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Abstract

The mobility of doctorate students, researchers and university professors has typically been considered a specialised sub-category of migration studies. Economic rationales may also drive the mobility of academic population, but they are not the sole or even the primary reason for such mobility. The mobility of academics and other highly skilled workers is being taken into account by policy makers and by business leaders as an important tool of knowledge accumulation, transfer and building up collaboration. The European Union has developed a large-scale programme known as the European Research Area (ERA). The vision of ERA was to accelerate brain circulation within the EU and to improve the training of scientists through both education reform and circulation. Following the clarification of mobility-related definitions, terminologies and typologies of mobility the paper summarises the mobility relevant policies and measures at the EU level. Then its novel analysis screens national policies/programmes by FP7 mobility related actions. The implementation of common goals in national policies is crucial criteria for realizing ERA.

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Introduction

It is increasingly common for researchers to pursue an international career. Although scholars have been internationally mobile for centuries, the process has been speeding up in the current era of globalisation and knowledge economies.

The mobility of doctorate students, researchers and university professors has typically been considered a specialised sub-category of migration studies. Economic rationales may also drive the mobility of academic population, but they are not the sole or even the primary reason for such mobility. Researchers' interest in science and inquiry are considered more important than pure economic returns. As many studies have demonstrated, the mobility of academics has a strong extra-market orientation.

The mobility of academics and other highly skilled workers is being taken into account by policy makers and by business leaders as an important tool of knowledge accumulation, transfer and building up collaboration. Mobile students, researchers and other professionals are, not only knowledge conveyors across countries but are also transferring codified and tacit knowledge between sectors both at the domestic and international levels. Because of that, international mobility has generally been considered to have positive effects on both researchers and their environment.

In response to the growing importance of the knowledge economy in European life and emerging global competition for brains, the European Union (EU) has developed a large-scale programme known as the European Research Area (ERA). The vision of ERA was to accelerate brain circulation within the EU and to improve the training of scientists through both education reform and circulation. It was assumed that the creation of an 'internal market' for research (Europianisation) would help to keep the outwardly-mobile EU academics in Europe, including star scientists, draw expatriates back home and attract excellence into Europe from third countries. EU research framework programmes (FPs) are playing important roles in the implementation of ERA targets. The most important European agendas are: attracting the best and most appropriate researchers from different geographical areas to the EU in different organisational sectors (academic, industrial) and/or involving them in FP7.

The implementation of ERA policy targets has shifted within the European policymaking processes. Linking or joint programming of European Commission and member states has emerged. The successful development of ERA depends to a great extent on how each member state implements the actions and budgets for the common European goals via its national legislation.

This paper investigates how the European Framework Programmes (in particular FP7) have been able to improve the mobility of European researchers and post-graduate students. It further examines how the programmes and incentives of member states are implementing European programmes.

The first chapter summarises the mobility relevant policies and measures at the EU level to back up further analysis, while the second section briefly describes the most relevant definitions, terminologies and typologies of mobility, for purposes of general clarity. The state of play on researchers' mobility in Europe and capacity of attractiveness are studied in the third chapter, while the fourth chapter attempts to screen national policies/programmes by FP7 mobility related actions.

Mobility relevant policies and measures at EU-level

EU programs and national programs support one another in the performance of ERA. FPs expressing joint European aims are supported at the EU level, and national programmes decided in National Action Plans clearly demonstrate how joint European targets are becoming national actions. The present European targets are deeply rooted in ERA policy

aims and in previous FPs.² Most of the mobility-related progress is overarched by the FPs, allowing us to observe how national policies have introduced common goals. Although information as to how member states are implementing common European goals is not yet available, the first step for surveying the situation has been made.

Key definitions, terminologies and typologies of mobility and methodology

The definitions, terminologies and typologies of mobility are differing by their maturity. Some of the definitions are internationally harmonised and accepted among the experts, but some of the others are only preliminary that we have to use in this report.

The researchers are defined in The Frascati Manual (OECD 2002. p. 93) that is widely accepted. Another OECD manual, The Canberra Manual (OECD 1995) proposes a definition of *Human Resources in Science and Technology (HRST)*. A bit more workable definition was proposed by the ISER expert group for *science, engineering and technicians (SET)* professionals. ‘SET professionals’ should be defined as people who fulfil *both* of the following criteria: (1) Possessing tertiary education at or above ISCED97 level 5, and (2) having an occupation in selected areas. These fields are the following, by ISCO codes: ISCO 211-214, 221-222 and 231³. This definition comes from the ‘HRST-core’ logical concept of the Canberra manual, but it is not an equivalent to it.

