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Developing the European Research Area: Improving Knowledge Flows via Researcher Mobility

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Foreword

This report has been prepared by the Institute for Prospective Technology Studies (IPTS) of the EU's Joint Research Centre (JRC) as a formal deliverable under the FP6 ERAWATCH contract (Contract No.: SDCP-CT-2004-516769).

ERAWATCH is a cooperative undertaking between DG RTD and DG JRC. It is a strategic intelligence service designed to support evidence-based policy making in the research field in Europe and to contribute to the realisation of the European Research Area (ERA). It aims to provide a better understanding of national and regional research systems and the environment in which they operate.

This report is one of a series of analytical reports intended to support the development of the ERA. It is aimed at all those policymakers at EU, national and regional levels who are interested in the implementation of the 2020 vision for the ERA. In particular, the topics addressed in it are particularly relevant to one of the five initiatives launched by the European Commission in 2008 to accelerate the development of the ERA, namely the attempt to improve researcher mobility and improve the career prospects of researchers, itself an attempt to improve knowledge flows and strengthen the foundations upon which a knowledge-based society can develop and flourish.

Table of Contents

Executive Summary

Focus

- This report focuses on some of the knowledge creation and circulation processes that underpin the development of knowledge-based societies. Specifically, the report looks at aspects of human resource development and researcher mobility within the European Research Area (ERA) and between the ERA and other parts of the world. This topic is critical to the evolution of the ERA and the free circulation of knowledge within it, the so-called 'Fifth Freedom'. Recent developments are reviewed and the implications for further policy assessed.

Highlights

- Increased mobility and the greater interaction of research-related personnel are increasingly seen as routes to the creation of dynamic networks, improved scientific performance, improved knowledge and technology transfer, improved productivity and ultimately enhanced economic and social welfare;
- There is a broad divide between countries that have embraced the concept of 'brain circulation' and those that have not;
- Countries with strong research systems tend to have higher levels of both inward and outward mobility than those with weak systems, though there are some notable exceptions;
- In countries with strong research capacities, broad based policies to improve research systems are considered to have positive impacts on overall mobility levels. These countries typically acknowledge the benefits of 'brain circulation' and welcome increased mobility;
- In countries with weaker research capacities, the potential for deleterious 'brain drain' is greater and the attractions of 'brain circulation' less immediately obvious, though the benefits of the latter are increasingly being recognised in some quarters;
- Factors having a strong impact on mobility flows are the quality of research conducted in a country, its past reputation, the strength of its research institutions and infrastructure, and salary levels for researchers;
- A broad range of other more subtle factors – both unintentional and intentional – also influence mobility flows. These range from a failure to advertise positions internationally to limited efforts to help foreign researchers overcome language and cultural barriers;
- The major beneficiaries of some intra-European flows of researchers are also the major beneficiaries of flows from non-European countries, and there is some evidence that Europe could be opening up more rapidly to non-European countries than to European countries.

Policy Implications

- Without further action, the gap between 'mobility winners' (i.e. those that have embraced the concept of 'brain circulation') and 'mobility losers' (i.e. those who have not) could widen further;
- In countries with strong research capacities, the policy emphasis needs to be on incremental changes, e.g. improved levels of research excellence along a broad front to attract mobile researchers and continued efforts to reduce the barriers to both inward and outward mobility;

- In countries with weaker research capacities, the most important step will be to embrace the concept of 'brain circulation' rather than to resist it. More focused policy efforts will then be needed to improve research capacities in specific, narrow areas rather than across the board, and these efforts will need to be complemented by targeted policies promoting mobility via, for example, a focus on improved opportunities for young researchers and greater incentives for emigrant researchers to return home;
- Countries should encourage 'brain circulation' at a global level rather than solely within the ERA, with the EU encouraging Member States to harmonise existing mobility-related practices in line with good practice in the leading 'mobility winners', most of which do not differentiate between EU and non-EU researchers;
- A concise understanding of intra-EU and extra-EU researcher mobility patterns is hindered by the lack of availability of relevant, comprehensive data sets. This needs to be rectified if progress towards the creation of a fully-functioning European Research Area is to be monitored and facilitated

1. Introduction

Knowledge creation, circulation and exploitation are the key elements of modern research and development (R&D) and innovation systems and underpin the evolution of so-called knowledge-based economies and societies. Easy access to sources of knowledge and unfettered knowledge flows, either in an easily transmittable codified form or embodied in people or technology, are thus crucial if R&D and innovation systems are to function efficiently and effectively. Moreover, since such systems at regional and national levels do not and cannot operate in a fully independent fashion in the context of increasing globalisation, access to knowledge generated in other R&D and innovation systems and cross-border flows of knowledge are becoming increasingly important. So too is the need for countries to pool the resources necessary for research and knowledge creation when attempting to tackle shared societal problems.

Recognising this, and the fact that public policies can play a seminal role in shaping developments in this sphere, many countries within the European Union (EU) have taken steps to improve cross-border access and knowledge flows and to rationalise R&D funding structures via support for initiatives at the level of the EU to create and nurture a European Research Area (ERA)[1] – an ambitious attempt to develop a new integrated research system at a European level that would exploit the full potential of Europe's talent pool and explore the possibility of working together towards common goals – and to promote the 'Fifth Freedom', i.e. the free movement of knowledge in addition to the classical free movement of goods, services, capital and labour.[2]

However, while the creation of such a 'free market' for knowledge has, in theory, the potential to improve overall R&D and innovation system performance across the EU as a whole, in practice market imperfections (caused, for example, by variations in the ability of different countries to absorb or retain knowledge) could have deleterious consequences for some countries and regions, leading in particular to a widening gap between those nations demonstrably and historically better at attracting, absorbing and exploiting knowledge than those starting from much less favourable starting points.

In such situations, the policies needed to ensure the efficient operation of a 'free market' for knowledge are likely to involve much more than policies affecting the general framework conditions within which such a market could function. Effective policy mixes are likely to include not only EU-wide policies designed, for example, to remove common obstacles to researcher mobility, but also to include policies at national and regional levels that aim to strengthen indigenous knowledge attraction and absorption capacities and counteract the deleterious consequences of sustained knowledge 'leakage'. Moreover, while private sector R&D and innovation actors will be expected to benefit significantly from the operation of a 'free market' for knowledge, policies designed to 'channel' knowledge flows towards the

[1] See European Commission (2000). The notion of a European Research Area was first promoted in 2000 by Commissioner Busquin. The initial aim was to improve the efficiency and effectiveness of the European research system within the broader context of the Lisbon Agenda, an ambitious attempt to transform the EU into the world's leading 'knowledge-based society' by 2010. Attempts to stimulate public and private investments in research were later emphasised by the European Council in Barcelona in 2002, and the need for more coherence and synergies between research policies and other EU policies was further stressed in the revised Lisbon strategy of 2005.

[2] The need for a 'Fifth Freedom' relating to research was first raised by Commissioner Potočnik in a speech in April 2007. It was fleshed out further in European Commission (2007a).

attainment of socially-determined goals will be needed at regional, national and international levels. In particular, there will be an increasing need for countries to pool resources on a multi-lateral basis to fund the research and create the knowledge needed to tackle many of the so-called 'grand challenges' common to all countries.

Many of the policies implemented as part of the drive to establish the ERA attempted to strengthen knowledge capabilities, enhance access to knowledge and promote and channel knowledge flows. Nevertheless, by 2007, seven years after the launch of the ERA initiative, the European Commission's own assessment was that, despite having become a key reference point for the development of research policy in Europe, the project had not achieved its full potential.[3] Member States thus subsequently agreed at Ljubljana to the establishment of a durable partnership between themselves and the Commission[4] that has since led to the adoption of a vision for the ERA in 2020[5] and the launch of five new initiatives[6] designed to accelerate the development of the ERA, namely:

- The European Partnership for Researchers: Better careers and more mobility;
- Towards Joint Programming in Research: Working together to tackle common challenges more effectively;
- A new Community legal framework for a European Research Infrastructure (ERI);
- Recommendations on the management of intellectual property in knowledge transfer activities and codes of practice for universities and public research organisations;
- A Strategic European Framework for International Science and Technology Cooperation.

