.

[90] In particular the priority area "An open labour market for researchers" (European Commission 2012c)
[91] European Commission (2010b)
[92] European Commission (2012c)
[93] Council of the European Union (2012)
[94] European Commission (2008b)
[95] European Commission (2009c)

Outline

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

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

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

Table 12: Open, transparent and merit-based recruitment - Key indicators

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

3.4 The EURAXESS Jobs Portal

In 2003, the European Commission launched the European Researcher's Mobility Portal[96] to provide researchers with up-to-date information about jobs and funding opportunities. In 2008 this portal became part of the broader EURAXESS – Researchers in Motion portal[97], 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 & Code, and the Human Resources Strategy for Researchers (HRS4R)[98] mechanism) and e-networking tools for 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 so as to ensure an optimal allocation of posts based on supply and demand. Open, transparent and merit-based recruitment is thus indispensable for the realisation of a European Research Area. Researchers across Europe must have equal access to competition-based research posts so as to ensure an optimal allocation of

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

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

[98] Available at: http://ec.europa.eu/euraxess/index.cfm/rights/strategy4Researcher

human resources in research. The number of research posts advertised via the EURAXESS Jobs portal provides an indication as to the level of (international) transparency in each country. It provides information on the number of research-related positions posted by employers. It is reasonable to assume that there is a positive correlation between the number of job postings on international job platforms, such as EURAXESS Jobs and the openness of a recruitment system.

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

Between 2009 and 2012[99], the total number of research-related jobs posted on the EURAXESS Jobs increased sharply from 4 997 to 36 521, including information from other national research job portals. This was due to concerted efforts by the Commission and several Member States to ensure that a much larger proportion of research vacancies were posted on the portal. This positive trend serves as an indicator of improved accessibility of information on publicly funded research posts across Europe. However, in the Public Consultation on the ERA Framework[100], 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 13: Researcher posts advertised through the EURAXESS Jobs portal, Europe, 2009-2012[101]

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

Source: Deloitte
Data: EURAXESS JOBS

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

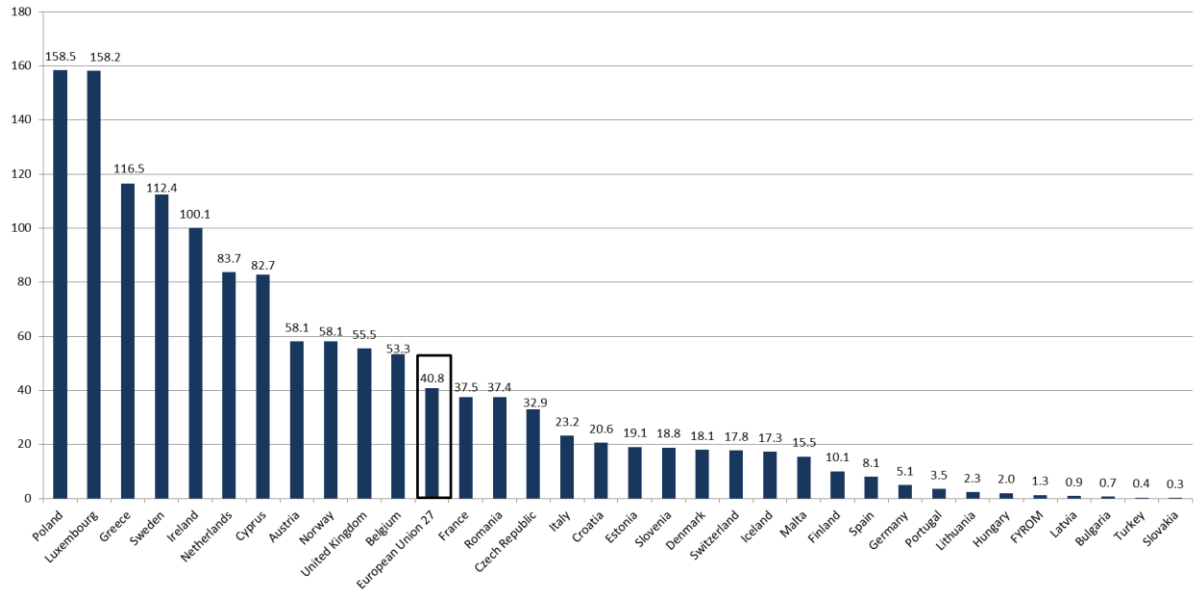
In 2012, the average number of job postings on the EURAXESS Jobs portal per thousand researchers in the public sector for the EU-27 was 41, with a range from 158 in Poland to five or fewer in several

[99] Data available for the period January-August 2011
[100] European Commission (2012a)
[101] The data for 2012 were extracted from the EURAXESS Jobs Portal in March 2013 and refer to the entire year 2012.

countries. The number of jobs advertised via the online platform was particularly high (>100) in Poland and Luxembourg (158), Greece (116), Sweden (112) and Ireland (100). Thus, researchers across Europe benefit from more open and transparent access to research-related jobs in these countries.

We note a low (<5) share of researchers posts advertised on the EURAXESS Jobs portal per thousand researchers in the public sector in a range of countries: Portugal, Lithuania, Hungary, FYROM, Latvia, Bulgaria, Turkey and Slovakia. Spain and Germany also report relatively a low (<10) numbers of job postings on EURAXESS per thousand researchers in the public sector, but Germany has a national system as noted above. Generally speaking, if job positions are not advertised publicly and widely, the chances of recruiting the best possible talent are more limited.

Figure 16: Researcher posts advertised through the EURAXESS Jobs portal per thousand researchers in the public sector, Europe, 2012



Source: Deloitte
Data: EURAXESS JOBS
*No information available for BiH, IL, LI, ME and SR
** Figures are rounded to the nearest 10

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 2011 and 2012, but not equally rapidly everywhere.

Between 2011 and 2012, 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 33.3 to 40.8 (+23%), 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, though the pattern of increases was uneven.

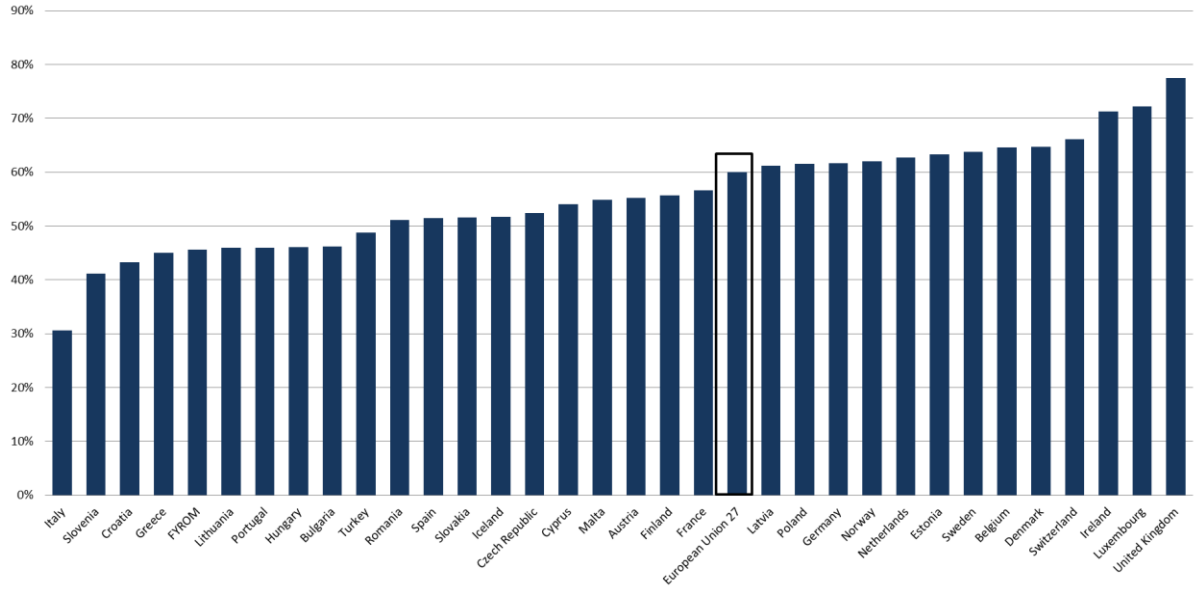
3.5 Open recruitment in institutions

The majority of EU researchers in the public sector (60%) are satisfied with the extent to which research job vacancies are advertised externally by their institution. The remaining

40% are dissatisfied with the situation, but this average masks significant differences between Member States.

According to a recent large-scale survey[102], 60% of EU researchers on average are satisfied with the extent to which research job vacancies are advertised externally by their institutions, meaning that 40% are dissatisfied. The country differences show a similar pattern compared to the number of researcher posts advertised on the EURAXESS Jobs portal per thousand researchers in the public sector. Researchers who benefit from working in more open, excellent and attractive research systems[103] in countries such as the UK (22% of researchers were not satisfied), Ireland, Denmark, Belgium and the Netherlands are also more likely to be satisfied with the extent to which research jobs are advertised externally by their institutions in those countries. In contrast, 54% in Portugal, 55% in Greece and 69% in Italy expressed dissatisfaction. Accordingly, efforts need to focus on those countries where the dissatisfaction is particularly acute.

Figure 17: Share of researchers in the public sector satisfied with the extent to which research job vacancies are advertised externally by their institution, Europe, 2012 (%)



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

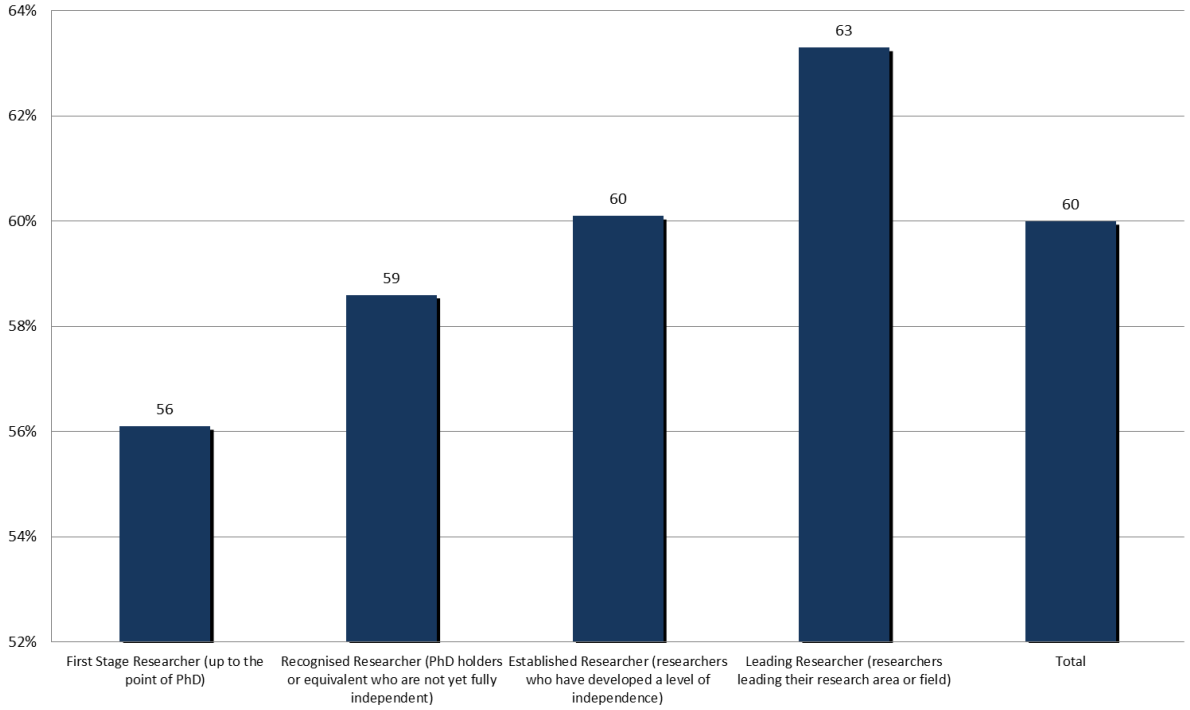
As shown in the figure below, the level of satisfaction increases during the researcher's career, though not dramatically: from a 56% satisfaction level among First Stage Researchers (R1) to 63% among Lead Researchers (R4).

In general, European researchers are more satisfied with the transparency of the recruitment process (65%) and that the recruitment is merit-based (66%) than with the extent to which vacancies are advertised (60%). It is difficult to know what to read into this as one might have expected researchers to be more dissatisfied about the transparency of the process. But most countries are

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

the opposite. For example, 46% of researchers in Italy are satisfied with the transparency of the process, while only 31% are satisfied with the extent to which posts are advertised. The differences appear subtle, and it is difficult to detect a pattern.

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



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

There is wide acknowledgement among stakeholders of the importance of an open, transparent and merit-based recruitment system as a precondition of excellence and innovation in research, and of attracting women. The European Science Foundation (ESF) argues that "*The importance of transparency of recruitment criteria and their accountability in order to ensure equal opportunities in all stages of the career process is a precondition to excellence and innovation in research. The lack of transparency and accountability (...) appear to disadvantage women scientists and other minority groups of researchers. This leads to a limited pool of potential* candidates *at the expense of scientific excellence"*.[104]

The position of the League of European Research Universities (LERU) is similar: "*It is well known that Europe is still under-utilising a considerable amount of its female intellectual capacity. Transparency of all assessment and recruitment procedures is essential at junior and senior levels; having consistent and rigorous recruitment processes for academic staff is critical for women's success*."[105]

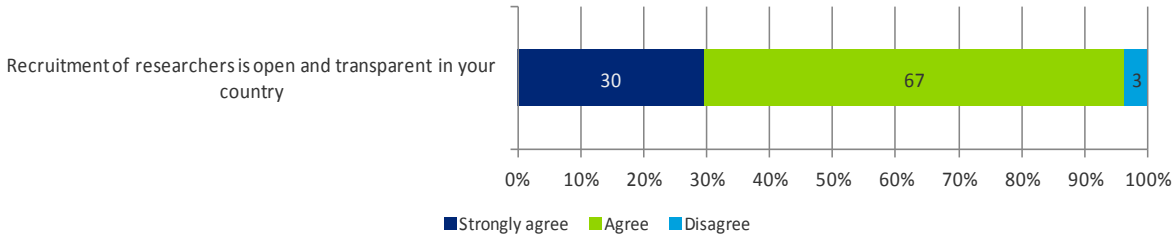
The vast majority of national authorities consider the recruitment system in their country to be largely open and transparent. Most countries report that public authorities and

[104] European Science Foundation (2010)
[105] League of European Research Universities (2011)

public research institutions have taken concrete steps to make the recruitment system more open, transparent and merit-based, by establishing selection panels, granting rights to applicants to receive adequate feedback, and establishing rules for the composition of selection panels.

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 shown in the next Figure. The result is in sharp contrast to the perceptions of many researchers in several Member States who perceive the public institutions' recruitment rules and procedures to be insufficiently open, transparent and merit-based[106]. It is therefore important to assess the countries' and public institutions' measures aimed at making European researchers' recruitment systems more open and transparent.

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

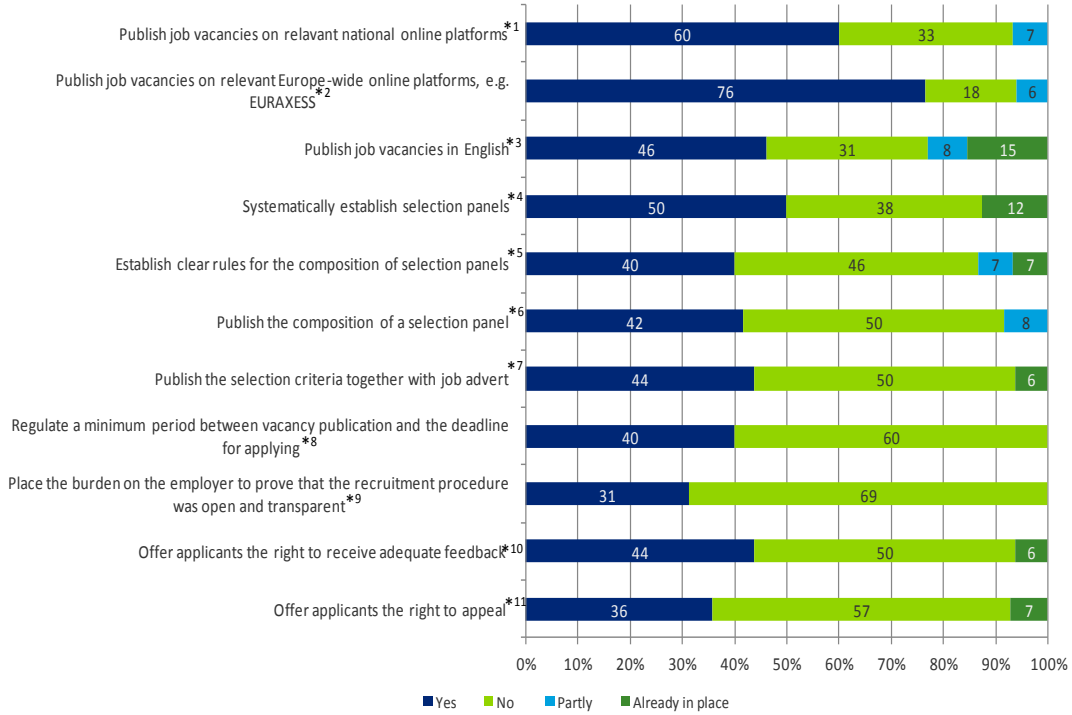


Source: Deloitte questionnaire (2011)

Public authorities and institutions have put a number of measures in place to make national recruitment systems more open, transparent and merit-based. The majority of countries report 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).

[106] IDEA Consult (2013)

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



Source: Deloitte questionnaire (2011)

Austrian Universities, for example, must advertise research job vacancies (for scientific and research staff) internationally, i.e. 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, Law no. 240/2010 requires all (fixed-term) positions to be made publicly available on the national and EU websites.

In Bulgaria, according to the guidance on implementation of the Law on Development of Academic Staff, all open research positions must be published in the Bulgarian Official Journal and on the institutional web sites (though they are mainly published in Bulgarian). The new law eliminates the age criterion formerly applied to applicants for scientific positions, including post-doctorate positions, provides defined evaluation criteria which become available to the candidates, and it also provides feedback on the decisions taken by the scientific commission.

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

- eliminates the age criterion formerly applied to applicants for FRS-FNRS mandates;
- provides pre-defined evaluation criteria that are communicated to the candidates in advance;
- provides candidates with feedback;
- develops an evaluation procedure for the selection of projects that involves more external experts from outside the Wallonia-Brussels Federation);

- advertises the calls for candidates and the mechanisms for obtaining a mandate in FRS-FNRS/Associated Funds more widely on different internet portals (FRS-FNRS, EURAXESS, etc.); and
- provides a renewed internet portal containing information of better quality on the FRS-FNRS procedures (mechanisms, calls, results, etc.)

Many public research institutions have taken steps to review their recruitment systems. A comprehensive review[107] of all universities or research institutes who have gained the HR Excellence in Research Award reveals that more than 90% had reviewed or were in the process of reviewing recruitment processes. Institutions were typically encouraging staff to involve at least three people in selection panels, including a representative from HR, having a gender balance on panels and creating a policy/guideline for recruitment panels to adhere to, including external experts as well as training all staff involved in the process.

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

The table below provides examples of the remaining barriers (institutional and cultural) to an open and transparent recruitment system for higher education and public research institutions. It should be noted, however, that open recruitment alone is not the remedy for some countries to, for example, attract foreign researchers. It needs to be part of a package including better salaries, faster visa procedures, etc.

Table 14: Remaining barriers (institutional and cultural) to an open and transparent recruitment system for higher education and public research institutions

Institutional	Cultural
– Tendency to protect/favour internal candidates, claiming that they are 'the best possible' for the available position (e.g. Italy); – Recruitment in laboratories performing research related to the interests of the nation is considered as "sensitive'' or "protected'' and thus inimical to the hosting of foreign scientists (e.g. France); – Absence of a legal instrument to influence the autonomy of the institution (e.g. Czech Republic).	– Strong institutional sense of attachment of doctorate holders to their Alma Mater (e.g. Portugal); – Knowledge of the national language (e.g. Estonia); – Language and tradition of the host country (e.g. Greece).

Source: Deloitte questionnaire (2011)

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

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-27 population aged 30-34 having completed tertiary education from 31% in 2010 to at least 40% by 2020. In 2011, the average was 34.6%, a significant increase of 12.2 percentage points since 2000 (22.4%);
- The EU-27 is lagging behind its main economic competitors like Canada, Japan, the US and South Korea in the percentage of the population aged 25-64 having completed tertiary education. This stood at 28% in the EU-27 in 2010;
- In line with the overall increase in the numbers in tertiary education, the number of tertiary graduates in Science, Technology, Engineering and Mathematics (STEM) subjects per thousand population aged 20-29 in the EU-27 increased from 10.1 (in 2000) to 12.5 (in 2010), a higher growth rate than in the US and Japan, but still below levels in those countries. However, the share of STEM degrees in the total number of academic degrees has remained virtually unchanged in the EU-27 over this period;
- The number of women graduates in STEM subjects per thousand women in the population aged 20-29 increased from 6.3 (in 2000) to 8.3 (in 2010), significantly outstripping the increase in the US and Japan, but still below levels in these countries in absolute terms.

Doctoral graduates in Europe:

- The number of new doctoral graduates in the EU-27 increased from 72 251 (in 2000) to 114 518 (in 2010). The increase for the US was from 44 808 in 2000 to 69 570 in 2010. In Japan, the number of new doctoral graduates increased from 12 192 in 2000 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 2010. It was 1.76 in the US and 1.0 in Japan;
- The highest number of new doctoral graduates per thousand population aged 25-34 in Europe in 2010 was in Switzerland. The leading EU-27 countries were Slovakia, Sweden, Germany and Finland; Cyprus, Malta, Latvia, Bulgaria and Poland had the lowest ratios;
- The average number of new women doctoral graduates in the EU-27 increased from 0.9 to 1.5 per thousand women in the population aged 25-34 between 2000 and 2010. In 2010, Slovakia reported the highest number of new women doctoral graduates in absolute terms; Cyprus the lowest.

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

- In line with the Charter & Code, European countries are implementing various measures to attract people to a research career. These include mentoring programmes, science communication action plans and financial support programmes for students (scholarships) to upgrade the quality of doctoral training. They are also taking measures to improve 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 order to attract people to take science to an advanced level, the countries reported measures targeting primary, secondary and higher education students, especially women and students in STEM subjects. For example, the 'Talente' programme (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;
- Other types of measure 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 scholars, in-company training programmes. For example, the Vitae programme (UK) supports knowledge exchange and the development of a strategic agenda to train and support high-level researchers to further improve their skills competencies;
- The countries have also introduced measures to boost partnerships between universities, research institutions and private companies. These include the implementation of joint projects, programmes to bring research results to market, research traineeships in companies, inter-sectoral mobility programmes, various government funding mechanisms and tax reduction provisions for enterprises hiring young researchers, voucher schemes and industrial PhD programmes. For example, the Fraunhofer-Gesellschaft (Germany) supports application-based research in cooperation with the private sector. Students are offered the possibility of pursuing a PhD in applied research in close collaboration with industry. The number of PhD degrees supported by Fraunhofer was 1 204 in 2007 (compared to 941 in 2005) and had nearly doubled by 2011;
- Universities increasingly offer doctoral training in structured programmes in line with the Principles for Innovative Doctoral Training[108], which reflect the Salzburg Principles and the Recommendations of the European University Association (EUA)[109], Member States' good practice and the experience of the Marie Curie Actions. The Council of Ministers has endorsed these principles and has called on Member States and universities to link, wherever relevant and appropriate, national funding for doctoral programmes to the principles.