Future HRST is *students. PhDs or doctoral students* are defined as people who have tertiary education at or above ISCED97 level 6 (i.e. doctorate holders). PhD students are the most mobile part of the population. The internationalisation of the post-doc workforce is largely supply-driven through education and training.

One of the typical target groups for attracting researchers in a country are the *best* and/or *most appropriate* researchers in the mobility programmes. There are no internationally accepted definitions for them. This paper uses these terms colloquially.

Colloquially the *best* researcher may be identified as the most skilful. The most *appropriate researcher or HRST* may be defined as the person who is the most suitable for the job, for a

² In 2005 the *European Charter and Code* made clear the value of mobility: “Employers and/or funders must recognise the value of geographical, inter-sectoral, inter- and trans-disciplinary and virtual (i.e. remote collaboration over electronic networks) mobility as well as mobility between the public and private sector as an important means of enhancing scientific knowledge and professional development at any stage of a researcher’s career.” In April 2007, the European Commission’s *Green Paper on the European Research Area* reconfirmed the importance of these two areas of action for the realisation of a European Research Area: a high level of mobility of researchers between countries and institutions and fully opening up academic research positions across Europe. In 2008, the EC Communication on mobility and careers [182] proposed the development of a partnership with member states to ensure that researchers across Europe could benefit from attractive careers and from the removal of barriers to their mobility (including the introduction of systematic open recruitment of European researchers).² The *ERA Expert Group Report* (2008, EUR 23321) on Realising a Single Labour Market for Researchers has identified the policy options in order to progressively eliminate the obstacles hampering researchers’ mobility. The implementations of several conditions by different actors will determine whether Europe does indeed become a single labour market for researchers and an attractive location for non-European talents. The European Commission can lead this process but member states have to be very active in matching legislation, regulations, measures and programmes. FP7 is focusing on these options and continuing previous initiatives either through modifications of the previous actions or launching new ones.

³ ISCO 211 Physicists, Chemists and Related Professionals; ISCO 212 Mathematicians, Statisticians and Related Professionals; ISCO 213 Computing Professionals; ISCO 214 Architects, Engineers and Related Professionals; ISCO 221 Life Science Professionals; ISCO 222 Health Professionals (except nursing); and ISCO 231 College, and University, and Higher Education Teaching-Professionals.

special purpose. In the mobility context the most appropriate implicitly includes missing knowledge at an organisation or in a country. The most appropriate incoming international expert may be an experienced manager who can guide the development of an invention through to commercialisation as this capability is usually missing at European universities.

Appropriate HRST can diminish the shortage of qualified people in a given field either to replace the outflow or to increase the available intellectual capacity. At the moment, mobility statistics are insufficient to measure researchers by these categories.

'*Mobile*' is defined as relating to everyone who has moved in from abroad to the national labour force or national education system. Usually, *mobility* is used to designate any type of change of country, job, employer, function, employment status, other types of transitions of labour or student status. International mobility comprises only those who have come from abroad at one point in time prior to the observation period.

For a better understanding of geographical mobility two terms are relevant here: '*foreigner*' and '*international*'. Three international organisations (Eurostat, OECD, and UNESCO) have developed a new term for international doctoral students that can apply to researchers too.

The term *international student* refers to students who have crossed borders with the express intention to study. International students are those who are not residents of their country of study or those who received their prior education in another country.

Foreign students (or foreign researchers) belong to an old statistical classification. Beyond the above mentioned international group, it includes all non-citizens who are studying or doing research in the country. They may have arrived in the country earlier with other intention as studying or doing research activities (more details in: OECD Education Database, 2009). Classification of non-naturalised 2nd or 3rd generation of immigrants as 'foreigners' does not represent the real inflow of HRST.

Recurrent mobility is used in the contexts of international collaboration, networks, and platforms. *International collaboration* is an important source of knowledge inflows. It can take a variety of forms and may occur at different levels or have different actors of interaction ranging from simple one-way information flows to highly interactive, formal arrangements. Actors can be individuals or intra-sectoral and inter-sectoral institutions.

Among the different types of mobile HRST, it is worth distinguishing them by their *employers*, by *categories* of mobiles, by *physical categories* and by length of stay:

- 1) By employers the mobility may be
 - a. Intra-sectoral
 - i. Between academic organisations
 - ii. Among firms
 - b. Inter-sectoral
 - i. Between firms and public research sectors
 - ii. Between academia and public sector

Each type of these may occur by any dimensions (regional, national, international).

2) By mobiles, several categories can also be distinguished:

- a) Potential S&E, student mobility
- b) Researchers
- c) Non-researcher HRST (engineers, medical doctors, lawyers, marketing managers and so on)

Mobiles also may be differentiated by the initiators of mobility, such as posted, recruited, job-seekers. These categories are general and not HRST specific.