This report focuses on topics that are directly relevant to the first of these initiatives and to the broader task of improving knowledge flows and access to knowledge. More specifically, it focuses on the lessons that can be learnt for future policies concerning human resources and researcher mobility (embodied knowledge flows).

Naturally, many other aspects of potential relevance need to be covered in order to develop a comprehensive understanding of the evolution of improved knowledge-related activities and flows within the ERA (and between the ERA and other parts of the world), but this report constitutes just one starting point in a longer term project being undertaken by JRC-IPTS[7] to monitor the implementation of the ERA. It is, in fact, one of two reports[8] that are the first in an annual series that will build upon work conducted or orchestrated by JRC-IPTS to provide a better understanding of the ERA process and its accelerated development. The underlying premise is that future policy choices in this sphere will benefit from the continuous collection and analysis of data on the evolution of a free market for knowledge; on the policy options that have already been explored by the EU and the Member States; and on the consequences of these policies for knowledge creation, access to knowledge and knowledge flows generally.

The specific aim of this report is to explore aspects of mobility relevant to the development of mobility policies within the EU. It focuses in particular on aspects of geographical mobility

3 See European Commission (2007a).
4 See EU Presidency (2008).
5 European Commission (2008a).
6 See European Commission (2007b) and European Commission (2009a).
7 The Institute for Prospective Technology Studies (IPTS) of the EU's Joint Research Centre (JRC).
8 The other report is entitled "Opening-up of National R&D Programmes and Joint R&D Policy Initiatives", Elena-Pérez, S., de Diminicis, L. and Guy, K. (forthcoming).

or 'brain circulation', i.e. on issues related to the physical movement of researchers from one spatial location to another, but also addresses – where relevant and feasible – issues related to sectoral mobility (the movement of researchers between different parts of the economy); disciplinary mobility (movement across disciplinary boundaries and cross fertilisation); and career development (how mobility affects career paths and *vice versa*, e.g. how constraints on career development options can limit or facilitate mobility).[9]

The analyses in this document draw upon policy reports and statistical evidence. Data on research policies stem mainly from the continuously updated information contained within the ERAWATCH database on R&D-related policies and programmes in 27 EU Member Countries, 8 Associated Countries and 14 Other Countries;[10] a series of Analytical Country Reports on policy mixes in ERA countries;[11] IPTS elaborations of the results of a questionnaire distributed to their authors in May-June 2009;[12] and a report synthesising the contents of the Analytical Country Reports and the results of the questionnaire.[13] A policy note on policies in support of human resources for research[14] and the ERA Monitoring study[15] provided additional policy evidence and examples.

The statistical evidence presented in this report largely comprises IPTS elaborations of data derived from Eurostat and other European sources. Analyses focus on the geographical dimension of researcher mobility, particularly the mobility of doctoral candidates, Marie Curie fellows and members of the Human Resources for Science and Technology Core (HRSTC) population, as defined by the OECD's Canberra manual.[16] The HRSTC population is more broadly defined than many of the other populations that are used to measure the human resources involved in research activities. It is used here because of the availability and reliability of data on this population across a relatively broad span of European countries. [17,18]

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9 A broader definition of spatial mobility would also focus on patterns of collaboration and interaction between researchers in different locations, but due to data availability constraints at a European level we focus here on 'foreign' workers and students, i.e. the citizens of one country conducting research in another country.

10 ERAWATCH is a web-based source of reference material on R&D-related policies in Europe and beyond, compiled by members of the ERAWATCH Network and published on the web by JRC-IPTS. All material can be found at http://cordis.europa.eu/erawatch/.

11 ERAWATCH (2009a). See the following web page: http://cordis.europa.eu/erawatch/index.cfm?fuseaction=reports.contentandtopicID=592andcountryCode=EU.

12 These elaborations were carried out in IPTS by Ana Fernandez-Zubieta.

13 ERAWATCH (2009b)

14 Pontikakis et al. (2009)

15 ERAWATCH (2009c)

16 OECD (1995). The OECD's Canberra Manual defines the different categories of people involved in science, education, research etc. The Human Resource Science and Technology (HRST) population comprises the sum of two overlapping populations: people who have completed third-level education in an S&T field of study (the HRSTE population) plus those who have an S&T education (the HRSTO population). In contrast, the HRSTC sub-population is defined as those people who have completed third-level education in an S&T field of study (the HRSTE population) and have an S&T occupation (the HRSTO population).

17 See Moguerou and Di Pietrogiacomo (2008).

18 The full set of populations referred to in this section spans the four categories of human resources for science and technology defined in the OECD Canberra Manual (HRST, HRSTE, HRSTO, HRSTC); the categories used by OECD and Eurostat covering 'Scientists and Engineers' (SE), 'R&D Personnel' (HC), 'Researchers' (HC/FTE); and another category – 'Science, Engineering and Technology Professionals (SET) – used in Nerdrum and Ekeland et al (2006).

Overall, the report presents evidence covering aspects of mobility in 33 ERA countries: 27 Members States[19] and 6 Associated Members[20]. Most of the statistical data sets used, however, typically cover fewer countries due to variations in the availability and reliability of data.[21]

The remainder of the report is organised as follows: firstly, it reviews the importance of adequate flows of researchers for the development of research capabilities within countries (Section 2); secondly, it presents statistical evidence at a European level concerning the international mobility of researchers (Section 3); thirdly, it reviews the main drivers and barriers to researcher mobility (Section 4). Finally, it discusses effective strategies and policy measures to ensure an adequate flow of human resources for research (Section 5).

2. Mobilising Human Resources for a European Society of Knowledge

Changing perspectives on the important role the research system plays in the evolution of 'knowledge societies'[22] have generated an increased interest in the dynamics of the research system and the role played by researcher mobility. The research system is becoming more dynamic, with more frequent and diverse interactions between its members (e.g. witness the evolution of a 'third mission' for universities involving increased interaction with the industrial community), and one element of this dynamism involves an increase in the mobility of researchers as attempts are made to improve knowledge appropriation[23] and stimulate technology transfer. In turn this has dramatic impacts on researcher communication patterns, career development paths and the policies needed to stimulate mobility and capture the resultant rewards.

The importance of mobilising researchers was recognised in the European Research Area (ERA) Green Paper of 2007[24] and realising a single labour market for researchers became one of the six axes of the ERA, the aim being to create an adequate flow of competent researchers, with high levels of mobility between institutions, disciplines, sectors and countries.

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19 Austria (AT), Belgium (BE), Bulgaria (BG), Cyprus (CY), Czech Republic (CZ), Denmark (DK), Estonia (EE), Finland (FI), France (FR), Germany (DE), Greece (GR), Hungary (HU), Ireland (IE), Italy (IT), Latvia (LV), Lithuania (LT), Luxembourg (LU), Malta (MT), Netherlands (NL), Poland (PL), Portugal (PT), Romania (RO), Slovakia (SK), Slovenia (SI), Spain (ES), Sweden (SE), United Kingdom (UK).

20 Croatia (HR), Iceland (IS), Israel (IL), Norway (NO), Switzerland (CH), Turkey (TR). Policy developments in Liechtenstein (LI) are not yet covered by the ERAWATCH database and are thus not covered in this report.

21 There is general agreement that empirical evidence concerning researcher mobility is limited and that this situation is of particular concern in Europe. See Musselin (2005); Nerdrum and Sarpebakken (2006); Moguerou and Di Pietrogiacomo (2008); Cañibano et al. (2008); all authors of IPTS Analytical Country Reports, ERAWATCH (2009).

22 Authors such as Castells (1996), Beck (1992), and Bauman (2000) point out that the roles played by scientific knowledge and technological development characterise our present-day society and distinguish it from previous societies, e.g. the industrial and post-industrial societies described by Touraine (1968), Bell (1973) and Giddens (1973). Other authors, e.g. Nelson (1959) and Rosenberg (1976), similarly emphasise the role that knowledge and technology play in the economic development of society. In general, therefore, there is broad agreement on the key role that the research system currently plays.