4.2 Introduction

It has been estimated that Europe needs at least an additional one million researchers by 2020 to meet its R&D targets of 3% of GDP[110] and remain competitive worldwide. In addition, Europe is facing a challenging increase in its ageing population that may lead to a deterioration in the knowledge-intensity of its labour force and consequently considerable productivity losses[111]. 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.

[108] Available at: http://ec.europa.eu/euraxess/pdf/research_policies/Principles_for_Innovative_Doctoral_Training.pdf
[109] Available at : http://www.eua.be/cde/publications.aspx
[110] European Commission (2010a)
[111] European Commission (2011a)

Europe's success in securing an adequate science base depends on a number of key factors. First, national governments and institutions must secure the foundation of their research systems by attracting sufficient numbers of young people into taking science to an advanced (doctoral) level and thus pursuing a research career. Second, the quality of Europe's education systems, including the universities, must meet the highest international standards throughout in order to attract and retain the most talented minds in Europe. Third, researchers must have access to the highest quality of (doctoral) training in order to be fully equipped to pursue and develop their careers in Europe. Fourth, there is a need to develop a strong relationship between the academic world and the business sector with a view to the latter attracting and absorbing more researchers as well as establishing an "environment of open innovation" [112], where research results are brought to market and ideas are effectively exploited. However, as this chapter demonstrates, Europe will need to invest substantially in education and training in order to meet its objectives.

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[113]. The 2010 Science and Technology Eurobarometer[114] 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[115].

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 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[116]. 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[117]. Moreover, the majority of researchers in Europe receive training in a traditional academic setting[118], and are not adequately prepared for the market, to manage their intellectual property, obtain employment or set up their own company. According to the Public Consultation on the European Research Area Framework, researchers are not well trained to meet

[112] European Commission (2008b)
[113] European Commission (2010a)
[114] European Commission (2010c)
[115] Ibid
[116] Technopolis Group (2010a)
[117] European Commission (2010a)
[118] European Commission (2008b)

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"[119] 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[120] 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[121].

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"), fewer than one in two researchers in the European Union 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 on "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 proportion of new doctoral graduates in the EU-27, US and Japan, including women and non-EU doctoral graduates studying in Europe. Fourth, the chapter closes with an overview of European countries' measures to attract people to become researchers, to enhance the quality of doctoral training and to further encourage partnerships between industry and academia.

4.3 Education and training – Key indicators

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

Table 15: Education and training - Key indicators

Indicators	Data source(s)
Population aged 30-34 having completed tertiary education, Europe, 2000 and 2011 (%)	Eurostat Labour Force population survey/IUS
Population aged 25-64 having completed tertiary education, EU-27 and main competitors, 2010 (%)	Eurostat, OECD
Tertiary graduates in Science, Technology, Engineering and Mathematics (STEM) studies (ISCED 5 & 6) per thousand population aged 20-29, Europe, US and Japan, 2000 and 2010	UNESCO OECD Eurostat education survey

[119] European Commission (2010b)

[120] The EU-27 Member 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)

[121] European Commission (2010b)

Indicators	Data source(s)
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 2010	UNESCO OECD Eurostat education survey
New doctoral graduates (ISCED 6) per thousand population aged 25-34, EU-27, US and Japan, 2000-2010	UNESCO OECD Eurostat education survey/IUS
New doctoral graduates (ISCED 6) per thousand population aged 25-34, Europe, 2000 and 2010	UNESCO OECD Eurostat education survey/IUS
New women doctoral graduates (ISCED 6) per thousand population aged 25-34, Europe, 2000 and 2010	UNESCO OECD Eurostat education survey

4.4 Tertiary graduates in Europe

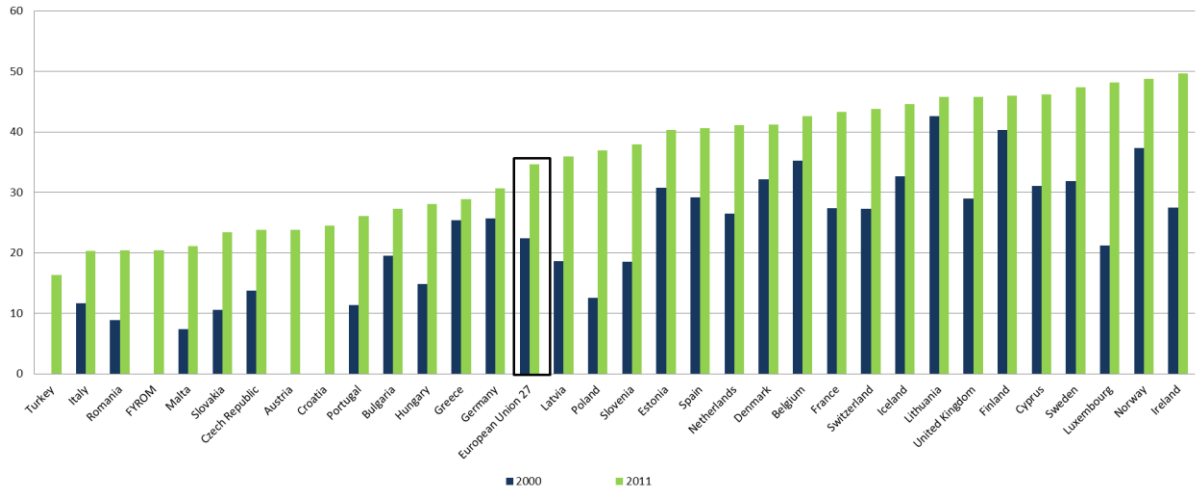
The percentage of the EU-27 population aged 30-34 having completed tertiary education averaged 34.6% in 2011, a significant increase of 12.2 percentage points since 2000 (22.4%). Between 2010 and 2011, the EU-27 average increased by one percentage point from 33.6% to 34.6%.

The Europe 2020 growth strategy[122] 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 2011, the average was 34.6%, a significant increase of 12.2 percentage points since 2000 (22.4%). Between 2010 and 2011, the EU-27 average increased by one percentage point from 33.6% to 34.6%.

In 2011, thirteen EU Member States (along with Iceland, Norway and Switzerland) had achieved or exceeded the target of 40%. Ireland was at the top at around 50%. Ten EU Member States (together with Croatia, FYROM and Turkey) were below 30%, while Slovenia, Poland, Latvia and Germany reported figures of 30-35%.

[122] European Commission (2010d)

Figure 21: Population aged 30-34 having completed tertiary education, Europe, 2000 and 2011 (%)



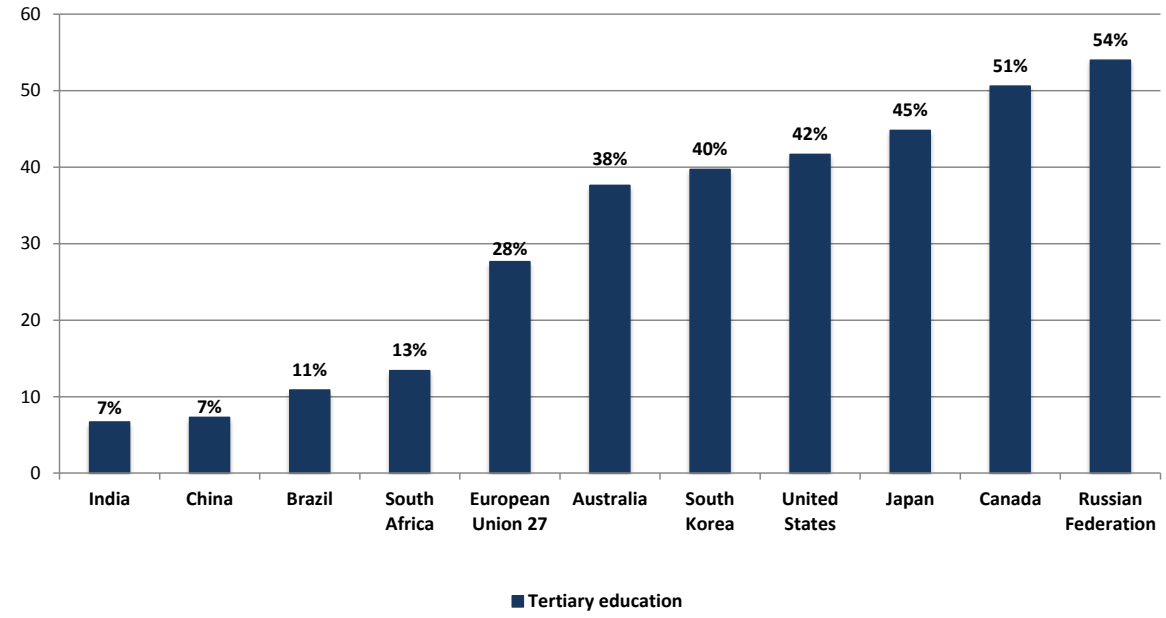
Source: Deloitte
Data: Eurostat Labour Force population survey/IUS
*No information unavailable for 2000 and 2011 for BiH, IL, LI, ME and SR and for 2000 for AT, FYROM, HR, TR

The EU-27 is lagging behind its main economic competitors like Canada, Japan, the US and South Korea in the percentage of the population aged 25-64 having completed tertiary education. This stood at 28% in the EU-27 in 2010.

This section provides a comparison of the EU's performance with some of its main global competitors, including Australia, the BRICS countries (Brazil, Russia, India, China and South Africa), Japan, South Korea and the US using a larger age group (aged 25-64)[123]. In 2010, the percentage of the population aged 25-64 having completed tertiary education in the EU-27 was 28%, far behind major economic competitors, like Russia (54%), Canada (51%), Japan (45%), the United States (42%) and South Korea (40%).

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

Figure 22: Population aged 25-64 having completed tertiary education, EU-27 and main competitors, 2010 (%)



Source: Deloitte
Data: Eurostat, OECD

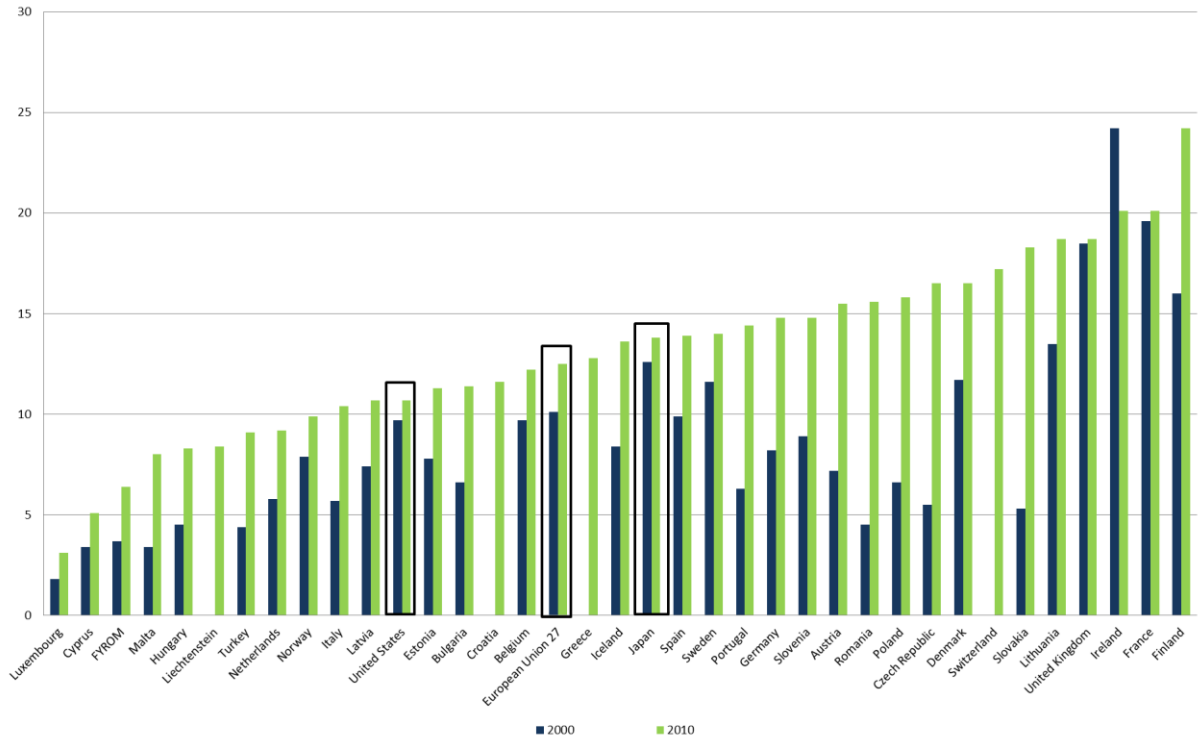
In line with the overall increase in the numbers in tertiary education, the number of tertiary graduates in Science, Technology, Engineering and Mathematics (STEM) subjects per thousand population aged 20-29 in the EU-27 increased from 10.1 (in 2000) to 12.5 (in 2010). This was a higher growth rate than in the US and Japan, but was still below levels in these countries. However, the share of STEM degrees in the total number of academic degrees has remained virtually unchanged in the EU-27 over this period.

In 2010, the proportion of graduates (ISCED 5 & 6) in STEM subjects per thousand population aged 20-29 in the EU-27 was similar to the proportion in Japan (12.5 and 13.8 respectively), but higher than in the United States (10.7). In the EU-27, it was up from 10.1 in 2000.

The European countries which reported the highest proportion of graduates in STEM subjects in 2010 (>20) were Finland (24.4), France (20.1) and Ireland (20.1). The lowest numbers (<10) were reported in Norway (9.9), the Netherlands (9.2), Turkey (9.1), Liechtenstein (8.4), Hungary (8.3), Malta (8.0), FYROM (6.4), Cyprus (5.1) and Luxembourg (3.1).

The number of tertiary graduates in STEM subjects per thousand population aged 20-29 in the EU-27 increased from 10.1 per thousand population aged 20-29 in 2000 to 12.5 in 2010 (Figure 23).

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 2010



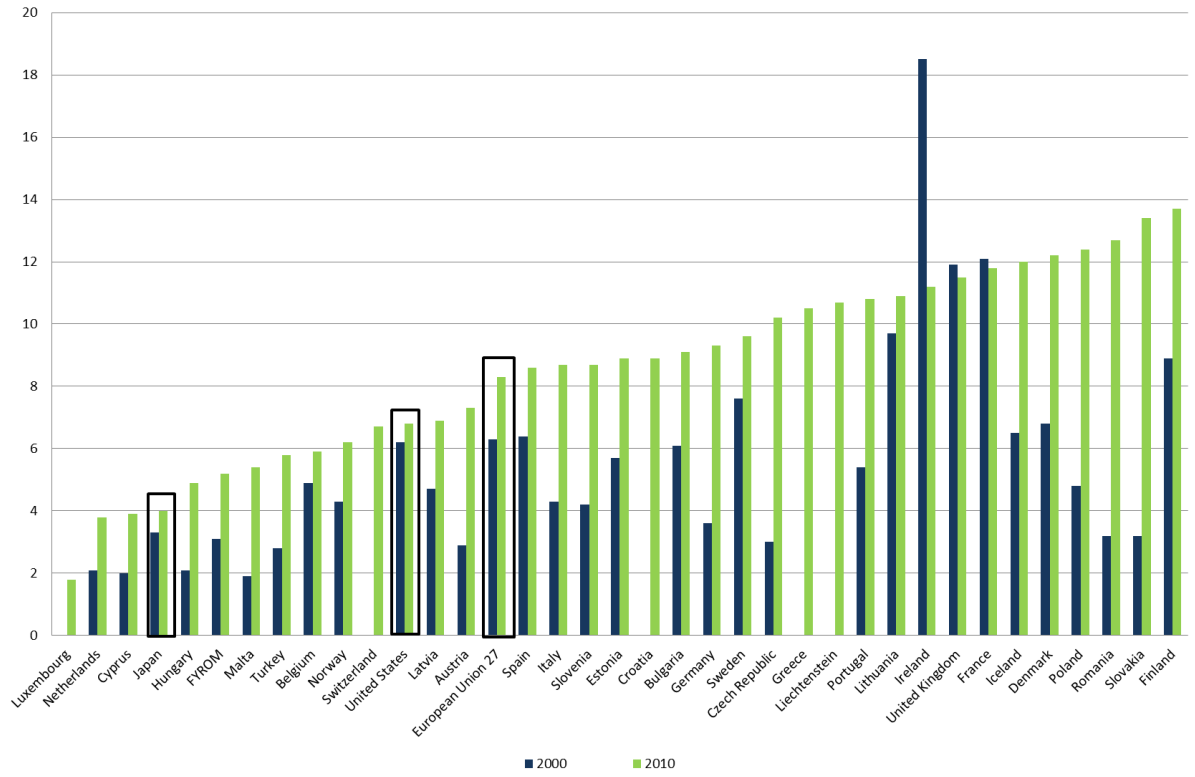
Source: Deloitte
Data: UNESCO OECD Eurostat education survey
*No information unavailable for 2000 and 2010 for BiH, IL, ME and SR and for 2000 for EL, CH, HR and LI

The number of women graduates in STEM subjects per thousand women population aged 20-29 increased from 6.3 (in 2000) to 8.3 (in 2010), significantly outstripping the increase in the US and Japan, but still below levels in these countries.

In 2010, the proportion of women graduates in STEM subjects (ISCED 5 & 6) per thousand women aged 20-29 in the EU-27 was 8.3, more than in the United States (6.8) and Japan (4). The ratio was highest in a number of new EU Member States, such as Slovakia (13.4), Romania (12.7) and Poland (12.4) as well as in Finland (13.7) and Denmark (12.2). The lowest EU-27 numbers were in Malta (5.4), Hungary (4.9), Cyprus (3.9), the Netherlands (3.8) and Luxembourg (1.8).

The number of women graduates in STEM in the EU-27 per thousand population in this age group increased from 6.3 in 2000 to 8.3 in 2010. Although the vast majority of countries conformed to the rising trend, the extent of the growth differed substantially. Between 2000 and 2010, a number of EU countries increased the number of women graduating in STEM very noticeably, such as (in descending order) Slovakia (from 3.2 to 13.4), Romania (from 3.2 to 12.7), Poland (from 4.8 to 12.4), the Czech Republic (from 3 to 10.2), Germany (from 3.6 to 9.3), Portugal (from 5.4 to 10.8) and Denmark (from 6.8 to 12.2). Conversely, the figures for Ireland, the United Kingdom and France 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 2010



Source: Deloitte
Data: UNESCO OECD Eurostat education survey.
*No information unavailable for 2000 and 2010 for BiH, IL, ME and SR and for 2000 for EL, CH, HR, LI and LU

4.5 New doctoral graduates in Europe

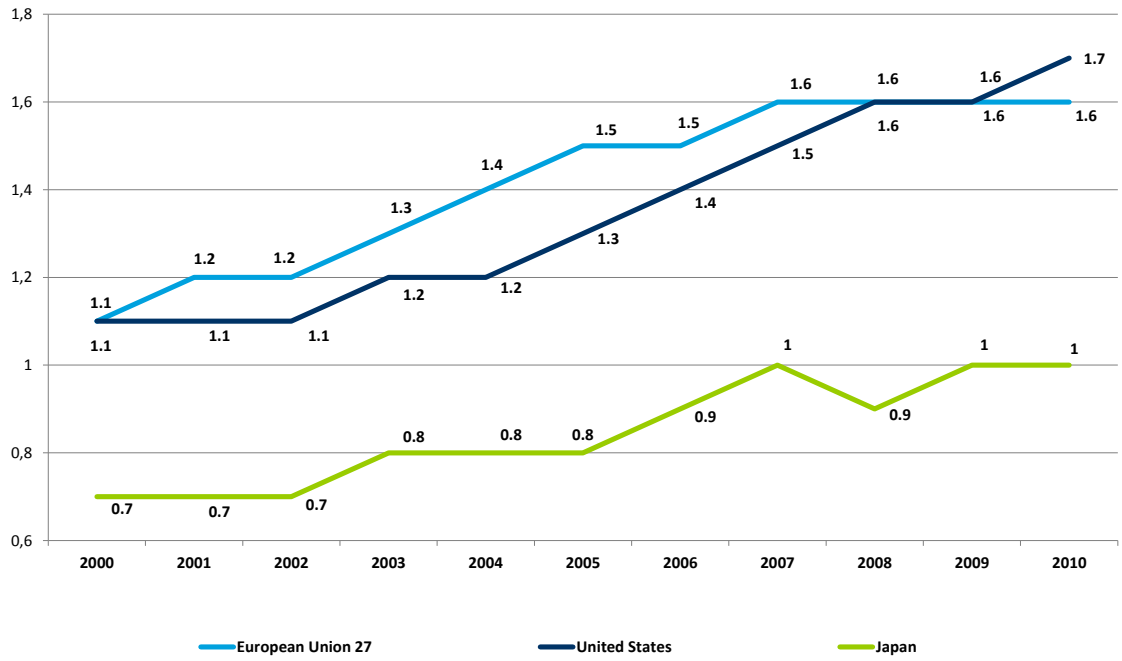
The number of new doctoral graduates in the EU-27 has risen significantly in the past decade, increasing from around 72 000 in 2000 to around 115 000 in 2010.

The number of new doctoral graduates in the EU-27 increased from 72 251 (in 2000) to 114 518[124] (in 2010). The increase for the US was from 44 808 in 2000 to 69 570 in 2010. In Japan, the number of new doctoral graduates increased from 12 192 in 2000 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[125] in 2010. The increase in the United States was from 1.1 in 2000 to 1.7 in 2010, while in Japan, it went from 0.7 in 2000 to 1.0 in 2010.

[124] Eurostat
[125] Computed by Deloitte by including Italy in the total provided by Eurostat

Figure 25: New doctoral graduates (ISCED 6) per thousand population aged 25-34, EU-27, US and Japan, 2000-2010

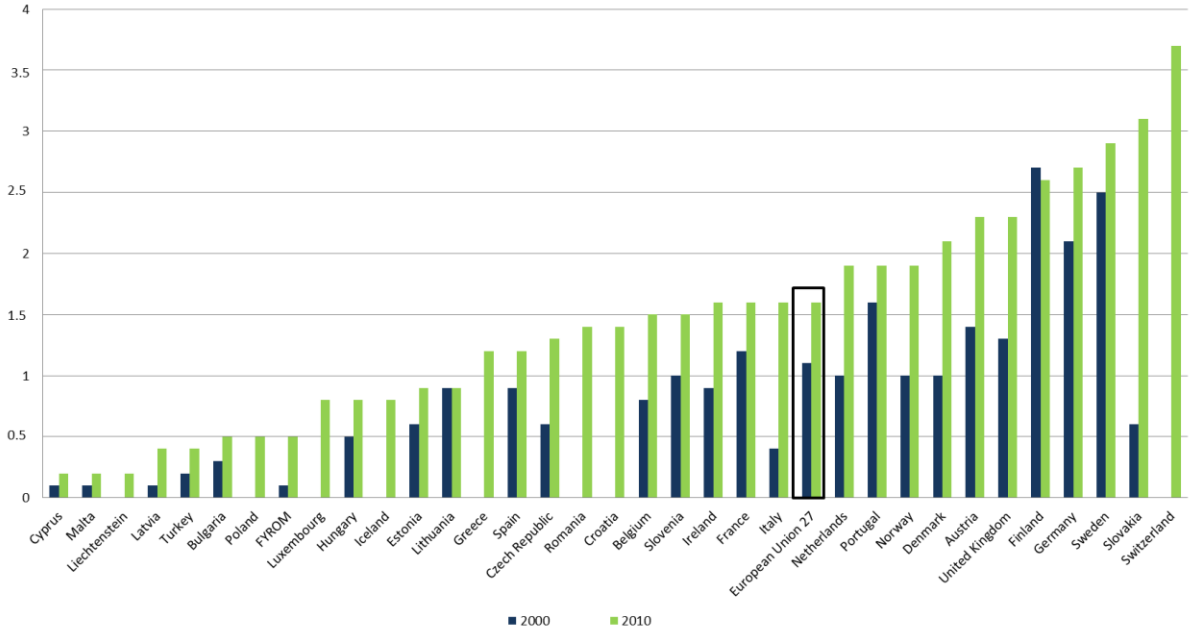


Source: Deloitte
Data: UNESCO OECD Eurostat education survey/IUS

The highest number of new doctoral graduates per thousand population aged 25-34 in Europe in 2010 was in Switzerland. The leading EU-27 countries were Slovakia, Sweden, Germany and Finland.