- 3) By type of physical conditions for mobility:
 - a) Geographical Virtual Virtual mobility is an effective and efficient complement to physical mobility.
 - b) Mixed (combination of physical and virtual mobility). Each kind of geographic (or physical) mobility may have intra- or inter-sectoral dimensions.
- 4) By length of stay
 - a) Short-term mobility (for giving a lecture, discussion on joint research, participating on workshops or conferences, teaching or studying on summer or winter schools, study tours, guest researchers or guest professor for 1 semester)
 - b) Long-term mobility is a delicate issue. Migration statistics is using more than 1 year (366 days) as borderline for migrants. It may employ the same numeric measure in mobility statistics. However many national statistics takes into account a shorter period as long-term mobility if students or professors are sending / hosting at least half a year visits. (Hardly mobile countries are using 3 month as borderline for long-term mobility.) There are pros and cons to these different lengths as long-term mobility.

The attempts comparing mobility related national policy measures of EU member states basically build upon Trendchart country reports containing information on national actions and mobility related research programmes (national legislation, programmes, allocated budgets, and incentives). The study also made use of some other international information sources to touch upon how European nations are progressing in the creation of mobility framework conditions.

Data used in this paper are descriptive statistics relating to EU mobility programs and national mobility patterns. Data were collected from EU and non-EU sources to give a reliable picture of the process, although the analysis was limited by the scarcity of available data.

Researchers' mobility in Europe and capacity of attractiveness

Putting Europe in a global context, the number of European inhabitants (EU27) is 40% less than population of China, but the number of European R&D personnel (in FTE) is significantly higher (36% more) than the corresponding Chinese figure. The total R&D personnel to total employment are a marginal fraction in any country. In 2007 it was 1.08 in EU27 (1.21 for EU15) and 0.23 for China.

Comparing the US and the EU27, the differences in population size are the following: the population of the EU27 now reaches 497 million, while there are 304 million people living in the US. The GDP per inhabitants in 2009 (market prices, Euro) was 32,900 in the US and 23,600 in the EU27 (27,500 for the EU15). Table A-2 gives the basic comparative figures on large geographic regions.

European R&D personnel may play an important role in decreasing the gap between the EU27 and other advanced regions, bringing the EU15 and the NMSs closer to each other.

According to an EU Report (2008, STC 2008/2009) the total non-national HRSTC having EU27 citizenship increased from 229,000 in 2000 to 376,000 in 2006. This implies an annual growth rate of 8.6%. Their share in the HRSTC total increased from 2.2% in 2000 to 2.9% in 2006. In Spain and in the United Kingdom, there were increases from 26,000 to 94,000 and from 80,000 to 110,000 respectively. (p. 120) Detailed data are available only for 9 member states.⁴

⁴ The most natural scientific tool would be to employ official European (and OECD) statistics to describe researcher mobility within Europe and between Europe and other countries. Currently however, there is not very much data on these issues in official statistics. An obstacle to detailed analysis is not only the lack of internationally comparable data and statistical information on researchers, but also the fact that national sources are scattered and contain limited information, despite the awareness of the importance of this kind of

The growth in the mobility of S&T professionals is not a strictly European dynamic, as could be expected of closer European integration. In fact, the number of non-nationals having citizenship from outside the EU27 increased over the 2000-2006 period, from 167,000 in 2000 to 318,000 in 2006 in the nine Member States from which relevant data are available. This implies an annual growth rate of 11.3%. The same trend exists for foreign-born HRSTC: the increase of mobility is higher for extra-EU HRSTC than for intra-EU HRSTC. The total HRSTC born in a country outside the EU27 increased from 524,000 to 854,000 (an increase of 8.5% per annum) (p. 121).