23 Especially the 'tacit' knowledge of individual researchers – see Polanyi (1958).

24 European Commission (2007b), p. 5

Subsequently, the ERA Vision 2020[25] recognised the free circulation of researchers as an important part of the 'fifth freedom' – the free movement of knowledge. In particular, it recognised the importance of developing appropriate structures for the training and balanced circulation of scientific talent and the establishment of a favourable work-life balance for researchers. These priorities set the scene for the development of an egalitarian single labour market that is capable of facilitating mobility between countries, disciplines and career stages.

Policy visions of this nature assume that the increased mobility and interaction of researchers lead not only to new patterns of collaboration and career development paths, but also to increased scientific performance, improved knowledge and technology transfer, the creation of networks and increased productivity.[26] In turn, all of these can be seen as a consequence of the increases in embedded human[27] and social capital[28] that occur as researchers move from one environment to another.[29] A corollary is that both the research system as whole and individual researchers are presumed to benefit from increased researcher mobility.

In the past, fears of 'brain drain' via high levels of outward mobility have dominated both the literature concerned with mobility and policy debates at a country level, and fears of this nature are still commonplace. High levels of outward mobility can still undermine a country's research capacity and lead to a 'brain drain' problem. Moreover, unbalanced levels, i.e. high levels of outward mobility coupled with low levels of inward mobility,[30] can often signal an unattractive research system and create problems when trying to encourage outwardly mobile researchers – especially students – to return home. This has been a particular problem, for example, in Greece.

Although fears of 'brain drain' still exist, current policy efforts are increasingly informed by a 'brain circulation' rather than a 'brain drain' perspective, with policy initiatives attempting not simply to stem the outward flow of researchers via 'brain drain', but aiming instead to encourage a balanced 'brain circulation', with outward mobility levels matching inward mobility levels.[31] Currently, therefore, many European countries try to ensure an adequate flow of researchers via policies designed to maintain similar levels of inward and outward mobility. According to IPTS analyses of data generated during the preparation of a synthesis of R&D-related policy mixes in ERA countries,[32] more countries perceive their levels of inward mobility to be low (nearly three fifths) than those perceiving outward mobility levels to be low (about one third), but rather than countries focusing primarily on attempts to lower outward mobility levels to match those of inward levels, many policy responses focus instead on raising inward levels to match those of outward levels. Increases in the level of inward mobility are perceived as a mechanism for internationalisation, economic growth and

25 European Commission (2008a)

26 These convictions can also be found in other policy documents, e.g. OECD (2000), OECD (2002) and European Commission (2001).

27 See Schultz (1961); Becker (1962).

28 See Bourdieu (1986); Coleman (1988) and Burt (1997).

29 See Granovetter (1985) and Griliches (1973).

30 'Inward' refers to non-nationals and 'outward' refers to nationals abroad.

31 The 'brain drain' concept initially referred to the unidirectional migration of skilled people from less developed to more developed countries or regions. The 'brain circulation' concept addresses geographical mobility as a two-way process in which more attention is paid to the benefits that accrue to the 'transmitter' countries. See Mahroum (2000) and Johnson and Regets (1998).

32 The data used in the preparation of ERAWATCH (2009a) were subsequently explored more extensively by Ana Fernandez-Zubieta in IPTS.

improvement in the quality of research. At the same time, inward mobility is seen as a way of compensating for a lack of local human resources.

Many of the policies attempting to promote inward mobility do so via efforts to lower or remove the barriers to inward flows of researchers. These include low salary levels, the limited availability of research positions, restricted career opportunities, the poor quality of research in national R&D organisations, the low volume and quality of national PhD studies, the absence of transparent and fair recruitment and promotion processes, limited access to high-quality research infrastructures, gender inequality and poor quality of life prospects. Precisely, in fact, the same set of problems that not only deter inward mobility but also drive indigenous researchers to contemplate research careers in other countries. Policy efforts geared to lowering the barriers to inward mobility by tackling these structural problems are thus also likely to lead, eventually, to a decline in outward mobility levels.

Tackling structural changes of this nature is notoriously difficult and calls for a broad sweep of policy measures spanning a range of policy fields, not least those providing incentives and mechanisms for the smoother integration of mobile researchers into local economies and cultures. If successful, however, policies aimed at stimulating mobility and reducing barriers could have much broader implications for the wholesale renovation and modernisation of the national and EU research systems.

3. Statistical Evidence of Geographical Mobility at a European Level

This section analyses the geographical mobility of human resources for research at the European level. The results for three populations are presented: doctoral candidates, Marie Curie fellows (a proxy for 'young mobile researchers of excellent quality'[33]) and the HRSTC population.[34] The analyses involving the first and last of these populations were carried out by JRC-IPTS using Eurostat data. The Marie Curie indicator was constructed at JRC-IPTS using data contained in the Marie Curie report of 2000.[35] Finally, the issue of data availability concerning doctorate and post-doctorate flows by field and the mobility of other research-related populations – the 'Researchers' and 'SET' populations – is addressed.

3.1. Net Flows of Doctoral Candidates in the EU

Doctoral candidates represent an important element of the research labour force and provide some indication of the potential supply of scientists and researchers. Flows of foreign doctoral candidates also provide a measure of the attractiveness of a country in terms of training and, to a more limited extent, research. This section discusses the inflows and outflows of doctoral candidates by country, distinguishing flows between EU Members and other EU Members, and between EU Members and non-EU countries.

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33 Here we use the set of Marie Curie fellowships labelled 'Category 30'. This is the set that contains the largest proportion of Marie Curie fellowships.

34 This population was chosen instead of researchers due to the availability and reliability of information.

35 See ftp://ftp.cordis.europa.eu/pub/improving/docs/mc_annual_report_2000.pdf.

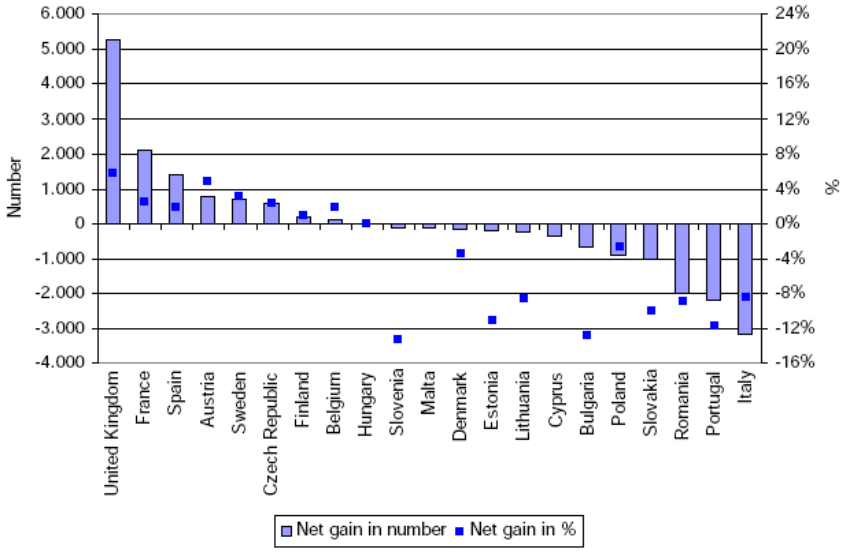
Exhibit 1 presents the net gains in doctoral candidates per country (EU-inflows minus EU-outflows)[36] for 21 countries where information was available and reliable. The UK is the country with the highest net gain in absolute and relative terms. It had a net gain of 5,300 doctoral candidates. This represents 5.8% of the total number of doctoral candidates in the country. France, Spain, Austria, Sweden, the Czech Republic, Finland and Belgium also had positive gains. The highest intra-EU net losses in absolute terms occurred in Italy, Portugal and Romania.[37]

Concerning inflows from non-EU countries, China, Mexico, Morocco and the United States send the most citizens to the EU-21. The UK, France and Spain are the major receivers of doctoral candidates from non-EU countries (Moguerou and Di Pietrogiacomo, 2008).

In terms of absolute numbers, the data also show that the UK, France and Spain are the major receivers of foreign doctoral candidates from both European (EU-21) and non-EU countries.