In 2010, the average number of new doctoral graduates per thousand population aged 25-34 for the EU-27 was 1.6, with a range from 3.7 in Switzerland to 0.5 or less in some other European countries. The countries can be grouped into three clusters: those countries with a number of new ISCED 6 graduates above 2.0 per thousand population, those in the 1.0-1.9 range, and those below 1.0.

Figure 26: New doctoral graduates (ISCED 6) per thousand population aged 25-34, Europe, 2000 and 2010

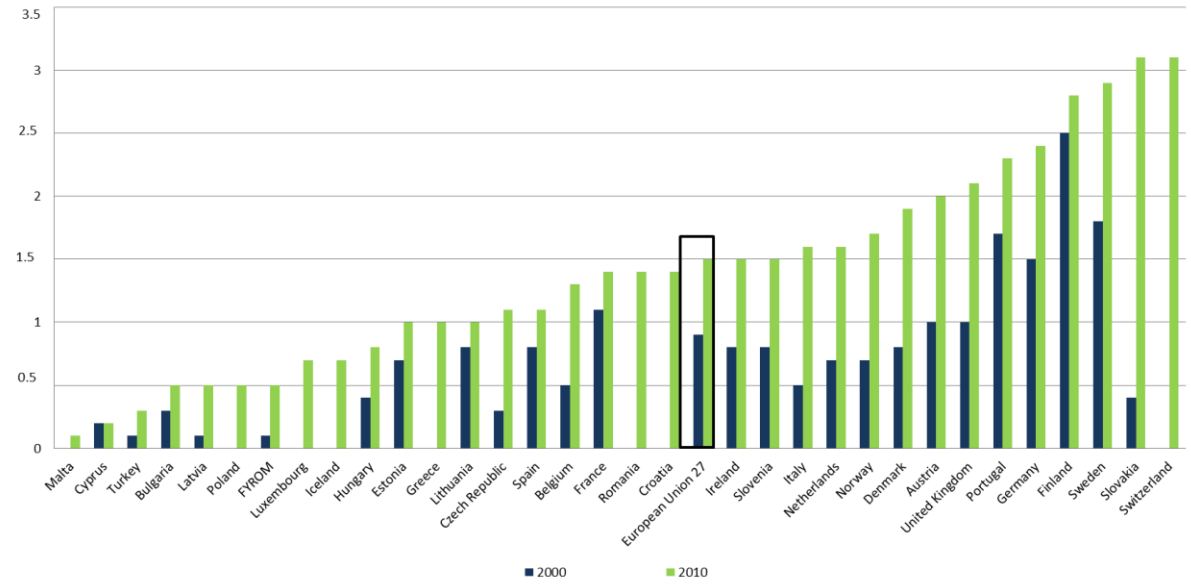


Source: Deloitte
Data: UNESCO OECD Eurostat education survey/IUS
*No information unavailable for 2000 and 2010 for BiH, IL, ME and SR and for 2000 for EL, CH, HR, IS, LI and RO

The average number of new women doctoral graduates in the EU-27 increased by from 0.9 to 1.5 per thousand women in the population aged 25-34 between 2000 and 2010. In 2010, Slovakia reported the highest number of new women doctoral graduates; Cyprus the lowest.

Between 2000 and 2010, 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 2010, Slovakia, Sweden, the United Kingdom, Denmark and Italy reported the highest increase in the proportion of new women doctoral graduates. In France, Spain, Estonia, Lithuania, Bulgaria and Turkey the number increased only slightly, but from different baselines.

Figure 27: New women doctoral graduates (ISCED 6) per thousand population aged 25-34, Europe, 2000 and 2010



Source: Deloitte
Data: UNESCO OECD Eurostat education survey
*No information unavailable for 2000 and 2010 for BiH, IL, ME and SR and for 2000 for CH, EL, IS, LU, MT, PL and RO

4.6 Attracting people to science and providing quality training for researchers

European countries are implementing various measures to attract people to a research career. These include mentoring programmes, science communication action plans and financial support programmes for students (scholarships) and measures to upgrade the quality of doctoral training (e.g. offering structured programmes in line with the Principles for Innovative Doctoral Training[126]) and post-doctoral career paths (e.g. in-company training programmes, professional development provision and tenure tracks). They are also developing measure to encourage academia-industry partnerships (e.g. via research traineeships in companies and inter-sectoral mobility programmes).

Europe needs to safeguard a sufficient supply of highly qualified researchers both to promote research and development, and accelerate the introduction of innovative business models by European enterprises[127]. In an attempt to increase the research culture, many European countries have developed measures to attract students to the research world and systematically expose students to interdisciplinary knowledge with the aim of producing better research. Special attention is paid to measures intended to bridge the gap between basic and applied research, encourage the dialogue between science and business, and promote interaction between research and economic development.

Universities increasingly offer doctoral training in structured programmes in line with the Principles for Innovative Doctoral Training[128], which reflect the Salzburg Principles and the Recommendations of the EUA[129], Member States' good practice[130] and the experience of the Marie Curie Actions. The

[126] Available at: http://ec.europa.eu/euraxess/pdf/research_policies/Principles_for_Innovative_Doctoral_Training.pdf
[127] European Commission (2010b)
[128] Available at: http://ec.europa.eu/euraxess/pdf/research_policies/Principles_for_Innovative_Doctoral_Training.pdf
[129] Available at : http://www.eua.be/cde/publications.aspx

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[131]. This year, experts designated by the Commission are visiting a number of doctoral schools in order to learn how to further spread the use of these principles.

The principles relate to:

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

The table below provides an overview of different measures[132] 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.

[130] Available at: http://ec.europa.eu/euraxess/pdf/research_policies/Report_of_Mapping_Exercise_on_Doctoral_Training_FIN AL.pdf

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

[132] 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 16: Measures aimed to attract young people to science and the research profession, raise the quality of doctoral training, and enhance collaboration between academia and industry

Country	Education and training		
	Types of measure		
	Attract young people to science and the research profession	Quality of doctoral training and life-long learning	Partnership between academia and industry
AUSTRIA	✓✓✓✓✓✓✓✓✓✓✓✓✓	✓✓✓✓✓✓✓✓	✓✓✓✓✓✓✓✓✓✓✓✓✓✓✓✓✓
BELGIUM	✓✓✓✓✓	✓✓✓✓✓	✓✓✓✓✓✓✓✓✓✓
BiH	✓✓✓✓✓✓✓✓	✓	✓✓✓✓✓
BULGARIA	✓✓✓✓✓✓✓✓	✓✓✓	✓✓✓✓
CROATIA		✓✓✓✓✓✓	✓✓✓✓✓✓✓
CYPRUS	✓✓✓	✓✓✓✓✓✓✓✓	✓✓✓✓
CZECH REPUBLIC	✓		✓
DENMARK	✓✓✓✓✓✓✓✓✓✓✓✓	✓✓	✓✓✓✓✓✓✓✓
ESTONIA	✓✓✓✓✓✓✓	✓✓✓✓	✓✓✓✓✓✓✓
FINLAND	✓✓✓✓	✓	✓✓✓
FRANCE	✓✓✓✓	✓✓✓✓✓	✓✓✓✓
FYROM	✓✓✓	✓	✓✓✓
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 2013*", Annex 'Country files'
Updated information is not available for IL, IS, LI and TR
Information presented in the table is based on individual country responses to the Deloitte Questionnaire (2011).

In the 2012 reporting exercise, the vast majority of countries reported new measures supporting education and training. The measures fall into three categories. The first group gathers together all measures national authorities and/or institutions have put in place to attract people to take science to an advanced (doctoral) level and thus potentially to become researchers. The measures target primary, secondary and higher education students, especially women and students in STEM subjects. Measures for the improvement of European education systems and university curricula are also covered by this category.

The second cluster of measures includes all activities taken by the national authorities and/or the institutions to enhance the quality and efficiency of doctoral training and provide life-long learning

to researchers in accordance with national priorities and industry requirements. This category includes measures such as the development of National Skills Agendas[133] to improve researchers' employment skills and competencies at all career stages (from early career to star researchers). It also covers national qualifications frameworks, skill grids, doctoral studies curricula and other career 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.[134]. For a detailed discussion on partnerships between industry and academia, see chapter "Collaboration between academia and industry" in this report. As depicted in the table, all 38 countries have put various measures in place in all three categories.

In relation to the first category, a significant majority of European countries 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 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 '*Talente*' programme (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, 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. As part 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 'Young Researchers' Programme' (Slovenia) aims to increase the number of students following PhD studies, incorporating specific measures to promote research in science, technology, engineering and mathematics (STEM) subjects. Since 2006, it has provided financing for more than 1 200 young researchers annually.

[133] European Commission (2009b)
[134] Ibid

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

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

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

The Helmholtz Association (Germany) provides structured doctoral training in the form of research schools and graduate schools, and grants universities access to the Helmholtz Association's laboratories and research infrastructures. The Helmholtz Research Schools are joint programmes established on the basis of cooperation agreements between Helmholtz Centres and universities with the aim of supporting young researchers. The Research Schools provide structured doctoral training over a period of three years in areas of mutual scientific interest and scientific excellence. The Graduate Schools offer PhD students an interdisciplinary education that teaches them important skills for a career in science or the private sector. Thirteen Helmholtz graduate schools and 21 Helmholtz research schools have been funded since 2006.

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

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

- increases in performance-based funding for doctoral studies;

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

Finally, European countries' measures to boost partnerships between universities, research institutions and private companies include the implementation of joint projects, programmes to bring research results to market, research traineeships in companies, inter-sectoral mobility programmes, various government funding mechanisms and tax reduction provisions for enterprises hiring young researchers, voucher schemes, industrial PhD programmes, etc. Some countries also encourage and sustain long-term cooperative public-private partnerships (for instance, under a Memorandum for Cooperation) whereas other countries prefer to create networking platforms and innovation clusters to link universities with the business world.

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

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

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

In response to the review of university-business collaboration in February 2012 by Professor Tim Wilson[135], the UK government announced new plans to strengthen that collaboration, including promotion of a new framework for business and universities to work together and support the Council for Industry and Higher Education (CIHE) to create a National Centre for Universities and Business.

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

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

5. Working conditions in the research profession

5.1 Working conditions in the research profession – Highlights

Researchers' contractual conditions:

- In 2012, many researchers were working on a fixed-term contract or had no contract at all. This was most pronounced during earlier career stages (R1 - First Stage Researcher and R2 – Recognised Researcher);
- In 2012, researchers with no contracts, 'others' (often student status) and those with a fixed-term contract of one year maximum accounted for 31% of R1[136] PhD researchers, 10% of R2[137], 4% of R3[138] and 3% of R4[139]. Moreover, 55% of researchers in the R1 group with a PhD and 47% of the R2 group also had fixed-term contracts, albeit of a slightly longer duration than 12 months;
- In 2012, the highest proportion of public sector researchers with an open-ended or fixed-term contract of more than four years was in a number of the new Member States. It is important to note, however, that there are a number of other factors which can have a major impact on a researcher's working conditions. This includes the remuneration package, access to research funding, provision of training and career development, career prospects, etc.

Researchers' remuneration

- 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;
- On average, as a percentage of the purchasing power adjusted salary of the best paying countries, non-European countries pay better than the EU-27 Member States in all career stages (R1-R4). The gap is 5 to 10 percentage points in R2, R3 and R4 and about 25 percentage points in R1. Amongst the best paying countries are the US (R2-R4), Brazil (R1-R4), Switzerland (R2-R4), Cyprus (R2-R4), the Netherlands (R3, R4), Ireland (R4), and Belgium (R1). Denmark pays the highest stipends for PhD candidates across all countries. US universities pay relatively low amounts for the R1 level researchers (both in terms of stipends but also to a lesser extent in terms of salaries for employed PhD candidates), but the higher the career level, the higher the PPP converted salaries are in the US in comparison to all other countries.

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

- EU Member States and Associated Countries continue to support the implementation of the Charter & Code (C&C) which aim to improve researchers' working conditions. As of June 2013, more than 480 organisations from 35 countries in Europe and beyond have explicitly endorsed the principles underlying the C&C, many of them membership or umbrella organisations. Level

[136] R1: First Stage Researcher (up to the point of PhD)
[137] R2: Recognized Researcher (PhD holders or equivalent who are not yet fully independent)
[138] R3: Established Researcher (researchers who have developed a level of independence)
[139] R4: Leading Researcher (researchers leading their research area or field)

of institutional endorsements of the C&C principles continues to grow;

- The Commission's Human Resources Strategy for Researchers (HRS4R) focuses on the practical implementation of the C&C principles. Award of the "HR Excellence in Research" logo[140] recognises institutional progress in implementing C&C principles. Currently, some 230 organisations are members of the Strategy Group. So far 148 organisations have received the logo. Half of the logos awarded are within one country (the UK), reflecting the enabling framework provided by national authorities.

Social security provisions:

- 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 (R1 researchers), 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.

Looking at Europe as a whole, research careers in the public sector appear relatively unattractive. According to the Public Consultation on the European Research Area Framework, 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 to be the main inhibiting factors for ensuring attractive careers in Europe.

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[141]. 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[142] considered a lack of career prospects and

[140] Available at: http://ec.europa.eu/euraxess/index.cfm/rights/strategy4Researcher
[141] European Commission (2008b)
[142] European Commission (2012a)

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. First, it offers an overview of the key indicators for monitoring working conditions in research. Second, it sheds light on the contractual conditions of researchers in Europe. Third, it presents statistics on the remuneration levels at different stages of a researcher career in Europe and at international level. Fourth, it discusses the impact of researchers' mobility on their career progression. Lastly, it offers an overview of the countries' social security provisions (statutory pension rights, healthcare and unemployment benefits) for researchers.

5.3 Working conditions in the research profession – Key indicators

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

Table 17: Working conditions in the research profession - Key indicators

Indicators	Data source(s)
Researchers employed on fixed-term contracts, Europe, 2012 (%)	MORE2 study
Estimated shares of researchers in the higher education sector by employment contract status and by country of affiliation, Europe 2012 (%)	MORE2 study
Remuneration of doctorate holders working as researchers compared to doctorate holders working as non-researchers (difference in median gross annual earnings), Europe (2009), US (2008) (%)	OECD, Science, Technology and Industry Scoreboard, 2011
Gross annual salaries and PhD stipends of university researchers as percentage of the best paying country within career stages, EU, the rest of Europe, and selected competitors and emerging economies	MORE2 study
Post-PhD researchers indicating that their time as mobile researcher had positive, negative or no impact on career progression, EU-27, 2012 (%)	MORE2 study

5.4 Employment contracts in the research profession

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

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

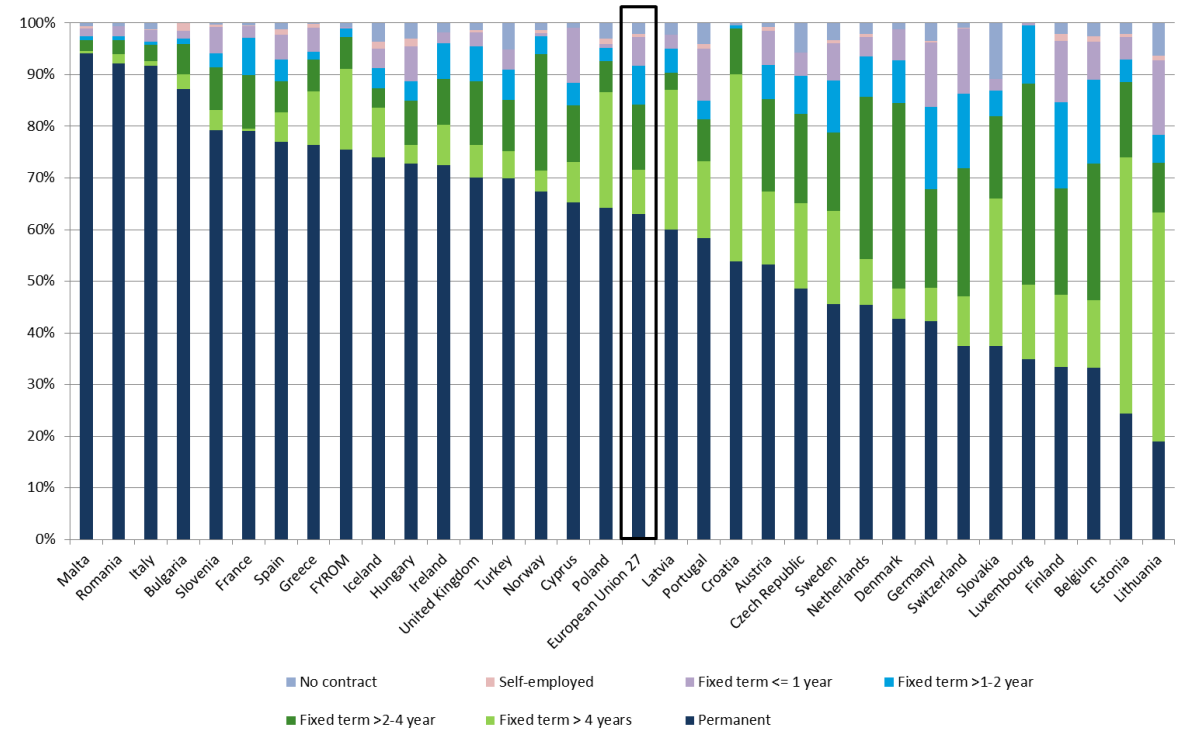
In 2012, researchers with no contracts, 'others' (often student status) and those with a fixed-term contract of one year maximum accounted for 31% of R1[143] PhD researchers, 10% of R2[144], 4% of R3[145] and 3% of R4[146]. Moreover, 55% of researchers in the R1 group with a PhD and 47% of the R2 group also had fixed-term contracts, albeit of a slightly longer duration than 12 months. These figures highlight the precarious contractual situation of early-stage researchers, particularly PhD researchers. The share of permanent (open-ended) contracts increases from lower (13% of R1 in PhD) to higher career stages (90% of R4). This suggests that researchers typically find stable positions only relatively late during their career paths, after having completed their doctorate[147].

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

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

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

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



Source: Deloitte
Data: MORE2 study "Support for continued data collection and analysis concerning mobility patterns and career paths of researchers", IDEA Consult (2013)
*No information unavailable for BiH, IL, LI and ME and SR

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[148]. The difference in median gross national earnings of doctorate holders employed as researchers compared with those working as non-researchers in different sectors provides a useful indication of researchers' salary levels[149].

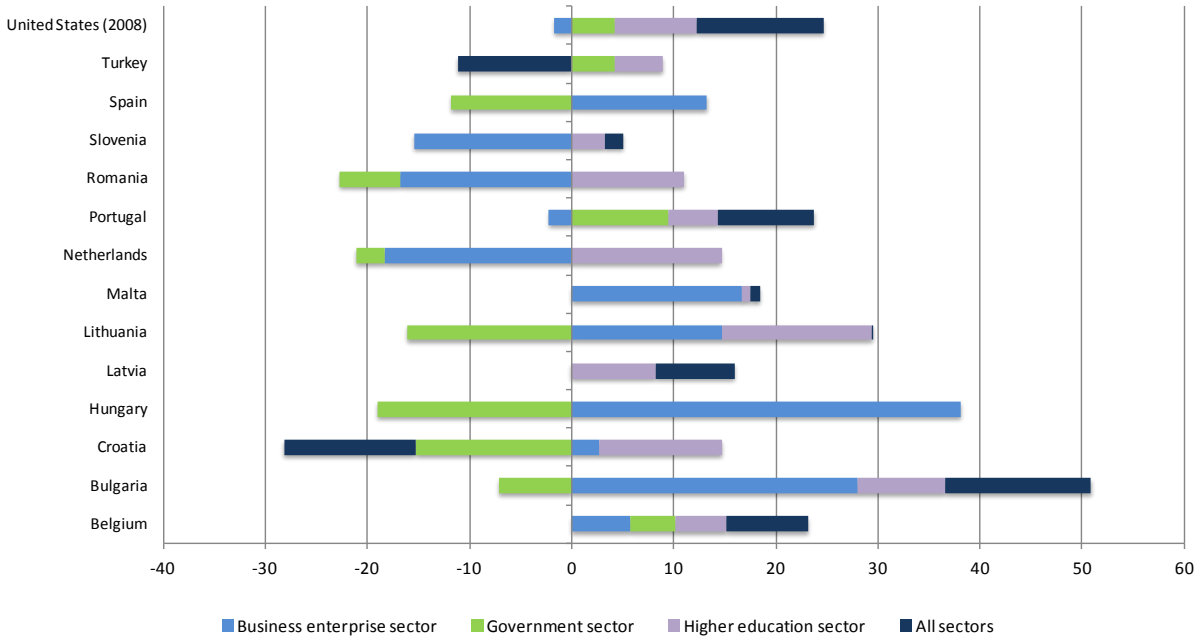
On average, gross annual earnings in all sectors are higher for doctorate holders working as researchers than those employed as non-researchers. Croatia and Turkey are exceptions. In all

[148] European Commission (2008b)

[149] 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

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

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



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

On average, non-European countries outperform the EU-27 Member States in terms of purchasing power adjusted salaries. Amongst the best paying countries are the US (R2-R4), Brazil (R1-R4), Switzerland (R2-R4), Cyprus (R2-R4), the Netherlands (R3, R4), Ireland (R4), and Belgium (R1). Denmark pays the highest stipends for PhD candidates across all countries.

The MORE2 Remuneration Cross-Country Report[150] provides a detailed description and analysis of researchers' remuneration in over 45 countries. This comparative study contains a set of country profiles covering the EU-27 Member States, 13 other European countries, as well as the USA, Canada, Japan, China, South Korea, Singapore, Australia, Brazil and Russia.

[150] Idea Consult (2013)

On average, as a percentage of the purchasing power adjusted salary of the best paying countries, non-European countries pay better than the EU-27 Member States in all career stages (R1-R4). The gap is 5 to 10 percentage points in R2, R3 and R4 and about 25 percentage points in R1. The largest differences occur with the US and Brazil (>80% of the highest salaries in all career stages compared to 45-55% in EU27).

Amongst the best paying countries are the US (R2-R4), Brazil (R1-R4), Switzerland (R2-R4), Cyprus (R2-R4), the Netherlands (R3, R4), Ireland (R4), and Belgium (R1). Denmark pays the highest stipends for PhD candidates across all countries. US universities pay relatively low amounts for the R1 level researchers (both in terms of stipends but also to a lesser extent in terms of salaries for employed PhD candidates), but the higher the career level, the higher the PPP converted salaries are in the US in comparison to all other countries. However, as this study points out, some of the difference may be compensated for by better levels of social security provision in the EU-27, but this is difficult to quantify.