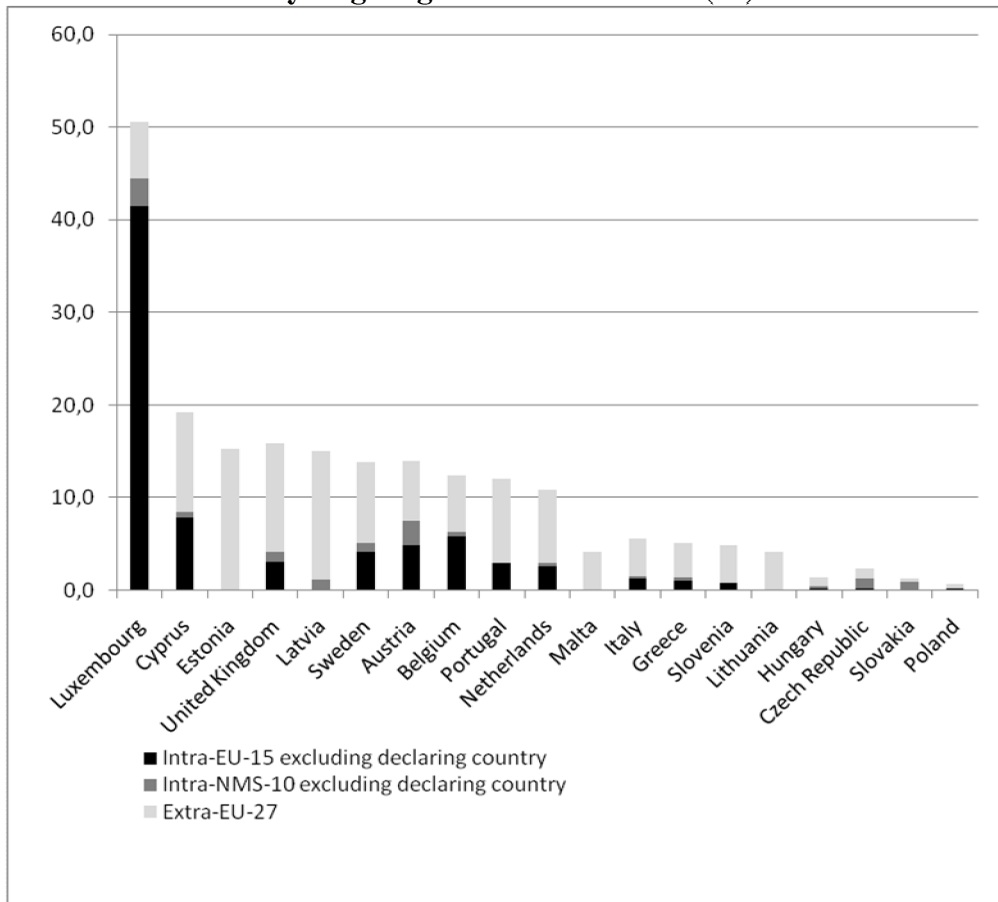
The vast majority of the HRST population in each country are home-born or second or multiple generation immigrants. The foreign-born population is between 5.8% and 16.2% in the EU15 (except in Luxembourg where it is 51.5%), while in NMSs it ranges between 0.7% and 21.0%.⁵

The number of foreign-born HRST has increased between 2002 and 2008. The fastest increase has been observed in Luxembourg, Ireland and in the UK. The proportion of foreign-born HRST is the highest in Luxembourg, Ireland and Cyprus and the lowest in Poland, Bulgaria and Romania. The next figure (Figure 1) shows the host countries and main regions where mobile HRST come from.

information. It must be mentioned that the accumulated knowledge and availability of data and indicators on mobility (spot data and time series) has improved a lot since the beginning of the breakthrough European Research Area programme. (Most of the sources are internationally co-ordinated pilot projects that usually do not cover all EU member states, as only volunteer countries are included that were ready for investigation. Country selection did not depend on their involvement in mobility but on their policy making culture (how strong matters are the facts in policy making) and, as a related issue, their statistical capacities for pilot surveys, for modifying sampling.) The most data available are those pertaining to doctoral students.

⁵ However the difference is conceptually clear between foreigners and internationals, the choice between these terms is limited by data scarcity. (Eurostat provides data on HRST by country of birth and by nationality. Data by nationality is useful for many reasons in studying HRST but it is somewhat misleading if we are focusing on inflow of HRST.) The term 'foreigners' is used as a proxy for internationally mobiles in most cases.

Figure 1 Proportion of foreign-born HRST in EU member states by large region of birth in 2008 (%)



Source: Author's compilation based on EUROSTAT online database

Apart from differences by the size of inflow, there is no different pattern by sending regions between old and new member states. More countries are hosting HRST from outside the EU27. The largest number and proportion is in the UK, followed by Italy, the Netherlands, Switzerland, Sweden, Portugal, and, to a lesser extent, in Greece, Poland and Slovenia. Numbers are much lower, but the proportion is still high in the former Soviet member states (Estonia, Latvia, and Lithuania). Within the EU27, the leading region sending mobile researchers consists of a few countries: Luxembourg, Hungary, Austria and Slovakia. In several countries, the inflow from the EU27 and from extra-EU27 countries was almost equal (Belgium, the Czech Republic, Iceland, Cyprus, and Norway).

Generally the inflow is much larger from the EU15 than from NMSs. It is possible that the deviation from this trend in the Czech Republic and Slovakia may originate from the split of Czechoslovakia and not from other reasons. More than 20,000 HRST born in NMSs were in the UK (121), Austria (38), Sweden (22) Italy (22), and Switzerland (20).