The level of inward mobility can also be measured by looking at the total and the relative number of foreign student enrolments in tertiary education in the EU-27 (see Exhibit 2).[38] Note, however, that this proxy neither considers net flows nor distinguishes between foreign students of European and non-European origin. Here, total and relative levels of inward mobility per country are counted, regardless of the country of origin and outflows.

Exhibit 1. Intra-EU 'net gains' of doctoral candidates: the difference between the number of doctoral candidates of EU nationality in a country and the number of its doctoral candidates in other Member States (2005).



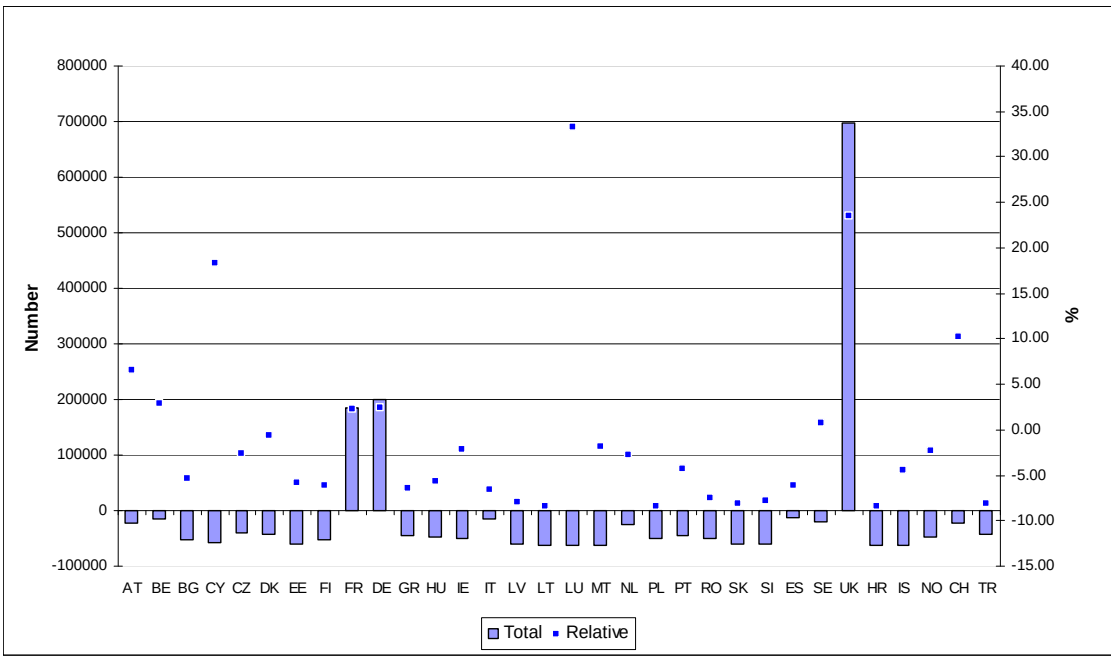
Source: JRC-IPTS with Eurostat data (Moguerou and Di Pietrogiacomo, 2008).
(N.B. Net loss expressed as a percentage is not represented in the Exhibit as it is 143% for Cyprus and 257% for Malta.)

36 That is, the number of doctoral candidates with EU nationality in the reporting country minus the number of its citizens' doctoral candidates in all the other Member States.

37 Greece, Germany and Italy had the highest total EU-outflows. Ireland had the highest share of doctoral candidates from other EU countries, representing over 24% of the total number of doctoral candidates in the country. See Moguerou and Di Pietrogiacomo (2008).

38 That is, the number of foreign student enrolments relative to the total number of enrolments.

Exhibit 2. Foreign student enrolment in tertiary education in the EU-27 in absolute terms and relative to the total number of students enrolled in each country (2006)



Source: JRC-IPTS with Eurostat data.

In 2006, most ERA countries had total and relative levels of inward mobility lower than the EU-27 average. This indicates that the majority of foreign students were concentrated in a few countries. In terms of total numbers, the UK, Germany and France had the largest number of foreign students. Spain, Italy and followed, though with total numbers of foreign students lower than the EU-27 average. In terms of foreign enrolments expressed as a percentage of total enrolments, Luxembourg, the UK, Cyprus and Switzerland were all ten or more percentage points higher than the European average. Austria, Belgium, Germany, France and Sweden also had proportions higher than the European average.

3.2. Net Flows of Marie Curie Fellows

Marie Curie fellows are a very specific part of the research labour force. Their cross-border movements tell us something about the mobility of excellent young researchers – pre- and post-doctoral researchers[39] – between European countries. This section presents the results of an analysis that first calculates the difference between the number of Category 30 Marie Curie fellowships hosted by an EU country in any one year (2000 in this instance) and the number awarded to citizens of the host country to conduct research in other EU countries. The first figure represents a measure of the attractiveness of a country as a location for research and hence acts as a proxy measure of inward mobility, whereas the latter acts as a proxy measure

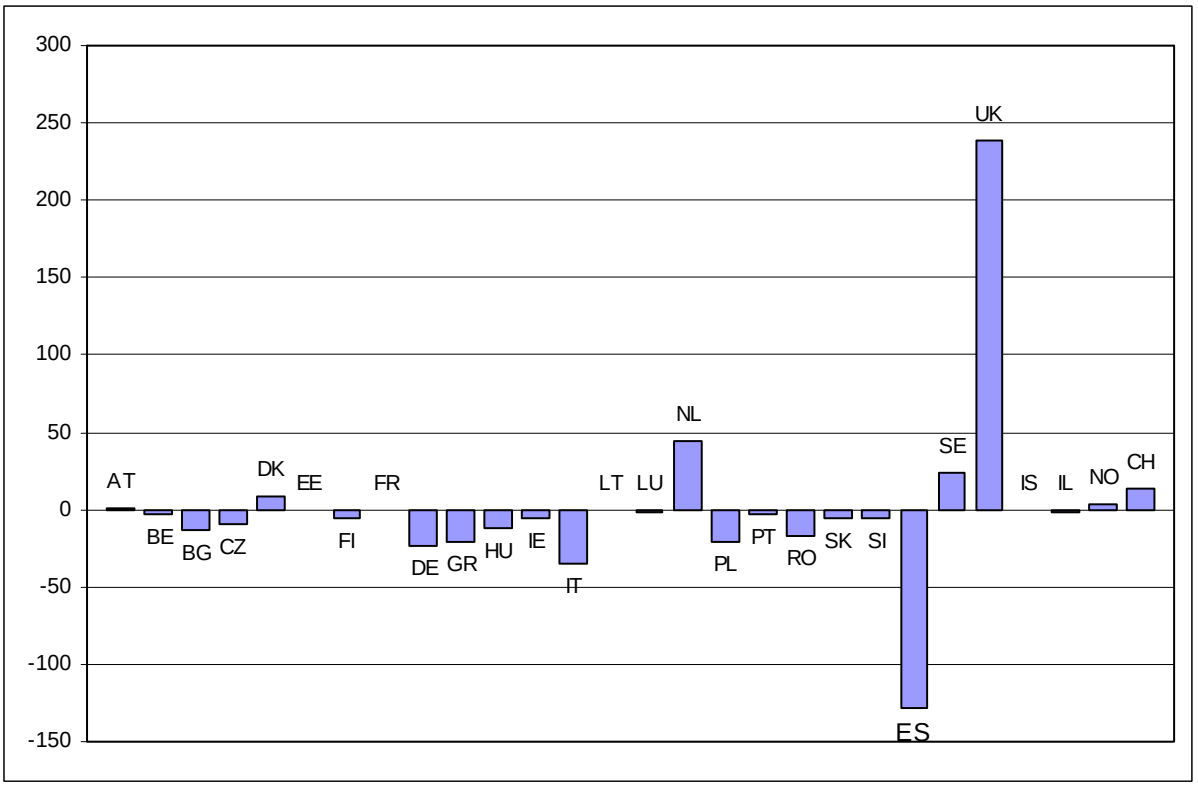
39 The Marie Curie programme is not thematically focused, fellowships can be awarded in any scientific discipline, and host organisations can be in academia or industry. Here we present the results for Category 30 of the Marie Curie fellowships. The programme also includes fellowships for experienced researchers, but these were not included in the analysis due to their small number and differences between their mobility patterns and those of young researchers.

of outward mobility. The difference – the net Marie Curie gain – thus acts as a proxy for net mobility flows.