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

A comparison of EU-27 countries with non-EU countries is strongly affected by the sample of non-EU countries[151]. While on average non-European countries offer higher gross annual salaries and PhD stipends to university researchers in comparison with the best paying country within the career stage, the difference diminishes when comparing EU-15 countries with those OECD countries that are not EU-27 Member States. Average researcher salaries in EU-12 countries are similar to those in non-OECD countries.

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

Table 18: Gross annual salaries and PhD stipends of university researchers as percentage of the best paying country within career stages, EU, the rest of Europe, and selected competitors and emerging economies

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

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

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

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

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

The '*Recommendation on the European Charter for Researchers and a Code of Conduct for the Recruitment of Researchers'* [152] spells out the roles, responsibilities and rights of researchers as well as of their employers and funders.

EU Member States and Associated Countries support the implementation of the Charter & Code[153]. The aim of the Charter is to ensure that the nature of the relationship between researchers and employers or funders is conducive to successful performance in generating, transferring, sharing and disseminating knowledge and technological development, and to the career development of researchers. The objectives of promoting the Charter & Code principles are to improve researchers' working conditions in accordance with common European principles (as set out in the Charter & Code).

To date (June 2013) more than 480 organisations from 35 countries in Europe and beyond have explicitly endorsed the principles underlying the Charter & Code, many of them membership or umbrella organisations. Together they represent more than 1 200 universities, research institutes and funding agencies. Several researcher associations have also endorsed the Charter & Code in writing, representing thousands of individual researchers.

The Human Resources Strategy for Researchers incorporating the Charter & Code[154] was launched in 2008 and provides European Commission support for employers and funders of researchers in the practical implementation of the Charter & Code principles. This five-step process enables organisations to truly integrate the principles in their own human resources policy, thereby promoting the organisation as a stimulating and favourable workplace, or as a funder that promotes the provision of such a favourable environment through its funding rules. Award of the 'HR Excellence in Research' logo recognises institutional progress in implementing Charter & Code principles. Currently, some 230 organisations are members of the Strategy Group. So far 148 organisations have received the logo[155].

For example, the promotion of the Charter & Code and broad implementation of their principles at Austrian universities was part of the negotiations for 2010-2012 performance agreements with

[152] Available at: http://ec.europa.eu/euraxess/index.cfm/rights/whatIsAResearcher
[153] Council of the European Union (2008b)
[154] Available at: http://ec.europa.eu/euraxess/index.cfm/rights/strategy4Researcher
[155] Ibid

universities. The implementation of the Charter & Code is part of the National Action Plan for Researchers. In Austria, 18 universities have signed the Charter & Code. In addition, four funding organisations, three umbrella organisations, three research organisations and three universities of applied sciences have signed the Charter & Code.

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

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

Vitae, the UK organisation championing researchers and research staff, manages a Researcher Development Framework (RDF). Within this Framework, thirty major UK organisations (e.g. Funding Councils, Research Councils, the Quality Assurance Agency, the unions and Universities UK) are involved in knowledge exchange and the development of a strategic agenda to train and support high-level researchers to further improve their skills competencies. The Vitae programme provides national leadership and strategic development, and works with higher education institutions, policy makers, stakeholders, employers and individual researchers. Institutions in other Member States also have plans to introduce similar professional development frameworks, as recommended in a report adopted by the ERA Steering Group on Human Resources and Mobility on 23 May 2012[156].

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

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

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

[156] Available at: http://ec.europa.eu/euraxess/pdf/research_policies/SGHRM-WG1-on-HR-Issues-Final-report-May-2012.pdf

According to a recent large-scale survey on researchers' mobility[157], the internationally mobile researchers in the category of those having been mobile >3 months in the last ten years during their post-PhD career feel that the output effects (quality of output, citation impact, patents, number of co-authored publications) are the most important factors related to mobility.

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

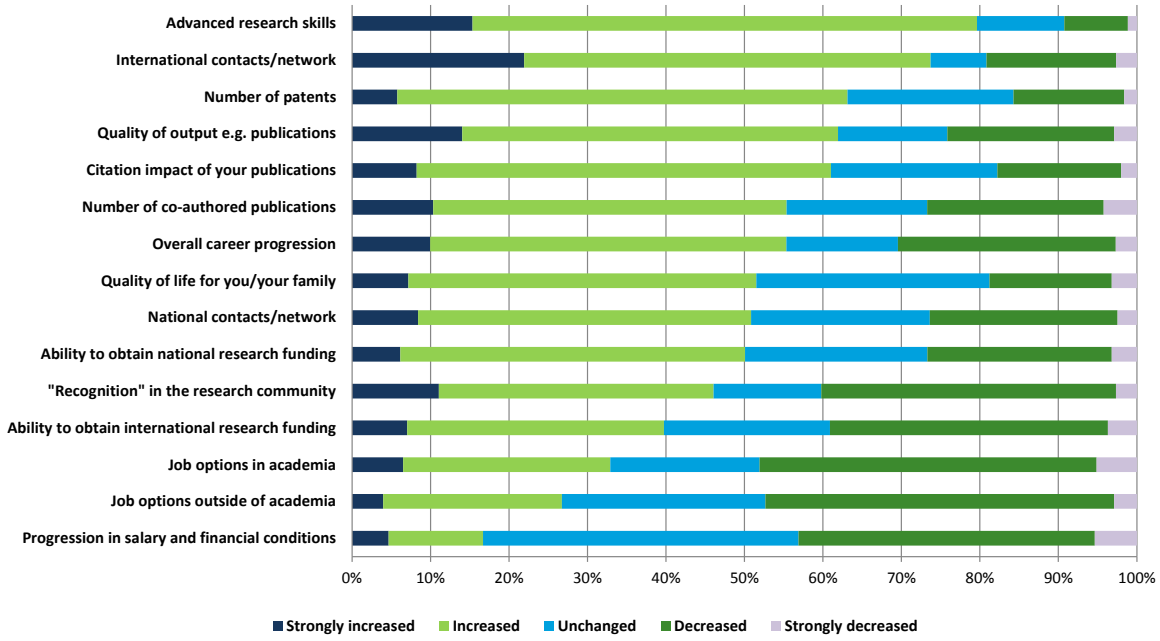
Other important effects are the advancement of research skills (80% increased, 11% unchanged and 9% decreased) and the development of international contacts and networks (74% increased, 7% unchanged and 19% decreased).

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

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

[157] IDEA Consult (2013)

Figure 30: Post-PhD researchers indicating that their time as a mobile researcher (>3 months in last 10 years) had positive, negative or no impact on career progression, EU-27, 2012 (%)



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

5.7 Social security benefits (sickness, unemployment, old-age)[158]

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[159].

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"*[160].

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

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[161].

[161] European Commission (2005a)

6. Collaboration between academia and non-academia

6.1 Collaboration between academia and non-academia – Highlights[162]

Collaboration between researchers from academia and non-academia:

- Around one in four researchers (23%) were mobile to a sector outside academia during their PhD, in or outside their country: 4% of researchers were active in private industry, 9% in the private not-for-profit sector and 10% were in the public or government sector;
- The proportion of researchers who have had a work placement or internship in the non-academic sector during their PhD is highest in some of the new Member States and lowest in some of the older Member States;
- During the post-doctoral career stages, 30% of EU researchers have been inter-sectorally mobile for a period of more than three months: 12% to private industry, 7% to the private not-for-profit sector and 15% to the public or government sector;
- The most important motives for private sector employment are career progression, the possibility of being able to gain experience, increased employability, availability of research funding and being able to bring research to market;
- Only 22% of respondents to the ERA public consultation[163] felt that EU researchers are equipped for the business sector market. Three in four acknowledge that they lack awareness of intellectual property rules and knowledge-transfer opportunities;
- The number of public-private co-publications between different sectors (universities, research institutes, industry) per million population provides some indication of the degree of collaboration between academia and industry. Only a limited number of European researchers collaborate formally with the business sector in this way. The number of scientific co-publications per million population is considerably higher in the US and Japan than in the EU.

Countries' measures to increase collaboration between academia and industry:

- European countries have put various measures in place to boost partnerships between universities, research institutions and private companies. These include the implementation of joint projects, exploitation 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;
- In Norway, for example, professors and associate professors have the opportunity of holding 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 and countries and between institutions across disciplines and countries may also take up part-time positions in the Higher Education Sector;
- 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-

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

[163] European Commission (2012a)

versa.

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"[164]. 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[165].

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, absence of training, a lack of entrepreneurial mind-set, etc. Individuals frequently prefer to be employees rather than employers, to the detriment of the development of innovative start-ups and SMEs[166].

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"[167], where research results are brought to market and ideas are exploited effectively. As described in the chapter on "Education and training" in this report, European countries have put various measures in place to boost partnerships between academia and non-academia[168].

It is important to note that Europe is not homogenous. There are stark differences between countries with regard to collaboration between academia and industry. Austria, Belgium, Croatia, Germany, Ireland, Poland and Spain, for example, have introduced a plethora of measures aimed to encourage partnerships between academia and industry while other countries report fewer[169].

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

[164] European Commission, ERA Website: Available at: http://ec.europa.eu/research/era/understanding/what/era_in_the_knowledge_triangle_en.htm
[165] European Commission (2010a)
[166] Ibid
[167] European Commission (2008b)
[168] For a detailed presentation of the countries' measures, see also Annex IV "Measures supporting education and training" in this report.
[169] For a full overview of countries' measures aimed to encourage collaboration between academia and industry, see Annex IV "Measures supporting education and training" in this report.

Outline

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

6.3 Collaboration between academia and non-academia – Key indicators

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

Table 19: Collaboration between academia and industry - Key indicators

Indicators	Data source(s)
Work placement or internship in the non-academic sector during PhD (per country of PhD), Europe, 2012 (%)	MORE2 study
Post-PhD researchers indicating inter-sectoral mobility > 3 months in private industry, Europe, 2012 (%)	MORE2 study
Motives for private sector employment, EU-27, 2012 (%)	MORE2 study
Public-private co-publications between two or more sectors (universities, research institutes, industry) per million population, EU-27, China, Japan and US, 2003 and 2008	Science Metrix/Scopus
Public-private co-publications between two or more sectors (universities, research institutes, industry) per million population, EU-27, 2008 and 2011	CWTS/Thomson Reuters

6.4 Collaboration between academia and non-academia

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

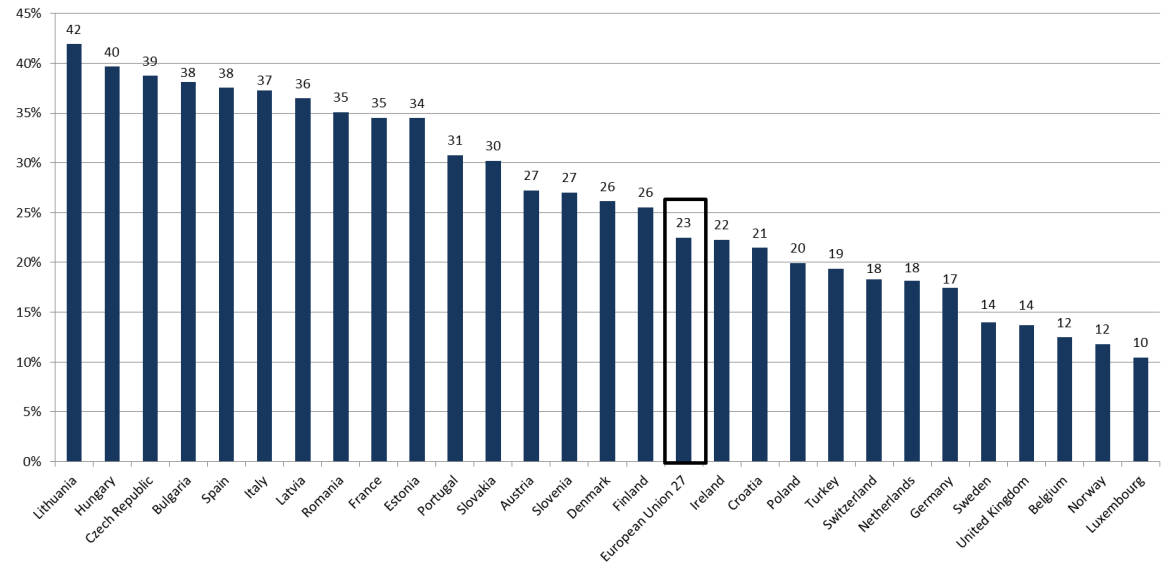
In a recent large-scale survey[170], 23% of researchers[171] indicated that they had been mobile to a sector outside of academia, in- or outside their country. This was made up of 4% in private industry, 9% in the private not-for-profit sector and 10% in the public or government sector. Overall, the highest proportion of researchers who have had a work placement or internship in the non-academic sector during their PhD (>35%) was in a number of new EU Member States (in descending order): Lithuania (42%), Hungary (40%), the Czech Republic (39%), Bulgaria (38%) and Latvia (36%). The lowest numbers (<15%) were reported in some of the older Member States (in descending order): Sweden (14%), UK (14%), Belgium (12%) and Luxembourg (10%). Eastern and Southern European countries thus have relatively high levels of inter-sectoral mobility. One explanation could

[170] Idea Consult (2013)

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

be the interpretation of the terminology 'work placement', e.g. as 'work' and, in particular, as to whether the work in non-academia was actually part of the PhD[172].

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



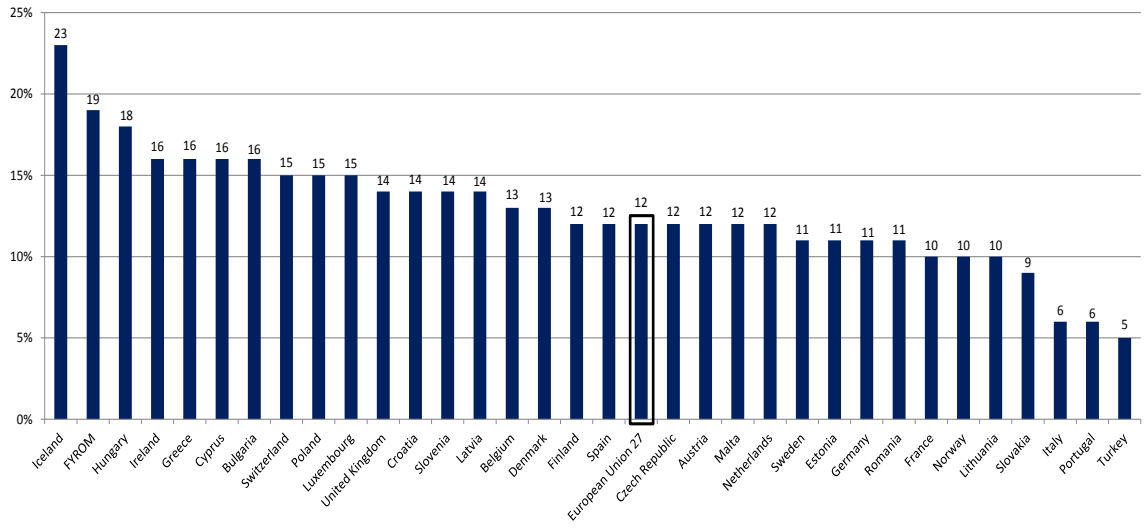
Source: Deloitte
Data: MORE2 study "Support for continued data collection and analysis concerning mobility patterns and career paths of researchers", IDEA Consult (2013)
*No information available for BiH, CY, EL, FI, FYROM, IL, IS, LI, ME and SR
**The data are presented for PhD candidates and R2 PhD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

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

The MORE2 study[173] found that 30% of the EU-27 post-PhD researcher population has at some time been active in another sector for a period of more than three months. The share of researchers indicating a period of inter-sectoral mobility of more than three months in private industry was 12% on average for the EU-27. It was highest (>15%) in Iceland (23%), FYROM (19%), Hungary (18%), Ireland, Greece, Cyprus and Bulgaria (all at 16%). The figures were lowest (<10%) in Slovakia (9%), Italy (6%), Portugal (6%) and Turkey (5%).

[172] Idea Consult (2013)
[173] Idea Consult (2013)

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



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

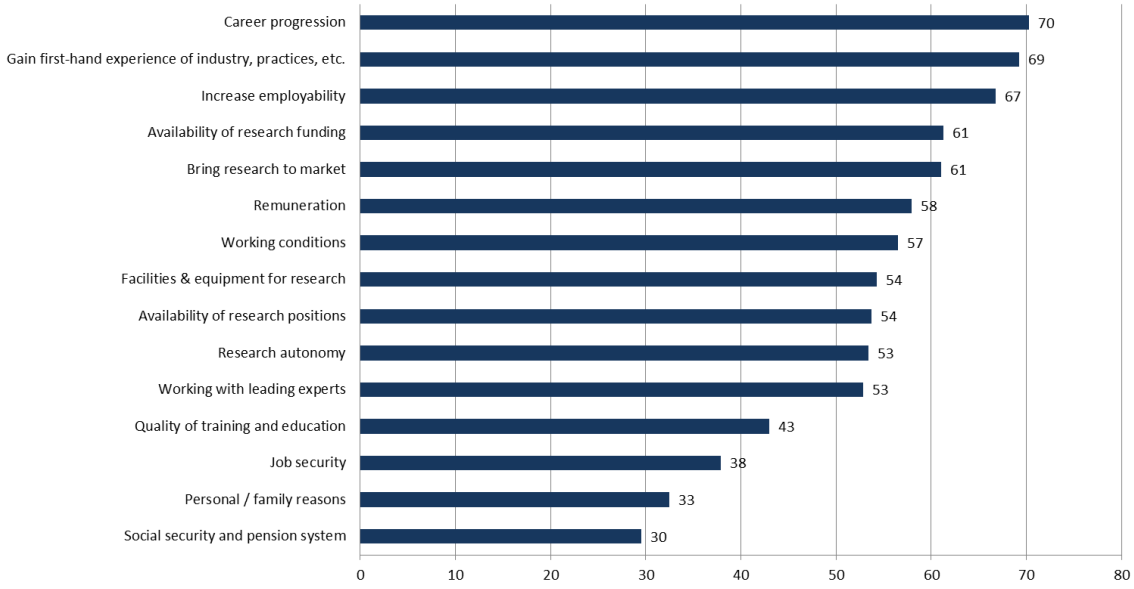
The most important motives for private sector employment are career progression, the possibility of being able to gain experience, increased employability, availability of research funding and being able to bring research to the market.

The MORE2 study[174] also looked at researchers' motives for taking up employment in the private sector. The most important factors motivating researchers to become mobile (>60%) in descending order are: career progression (70%), gaining first-hand experience in industry (69%), increasing employability (67%), availability of research funding (61%) and bringing research to the market (61%). This matches the motives for international mobility, where career progression and working with leading experts are considered most important[175].

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

[174] Ibid
[175] Ibid

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



Source: Deloitte

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

6.5 Public-private co-publications between different sectors

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

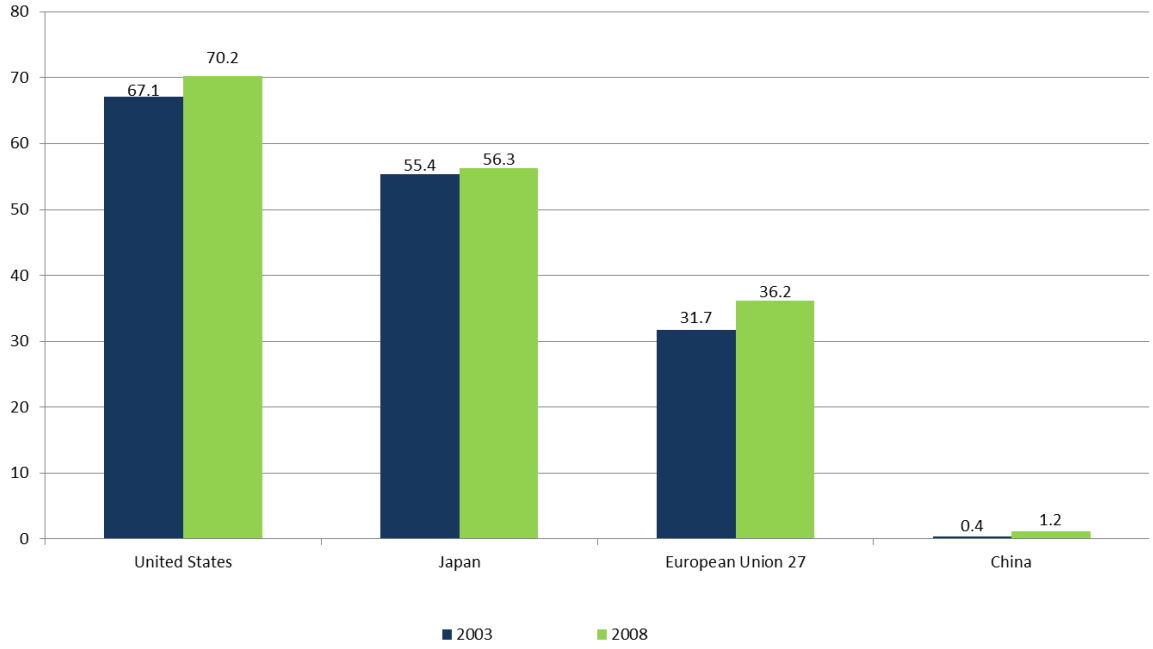
The number of public-private co-publications between different sectors (universities, research institutes, industry) per million population provides an indication of the degree of collaboration between academia and industry. In 2008, the figures for the US were 70.2, followed by Japan (56.3), EU-27 (36.2) and China (1.2).

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

"One factor behind the lower public-private scientific cooperation in the EU could be that in general universities and PROs are not the main cooperation partners for innovative firms, except in Finland, Austria and Belgium. Another reason may be the lower size and intensity of researchers in the

private sector in Europe, given that public-private cooperation to a large extent is made by people"[176].

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



Source: Deloitte
Data: Science Metrix/Scopus

[176] European Commission (2011b)

7. Mobility and international attractiveness

7.1 Mobility and international attractiveness – Highlights

Mobility of researchers in Europe[177]:

- Just under one in three EU researchers (31%) have been 'internationally mobile' for at least three months in the last 10 years (2012 data);
- Around one in two EU researchers (48%) have been 'internationally mobile' for at least three months in the last 10 years or more than 10 years ago (2012 data);
- The ratio of male researchers having spent a period of at least three months as a researcher in another country in the last ten years (34%) is higher than for women researchers (25%);
- 'EURAXESS – Researchers in motion' continues to provide access to a complete range of information and support services for researchers wishing to pursue their research careers in Europe[178];
- See also the impact of mobility on a researcher's career (Chapter 5 – "Working conditions").

Mobility of doctoral candidates:

- EU-wide, there were around 735 000[179] doctoral candidates in 2010: 72% were EU-27 nationals studying in their own country, while 8% were EU-27 nationals studying in another EU-27 country. The remaining 20% are from outside the EU. The highest number of foreign (non-EU) doctoral candidates in the EU-27 came from China (2010);
- The proportion of non-national researchers serves as a useful indicator of the degree of openness of national recruitment systems. France (35%) and the UK (31%) have a relatively high proportion of non-EU doctoral candidates as a percentage of all doctoral candidates[180];
- Compared to the EU-27 average (8%), Austria (18%) is the EU-27 country where the highest proportion of doctoral students from other EU-27 countries are to be found , followed by the UK (16%) and Ireland (16%). Member States with the lowest relative inflows of doctoral candidates from other EU countries are some of the new Member States, and Italy and Portugal.