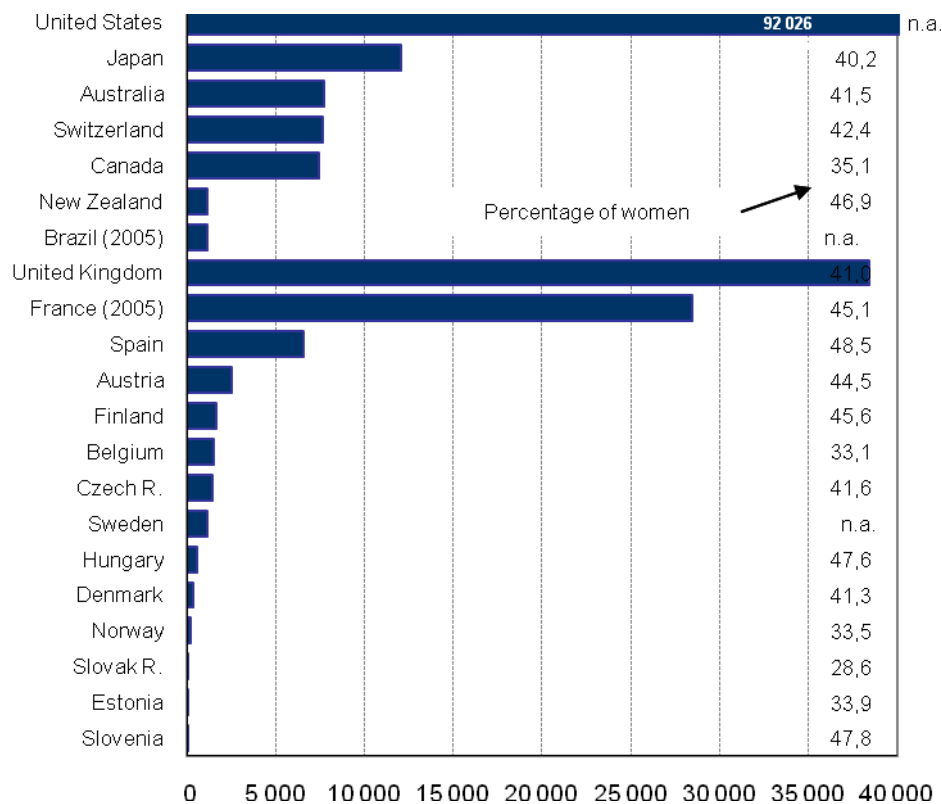
Going abroad to study is a tradition with deep roots in European history. However, the volume of international students has changed significantly in recent decades. What is interesting about the mobility pattern of this population is that international mobility often starts at the time of researcher training, since many doctoral students register in a doctoral programme abroad and therefore conduct research for their thesis in the host country. Mobility during the years of studying has an influence on post-doctoral mobility. A number of post-docs will also remain in the host country for a post-doctoral or other job position. In

addition, it seems that international students are increasingly targeted by the recruitment strategies of large transnational corporations (Auriol 2010 p. 18).

The share of foreign doctoral students in the total doctoral enrolment is around 40% in the UK and Switzerland, the largest European destination countries, followed by France and Belgium (whereas data on Germany is again absent). Each European host country (on which data are available) has increased the share of foreign doctoral student enrolment between 1998 and 2006 except for Slovakia.

If we compare Europe's performance on a global level, the United States hosted the largest foreign doctoral population, with more than 92,000 students from abroad in 2006, followed by the United Kingdom (38,000) and France (28,000). (Figure 2) This is a clear indication of the international attractiveness of US universities and research opportunities.

Figure 2 Number of international doctoral students by host country, 2006



Source: OECD STI Scoreboard 2009.

European universities enrol large shares of doctoral students from other European countries. The existence of exchange programmes (e.g. Erasmus) are, in addition to traditional cultural and historical ties and geographical proximity, all factors promoting intra-European student mobility.