Comparing across countries, the UK was the country with highest net Marie Curie gain in 2000, with a net gain of 238 Marie Curie fellows (see Exhibit 3). The Netherlands, Sweden, Switzerland, Denmark, Norway and Austria all hosted more Marie Curie fellows than were granted to their own nationals to conduct research in other EU countries. Spain had the highest net loss. The number of Marie Curie fellowships granted to Spanish nationals was 166, but the country only hosted 38 Marie Curie fellows. Italy, Germany, Greece and Poland all had net losses greater than 20.

Compared to the results for the inward and outward mobility of doctoral candidates in Section 2.3.1, the results for Marie Curie fellowships are even more skewed for this cadre of 'young researchers of excellent quality', with the UK once again having the highest difference between inward to outward mobility. In Spain, many excellent young Spanish researchers exploited the Marie Curie fellowship scheme to conduct research abroad, but few researchers from other EU countries exploited the same mechanism to conduct research in Spain in 2000, though the net inward flow of doctoral candidates shown in Exhibit 1 suggests either that this situation may have changed by 2006 or that there are marked differences between the mobility patterns of the post-doctoral and Marie-Curie fellowship populations as far as Spain is concerned.

Exhibit 3. Intra-EU net gains of Marie Curie fellowships: the difference between the number of Marie Curies (cat. 30) hosted by a country and the number granted to applicants of that nationality (2000)



Countries with no fellowships granted are excluded (CY, LV, HR and TR)
Source: JRC-IPTS with Marie Curie reports data.

3.3. Net Flows within the HRSTC Population

The Human Resources for Science and Technology Core (HRSTC) population comprises those people who have completed third-level education in an S&T field of study (HRSTE) who also have an S&T occupation (HRSTO). Data are collected nationally for this population on the size of the population in each country, the proportions of the population that are of national and non-national origin, and rates of change in these figures over time. As such, the set of data on the HRSTC population constitutes one of the most readily available and reliable sources of information at a national level on labour force mobility in the EU.

Exhibit 4 shows the size of the non-national components (Intra-EU and Extra-EU)[40] of the HRSTC population in each country both in absolute terms and expressed as a percentage of the total HRSTC population, together with the corresponding annual growth rates for the non-national components of the population over the period 2000-2006. For the nine Member States for which comparable information was available, the share of non-nationals with EU-27 citizenship (the intra-EU component) increased between 2000 and 2006 from 2.2% to 2.9%. The levels of non-nationals with non EU-27 citizenship (the extra-EU component) also increased from 1.6% to 2.4%. Spain and the UK had the highest increment in the share of the non-national component of HRSTC. Spain had an annual growth rate of 23.9% for the intra-EU component and 29.4% for the extra-EU component. Overall, the non-national HRSTC population levels increased for all nine European countries considered. However, the extra-EU levels increased more than the intra-EU levels, indicating that the EU is rapidly becoming as open to non-EU countries as it is to other EU countries.

Exhibit 4. Non-national (intra-EU and extra-EU) components of the HRSTC Population: absolute numbers (in thousands); shares of the total HRSTC population (in %) in 2000 and 2006; annual growth rates of these components (in %); and evolution of the corresponding shares (in percentage points) over the period 2000-06

	2000				*2006*				*2000-06, average annual growth rates in % and evolution of the share in percentage points*			
	Intra-EU-27	*%*	*Extra-EU-27*	*%*	*Intra-EU-27*	*%*	*Extra-EU-27*	*%*	*Intra-EU-27*	*Share*	*Extra-EU-27*	*Share*
Belgium	36	4.5	7	0.9	45	4.9	8	0.9	3.8	0.4	2.3	0.0
Greece	4	0.7	3	0.5	5	0.7	4	0.5	3.8	-0.1	4.9	0.0
Spain	26	1.1	16	0.7	94	2.7	75	2.1	23.9	1.5	29.4	1.4
Cyprus	3	6.4	1	2.1	3	4.6	2	3.1	0.0	-1.8	12.2	0.9
Luxembourg	12	38.7	1	3.2	22	48.9	1	2.2	10.6	10.2	0.0	-1.0
Netherlands	27	2.1	10	0.8	33	2.0	12	0.7	3.4	-0.1	3.1	-0.1
Austria	17	5.2	11	3.4	34	7.7	13	2.9	12.2	2.4	2.8	-0.5
Sweden	24	2.6	13	1.4	30	3.0	15	1.5	3.8	0.4	2.4	0.1
United Kingdom	80	2.0	105	2.6	110	2.3	188	4.0	5.5	0.3	10.2	1.4
Total 9 MS	**229**	**2.2**	**167**	**1.6**	**376**	**2.9**	**318**	**2.4**	**8.6**	**0.6**	**11.3**	**0.8**

Source: JRC-IPTS with Eurostat data (Moguerou and *Di Pietrogiacomo, 2008).*

[40] As noted earlier, Intra-EU = the population coming from other EU countries; Extra-EU = the population coming from non-EU countries.

3.4. Other Sources of Information on Net Flows

Little information at a national level concerning the mobility of national, EU and Non-EU researchers is available for all or even most of the EU countries. Information on researchers by citizenship, for example, is available in Eurostat for only seven countries (the Czech Republic, Estonia, Latvia, Hungary, Malta, Romania and Slovakia).[41] These represent only 7% of the population of researchers in the EU-27.[42] Concerning 'Science, Engineering and Technology Professionals' (SET Professionals),[43] information is available for six European countries (France, Germany, the Netherlands, Norway, Poland and the UK). For these, the proportion of non-national SET Professionals is 0.1% in Poland, 4.5% in the Netherlands, 4.8% in France, 6.2% in Germany, 7.0% in Norway and 10.2% in the UK.[44] Information on the mobility of doctoral and postdoctoral researchers in EU by field is also available for nine EU Countries (the Czech Republic, Germany, Spain, France, Hungary, Italy, Portugal, Sweden and the UK) through the Ret Re Act survey in 2005 and the Rescar survey in 2007, both commissioned by IPTS.[45] From these, we know that postdoctoral life scientists are the most mobile, with non-nationals comprising 42% of the doctoral and postdoctoral populations studied.

4. Drivers and Barriers to the Inward and Outward Mobility of Researchers

All the evidence concerning flows points to the fact that variations between countries are heavily skewed, with a small number of countries – notably the UK – acting as a magnet for different research-related populations, both of EU origin and, increasingly, of a non-EU origin. For the majority of countries, however, the partial data available suggest that both inward and outward mobility levels are moderate to low, with outward mobility levels frequently slightly higher than inward levels. These patterns suggest that the drivers and barriers associated with inward and outward mobility vary significantly between a few countries and the rest, but may be similar within these respective groups. In this section, therefore, we draw upon material contained within the Analytical Country Reports prepared by the ERAWATCH Network for IPTS to review the different barriers and drivers associated with international researcher mobility – both inward and outward.

Earlier we noted that many factors could have a potential impact on researcher mobility. These include salary levels, the quality of research in a particular country, the calibre of the research infrastructure, the visibility and availability of positions and the existence of legal and regulatory hurdles governing aspects such as the transferability of pensions or access to health and social welfare schemes.

In terms of salaries, remuneration levels for researchers vary considerably both within the EU-25 and the Associated Countries, and between the EU and the US, Japan and Australia, where salaries are generally higher.[46] This could be one factor explaining why the number of

41 The data in Exhibit 4 for nine countries refers to the broader HRSTC population.

42 Moguerou and Di Pietrogiacomo (2008), p. 84

43 This population is larger than the population of researchers. See European Commission (2008b) and Moguerou and Di Pietrogiacomo (2008) for more details.