Factors influencing and motivations for mobility[181]:

- The most important factors influencing researchers' mobility are 'career progression', 'leading experts', 'available funds', 'facilities & equipment', 'available positions' and 'quality of training;
- 'Personal/family reasons' as well as problems associated with 'obtaining funding' for mobility or research, 'logistical issues' and 'finding a suitable position' are the top barriers hampering researchers' mobility;
- The European Commission has proposed a recast[182] of the Scientific Visa Directive that will set clearer time limits for national authorities to decide on applications, provide researchers with

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

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

[179] Source: Eurostat data. Germany estimates its number of doctoral candidates at 200 400 for 2011. This number was integrated in the 2010 total. However, no breakdown by citizenship is available for Germany so the following percentages are based on the EU total without Germany.

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

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

[182] European Commission (2013e)

greater opportunities to access the labour market during their stay, and facilitate mobility within the EU. The proposed Directive is under negotiation bythe European Parliament and Council.

Countries' measures to remove the remaining barriers to mobility:

- European countries have put various measures in place to remove obstacles to researchers' mobility. These include reforms in the university and higher education sectors linked to the Bologna process. In addition, many countries have introduced national mobility schemes to boost different 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. The KOLUMB Programme (Poland), for example, awards fellowships to the best young scholars to enable them to stay (from 6-12 months) at the world's leading research centres;
- Non-financial incentives include measures promoting 'dual careers'[183], 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 geographic area, and assists them with accommodation and childcare;
- Some countries provide tax incentives to facilitate researchers' mobility in Europe while others offer special visas to attract researchers to engage in research or teach at university level. France, for example, offers special visas to attract researchers to engage in research or teach at university level. Public and private institutions of higher education and research organisations may use the "VLS-TS visa" (Extended-stay research scholar visa) to bring doctoral candidates, research scholars and research faculty to France to perform research or teach at university level.

Attractiveness of public research institutions:

- In 2010, the EU-27 was second in the production of international scientific co-publications behind the United States;
- The EU-27 lagged behind the US in terms of scientific publications in the top 10% most-cited publications worldwide (2008). The indicator is a proxy for the excellence of the research system as highly cited publications are assumed to be of higher quality;
- The number of scientific co-publications provides insight into cooperation between researchers from different countries. European researchers co-publish mainly with colleagues from other European countries (85-95%) and with at least one author from a country outside the EU. Within Europe, researchers from most countries collaborate intensively with colleagues from large countries in particular (i.e. Germany, France, Italy and the UK);
- 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.

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

7.2 Introduction

As previously stated, mobility is a core concept of the ERA. This in turn is fundamental to the EU's Growth and Jobs Strategy [184]and Vision for 2020[185], which aim to improve the dynamism and competitiveness of the EU economy. According to the European Commission, "the benefits of mobility across institutions, disciplines, countries and sectors are becoming increasingly recognised"[186].

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)[187]. In addition, a distinction can be made between long-term mobility (to another country for the duration of several months or years) and short-term mobility (visits or project-related activities). Mobility also includes moving to another country to change jobs or being mobile with the same employer for short- or long-term. Moreover, there are increasingly new forms of mobility such as combined part-time positions, interdisciplinary mobility and virtual mobility[188].

There are many factors affecting each individual researcher's motivation, and the likelihood and duration of becoming and/or remaining mobile. Researcher mobility (inward, outward and cross-sectoral) depends largely on a (combination of): open, transparent and merit-based recruitment[189], portability of publicly funded grants[190], transparent transfer conditions, clear immigration rules and procedures, attractive employment and working conditions[191] – including career prospects with long-term employment opportunities, competitive salaries, sufficient social security benefits (including statutory pension rights, health care and unemployment benefits), and the possibility of balancing personal and private life.

During the last decade, the European Commission, in cooperation with Member States, has initiated a wide range of initiatives to facilitate researchers' mobility. These include measures to facilitate access to information on mobility (via the EURAXESS portals[192]), a "Scientific Visa" package[193] 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[194] to improve researchers' rights across Europe (the Charter &

[184] European Commission (2010a)
[185] Council of the European Union (2008a)
[186] Ibid
[187] For more information on collaboration between academia and industry, see chapter "Collaboration between academia and industry" in this report.
[188] European Science Foundation (2013)
[189] 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.
[190] 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
[191] Attractive employment and working conditions and career prospects are a prerequisite for attracting the most talented researchers in Europe and facilitating researchers' mobility For a detailed discussion on researchers' working conditions in European countries, see chapter "Working conditions in the research profession" in this report.
[192] EURAXESS Researchers in Motion. Available at: http://ec.europa.eu/euraxess/
[193] 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
[194] European Commission (2005a)

Code), a "European Partnership for Researchers"[195] to create a genuine labour market for researchers and the Europe 2020 "Innovation Union"[196] initiative to remove obstacles to researchers' mobility.

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

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

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

Fast-track immigration is an important consideration for internationally mobile researchers and is thus an important factor in helping attract the best global talent to Europe. Ireland[197] has been successfully operating the Scientific Visa for non-EU researchers since 2007. A recent survey of researchers who had used the fast track scheme in revealed that 23% of them would definitely not have come to Ireland if the scheme were not in place.

In March 2013, the Commission proposed a recast[198] of the Scientific Visa Directive that will set clearer time limits for national authorities to decide on applications, provide researchers with greater opportunities to access the labour market during their stay, and facilitate mobility within the EU. The proposed Directive is under negotiation bythe European Parliament and Council.

Outline

This chapter presents the most recent data on researchers' mobility and international attractiveness. First, it offers an overview of the key indicators for monitoring researchers' mobility. Second, it presents the most recent figures on researchers' mobility (inward, outward and cross-sectoral). Third, it presents information on different factors influencing researchers' mobility. Fourth, it presents statistics on scientific publications and co-publications, which serve as an indicator for cooperation between researchers in different countries. Fifth, the chapter presents information on

[195] European Commission (2008b)
[196] European Commission (2010b)
[197] The scheme, which is free of charge and open to universities and companies, is operated by the EURAXESS Ireland office based in the Irish Universities Association and supported by the government Department of Jobs, Enterprise and Innovation.
[198] European Commission (2013e)

the attractiveness of European countries and institutions by means of a number of useful indicators. Sixth, it provides an overview of the countries' measures to remove the remaining barriers to researchers' mobility.

7.3 Mobility and international attractiveness – Key indicators

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

Table 20: Mobility and international attractiveness - Key indicators

Indicators	Data source(s)
Foreign (non-EU) doctoral candidates (ISCED 6) in the EU-27 by the top 30 countries of origin, 2010	UNESCO OECD Eurostat education survey
Non-EU doctoral candidates as a percentage of all doctoral candidates, Europe, 2010	Innovation Union Scoreboard database 2013
Doctoral candidates (ISCED 6) with a citizenship of another EU-27 Member State, Europe, 2008 and 2010 (%)	EUROSTAT OECD UNESCO survey
Researchers (post-PhD) having spent a period of at least three months as researchers in another country in the last 10 years, Europe, 2012 (%)	MORE2 study
Differences in gender of researchers (post-PhD) having spent a period of at least three months as researchers in another country in the last 10 years, Europe, 2012 (%)	MORE2 study
Factors motivating EU researchers (post-PhD) to spend a period of at least three months as researchers in another country in the last 10 years, EU-27, 2012	MORE2 study
Factors motivating European researchers (post-PhD) to spend a period of at least three months as researchers in another country in the last 10 years, by career stages, EU-27, 2012	MORE2 study
Importance of barriers as reasons for international non-mobility in post-PhD career, EU-27, 2012 (%)	MORE2 study
International scientific co-publications per million population, Europe, US, Japan and China, 2011	Science Metrix/ Scopus/IUS
Scientific publications in the top 10% most-cited publications worldwide as a percentage of all scientific publications, Europe, US, Japan and China, 2008	Science Metrix/Scopus /IUS
Main producers of scientific publications, EU, 2000 and 2008	Innovation Union Competitiveness Report 2011[199]
Co-publications with an author from another EU-27 Member State by five main partners in Europe, other countries, 2010 (%)	Science Metrix/Scopus
Most active research universities by normalised citation impact ('Leiden Ranking'), Europe, 1997-2006	Innovation Union Competitiveness Report 2011

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

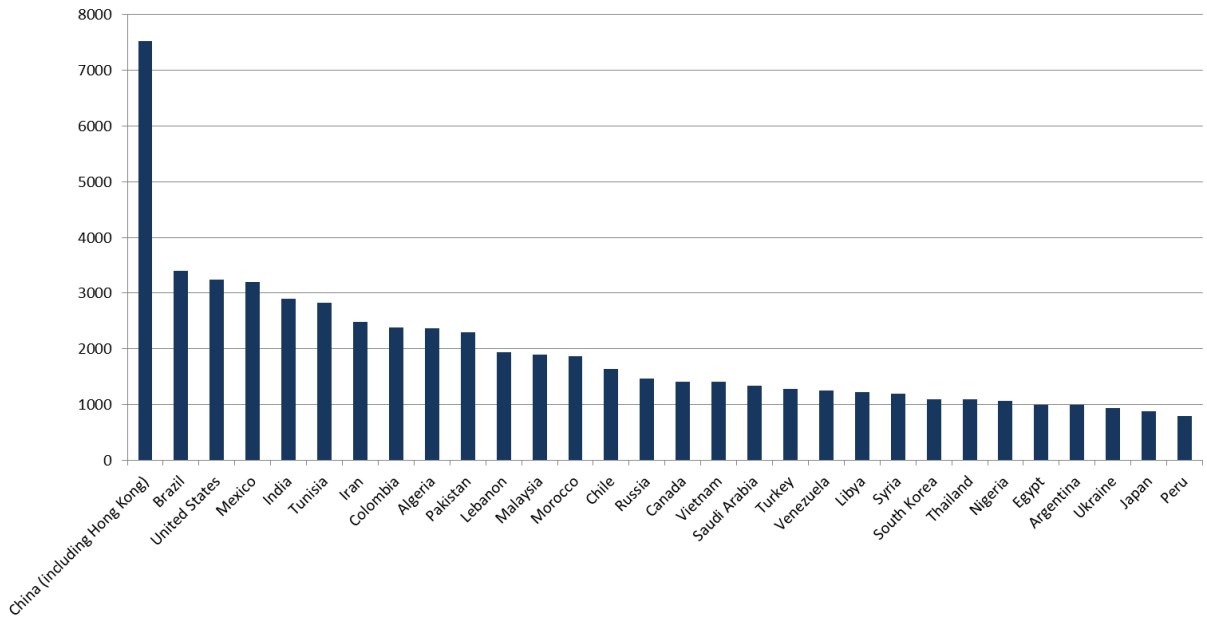
In 2010, the highest number of foreign (non-EU) doctoral candidates in the EU-27 came from China.

According to 2010 data, the most important country of origin of non-EU doctoral candidates was China with 7 523 doctoral candidates, followed by Brazil (3 400), the United States (3 243) and

[199] European Commission (2011a)

Mexico (3 206). Between 2 000 and 3 000 doctoral candidates came (in descending order) from India, Tunisia, Iran, Colombia, Algeria and Pakistan each, while fewer than 1 000 non-EU doctoral students came from (in descending order) Egypt, Argentina, Ukraine, Japan and Peru.

Figure 35: Foreign (non-EU) doctoral candidates (ISCED 6) in the EU-27 by the top 30 countries of origin, 2010



Source: Deloitte
Data: UNESCO OECD Eurostat education survey

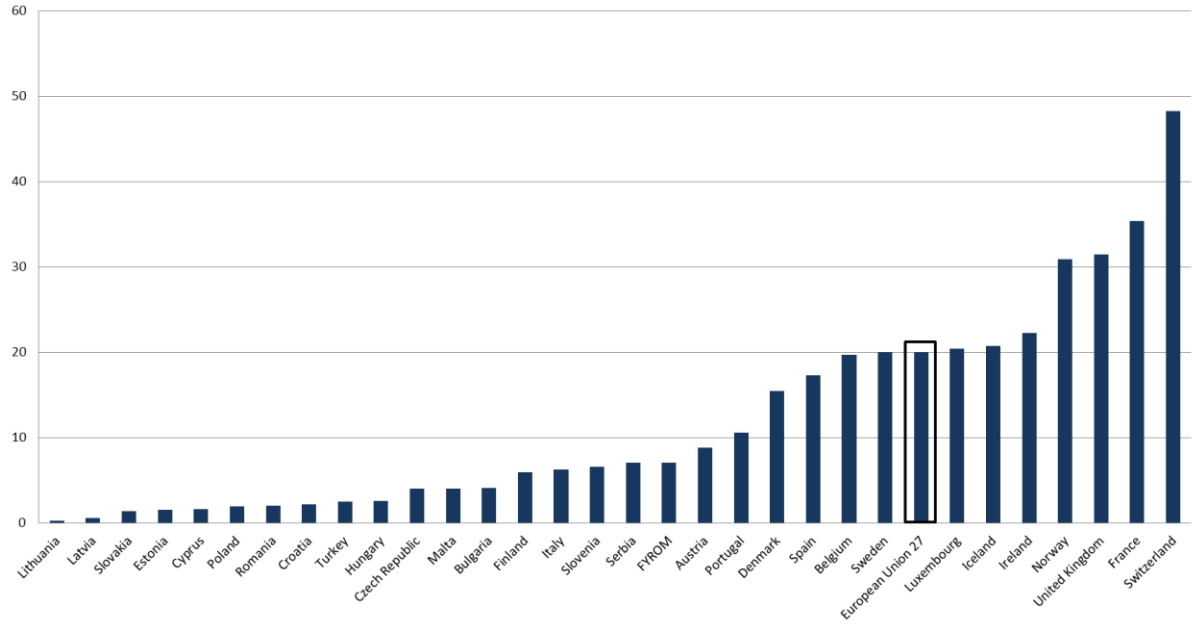
The share of non-EU doctoral candidates[200] as a percentage of all doctoral candidates serves as a useful indicator of the openness and attractiveness of a research system. The average share for the EU-27 is 20%. Those above the EU-27 average are Ireland (22.3%), the UK (31.4%) and France (35.4%).

The share of non-EU doctoral candidates serves as an indication of the openness and attractiveness of the research system. The average share of non-EU doctoral candidates is 20%.

In France and the UK the share of non-EU doctoral candidates is between 30% and 35%. The proportion of foreign doctoral candidates is even higher in Switzerland — almost half, and it is above 30% in Norway, but this includes those from EU countries. In addition to the cases of France and the UK, there is a relatively high share (10-20%)) of non-EU doctoral candidates in a number of other older Member States, e.g. Belgium (19.7%), Spain (17.3%), Denmark (15.4%) and Portugal (10.6%) 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 4.1% in Bulgaria to 0.2% in Lithuania.

Figure 36: Non-EU doctoral candidates as a percentage of all doctoral candidates, Europe, 2010

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



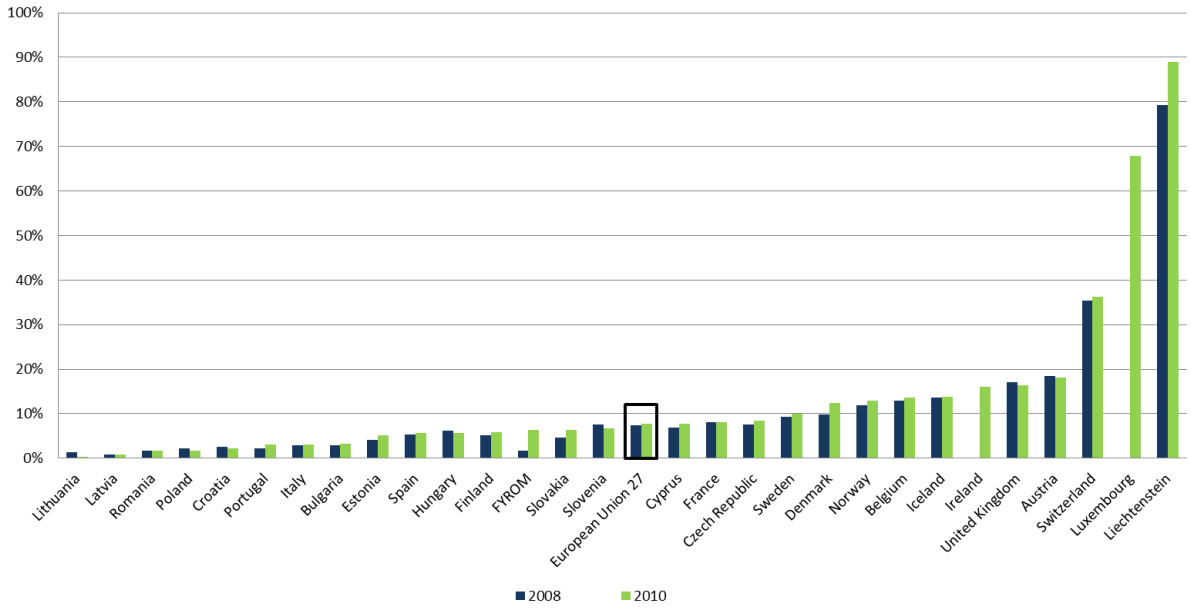
Source: Deloitte
Data: Innovation Union Scoreboard 2013[201]
*No information available for BiH, DE, FI, IL, LI, ME and NL

Compared to the EU-27 average (7.8%), Austria (18.2%) is the EU-27 country where the highest proportion of doctoral students from other EU-27 countries are to be found, followed by the UK (16.4%) and Ireland (16%). Member States with the lowest relative inflows of doctoral candidates from other EU-27 countries are some of the new Member States, Italy and Portugal.

The highest level of doctoral candidates with citizenship of another EU-27 Member State in 2010 (>10%) was in a number of the older Member States, e.g. Austria (18.2%), the UK (16.4%), Ireland (16%), Belgium (13.6%) and Denmark (12.4%). In terms of absolute numbers, the UK is the first choice, followed by France and Spain, but it should be noted that there are no figures available for Germany. The lowest share (<5%) was in a number of the new Member States, ranging from 3.3% in Bulgaria to 0.3% in Lithuania.

[201] European Commission (2013a)

Figure 37: Doctoral candidates (ISCED 6) with a citizenship of another EU-27 Member State, Europe, 2008 and 2010 (%)



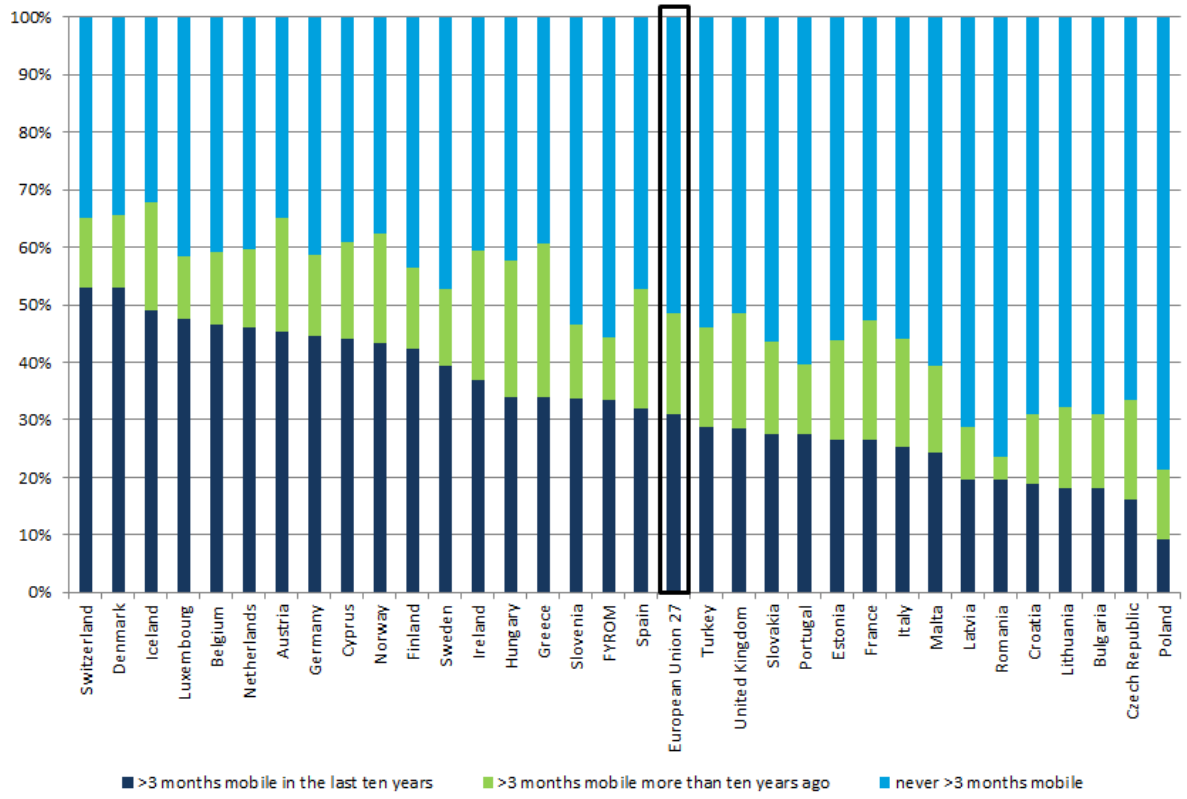
Source: Deloitte
Data: EUROSTAT OECD UNESCO survey
*No information available for BiH, DE, EL, FI, IL, ME, MT, NL and SR

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

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

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

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



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

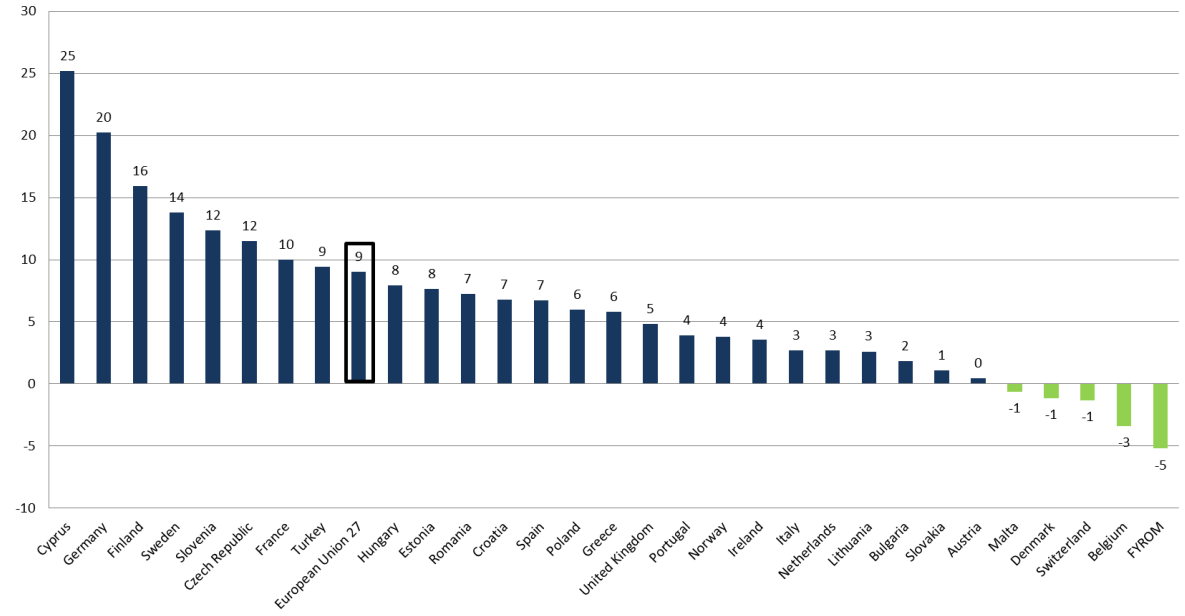
The ratio of male researchers having spent a period of at least three months as a researcher in the last ten years in another country (34%) is higher than for women researchers (25%).