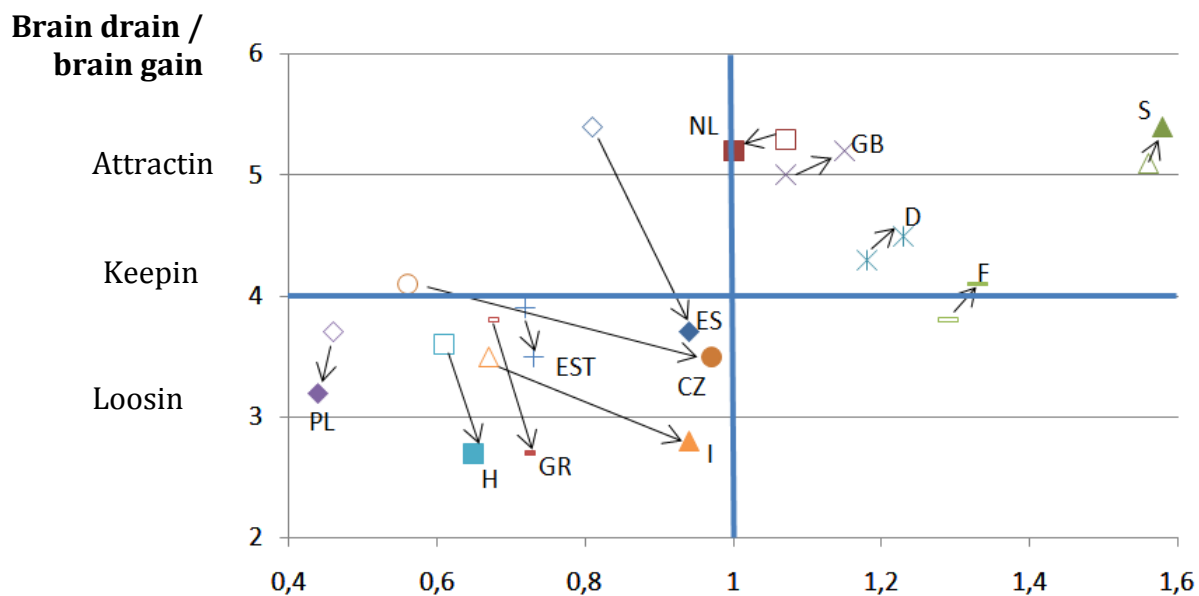
With regards to *gender issues*, female doctoral students constitute less than 50% of mobile students in each country. During their years of study women are more mobile than during their working lives. Spreading virtual mobility might be useful in involving more women in brain circulation.

The importance of brain circulation is highly appreciated by the EU. However, brain losses are avoidable for Europe as a whole and for less advanced EU member states. So attractiveness is not only an issue for increasing the inflow of foreign researchers into Europe

and from one member state to another one, but is also an issue of how national systems can keep European researchers in their own countries.

The World Economic Forum (WEF) indicator is a very useful tool to gain a better understanding of the attractiveness of European countries for their own research communities (and for internationals too.) The WEF indicator is characterised to some extent by the differences in the mobility patterns of countries, although this indicator is less accurate from a statistical point of view. Figure 3 clearly shows the strong relationship between relatively high proportion of R&D jobs and countries' capabilities to keep their own researchers.

Figure 3 Average WEF score for the lack of brain drain / brain gain, Change from 2004 to 2010



Source: Total R&D personnel data (2004 and 2008) from Eurostat online database, brain drain data from WEF Global Competitiveness Report, 2010-2011 and from 2003-2004. : <http://www.cap-lmu.de/fgz/statistics/brain-drain.php>

Notes: 1) Brain drain is judged by the following question: Does your country retain and attract talented people? (1 = no, the best and brightest normally leave to pursue opportunities in other countries; 7 = yes, there are many opportunities for talented people within the country), 2008–2009; 2003-2004 weighted averages.

2) The direction of the arrows points from 2004 to 2010.

3) At each countries from 2003-2004 → to 2010-2011

As figure shows Sweden, Great Britain, Germany and France (and somehow the Netherlands) have relatively high proportion of R&D jobs and these countries had not only good position in 2004 to avoid brain losses but they were able to improve their position by 2010. These countries can offer many opportunities for talented people: they are very attractive for talented people and, in addition to keeping their own researchers.

Conversely, many EU Member States suffer a loss of talent. Even if Spain has increased the proportion of R&D jobs from 2004 to 2008 the country lost her attractive position she is just keeping the brains.

The hardly attracting and more loosing countries are some other Southern European countries, and NMSThese loosing countries are forcing their talented people to find opportunities in other countries or regions, while mobile people avoid these less attractive regions. Even if these less advanced regions can engage in brain circulation they are usually the net losers of the process.

Attractiveness of European countries

The ability to attract researchers, non-researcher HRST or students are different issues. Many different economic, social and educational factors influence the inflow of doctoral candidates or researchers.

The best statistical information for mapping the attractiveness of doctoral students in different countries can be found in the OECD/UNESCO/Eurostat project of Careers of doctorate-holders data collection (OECD/UNESCO/Eurostat 2010) and the IPTS-IISER project. Data from these projects are applied here. Although none of these cover all EU member states, they do provide relevant information.