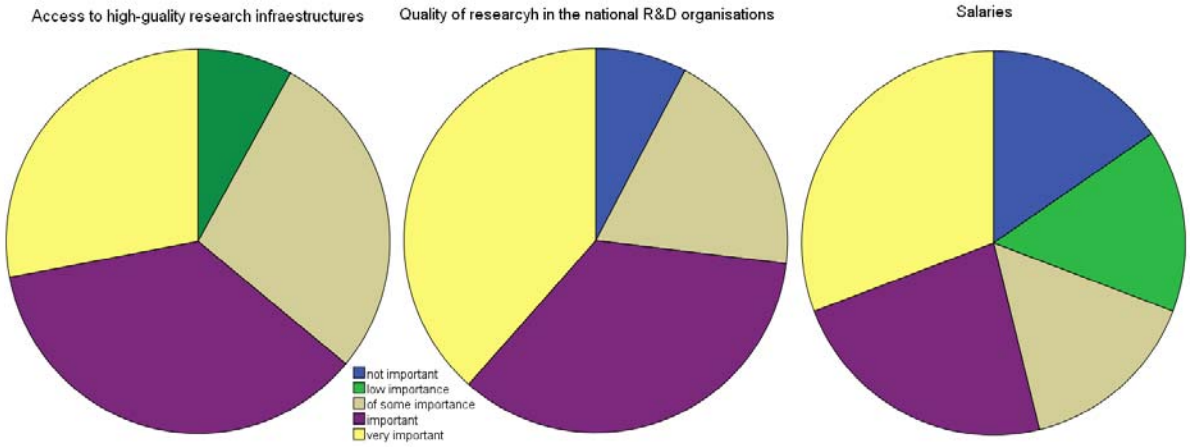
44 Moguerou and Di Pietrogiacomo (2008)

45 See Moguerou and Di Pietrogiacomo (2008).

46 European Commission (2007c)

researchers per thousand of the labour force is lower in the EU-27 (5.0) than it is in Japan (11.4) or the US (9.3).[47] However, although the prospect of higher salaries is generally considered to be an important driver of mobility (and low salaries a disincentive or barrier to mobility), salary levels may not be the most important driver or barrier to international mobility. In a recent survey, the authors of the Analytical Country Reports produced by the ERAWATCH Network cited the quality of the research conducted in national R&D organisations and access to high-quality research infrastructures as important drivers/barriers more frequently than they cited salaries (see Exhibit 5). The differences, however, are not as noteworthy as the fact that all these factors were considered to be important determinants of mobility, and that this was the case in most EU Member States and Associated countries.[48]

Exhibit 5. Most important drivers of inward researcher mobility



Source: JRC-IPTS elaborations of a questionnaire distributed to the authors of the ERAWATCH Analytical Country Reports

Looking across all the ERAWATCH Analytical Country Reports, salary differentials frequently act either on their own or in conjunction with other factors to both stimulate mobility (from countries with low levels to those with high levels) and to limit movements (from countries with high levels to those with low levels). In Estonia, for instance, low remuneration levels mean that researchers in the public sector frequently have to combine several jobs, which is hardly an attractive proposition, while in Spain rigid wage scales and a lack of productivity incentives act as spurs to outward mobility and a deterrent to inward mobility. In Slovakia, low levels of remuneration are exacerbated by a dearth of opportunities for young researchers, making it difficult for young scientists and engineers to follow research careers when other occupational opportunities are both more abundant and lucrative. In some countries, however, the incentive to switch career tracks from relatively low paid research posts in the public sector to higher paid posts in the private sector (both research posts and others) is partially countered by higher job security in the public sector (as in Croatia, for example).

Low salaries, poor research reputations and relatively weak research infrastructures are relatively overt barriers to mobility, but others are more subtle. A preference for indigenous researchers over 'foreign' researchers, for example, is often covert rather than overt and can

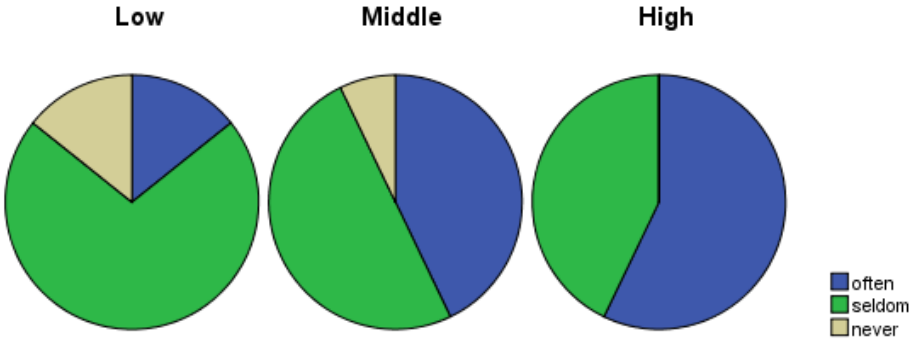
47 European Commission (2008c) p. 53

48 These findings are in line with earlier work stressing the importance of excellence and reputation (Merton,1968) as determinants of scientific behaviour.

be either intentional or unintentional – the result, for example, of a failure to advertise vacancies sufficiently outside of a country, or a consequence of underestimating the language barriers that foreign researchers have to overcome, or implicitly favouring mobility links with researchers in countries with which there are strong historical and cultural ties.

There is evidence, however, that some of the less tangible barriers to mobility are themselves linked to more overt factors driving or restricting mobility, in particular the relative strength of a country's research capacity. Exhibit 6 shows the results of an analysis of the data produced via the questionnaire completed by the authors of the ERAWATCH Analytical Country Reports. It demonstrates a link between the research capacity of a country and the frequency with which research posts are advertised internationally – with 'strong' countries advertising internationally far more frequently than countries with 'weak' research capacities.[49]

Exhibit 6. The relationship between research capacity (high/middle/low) and the frequency (often/seldom/never) of the international advertising of research positions

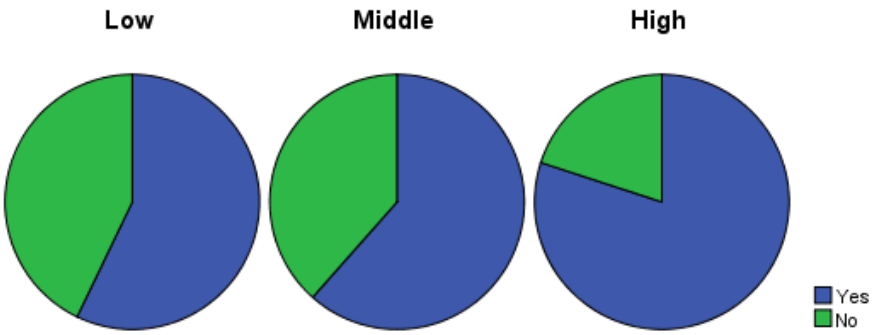


Source: JRC-IPTS elaborations of a questionnaire distributed to the authors of the ERAWATCH Analytical Country Reports

More broadly, a similar analysis reveals that research capacity is also linked to the existence of equal opportunities for indigenous and foreign candidates for research positions (see Exhibit 7). Whatever the nature of some of the more subtle barriers to equal opportunities, they appear to be far less pronounced in countries with strong research capacities.

[49] The ERA countries are divided into three groups according to their research capacity, measured in terms of GERD as a percentage of GDP in 2006. The cutting points ─ percentile 25 and 75 ─ are calculated using the EU-27 average in order to be consistent with other statistics used in this chapter. The ERA associated members are included in one of these groups after calculating the cutting points. The low-end capacity group comprises Cyprus, Romania, Bulgaria, Slovakia, Poland, Greece, Turkey and Malta; the medium capacity group comprises Latvia, Lithuania, Croatia, Hungary, Portugal, Italy, Estonia, Spain, Ireland, Norway, Czech Republic, Slovenia, Luxembourg and the Netherlands; the high-end capacity group comprises Iceland, Israel, Switzerland, the United Kingdom, Belgium, France, Austria, Denmark, Germany, Finland and Sweden.