The MORE2 study[202] revealed a difference between mobility patterns when looking at the proportion of female and male researchers. The ratio of male researchers indicating that they have spent a period of at least three months as a researcher in another country in the last ten years was higher (34%) than that of women (25%). While this holds true across all scientific domains, the difference was slightly greater in the social sciences and humanities (35% compared to 24%).

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

[202] Idea Consult (2013)

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



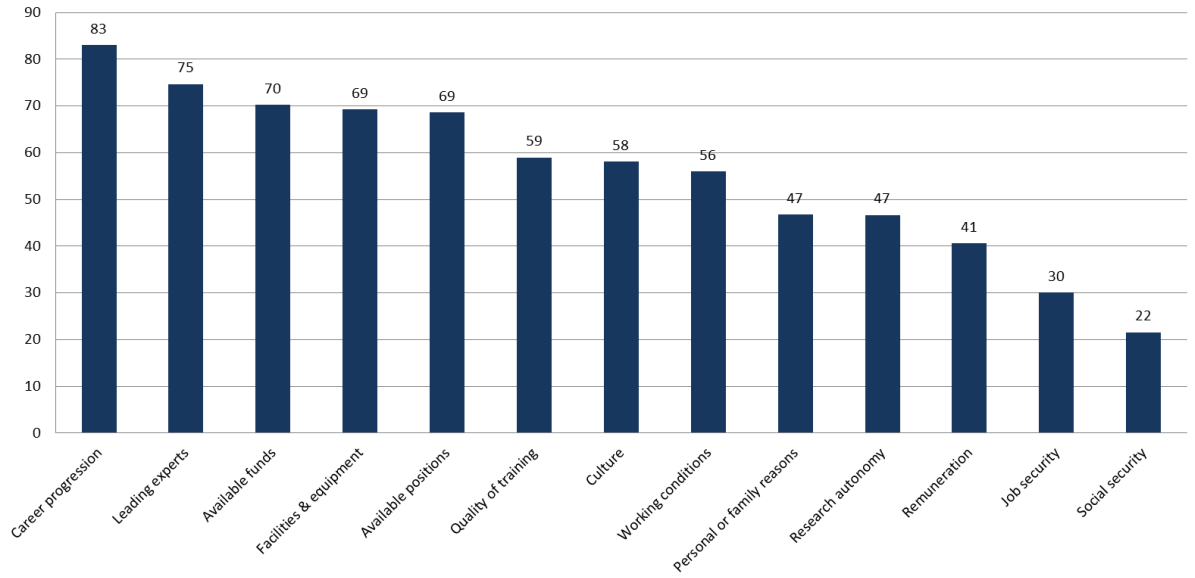
Source: Deloitte
Data: MORE2 study "Support for continued data collection and analysis concerning mobility patterns and career paths of researchers", IDEA Consult (2013)
*No information available for BiH, IL, IS, LI, LU, LV, ME and SR

7.6 Factors influencing and motivations for mobility

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

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

Figure 40: Factors motivating EU researchers (post-PhD) to spend a period of at least three months as researchers in another country in the last 10 years, EU-27, 2012 (average scores) (%)



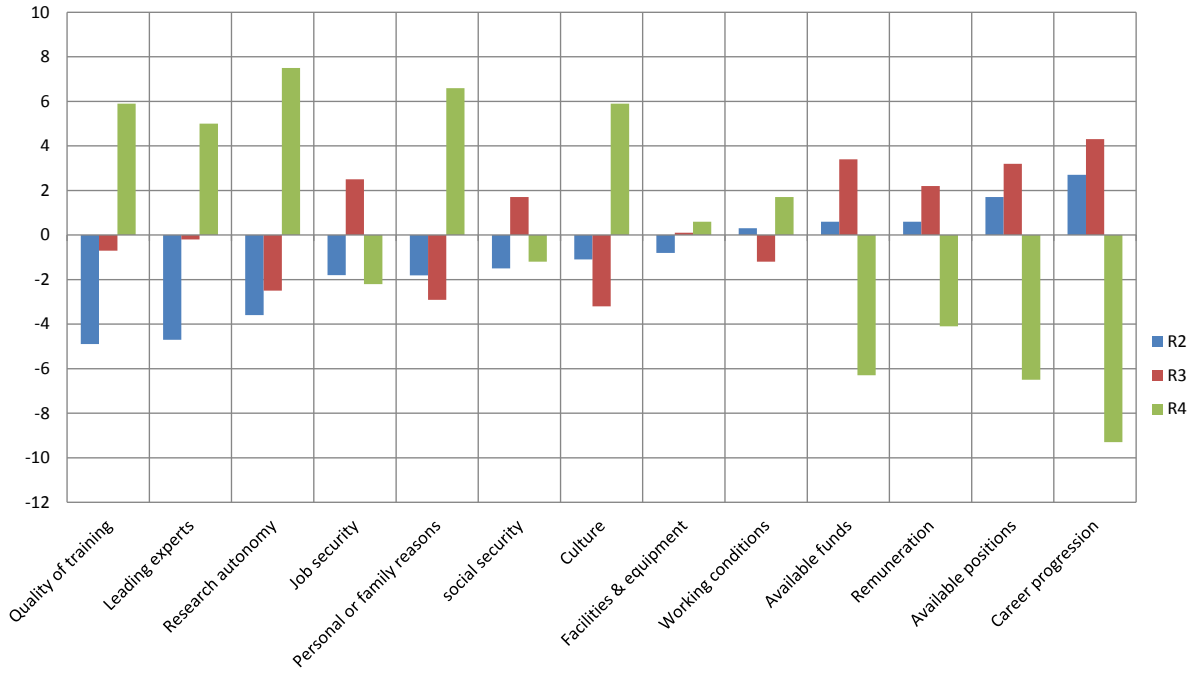
Source: Deloitte
Data: MORE2 study "Support for continued data collection and analysis concerning mobility patterns and career paths of researchers", IDEA Consult (2013)

The degree of importance of motives for becoming mobile show remarkable differences when comparing the different career stages (R4, R3 and R2). For established researchers (R4), research autonomy, personal and family reasons, the quality of training and culture stand out as the most important factors for becoming mobile. Established researchers usually have a leading role in their research area or field and if a foreign position is available they are mostly attracted by the autonomy offered[203].

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

[203] Idea Consult (2013)

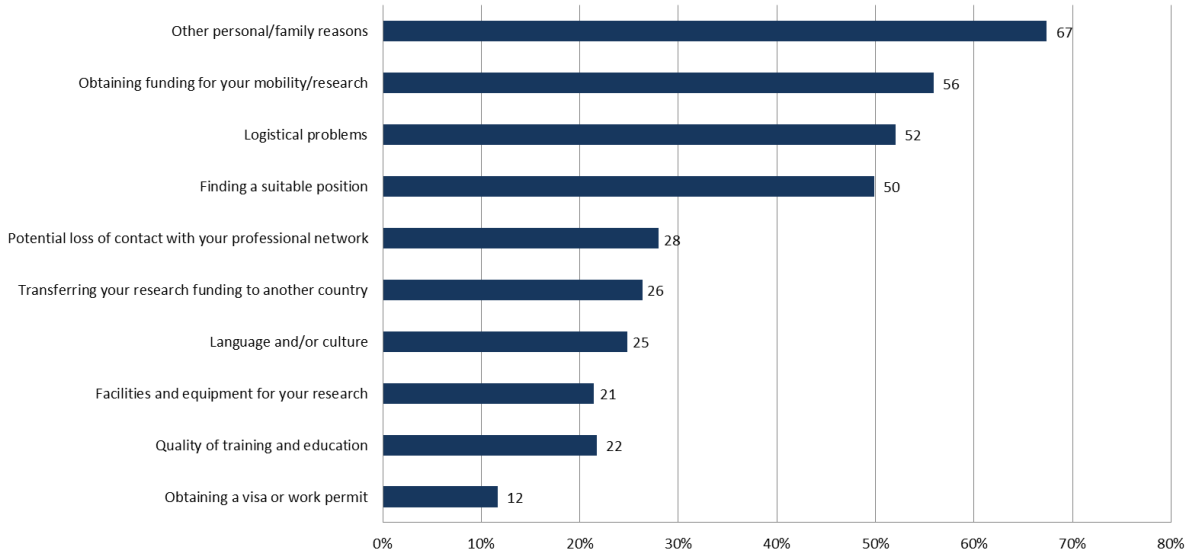
Figure 41: Factors motivating EU researchers (post-PhD) to spend a period of at least three months as researchers in another country in the last 10 years, EU-27, 2012 (%)



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

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

Figure 42: Importance of barriers as reasons for international non-mobility in post-PhD career, EU-27, 2012 (%)



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

7.7 Scientific co-publications with an author from another country

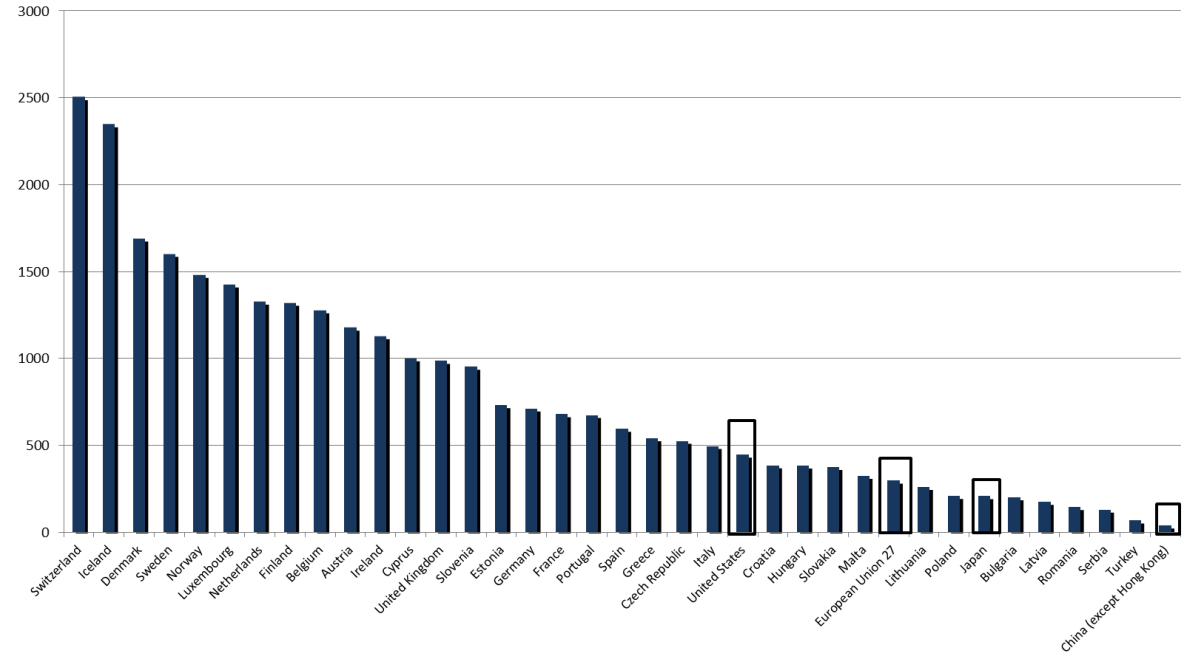
In 2011, the EU-27 was second to the United States in the production of international scientific co-publications.

In 2011, the EU-27 lagged behind the United States in terms of international scientific co-publications per million population[204]. The EU-27 average was around 300 co-publications per million population in comparison with around 450 in the United States, 211 in Japan and 43 in China. The EU-27 average should be seen in context: only co-publications with non-EU countries are included. This obviously creates a downward distortion. The level per Member State is higher than that for the US in a very large number of cases.

Switzerland and Iceland 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) and Luxembourg, the Netherlands, Belgium, Austria, Ireland and Cyprus 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 Hungary, Slovakia, Lithuania, Poland, Bulgaria, Latvia and Romania (in descending order).

[204] 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 43: International scientific co-publications per million population, Europe, US, Japan and China, 2011



Source: Deloitte
Data: Science Metrix/Scopus /IUS
*No information unavailable for BiH, FYROM, IL, LI and ME. The EU-27 average should be seen in context: only co-publications with non-EU countries are included. This obviously creates a downward distortion.

In 2008, 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.

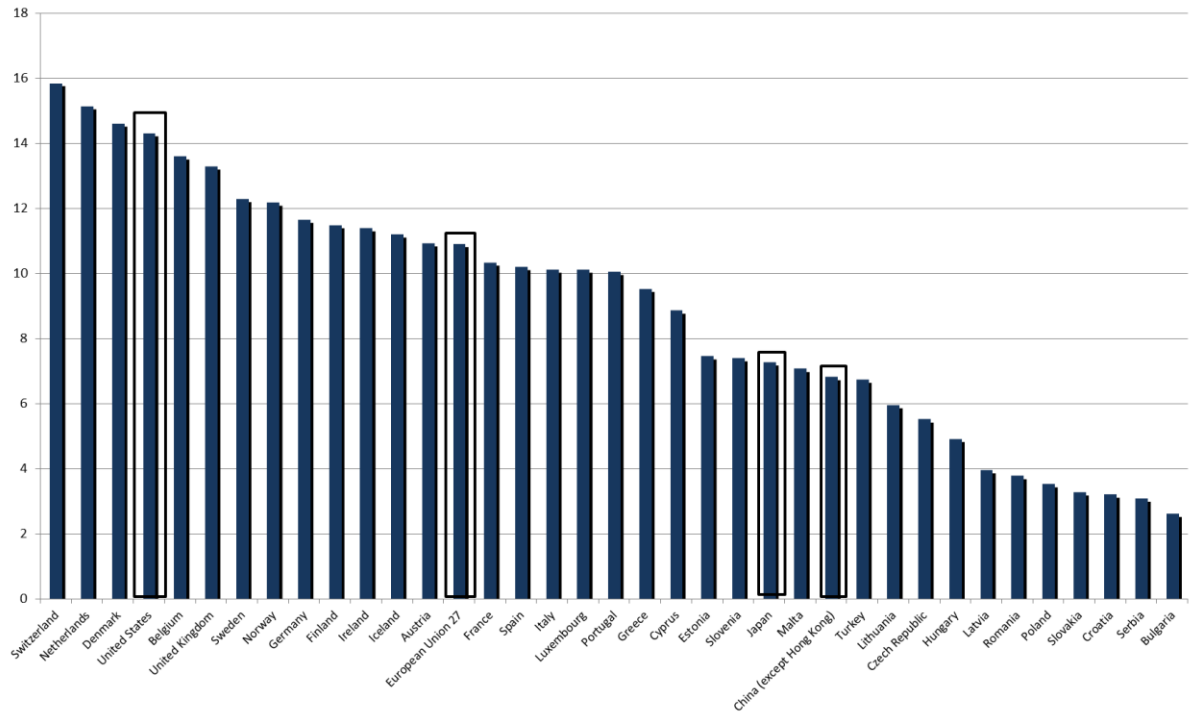
When it comes to the scientific quality of research worldwide, an indicator even more important than the sheer number of scientific co-publications is the capacity to produce scientific publications with high international impact. The number of citations that a scientific publication generates is an 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.

In 2008, 10.9% of EU-27 scientific publications were 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, Germany, Finland, Ireland, Austria, France, Spain, Italy, Luxembourg and Portugal. Countries like France and Germany, where researchers are more likely to publish more in their own language, are more likely to underperform on this indicator relative to their real academic excellence[205]. The share is lowest in Bulgaria followed by Croatia, Slovakia, Poland, Romania, Latvia and Hungary.

[205] European Commission (2011c)

Figure 44: Scientific publications in the top 10% most-cited publications worldwide as a percentage of all scientific publications, Europe, US, Japan and China, 2008 (%)



Source: Deloitte
Data: Science Metrix/Scopus/IUS
*No information unavailable for BiH, FYROM, IL, LI and ME

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

The table below presents the main EU-27 producers of scientific publications for 2000 and 2008, and the annual average growth (2000-2008). In 2008, the EU-27 Member States with the highest number of scientific publications were the UK (21.5% of all EU-27 publications), Germany (20.4%), France (15.0%), Italy (11.6%) and Spain (9.6%).

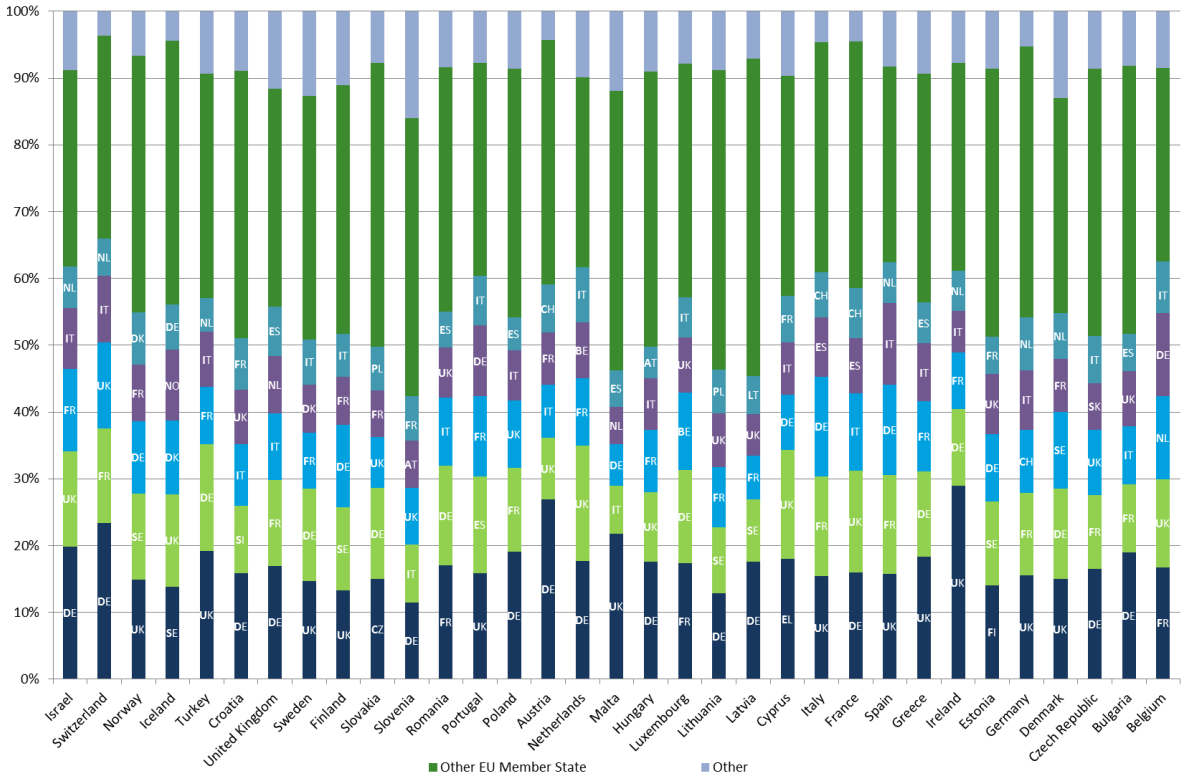
Table 21: Main producers of scientific publications, EU, 2000 and 2008

	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 2011

In 2008, EU-27 transnational co-publications represented 33.5% of all EU-27 publications, as opposed to 30.5% in 2003 (+9.8%). European researchers co-publish mainly with colleagues from other EU-27 countries (85-95%). Researchers from Germany, France, Italy, and the UK are the main partners for co-publications. This can largely be explained by their high research capacity as reflected in the comparatively large volume of scientific publications. Geographical proximity also plays a significant role: for instance, there is a clear preference for collaboration between Belgium and the Netherlands, the Czech Republic and Slovakia[206].

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



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

7.8 Removing the remaining barriers to researchers' mobility

The EU-27 Member States have put various measures in place to remove obstacles to researchers' mobility. These include reforms in the university and higher education sectors linked to the Bologna process. In addition, many countries have introduced national mobility schemes to boost different researchers' mobility (inward, outward and cross-sectoral). Many of these schemes promote inward mobility from both the EU and non-EU countries providing financial incentives for early stage researchers.

The APART Programme (Austria), for example, awards fellowships to national and international students in support of a post-doctoral thesis, or the continuation of a scientific project. In 2011, 25%

[206] European Commission (2011b)

of the fellows conducted research at universities or research institutions abroad. The percentage of foreign researchers among APART fellows in 2010-2012 was 18%.

The Momentum (*Lendület*) Young Investigator Programme of the Hungarian Academy of Sciences (Hungary) supports the re-integration of Hungarian researchers working abroad by providing personal allowances for two to three years for projects carried out in Hungary in the field of their speciality. The Programme invites researchers to take part in scientific/development programmes in Hungary. In 2012, approximately HUF 1.25 billion (some EUR 4.3 million) were granted to 37 Hungarian researchers under this programme.

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

The 'Mobility of Spanish university lecturers and researchers in foreign centres' Programme (Spain) offers senior researchers with permanent positions in a public research institution the opportunity to apply and spend three to twelve months at a foreign institution. Young researchers with a temporary or permanent contract in a public research institution can also apply for a four- to ten-month stay at a foreign institution. In 2012, the total budget was EUR 7.59 million.

The objective of the 'Brains (Back) to Brussels' Programme (BB2B) (Belgium), is to attract foreign researchers and Belgian researchers currently settled abroad. It offers two kinds of support, one for short-term research projects in a Brussels-based higher education institution and the other for long-term projects for researchers who ultimately plan to settle down in Brussels. While the first option is only accessible to highly qualified researchers, the second option is available to any researcher wishing to plan a career in Brussels. The host institution is therefore strongly involved in the measure and must commit itself to offer a long-lasting position to the researcher.

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

The Swiss Federal Equal Opportunity at Universities Programme initiated a Module 3 project in 2009 in order to build up dual career structures and measures at every Swiss university. It also established a fund for the support of incoming couples at professorial and postdoc level taking into consideration a gender equality aspect in the respective funding.

Some countries provide tax incentives to facilitate researchers' mobility in Europe. For example, under the 'Researcher Taxation Scheme' (Denmark), researchers and highly paid employees recruited abroad who are able to meet a number of conditions, and have not been a Danish tax resident in the previous 10 years can be employed at a special 26% tax rate for 60 months. In addition, in line with the circular on exemption from payment of pension contributions for certain

temporary employees in the State (Denmark), foreign academic staff recruited abroad and employed on a temporary contract can request that their total pension (both employer contribution and their own contribution) be paid as part of their salary during their employment. This arrangement can only be agreed upon for a period of up to five years (six years if this is agreed between the appointing authority and the organisations mandated to negotiate).