Table 1 Destination of doctoral candidates

Rank	Country	TOTAL	Own country	Intra EU	Other European countries	Africa	North-Central America	South America	Asia
1	France	23.2	19.9	21.1	39.7	75.8	14.0	17.8	29.4
2	United Kingdom	20.5	16.3	44.7	19.0	12.3	46.3	7.9	57.8
3	Spain	17.6	18.9	10.8	1.4	3.7	34.1	63.2	1.5
4	Italy	8.6	10.8	1.4	4.2	0.7	0.7	1.9	0.9
Share of TOP-4		69.9	65.9	78.0	64.3	92.5	95.1	90.8	89.6
5	Czech	5.3	6.4	0.0	0.0	0.0	0.0	0.0	0.0
6	Sweden	5.1	5.3	6.2	9.2	1.0	1.8	1.1	3.3
7	Finland	4.9	5.9	2.4	4.8	0.4	0.6	0.2	1.6
8	Portugal	4.0	4.8	0.8	1.3	1.8	0.4	5.9	0.2
9	Austria	3.6	3.6	7.7	9.4	0.7	0.6	0.6	2.2
10	Slovakia	2.1	2.8	0.0	0.4	0.2	0.0	0.0	0.2
11	Hungary	1.8	2.2	0.4	5.9	0.2	0.1	0.0	0.2
12	Belgium	1.6	1.4	3.1	2.6	3.2	1.0	1.4	1.4
TOTAL-16		100	100	100	100	100	100	100	100

Source: IPTS-IISER project, *Researchers coming into the EU*, 2007 based on EUROSTAT data. How to read: 75, 8% of doctoral candidates in the EU-16 from Africa are located in France.

Note: Data are available only for 16 EU MSs (From large countries is not available for Germany.) Among 16 countries the share by broad regions is less than 2% for Denmark and less than 1% if any for Estonia, Cyprus and Malta.)

As Table 1 clearly shows, there are four European countries that host at least two thirds of foreign doctoral students coming from the large geographic regions. The share of these countries hosts more than 90% of the doctoral students coming from the Americas. (Auriol 2010).

The attractiveness of leading European countries is still lagging behind the US, where a large inflow of doctorate holders of Asian origin characterises the mobility situation. The presence of Asians is even more significant at the level of doctoral education, reaching two-thirds of all foreign students.

Attractiveness between academic organizations

The world famous Nobel Prize milieus could attract researchers from all over the world. Well-equipped US labs are attracting many researchers from all over the world. Many non-American born Nobel Prize laureates from different scientific fields emphasised in their speech that they had come to America to test their theory there. They found a large pool of excellent researchers with whom to discuss their work. At present, few European research labs are important meeting places for emerging fields of science. Shorter or longer temporary work there could upgrade the scientific career for many young researchers.

One of the important functions of European Research Council (ERC) is to fund frontier research projects. As the preliminary ‘self assessment’ (p. 6) stated, although the ERC operations have only been running for a few years and will need a longer time to yield the expected impact, there are some important structural impacts. One of them that are crucial for European researchers is mobility. Thus, a number of institutions try to make them more attractive to become an important location – meeting place – for ERC Grantees. The best performing and highest ranked European institutions for ERC Grantees took part in and were among the winners in ERC competitions. They may take into account as a relevant meeting place for European researchers and the availability of these places are backed up by ERC.

Table 2 List of most successful institutions with the number of their grantees

Rank	Name of the organisation	Nr. of ERC grantees
1	CNRS	47
2	The University of Cambridge	27
3	The University of Oxford	25
4	Ecole Polytechnique Federale de Lausanne	24
5	Max Planck Gesellschaft E. V.	23
6	Eidgenössische Technische Hochschule Zürich	22
7	Weizmann Institute	20
8	Imperial College of Science, Technology and Medicine	20
9	The Hebrew University of Jerusalem	20
10	University College London	19

Source: Interim evaluation of the 7th Framework Programme “Self-assessment”, circa.europa.eu/FP7 Interim Evaluation

Table 2 shows the *top 10 institutions* hosting ERC Grantees, 6 of them located in EU member states, including the University of Cambridge, Oxford, Imperial College and University College London are British, while CNRS is a large French organization, covering many institutions as well as the Max Planck institutes in Germany. There are 4 institutions in contracted countries. These labs also can profit from hosting gifted talents.

Knowledge flows between firms and public research sectors

It is a delicate issue to map knowledge flows between the public research sector and firms. It is assumed that this type of mobility speeds up the diffusion of new knowledge and promotes the access to not only codified but also to tacit knowledge. This can occur in many different ways, and may be the taking of a permanent position in another sector or merely temporary exchanges. Inter-organisational collaborations such as academia/industry, academia/public sector co-operations are devoted not only to R&D but innovations too.