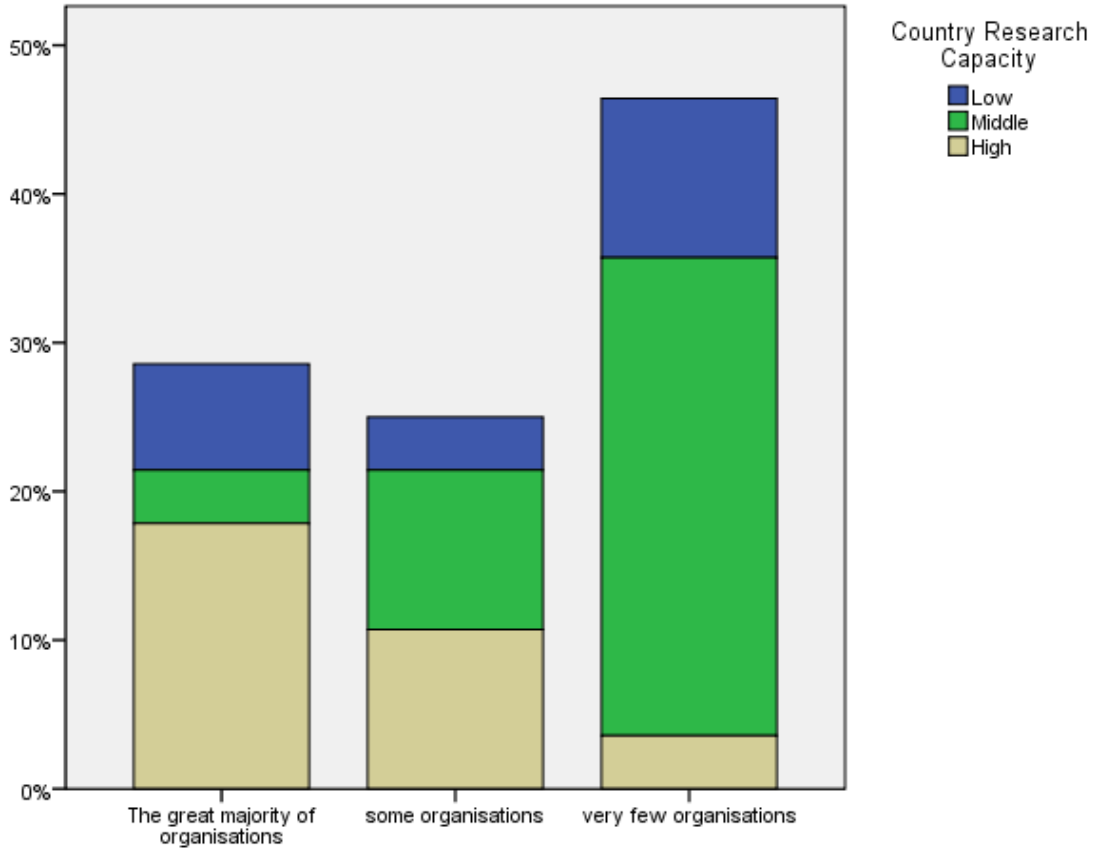
Exhibit 7. The relationship between research capacity (high/middle/low) and the existence of equal opportunities for foreigners to get permanent research positions



Source: JRC-IPTS elaborations of a questionnaire distributed to the authors of the ERAWATCH Analytical Country Reports

Exhibit 8 further shows that more organisations have signed the Charter for Researchers in countries with strong research systems than in those with weaker systems. Overall, however, very few organisations have signed it.

Exhibit 8. The relationship between research capacity (high/middle/low) and the number of organisations (the great majority/some/very few) in a country that have signed the Charter for Researchers



Source: JRC-IPTS elaborations of a questionnaire distributed to the authors of the ERAWATCH Analytical Country Reports

According to the authors of the ERAWATCH Analytical Country Reports, ease of access to the benefits of social welfare systems (e.g. access to national insurance systems, health care, pensions, maternity leave etc.) is not a major factor affecting mobility as far as job positions are concerned. Indigenous and foreign researchers employed in EU countries have equal, indiscriminate access to the benefits of such systems. The situation is different, however, for time-limited studentships and post-doctoral fellowships.[50] In some countries, indigenous and foreign students and post-docs are treated differently, both from a tax perspective and in terms of access to social benefit systems. In other countries (e.g. Luxembourg, the UK and the Netherlands), they are not. In Spain, different rules apply at different stages of the life-cycles of studentships and post-doctoral fellowships, while in other countries equal access to social benefit systems for research students and post-docs from particular countries is the outcome of bilateral or multilateral agreements. At a Community level, Art. 17 of EU Regulation 1407/71 and instruments such as scientific visas for researchers from non-EU countries have the potential to lower barriers to mobility by providing for equal access to social benefit systems, but to date limited use has been made of such visas.

Considering all the evidence available on drivers and barriers to the inward and outward mobility of researchers, it is clear that a number of strong and obvious factors that help determine mobility flows, e.g. salary levels and the comparative quality of research communities and infrastructures, are complemented (or exacerbated) by a range of more subtle factors, often difficult to discern clearly because of the varying levels of transparency or opacity surrounding recruitment procedures. It appears, however, that many of the subtler factors hindering mobility are stronger or more prevalent in systems with weaker research capacities. Why this is so is not immediately obvious, but one possibility is that the greater degree of openness and transparency associated with recruitment procedures in countries with strong research capacities (reflected in part by their greater propensity to advertise research positions internationally) makes it more difficult for subtle deterrents to mobility (e.g. conscious or unconscious xenophobia) to continue to exist. Policy efforts to increase transparency could thus have a positive influence on overall levels of mobility. These could include greater efforts to encourage the use of scientific visas and the adoption of a uniform set of open and transparent selection procedures and criteria for post-graduate studentships and post-doctoral fellowships across the EU.

5. National Strategies Encouraging Brain Circulation

Data provided in the report synthesising the Analytical Country Reports discussed earlier[51] suggest that there are marked differences between the mobility flows associated with countries with high and low research capacities. Exhibit 9 shows that countries with high research capacities generally have high or medium flows in terms of both inward and outward mobility (Switzerland, Austria, Sweden, and Israel). The exceptions are Denmark, which has medium outward mobility and low inward mobility, and the UK and Iceland, both of which are outliers in very different ways. The UK, for example, has high inward mobility but low outward mobility, whereas for Iceland the situation is just the reverse – high outward mobility but low inward mobility.

50 European Commission (2008b)

51 ERAWATCH (2009b). Please note that data relating research capacity to mobility flows were not available for Belgium, France, Germany, Finland (High Research Capacity) or Romania and Malta (Low Research Capacity).

Exhibit 9. The relationship between research capacity (high/middle/low) and inward and outward mobility flows (high/medium/low)

Inward Mobility (IM) Greater than Outward Mobility (OM)

	High Research Capacity			Medium Research Capacity			Low Research Capacity		
	High IM - Low OM	High IM - Medium OM	Medium IM - Low OM	High IM - Low OM	High IM - Medium OM	Medium IM - Low OM	High IM - Low OM	High IM - Medium OM	Medium IM - Low OM
IM>0M	UK			IE	LU	NO			

Outward Mobility (OM) Equals Inward Mobility (IM)

	High Research Capacity			Medium Research Capacity			Low Research Capacity		
	High IM - High OM	Medium IM - Medium OM	Low IM - Low OM	High IM - High OM	Medium IM - Medium OM	Low IM - Low OM	High IM - High OM	Medium IM - Medium OM	Low IM - Low OM
0M=IM	CH	AT			HR	SI			BG
		SE				HU			PL
						CZ			TR
						EE			

Outward Mobility (OM) Greater than Inward Mobility (IM)

	High Research Capacity			Medium Research Capacity			Low Research Capacity		
	High OM - Low IM	High OM - Medium IM	Medium OM - Low IM	High OM - Low IM	High OM - Medium IM	Medium OM - Low IM	High OM - Low IM	High OM - Medium IM	Medium OM - Low IM
0M>IM	IS	IL	DK	LV	NE	PT	GR	CY	SK
				LT		IT			
						ES			

In contrast, countries with low research capacities tend to have low to medium inward and outward mobility flows. Bulgaria, Poland and Turkey, for example, all have low inward and outward flows, while Slovakia has low inward flows and moderate outward flows. For both Greece and Cyprus, however, the situation is more serious. Cyprus has moderate inward flows but high outward flows, while Greece also has high outward flows but only low inward flows to compensate.