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

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9. Annex I: Data

9.1 "The stock of researchers in Europe"

Table 22: Researchers (Full Time Equivalent) per thousand labour force, EU-27, US, China, Japan, 2000, 2009 and 2010

Country	2000	2009	2010
China	0.95	1.45	1.91
Romania	1.79	1.94	1.99
Cyprus	0.98	2.16	2.18
Turkey	1.35	2.38	2.54
Bulgaria	2.82	3.43	3.23
Malta	1.36	2.86	3.39
Latvia	3.49	3.08	3.41
Croatia	3.28	3.60	3.64
Poland	3.19	3.55	3.67
Italy	2.81	4.08	4.14
Greece	2.85	4.48	4.59
Hungary	3.53	4.77	5.01
Switzerland	6.18	N/A	5.23
Lithuania	4.63	5.22	5.31
Czech Republic	2.70	5.44	5.55
Slovakia	3.85	4.95	5.62
Spain	4.36	5.81	5.83
Estonia	4.02	6.24	5.94
Netherlands	5.20	5.26	6.13
Ireland	4.82	6.61	6.59
European Union 27	**4.92**	**6.49**	**6.64**
Slovenia	4.49	7.15	7.40
Belgium	6.95	7.96	7.83
Germany	6.50	7.61	7.87
United Kingdom	5.90	8.19	8.18
Portugal	3.19	7.82	8.21
France	6.69	8.25	8.40
Austria	5.31	8.10	8.46
United States	**9.00**	**9.40**	**9.51**
Sweden	11.29	9.57	9.94
Norway	7.59	10.18	10.20
Japan	**9.57**	**9.91**	**10.27**
Luxembourg	8.86	10.47	11.40
Denmark	6.71	12.48	12.86
Finland	15.41	15.25	15.51
Iceland	10.52	15.97	15.52
Former Yugoslav Republic of Macedonia	N/A	N/A	N/A

Source: Deloitte
Data: Eurostat

Table 23: Researchers in the business sector (Full Time Equivalent) per thousand labour force, Europe, 2000, 2009 and 2010

Country	2000	2009	2010
Bulgaria	0.34	0.49	0.45
Cyprus	0.25	0.52	0.48
Latvia	0.91	0.27	0.55
Romania	1.11	0.62	0.59
Croatia	0.40	0.67	0.66
Poland	0.57	0.57	0.67
Slovakia	0.94	0.61	0.71
Lithuania	0.17	0.68	0.77
Turkey	0.22	0.86	1.00
Greece	0.70	1.26	1.28
Italy	1.11	1.53	1.53
Estonia	0.41	1.90	1.87
Portugal	0.45	1.80	1.88
Malta	0.01	1.48	1.93
Spain	1.19	2.00	1.97
Switzerland	3.85	2.17	2.15
Czech Republic	1.08	2.40	2.40
Hungary	0.95	2.13	2.41
United Kingdom	2.96	2.70	2.68
European Union 27	**2.27**	**2.91**	**2.98**
Netherlands	2.47	2.29	3.04
Slovenia	1.43	3.15	3.25
Belgium	3.80	3.72	3.48
Ireland	3.19	3.52	3.67
Germany	3.86	4.39	4.46
Norway	4.25	4.91	4.82
France	3.15	4.71	4.90
Austria	3.54	5.04	5.27
Sweden	6.85	5.93	6.13
Luxembourg	7.53	5.99	6.31
Iceland	5.39	6.28	6.44
Denmark	3.85	7.97	7.85
Finland	8.65	8.82	8.57

Source: Deloitte
Data: Eurostat

Table 24: Researchers in the public sector (Full Time Equivalent) per thousand labour force, Europe, 2000, 2009 and 2010

Country	2000	2009	2010
Romania	0.68	1.32	1.39
Malta	1.44	1.38	1.46
Cyprus	0.67	1.46	1.52
Turkey	1.13	1.51	1.54

Country	2000	2009	2010
Italy	1.70	2.39	2.44
Hungary	2.57	2.64	2.60
Bulgaria	2.47	2.92	2.75
Latvia	2.58	2.81	2.85
Ireland	1.63	3.09	2.93
Croatia	2.89	2.93	2.98
Poland	2.62	2.98	3.00
Netherlands	2.65	2.97	3.10
Czech Republic	1.60	3.02	3.11
Austria	1.77	2.99	3.13
Greece	2.06	3.18	3.27
France	3.41	3.43	3.40
Germany	2.64	3.21	3.41
European Union 27	**2.61**	**3.50**	**3.58**
Switzerland	2.33	3.37	3.60
Sweden	4.38	3.62	3.80
Spain	3.11	3.79	3.85
Estonia	3.57	4.21	3.97
Slovenia	2.94	3.98	4.13
Belgium	3.09	4.18	4.29
Lithuania	4.46	4.54	4.55
Slovakia	2.92	4.33	4.88
Denmark	3.33	4.45	4.94
Luxembourg	1.33	4.48	5.08
Portugal	2.31	5.37	5.51
United Kingdom	2.82	5.33	5.37
Norway	3.34	5.27	5.38
Finland	5.60	6.28	6.77
Iceland	4.83	9.33	8.72
Former Yugoslav Republic of Macedonia, the	N/A	N/A	N/A

Source: Deloitte
Data: Eurostat

9.2 "Women in the research profession"

Data for the chapter on "Women in the research profession" are largely based on the 2012 'SHE Figures' report[207].

9.3 "Education and training"

Table 25: Population aged 30-34 having completed tertiary education, Europe, 2000, 2010 and 2011 (%)

Country	2000	2010	2011
Turkey	N/A	15.5	16.3
Italy	11.6	19.8	20.3

[207] European Commission (2013b)

Country	2000	2010	2011
Former Yugoslav Republic of Macedonia, the	N/A	17.1	20.4
Romania	8.9	18.1	20.4
Malta	7.4	21.5	21.1
Slovakia	10.6	22.1	23.4
Czech Republic	13.7	20.4	23.8
Austria	N/A	23.5	23.8
Croatia	N/A	24.3	24.5
Portugal	11.3	23.5	26.1
Bulgaria	19.5	27.7	27.3
Hungary	14.8	25.7	28.1
Greece	25.4	28.4	28.9
Germany	25.7	29.8	30.7
European Union 27	**22.4**	**33.5**	**34.6**
Latvia	18.6	32.3	35.9
Poland	12.5	35.3	36.9
Slovenia	18.5	34.8	37.9
Estonia	30.8	40	40.3
Spain	29.2	40.6	40.6
Netherlands	26.5	41.4	41.1
Denmark	32.1	41.2	41.2
Belgium	35.2	44.4	42.6
France	27.4	43.5	43.3
Switzerland	27.3	44.2	43.8
Iceland	32.6	40.9	44.6
United Kingdom	29	43	45.8
Lithuania	42.6	43.8	45.8
Finland	40.3	45.7	46
Cyprus	31.1	45.3	46.2
Sweden	31.8	45.8	47.4
Norway	37.3	47.3	48.8
Ireland	27.5	49.9	49.7

Source: Deloitte
Data: Eurostat Labour Force population survey / IUS

Table 26: Tertiary graduates in Science, Technology, Engineering and Mathematics (STEM) studies (ISCED 5 & 6) per thousand population aged 20-29, Europe, US and Japan, 2000, 2009 and 2010

Country	2000	2009	2010
Luxembourg	1.8	N/A	3.1
Cyprus	3.4	4.6	5.1
Former Yugoslav Republic of Macedonia, the	3.7	7.0	6.4
Malta	3.4	7.0	8.0
Hungary	4.5	7.5	8.3
Liechtenstein	N/A	7.0	8.4
Turkey	4.4	8.0	9.1

Country	2000	2009	2010
Netherlands	5.8	8.9	9.2
Norway	7.9	9.0	9.9
Italy	5.7	10.8	10.4
Latvia	7.4	9.8	10.7
United States	**9.7**	**10.3**	**10.7**
Estonia	7.8	10.8	11.3
Bulgaria	6.6	10.1	11.4
Croatia	N/A	12.8	11.6
Belgium	9.7	12.0	12.2
European Union 27	**10.1**	**14.4**	**12.5**
Greece	N/A	N/A	12.8
Iceland	8.4	10.3	13.6
Japan	**12.6**	**14.2**	**13.8**
Spain	9.9	12.5	13.9
Sweden	11.6	13.0	14.0
Portugal	6.3	14.6	14.4
Slovenia	8.9	11.3	14.8
Germany	8.2	13.5	14.8
Austria	7.2	14.0	15.5
Romania	4.5	20.0	15.6
Poland	6.6	14.3	15.8
Czech Republic	5.5	15.3	16.5
Denmark	11.7	15.2	16.5
Switzerland	N/A	18.1	17.2
Slovakia	5.3	17.5	18.3
United Kingdom	18.5	17.5	18.7
Lithuania	13.5	18.5	18.7
Ireland	24.2	17.2	20.1
France	19.6	20.4	20.1
Finland	16.0	19.0	24.2

Source: Deloitte

Table 27: Women tertiary graduates in Science, Technology, Engineering and Mathematics (STEM) studies (ISCED 5 & 6) per thousand women aged 20-29, Europe, US and Japan, 2000, 2009 and 2010

Country	2000	2009	2010
Luxembourg	N/A	N/A	1.8
Netherlands	2.1	3.6	3.8
Cyprus	2.0	3.4	3.9
Japan	**3.3**	**4.1**	**4.0**
Hungary	2.1	4.4	4.9
Former Yugoslav Republic of Macedonia, the	3.1	6.0	5.2
Malta	1.9	4.5	5.4
Turkey	2.8	4.9	5.8
Belgium	4.9	6.6	5.9

Country	2000	2009	2010
Norway	4.3	5,.5	6.2
Switzerland	N/A	7.1	6.7
United States	**6.2**	**6.5**	**6.8**
Latvia	4.7	6.3	6.9
Austria	2.9	6.8	7.3
European Union 27	**6.3**	**9.4**	**8.3**
Spain	6.4	7.8	8.6
Slovenia	4.2	6.0	8.7
Italy	4.3	8.8	8.7
Estonia	5.7	8.7	8.9
Croatia	N/A	8.9	8.9
Bulgaria	6.1	7.8	9.1
Germany	3.6	8.6	9.3
Sweden	7.6	8.7	9.6
Czech Republic	3.0	9.8	10.2
Greece	N/A	N/A	10.5
Liechtenstein	N/A	3.7	10.7
Portugal	5.4	10.8	10.8
Lithuania	9.7	11.4	10.9
Ireland	18.5	10.5	11.2
United Kingdom	11.9	11.0	11.5
France	12.1	11.6	11.8
Iceland	6.5	7.8	12.0
Denmark	6.8	11.2	12.2
Poland	4.8	11.0	12.4
Romania	3.2	14.9	12.7
Slovakia	3.2	12.5	13.4
Finland	8.9	11.3	13.7
Albania	N/A	N/A	N/A

Source: Deloitte
Data: UNESCO OECD Eurostat education survey

Table 28: New women doctoral graduates (ISCED 6) per thousand population aged 25-34, Europe, 2000 and 2010

Country	2000	2010
Cyprus	0.1	0.2
Malta	0.1	0.2
Liechtenstein	N/A	0.2
Latvia	0.1	0.4
Turkey	0.2	0.4
Bulgaria	0.3	0.5
Poland	N/A	0.5
Former Yugoslav Republic of Macedonia, the	0.1	0.5
Luxembourg	N/A	0.8
Hungary	0.5	0.8

Country	2000	2010
Iceland	0	0.8
Estonia	0.6	0.9
Lithuania	0.9	0.9
Greece	N/A	1.2
Spain	0.9	1.2
Czech Republic	0.6	1.3
Romania	N/A	1.4
Croatia	N/A	1.4
Belgium	0.8	1.5
Slovenia	1	1.5
Ireland	0.9	1.6
France	1.2	1.6
Italy	0.4	1.6
European Union 27	**1.1**	**1.6**
Netherlands	1	1.9
Portugal	1.6	1.9
Norway	1	1.9
Denmark	1	2.1
Austria	1.4	2.3
United Kingdom	1.3	2.3
Finland	2.7	2.6
Germany	2.1	2.7
Sweden	2.5	2.9
Slovakia	0.6	3.1
Switzerland	N/A	3.7

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

Table 29: International scientific co-publications per million population, Europe, 2010 and 2011

Country	2010	2011
Switzerland	2 350.7	2 505.2
Iceland	2 386.4	2 348.9
Denmark	1 561.8	1 692.3
Sweden	1 512.8	1 603.9
Norway	1 416.2	1 483.4
Luxembourg	1 256.8	1 428.2
Netherlands	1 271.4	1 329.7
Belgium	1 194.9	1 279.9
Austria	1 095.7	1 179.9
Finland	1 266.2	1 323.5
Ireland	1 093.6	1 131.3
Cyprus	985.2	1 003.9
United Kingdom	949.2	988.6

Country	2010	2011
Slovenia	857.4	954.5
Estonia	673.1	734.2
Germany	681.1	715.3
France	659.8	682.7
Portugal	599.9	678.0
Spain	546.1	598.7
Czech Republic	509.1	529.4
Greece	511.7	543.9
Italy	476.4	499.8
Croatia	334.4	388.2
Hungary	358.9	386.9
Slovakia	358.3	379.4
Malta	292.0	328.1
European Union 27	**301.1**	**300.3**
Lithuania	219.3	264.7
Poland	203.1	212.6
Bulgaria	210.7	205.3
Romania	144.4	148.5
Latvia	131.2	178.1
Serbia	119.4	133.7
Turkey	66.5	70.9
Former Yugoslav Republic of Macedonia	N/A	N/A

Source: Deloitte
Data: Science Metrix/Scopus/IUS

Table 30: Scientific publications in top 10% most-cited publications worldwide as percentage of total scientific publications, Europe, US, Japan and China, 2007 and 2008

Country	2007	2008
Switzerland	15.37	15.84
Netherlands	14.96	15.13
Denmark	14.76	14.60
Belgium	13.42	13.59
United Kingdom	12.83	13.28
Sweden	12.21	12.28
Norway	11.09	12.17
Germany	11.38	11.64
Finland	11.75	11.48
Ireland	11.46	11.38
Iceland	11.72	11.19
Austria	11.37	10.92
European Union 27	10.74	10.90
France	10.07	10.33
Spain	9.56	10.19
Italy	9.89	10.11

Country	2007	2008
Luxembourg	9.05	10.11
Portugal	9.28	10.04
Greece	9.45	9.52
Cyprus	8.97	8.85
Estonia	7.53	7.45
Slovenia	7.63	7.39
Malta	5.31	7.06
Turkey	6.58	6.73
Lithuania	5.71	5.95
Czech Republic	4.83	5.51
Hungary	5.54	4.91
Latvia	2.19	3.95
Romania	4.2	3.77
Poland	3.6	3.52
Slovakia	3.72	3.27
Croatia	3.13	3.20
Serbia	1.78	3.08
Bulgaria	3.63	2.61
Former Yugoslav Republic of Macedonia	N/A	N/A

Source: Deloitte

Data: Science Metrix/Scopus/IUS

9.4 "Working conditions in the research profession"

Table 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) (%)

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

9.5 "Mobility and international attractiveness"

Table 32: Foreign (non-EU) doctoral candidates (ISCED 6) in the EU-27 by top 30 countries of origin, 2010

Country	2010
China (including Hong Kong)	7523
Brazil	3400
United States	3243
Mexico	3206
India	2903
Tunisia	2831
Iran	2488
Colombia	2387
Algeria	2374
Pakistan	2290
Lebanon	1945
Malaysia	1892
Morocco	1872
Chile	1641
Russia	1462
Canada	1401
Vietnam	1401
Saudi Arabia	1335
Turkey	1279
Venezuela	1244
Libya	1225
Syria	1198
South Korea	1088
Thailand	1088
Nigeria	1061
Egypt	991
Argentina	986
Ukraine	928
Japan	874
Peru	790

Source: Deloitte

Data: UNESCO OECD Eurostat education survey

Table 33: Researchers (post-PhD) having spent a period of at least three months as researchers in another country in the last 10 years Europe, 2012 (%)

	>3 month mobile in the last ten years	>3 month mobile more than ten years ago
Romania	19.7%	4.0%
Latvia	19.7%	9.1%
Former Yugoslav Republic of Macedonia, the	33.5%	10.8%
Luxembourg	47.4%	11.0%

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

Source: Deloitte
Data: MORE2 study

Table 34: Co-publications with an author from another EU Member State 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

	MS1	MS2	MS3	MS4	MS5	Other EU MS	Other country
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: Impacts reported

10.1 Measures supporting women in top-level positions

The table below provides an overview of the impacts of measures supporting women in top-level positions. The information is based on the 2012 reporting exercise with the participating countries within the scope of this study.

Table 35: Measures supporting women in top-level positions (Impact reported)

Country	Measures explicitly to improve research funding	Appointment/promotion to decision-making posts at a later stage of researcher career				General support by national authorities for the principle of gender balance
		Gender parity on boards, targets & quotas	Work-life balance	Training / support for high-level positions	Transparency in appointment procedures & results	
AUSTRIA	– fForte Coaching Programme supporting women in writing successful grant proposals: between 2003 and 2012, 297 women took part in the Coaching Programme. The total budget was EUR 572 587.			– Media training: In 2009/2010 the trainings were also opened to male scientists. All in all: summer 2008 till summer 2010: 40 interview trainings for about 190 scientists. Next round in spring 2013; – Training of members of university boards (ongoing) by the Ministry of Science and Research: Sixty individual trainings courses are offered. The total budget is EUR 250 000; – w-fFORTE – *Wissenschaf(f)t Erkenntnis* – knowledge creates insights (including w-fFORTE – Laura Bassi Centres of Expertise[208] and w-fFORTE – In focus: Career): The total budget allocated for this		

[208] The eight "Laura Bassi Centres of Expertise" have a term of up to seven years with a total funding budget of EUR 15 million. An interim evaluation will be carried out in 2013. If the evaluation is positive, the funding period may be extended for a further three years.

Country	Measures explicitly to improve research funding	Appointment/promotion to decision-making posts at a later stage of researcher career				General support by national authorities for the principle of gender balance
		Gender parity on boards, targets & quotas	Work-life balance	Training / support for high-level positions	Transparency in appointment procedures & results	
				programme is EUR 17.33 million.		
BELGIUM		– The Flemish Government Act of 13.07.2007 includes provisions aimed at safeguarding gender balance in advisory bodies and steering committees. For instance, in the Agency for Innovation by Science and Technology, 30% of the internal scientific advisors are women.				
DENMARK	– Female Research Leaders instrument (2008-2009) targeted women at minimum associate professor level. In 2008, 10 female researchers received DKK 43 million (some EUR 5.8 million) in funding and in 2009, 15 female research leaders received DKK 70 million (some EUR 9.4 million).					
GERMANY				– Female Professors Programme promoting outstanding women researchers: 262 additional female professors were appointed at German Higher Education Institutions. As a result of the positive evaluation of the programme on the development of equal opportunities in institutions of higher education, the Joint Science Conference of the Federal Government and the		

Country	Measures explicitly to improve research funding	Appointment/promotion to decision-making posts at a later stage of researcher career				General support by national authorities for the principle of gender balance
		Gender parity on boards, targets & quotas	Work-life balance	Training / support for high-level positions	Transparency in appointment procedures & results	
				– Heads of Government of the Federal States (*Länder*) (GWK) decided in 2012 to continue the programme for a second period of five years until 2017; – Pact for Research and Innovation: four German science organisations (FhG, MPG, HGF and WGL) have agreed to capitalise better on women's scientific potential (including in positions of responsibility).		
SLOVENIA	– The Young Researcher Programme giving priority to women. As of 2012, there were 51% young women researchers participating in the programme. The same proportion (51%) benefit from a post-doctoral programme (post-doctoral projects).					
SWITZERLAND		– The Swiss Federal Equal Opportunities Programme 2008-11/12 aimed to increase the proportion of women category I Professors from 14% in 2006 to 25% by the end of 2012. The CRUS (university rectors' conference) will set targets per domain for newly nominated women Category I professors and assistant professors in the				– Gender Campus is the national platform for gender equality, gender studies and the promotion of gender-sensitive careers in higher education. From 2013-2016, the platform is financed by the Swiss University Conference (SUC) sub-programme 'Gender Studies' and the new State Secretariat for Education,

Country	Measures explicitly to improve research funding	Appointment/promotion to decision-making posts at a later stage of researcher career				General support by national authorities for the principle of gender balance
		Gender parity on boards, targets & quotas	Work-life balance	Training / support for high-level positions	Transparency in appointment procedures & results	
		forthcoming Swiss University Conference sub-programme Equal Opportunity at Universities 2013-2016. The overall goal of the programme is for 25% of grade A professors and 40% of assistant professors (grade B) to be women by 2016.				Research and Innovation (SERI).

Source: Deloitte, 2012 reporting exercise

10.2 Measures supporting education and training

The table below provides an overview of the impacts of measures supporting education and training. The information is based on the 2012 reporting exercise with the participating countries within the scope of this study.

Table 36: Measures to attract young people to science and the research profession, to increase the quality of doctoral training and life-long learning (including the development of a Skills' agenda) and to develop partnerships between academia and industry by fostering doctoral training in cooperation with industry (Impact reported)

Country	Attract young people to science and the research profession	Quality of doctoral training and life-long learning	Collaboration between academia and industry
AUSTRIA	– Talents Programme 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. In 2012, 1 446 traineeships were funded under the action line "discover talents". The budget is EUR 1.446 million; – Young Science programme which includes: the Sparkling Science Research Agenda supports (new) methods of promoting young researchers and artists in Europe, and fosters cooperation between experienced scientists and young people. To date, 45 000 pupils have worked with some 1 000 researchers and 1 050 teachers in 209 projects covering current scientific questions in the fields of humanities, life sciences, natural sciences, computer sciences, engineering and medicine. The number of schools involved in the project in Austria is 353; there are 29 partner schools located abroad; the Kids Universities Initiative[209] (enables children between the age of 7 and 12 to explore science with the support of researchers); and the *Nachwuchsförderung im* BMWF (2011-2014) (pre-university promotion of the next generation of researchers); – Summer school Alpbach has been organised each year and lasts two weeks. The summer school offers lectures as well as project-oriented		– COMET Programme: aims to boost researchers' potential at the interface between science and industry by creating attractive opportunities to develop and use researchers' skills in science and industry. There are currently 21 COMET K-Centres (5 K2 Centres and 16 K1 Centres) as well as 33 K-Projects running with federal funding of approx. EUR 50 million per year; – COIN Programme promotes ties between companies (especially SMEs) and universities of applied sciences, as well as non-research institutions. The 6th Call of the COIN "Cooperation and Network" line has a budget of EUR 4.5 million. Projects will start at mid-year 2013 and the duration is up to 3 years; – AplusB Programme supports young researchers in the formation of enterprises. In total, eight regional AplusB Centres ensure a sustainable increase in the number of academic spin-offs from universities, universities of applied science and non-university research institutions by supporting technology transfer through exploitation of research results by the industry. An analysis of academic start-ups supported by the AplusB programme from 2002 to 2009 has demonstrated that these companies have a high level of research and development intensity in high-tech sectors, employ highly qualified personnel, are engaged in technology transfer and show significant growth and survival rates; – Intelligent Production Programme: supports

[209] Since 2008 about 64 000 kids benefited from the initiative. About 12 Kids Universities took place in Austria in 2012.

Country	Attract young people to science and the research profession	Quality of doctoral training and life-long learning	Collaboration between academia and industry
	workshops for typically 60 mainly European students on a given space-related topic, which changes each year. The funds are raised by the partners and the FFG covers the costs for the Austrian participants (typically 12) and the overall organisation. The yearly budget allocated by FFG is approximately EUR 70 000.		cooperation between industry and academia to foster highly competitive (intelligent) production. The budget is EUR 14 million and it targets 80 beneficiaries. In the second call there were 399 participants (50% RTD organisations and 50% companies); – IV2S Plus Programme: supports cooperation between industry and academia to foster the development of intelligent and competitive transport systems. The follow-up programme will be called "Future Mobility" and will touch upon the following research areas: mobility of persons and of goods, transportation infrastructure and vehicle technology.
BELGIUM	– Annual Science Communication Action Plan attracts pupils, students and teachers into a research career by promoting science, technology and technological innovation. In 2012 this action plan was replaced by the Communication policy plan 2012-2014 (about EUR 9 million for 2012).	– Support Programme for Young Researchers of the Flemish community: aims to train young researchers, develop careers and open up career prospects, reinforce the international orientation of researchers' careers and cooperate within Flanders. A first evaluation, by the Expertise Centre on R&D monitoring in 2013, showed that the money has been used by the universities to reinforce their HR policy for young researchers and create more opportunities for training and career development for them. In 2013, the objective is to make this programme a permanent funding programme for the universities.	– Agency for Innovation by Science and Technology (IWT) Innovation Mandates are set up with the objective of connecting the academic and the industrial world, and stimulating postdoctoral researchers to improve their skills in maximising the value of their research and to develop their careers, taking a step towards industry. The budget is between EUR 2 and 3 million per year. Some 40 mandates are granted yearly.
BOSNIA AND HERZEGOVIA	– Fund Dr *Milan Jelić* provides financial support to the most talented students of all three levels of higher education. In December 2012, 13 students were awarded study grants as financial support for their own initiatives of scientific and other sorts of cooperation between foreign and national universities and scientific institutions. The annual budget of the Fund Dr *Milan Jelic* is BAM 750 000 (some EUR 384 615); – Scholarships of the Ministry of Education and Culture of Republika Srpska for students of mathematics, natural sciences and technology, so as to promote their career in these professions. In 2011-12: 474 students who enrolled for the first time in the study of mathematics and physics, and students in the second, third and fourth year of		

Country	Attract young people to science and the research profession	Quality of doctoral training and life-long learning	Collaboration between academia and industry
	study of mathematics, physics, informatics, electrical engineering, mechanical engineering and geodesy.		
CROATIA		– The University of Rijeka in 2012 organised 37 different lectures and workshops for almost 1 500 participants with the goal of enhancing researchers' knowledge in development of entrepreneurial skills, preparation and management of projects funded by the EU and intellectual property rights.	
DENMARK			– Application of Science and Languages: the Danish Ministry of Children and Education co-funds a number of collaborative project groups with the participation of upper secondary school teachers, researchers and project managers from universities, museums/science centres and/or private and public companies. The groups develop individual projects and exchange knowledge in a joint project. From 2012 the Programme also includes a number of projects focusing on initiatives for talented students.
FRANCE		– As of September 2010, 285 doctoral schools (*Ecoles Doctorales*) with 70 000 doctoral students were accredited by the Ministry of Higher Education and Research. The doctoral schools are established under an agreement between the State and universities (*contrats d'établissements*). The doctoral schools provide training and development for participants. They offer future PhD holders high-level scientific supervision as well as preparation to enter the labour market. Of the total of 285 doctoral schools accredited by the Ministry of Higher Education and Research, 131 host doctoral students engaged in original PhD research projects which will enable them to pursue a scientific career in the private sector. These 131 doctoral schools enrol about 33 000 doctoral students. They hear the defence of some 7 500 dissertations each year.	
FORMER YUGOSLAV REPUBLIC OF MACEDONIA		– 'Equipping Laboratories for Scientific Research and Applicative Activities' (2009-14): aims to advance research at state universities and public scientific organisations by creating and equipping research	

Country	Attract young people to science and the research profession	Quality of doctoral training and life-long learning	Collaboration between academia and industry
		laboratories. The first list of 22 laboratories selected for financing was announced in October 2010. By the end of the project it is expected that a total of 130 laboratories will have received finance totalling EUR 60 million.	
GERMANY		– The Helmholtz Association provides structured doctoral training in the form of research schools and graduate schools, and grants universities access to the Helmholtz Association's laboratories and research infrastructures. The Helmholtz Research Schools are joint programmes established on the basis of cooperation agreements between Helmholtz Centres and universities with the aim of supporting young researchers. The Research Schools provide structured doctoral training over a period of three years in areas of mutual scientific interest and scientific excellence. The Graduate Schools offer PhD students an interdisciplinary education that teaches them important skills for a career in science or the private sector. Thirteen Helmholtz graduate schools and 21 Helmholtz research schools have been funded since 2006.	– *Fraunhofer Gesellschaft* supports application-based research in cooperation with the private sector. Students are offered the possibility of pursuing a PhD in applied research in close collaboration with industry. The number of PhD degrees supported by *Fraunhofer* in 2007 was 1 204 (compared to 941 in 2005) and nearly doubled by 2011.
HUNGARY		– Hungarian universities develop and promote their own post-doctoral programmes financed by the State. When an education institution plans to introduce a new PhD curriculum, it needs the approval of the Hungarian Accreditation Committee. In 2012, there were 174 accredited doctoral schools at 27 universities in Hungary. The new Act on Higher Education (Act CCIV of 2011, in force since 1 January 2012) further supports the strategic ambition of increasing the quality of doctoral training in Hungarian institutions.	
LITHUANIA		– The Ministry of Education and Science in 2011 has allocated EUR 67 101 to support Intellectual Property Rights (IPR) protection (in 2011, the Ministry of Education and Science granted financial support for patent registration to 14 higher education and research institutions). Implemented by the Agency for Science, Innovation and Technology (MITA), the measure aims to encourage universities, research institutes and companies to	

Country	Attract young people to science and the research profession	Quality of doctoral training and life-long learning	Collaboration between academia and industry
		protect their intellectual property. In addition, it encourages stakeholders to cooperate more closely in the development of innovative and competitive products.	
NORWAY		– The Research Council has designated 10 new national research schools for the next eight years with a total budget of NOK 218 million (some EUR 29 million).	– The Centres for Research-based Innovation (SFI) scheme seeks to promote innovation by providing funding for long-term research conducted in close cooperation between R&D-performing companies and prominent research groups. The scheme is designed to enhance technology transfer, internationalisation and researcher training. The Centres for Research-based Innovation (SFI) scheme provided NOK 155 million (some EUR 21 million) for top-up financing of 21 Centres in 2012. The SFIs are centres of excellence which include a frontline knowledge based industrial partner.
SLOVENIA	– The 'Young Researchers' Programme aims to increase the number of students who follow PhD studies, incorporating specific measures to promote research in science, technology, engineering and mathematics (STEM) subjects. Since 2006, it has provided financing for more than 1 200 young researchers annually; – Research and Innovation Strategy of Slovenia 2011-2020: funding for promotional purposes increased from EUR 1 million in 2010 to EUR 2 million in 2014, and an increase in the number of practical creativity and entrepreneurship programmes for primary and secondary schools – establishing a network of model creative schools, such as eco-schools.	– Universities establish special lifelong learning programmes that offer access to special competencies for career development as well as for the daily life of a researcher (e.g. University of Ljubljana's Doctoral school). As of 2012, the doctoral school of the University of Ljubljana was providing 21 doctoral Study Programmes for 2 600 students; – The *Jožef Stefan* International Postgraduate School (IPS): doctoral study since 2004 supported by industry and an international network of cooperating universities and research institutes from the EU, the US, Japan, and a number of other countries. In 2012, 180 doctoral students were enrolled in the programme.	– 'Young Researchers in the Economy' (Slovenian Technology Agency): aims to introduce more highly-educated staff into private companies and stimulate companies to hire young graduates to enhance their R&D and innovation activities. In 2011, the Agency devoted EUR 11 million to this programme and funded 400 young researchers in business; – Innovative Scholarship Scheme for Funding Doctoral Studies (2011): in 2011, more than 700 doctoral candidates were funded for an annual amount of EUR 3.3 million.
SPAIN	– Summer campuses on university campuses under the auspices of the International Campus of Excellence (CEI) Programme. In 2013, 1 808 students will take part in this programme; – FPU Programme (Ministry of Education): train future university professors, including the presentation of a doctoral thesis. It includes short-term visiting fellowships and tuition fee grants. In 2012, 50 of a total of 800 grants went to non-EU candidates. In addition, the programme funds 500		– *Torres Quevedo* Programme. In 2012, the number of *Torres Quevedo* grants was 330.

Country	Attract young people to science and the research profession	Quality of doctoral training and life-long learning	Collaboration between academia and industry
	visiting fellowships for a period of between two and four months, and 40 visiting fellowships for a period of between six and nine months. In 2011, the number of FPU grants was 945, or 1.37% of all doctoral candidates; – FPI programme (Ministry of the Economy and Competitiveness): train researchers, including the presentation of a doctoral thesis. In addition, the programme funds visiting fellowships for a period of between two and six months, including tuition fees. In 2011, the number of FPI grants was 972, or 1.41% of all doctoral candidates.		

Source: Deloitte, 2012 reporting exercise

10.3 Mobility and international attractiveness

The table below provides an overview of the impacts of measures supporting mobility and international attractiveness. The information is based on the 2012 reporting exercise with the participating countries within the scope of this study.

Table 37: Mobility and international attractiveness (Impact reported)

Country	Measures to attract and retain 'leading' national, EU and third country researchers	Measures supporting researchers' inward mobility	Measures supporting researchers' outbound mobility	Promotion of 'dual careers'	Portability of national grants	Access to cross-border grants
AUSTRIA			- The APART Programme awards fellowships to national and international researchers in support of a post-doctoral thesis, or the continuation of a scientific project. In 2011, 25% of the fellows conducted research at universities or research institutions abroad; - DOC Programme: PhD studies can be conducted at universities or research institutions both in Austria and abroad. In 2011, 15% of the fellows conducted research at universities or research institutions abroad; - ROM Programme: supports doctoral candidates and young post-docs in humanities and cultural studies to conduct research in Italy (Rome) (as part of their			- The following programmes administered by the Austrian Academy of Sciences are open to non-residents: a) APART, a programme for post-docs from any discipline is open to Austrian citizens and anyone else planning to carry out their research project at a research institution in Austria; the percentage of foreign researchers among those receiving an APART fellowship from 2010 to 2012 was 18%; and b) DOC or DOC-team programmes for doctoral candidates, are open to Austrian citizens or anyone enrolled in a PhD programme at an Austrian university;

Country	Measures to attract and retain 'leading' national, EU and third country researchers	Measures supporting researchers' inward mobility	Measures supporting researchers' outbound mobility	Promotion of 'dual careers'	Portability of national grants	Access to cross-border grants
			research project). In 2011, nine stipends were granted.			the percentage of foreign PhD candidates receiving a fellowship from 2010 to 2012 was 20%.
CROATIA	– Fellowships for Doctoral Students: foreign doctoral students from academic institutions are invited to conduct research projects within accredited doctoral study courses at one of the Croatian scientific and academic institutions. Personal grants are given for research stays lasting from three to twelve months and the monthly budget per grant is approximately HRK 7 500 (some EUR 988); – HRZZ Installation Grants: the grants are available to Croatian and foreign researchers with two to five years of postdoctoral experience in Croatia or abroad with proven institutional support. Projects are submitted within three research fields. Successful applicants receive up to					

Country	Measures to attract and retain 'leading' national, EU and third country researchers	Measures supporting researchers' inward mobility	Measures supporting researchers' outbound mobility	Promotion of 'dual careers'	Portability of national grants	Access to cross-border grants
	– HRK 350 000 (some EUR 46 141) annually for three years; – Postdoc Programme: personal grants are given for research stays lasting from three to twelve months and the monthly budget per grant is approximately HRK 9 750 (some EUR 1 285).					
ESTONIA	- The DoRa Doctoral Studies and Internationalisation Programme: the total cost of the programme is EUR 33.5 million for the period 01.01.2008–31.05.2015; the support is divided between support from the European Social Fund up to 73% (EUR 24.6 million), state financing 9% (EUR 2.9 million) and self-financing by partners 18% (EUR 6 million).					
GERMANY	– Recruiting Initiative (HGF): the initiative aims to recruit from three target groups: outstanding researchers, women scientists and researchers from abroad. The	– Leibniz-DAAD Research Fellowships: the fellowships offer highly qualified recent foreign postdocs the opportunity to conduct special research at one of the 84 Leibniz Association	– Helmholtz Association Research Grants (HGF): additional focus regions will be addressed from 2013 by a new programme called Helmholtz International Research Groups.			

Country	Measures to attract and retain 'leading' national, EU and third country researchers	Measures supporting researchers' inward mobility	Measures supporting researchers' outbound mobility	Promotion of 'dual careers'	Portability of national grants	Access to cross-border grants
	programme will run until 2015 and encompasses 40 extra positions.	participating institutions in Germany for up to one year.				
HUNGARY	– Charles Simonyi Scholarship: the objective is to support Hungarian researchers with outstanding scientific achievements. Three researchers were awarded scholarships in 2012; – *Leó Szilárd* Fellowship: the aim of this scholarship is to fund renowned Hungarian scientists and thus acknowledge their scientific work and retain them. Three researchers were awarded scholarships in 2012; – The TRANSMOB-HU - Hungarian support programme for improving the transnational mobility of researchers: during the period 2009-2011, three calls for proposals were published, and as a result, 55 researchers benefited from the scheme. No calls for proposals were published in 2012;	– Momentum (*Lendület*) Young Investigator Programme: Programme supports young researchers from various fields of science in establishing independent laboratories in Hungary. In 2012, approximately HUF 1.25 billion (some EUR 4.3 million) were granted to 37 Hungarian researchers.				

Country	Measures to attract and retain 'leading' national, EU and third country researchers	Measures supporting researchers' inward mobility	Measures supporting researchers' outbound mobility	Promotion of 'dual careers'	Portability of national grants	Access to cross-border grants
	– *Zoltán Magyary* Fellowship Programme (under National Excellence Programme): in 2012, the total number of beneficiaries was 33.					
NORWAY		– There is an individual scholarship programme of 3-12 months for young researchers. There is also a visiting researcher's grant for attracting senior researchers. A total of 68 scholarships with a total budget of NOK 10 million (some EUR 1.4 million) were granted in 2012.				
SPAIN	– Ramón y Cajal Programme: since 2012, the programme has also included financial support to the creation of jobs on a permanent basis. In 2012, the Ramón y Cajal programme increased the amount of each grant by 10%. In addition, it includes a EUR 100 000 sum per grant to support a long-term contract. In 2012, the number of Ramón y Cajal grants was 175; – Juan de la Cierva		– Human Resources Sub-programme Salvador Madariaga: in 2012, the total budget was EUR 391000; – Mobility of Spanish university lecturers and researchers in foreign centres: in 2012, the total budget was EUR 7.59 million.			

Country	Measures to attract and retain 'leading' national, EU and third country researchers	Measures supporting researchers' inward mobility	Measures supporting researchers' outbound mobility	Promotion of 'dual careers'	Portability of national grants	Access to cross-border grants
	Programme: in 2012, the number of Juan de la Cierva grants was 225.					
SWITZERLAND				– The Swiss Federal Equal Opportunity at Universities Programme (CRUS) initiated a Module 3 project in 2009 in order to build up dual career structures and measures at every Swiss university. It also established a fund for the support of incoming couples at professorial and postdoc level taking into consideration a gender equality aspect in the respective funding. The project was evaluated in 2011. Available at: http://www.crus.ch/information-programme/chancengleichheit/rechte-navigation/publikationen.html	– In 2011, 15 SNSF grants under the EUROHORCS 'Money follows researcher' scheme were transferred (compared to 47 SNSF grants in 2010), with a total transferred amount of CHF 2.2 million (some EUR 1.8 million) (compared to CHF 5 million in 2010).	

Source: Deloitte, 2012 reporting exercise

11. Technical Annex

The technical annex presents information on:

- List of indicators;
- Sources of indicators and years of reference;
- List of sources used during the desk research phase and production of the *Researchers' Report 2013;*
- Country abbreviations.

11.1 List of indicators

Table 38: *Researchers' Report 2013* - List of indicators

Indicators	Data source(s)
The stock of researchers in Europe	
Researchers (Full Time Equivalent), EU-27, US, China, Japan, 2000, 2009 and 2010 (in million)	Eurostat
Researchers (Full Time Equivalent) per thousand labour force, EU-27, US, China, Japan, 2000, 2009 and 2010	Eurostat
Researchers (Full Time Equivalent) per thousand labour force, Europe, 2000 and 2010	Eurostat
Researchers (Full Time Equivalent) working in the business and public sectors (in million), EU-27, US, China, Japan, 2010	Eurostat
Researchers (Full Time Equivalent) by sector, EU- 27, 2000-2010 (in million)	Eurostat
Share of Full Time Equivalent (FTE) researchers working in the business sector (as % of all researchers), EU-27, US, China, Japan, 2010	Eurostat
Researchers in the business sector (Full Time Equivalent) per thousand labour force, EU-27, US, China, Japan, 2000 and 2010	Eurostat
Researchers in the business sector (Full Time Equivalent) per thousand labour force, Europe, 2000 and 2010	Eurostat
Researchers in the public sector (Full Time Equivalent) per thousand labour force, EU-27, US, China, Japan, 2000 and 2010	Eurostat
Researchers in the public sector (Full Time Equivalent) per thousand labour force, Europe, 2000 and 2010	Eurostat
Women in the research profession	
Proportion of academic staff by grade and gender, EU-27, 2002 and 2010 (%)	WiS database/ SHE figures
Glass Ceiling Index, Europe, 2004 and 2010	WiS database/ SHE figures
Women as Grade A academic staff, Europe, 2010 (%)	WiS database/ SHE figures
Proportion of woman as Grade A academic staff by main field of science (natural sciences, engineering and technology, medical sciences, agricultural sciences, social sciences, and humanities), Europe, 2010 (%)	WiS database/ SHE figures
Proportion of women heads (president/rector) of institutions in the Higher Education Sector, Europe, 2010 (%)	WiS database/ SHE figures
Proportion of women on boards, Europe, 2010 (%)	WiS database/ SHE figures
Open, transparent and merit-based recruitment	
Researcher posts advertised through the EURAXESS Jobs portal, Europe, 2009-2012	EURAXESS JOBS
Researcher posts advertised through the EURAXESS Jobs portal per thousand researchers in the public sector, Europe, 2012	EURAXESS JOBS
Share of researchers in the public sector satisfied with the extent to which research job vacancies are advertised externally by their institution, Europe, 2012 (%)	MORE2 study

Indicators	Data source(s)
Share of researchers in the public sector satisfied with the extent to which research job vacancies are advertised externally by their institution, by career stages, Europe, 2012 (%)	MORE2 study
Education and training	
Population aged 30-34 having completed tertiary education, Europe, 2000 and 2011 (%)	Eurostat Labour Force population survey/IUS
Population aged 25-64 having completed tertiary education, EU-27 and main competitors, 2010 (%)	Eurostat, OECD
Tertiary graduates in Science, Technology, Engineering and Mathematics (STEM) studies (ISCED 5 & 6) per thousand population aged 20-29, Europe, US and Japan, 2000 and 2010	UNESCO OECD Eurostat education survey
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 2010	UNESCO OECD Eurostat education survey
New doctoral graduates (ISCED 6) per thousand population aged 25-34, EU-27, US and Japan, 2000-2010	UNESCO OECD Eurostat education survey/IUS
New doctoral graduates (ISCED 6) per thousand population aged 25-34, Europe, 2000 and 2010	UNESCO OECD Eurostat education survey/IUS
New women doctoral graduates (ISCED 6) per thousand population aged 25-34, Europe, 2000 and 2010	UNESCO OECD Eurostat education survey
Working conditions	
Researchers employed on fixed-term contracts, Europe, 2012 (%)	MORE2 study
Estimated shares of researchers in the higher education sector by employment contract status and by country of affiliation, Europe, 2012 (%)	MORE2 study
Remuneration of doctorate holders working as researchers compared to doctorate holders working as non-researchers (difference in median gross annual earnings), Europe (2009), US (2008) (%)	OECD, Science, Technology and Industry Scoreboard, 2011
Gross annual salaries and PhD stipends of university researchers as percentage of the best paying country within career stages	MORE2 study
Post-PhD researchers indicating that their time as mobile researcher had positive, negative or no impact on career progression, EU-27, 2012 (%)	MORE2 study
Collaboration between academia and industry	
Work placement or internship in the non-academic sector during PhD (per country of PhD), Europe, 2012 (%)	MORE2 study
Post-PhD researchers indicating inter-sectoral mobility >3 months in private industry, Europe, 2012 (%)	MORE2 study
Motives for private sector employment, EU-27, 2012 (%)	MORE2 study
Public-private co-publications between two or more sectors (universities, research institutes, industry) per million population, EU-27, China, Japan and US, 2003 and 2008	Science Metrix/Scopus
Public-private co-publications between two or more sectors (universities, research institutes, industry) per million population, EU-27, 2008 and 2011	CWTS/Thomson Reuters
Mobility and international attractiveness	
Foreign (non-EU) doctoral candidates (ISCED 6) in the EU-27 by the top 30 countries of origin, 2010	UNESCO OECD Eurostat education survey
Non-EU doctoral candidates as a percentage of all doctoral candidates, Europe, 2010	Innovation Union Scoreboard database 2013
Doctoral candidates (ISCED 6) with a citizenship of another EU-27 Member State, Europe, 2008 and 2010 (%)	EUROSTAT OECD UNESCO survey
Researchers (post-PhD) having spent a period of at least three months as a researcher in another country in the last 10 years, Europe, 2012 (%)	MORE2 study
Differences in gender for researchers (post-PhD) having spent a period of at least three months as researchers in another country in the last 10 years, Europe, 2012 (%)	MORE2 study
Factors motivating EU researchers (post-PhD) to spend a period of at least three months as researchers in another country in the last 10 years, EU-27, 2012 (%)	MORE2 study

Indicators	Data source(s)
Factors motivating EU researchers (post-PhD) to spend a period of at least three months as researchers in another country in the last 10 years, by career stages, EU-27, 2012 (%)	MORE2 study
Importance of barriers as reasons for international non-mobility in post-PhD career, EU-27, 2012 (%)	MORE2 study
International scientific co-publications per million population, Europe, US, Japan and China, 2011	Science Metrix/ Scopus/IUS
Scientific publications in the top 10% most-cited publications worldwide as a percentage of all scientific publications, Europe, US, Japan and China, 2008	Science Metrix/Scopus /IUS
Main producers of scientific publications, EU, 2000 and 2008	Innovation Union Competitiveness Report 2011
Co-publications with an author from another EU Member State by five main partners in Europe, other countries, 2010 (%)	Science Metrix/Scopus
Most active research universities by normalised citation impact ('Leiden Ranking'), Europe, 1997-2006	Innovation Union Competitiveness Report 2011

11.2 Sources of indicators and years of reference

Timing

The *Researchers' Report 2013* presents the most recent data to monitor the reseacher profession in Europe with a cut-off date of end of March 2013. It refers to a number of studies and combines several data sets in order to present a comprehensive and complete picture of the research profession in Europe. It is based on an update by the countries in scope of this report provided during the 2012 reporting exercise during which the countries have updated their country profiles with new information.

Qualitative data

Deloitte collected and analysed a wealth of qualitative data for the production of the *Researchers' Report 2013* (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 drew up a comprehensive questionnaire which was completed by the majority of countries' delegates of the ERA Steering Group on Human Resources and Mobility (SGHRM). The questionnaire also served as a means for the identification and selection of Good Practices (a separate Annex to this report). A literature review complemented the collection and analysis of the qualitative data. Also, for the 2013 edition of the *Researchers' Report*, the countries were asked to provide new information in each of the monitoring categories. All responses were carefully analysed and were reflected in the *Researchers' Report 2013*.

Quantitative data

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

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

Data limitation

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

- Availability of comparable data for 38 countries: Many studies and Eurostat databases do not always cover all countries. As a result, a comparison of countries across all indicators may not be possible;
- 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[210] or EUMIDA[211]);
- 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

[210] Idea Consult (2010)

[211] European Commission (2009), "Feasibility Study for Creating a European University Data Collection"

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

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 Commission (2013), “Research and Innovation performance in EU Member States and Associated countries. Innovation Union progress at country level 2013”, 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

The study aims at providing a reliable, complete and up-to-date picture of the research profession in 38 countries[212]

Table 39: Country abbreviations

Countries monitored	'Regions' monitored
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	

[212] 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.

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