In countries with high research capacity and high levels of internationalisation, policies geared towards improving the quality of the research system can generally be expected to have positive influences on inward mobility flows given the broad correlation between research capacity and mobility flows. Correspondingly, there is little overt emphasis on policies specifically designed to improve either inward or outward mobility levels, though policies aimed at improving inter-sectoral and inter-institutional mobility (e.g. between government labs, universities, RTOs and industrial enterprises etc.) are becoming more

prevalent. Instead, a wide variety of policies aim to raise standards of excellence and improve research institutions and infrastructures, all of which have a tendency to attract foreign researchers (and retain indigenous ones).

For countries with weaker research capacities, scarce resources frequently constrain efforts to improve research systems across the board and specialisation on specific thematic areas is becoming more commonplace (e.g. in Spain), sometimes complemented by targeted efforts to improve human resource competences in specific areas, improve career prospects, encourage national institutions and researchers to participate in international programmes and infrastructures and collaborate with researchers in other countries. Increasingly, measures designed to attract inward flows of top class and young researchers and others encouraging migrant researchers to return home are also in evidence, as are efforts to ensure that indigenous and foreign researchers are truly integrated into national systems rather than treated differentially. Efforts such as these, however, are still comparatively rare, especially in those countries with the lowest research capacities and perhaps the most severe mobility problems, either in terms of low mobility levels all round or in terms of high net outward flows. Also conspicuous by their relative absence are concerted efforts to create truly open systems by lowering the overt and covert barriers to mobility, particularly the barriers to outward flows of researchers. When indigenous human resource problems are severe, there is often a temptation to encourage inward mobility but restrict outward mobility, even though exemplary practice in countries with high research capacities is to favour both.

One of the most promising routes for those countries attempting to encourage greater mobility is to target young researchers – post-graduate and postdoctoral fellows – given that the attractions of mobility tend to be greatest in this age range. This is a route increasingly being taken by countries of low, medium and high research capacity, with many institutions often offering courses in English as an inducement to foreign researchers. In the long-term, however, these efforts will also have to be complemented by other policy measures that enhance the integration of foreign and indigenous researchers, ensure equality of opportunity in terms of future career prospects, and facilitate future mobility – including the prospect of return migration.

6. Knowledge Flows and Mobility: Summary and Policy Implications

6.1. Summary

Our current understanding of mobility based on the evidence reviewed in this report can be summarised as follows:

- Increased mobility and the greater interaction of research-related personnel are increasingly seen as routes to the creation of dynamic networks, improved scientific performance, improved knowledge and technology transfer, improved productivity and ultimately enhanced economic and social welfare;
- There is a broad divide between countries that have embraced the concept of ‘brain circulation’ and those that have not;
- Inward and outward mobility levels for researchers are comparable in many countries, though outward mobility is higher than inward mobility in a similar proportion of

countries. Inward mobility is only higher than outward mobility in a small number of countries, most notably the UK;

- Countries with strong research systems tend to have higher levels of both inward and outward mobility than those with weak systems, though this is not always the case (e.g. the UK has a strong research system and high inward mobility levels, but low outward flows, while Greece has a relatively weak system and low inward flows, but high outward flows);
- The major beneficiaries of intra-European flows of doctoral candidates are also the major beneficiaries of flows from non-European countries, and there is some evidence that Europe could be opening up more rapidly to non-European countries than to European countries;
- A concise understanding of intra-EU and extra-EU researcher mobility patterns is hindered by the lack of availability of relevant, comprehensive data sets. This needs to be rectified if progress towards the creation of a fully-functioning European Research Area is to be monitored and facilitated;
- Factors having a strong impact on mobility flows are the quality of research conducted in a country, its past reputation, the strength of its research institutions and infrastructure, and salary levels for researchers;
- A broad range of other more subtle factors – both unintentional and intentional – also influence mobility flows. These range from a failure to advertise positions internationally to limited efforts to help foreign researchers overcome language and cultural barriers;
- In countries with strong research capacities, broad based policies to improve research systems are generally presumed to have positive impacts on overall mobility levels. These countries typically acknowledge the benefits of 'brain circulation' and tend to welcome mobility, with institutions advertising positions internationally and making greater use of instruments such as the European Charter of Researchers;
- In countries with weaker research capacities, the potential for deleterious 'brain drain' is greater and the attractions of 'brain circulation' less immediately obvious, though the benefits of the latter are increasingly being recognised in some quarters. More focused policy efforts are needed to improve research capacities in specific areas rather than across the board, and these efforts need to be complemented by targeted policies promoting mobility via a focus on improved opportunities for young researchers and greater incentives for emigrant researchers to return home.

6.2. Policy Implications

The historical evidence on mobility, patchy and incomplete as it is, generally suggests not only that there is currently a broad divide between 'mobility winners' and 'mobility losers', i.e. between those countries that have developed an enviable track record in attracting, absorbing and exploiting the knowledge embodied in the mobile researcher population and those suffering far more 'brain drain' than 'brain gain', but also that this divide or gap could widen unless appropriate steps are taken by individual countries, notably by the current crop of 'mobility losers', to develop policies that encourage a balanced and expanded 'brain circulation' rather than policies that simply attempt either to stem outward flows or to encourage inward mobility.

As things stand, 'mobility winners' not only enjoy an enviable reputation for research excellence, which acts as a magnet for high quality researchers, but they also tend to have

more ‘open’ regimes in place, with far fewer legislative or regulatory hurdles impeding the flow of knowledge either in or out of their boundaries. In contrast, many of the ‘mobility losers’ have more weakly developed R&D capacities and infrastructures and suffer from ‘closed’ regimes in which regulatory hurdles, nourished by fear of ‘leakage’, constrain outward flows of researchers, with few incentives in place to encourage foreign researchers to relocate and boost inward mobility.

In such circumstances, the policy options for ‘mobility winners’ intent on benefiting most from EU-wide attempts to improve knowledge flows and encourage greater ‘brain circulation’ are simple: keep focusing on excellence along (typically) broad fronts in order to maintain the attractiveness of their research systems while maintaining and expanding efforts to reduce barriers to mobility. For the current ‘mobility losers’, however, the options are not as clear cut. In many instances, the resources needed to focus on excellence along a broad front and raise standards to anything approaching even EU averages are just not available, which in turn argues for policies designed to bolster research capacity, infrastructures and excellence on much narrower fronts in selected niche areas. It also argues, however, for much more concerted, parallel efforts to lower mobility barriers in order to encourage inward flows in these areas, with special emphasis, perhaps, on initiatives designed to encourage outward-bound researchers to return home after benefitting from their experiences abroad. Conversely, attempts to maintain or strengthen existing barriers to mobility on the grounds that lowering barriers will exacerbate ‘brain drain’ should be resisted, since there is little evidence to support the efficacy of this approach.

It is also important to highlight one other point about mobility. Most of the efforts made to create ‘open’ regimes and stimulate ‘brain circulation’ by existing ‘mobility winners’ in the EU are not specifically geared towards stimulating the flow of embedded knowledge solely between EU countries, but designed instead to encourage global flows. EU policies should take this into account by encouraging Member States to harmonise existing practices in line with some of the best practices found in the leading European ‘mobility winners’, most of which make little distinction between EU and non-EU researchers. This will undoubtedly encourage intra-EU ‘brain circulation’, but it is also likely to enhance the overall attractiveness of Europe as a major hub for global ‘brain circulation’, with positive consequences for R&D and innovation performance across the EU.

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Abstract

This report focuses on some of the knowledge creation and circulation processes that underpin the development of knowledge-based societies. Specifically, the report looks at aspects of human resource development and researcher mobility within the European Research Area (ERA) and between the ERA and other parts of the world. This topic is critical to the evolution of the ERA and the free circulation of knowledge within it, the so-called "Fifth Freedom". Recent developments are reviewed and the implications for further policy assessed.

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