Industry/academia collaboration with foreign partners is very limited in Europe. According to the latest available innovation survey data (2004-06) the total share of firms collaborating on innovation with partners across Europe ranges from less than 2% in Spain and Turkey to over 13% in Finland, Luxembourg and Slovenia. Collaboration with partners outside Europe is much less frequent and concerns between 1% and 5% of firms in most European countries. Overall, innovating firms from the Nordic countries and some small European economies (Belgium, Luxembourg and Slovenia) tend to collaborate more frequently with partners abroad. (OECD STI Scoreboard 2008, p. 124) It must be noted that this international collaboration performance includes not only industry/academia collaboration but also customers and suppliers, who are more sizeable partners than academia. Multinational companies are important initiators in this mobility process.

National policies/programmes by FP7 mobility related actions

Looking at one of the EU pillars, the free movement of workers within the Community (1968) has some limitations; thus, labour regulations may prevent or may not prevent companies from employing/hiring foreign highly skilled labour. The citizens of new member states do not have complete freedom to be mobile as EU15 countries made different decisions. National regulations may prescribe different limits on the inflow of non-EU nationals.

The aim of the PEOPLE Programme⁶ in FP7 is the 5th freedom, through the implementation of the ‘*European Partnership for Researchers*’ (EPR) for better careers and more mobility. The EPR is implemented through National Action Plans (NAPs) in partnership with the Commission in four priority areas: *open recruitment, skill, working conditions and social security*.

Scattered information is available from various sources on how European countries are implementing joint European policies that are co-ordinated only on the conceptual level. A comprehensive but non-exhaustive source is the Trendchart (IPTS, ERAWATCH Programme, [www. http://cordis.europa.eu/erawatch/index.cfm](http://cordis.europa.eu/erawatch/index.cfm)). The Trendchart country reports allow us to analyse how national policies are including the investigated policy targets. Trendchart reports are available on all EU member states and give a short description of mobility related measures. Evaluation of the measures is scattered. According to Trendchart reports, the EU27 have launched several *actions* related to HRST. Some of the programmes in a few countries are fully devoted to the issue of mobility, while some other programmes cover various issues of STI policy. The number of mobility programs and actions varies from country to country but the differences in numbers are not an accurate reflection of variations in mobility-supporting policies. Sometimes it simply maps programming habits (umbrella programs versus single focus programs.)

In accordance with the Trendchart based information, national actions can be grouped by physical mobility types as follows.

Geographical mobility

All national programs labelled geographical have an international dimension. The geographic mobility programs differ by their direction of mobility. There are programmes that support both outgoing, incoming mobility and the reintegration of returnees.

Taken from Trendchart, geographical mobility programmes are summarised in Table 3, which provides an overview of international geographical mobility programs. Eleven member states from the EU27 reported these kinds of programs. In this summary, the multipurpose programmes are taken into account as mobility programmes if one of their elements focuses on any kinds of HRST mobility.

Programmes on *outflow* of researchers and students are encouraging/supporting them to accumulate knowledge and good practices abroad. These programmes usually implicitly assume brain circulation. Some of the programmes are general purpose programmes for international experiences, improving professional quality, knowledge accumulation and transfer, and upgrading linguistic capabilities.

Four countries, Belgium, Czech Republic, Estonia and Hungary have outflow programmes. These countries are also encouraging inflow of researchers and two of them

⁶ Since the 1st of March 2010, the PEOPLE Programme was transferred to the Directorate-General for Education and Culture. The implementation of the Marie Curie Actions is ensured by the Research Executive Agency (REA), set up by the Commission in December 2007. REA reached its administrative autonomy on 15 June 2009. Until then, a dedicated service of the European Commission was in charge of the operational activities and management of the programme over the life of FP7, REA will manage research projects to a value of €6.4 billion (of which €4.7 billion of the People Programme).

(Belgium and Hungary) also encourage returnees and support their relocation and reintegration.

Outflow programmes in several countries give precedence to knowledge accumulation in selected fields to upgrade home-country capabilities, such as training researchers in research project administration and in contemporary research methodologies. Support the access to international research infrastructure and equipment (Hungary – Development of human resources for basic research).

Inflow programs seek to attract researchers (HRST) from other EU27 and non-EU countries. Few programs have a clear focus on locating world class / best researchers for upgrading research activities in order to strengthen the position of the national community globally (e.g. the Ireland – E.T. S. Walton Visitor Awards, SFI Research Professorship Programme.) Several other countries have set up measures to generate inflow and to attract foreign researchers. Besides those countries already mentioned, Denmark, Finland, Germany, Ireland and Italy have enacted inflow policies.

Table 3 Geographical mobility programmes by target activity and by country

Target activity	Country	Program Title	Type
Outflow	Estonia	Doctoral Studies and Internationalisation Programme “DoRa”	M
	Belgium	French-speaking Community - Scientific impulse mandate – ULYSSES mobility F.R.S.-FNRS	S
	Hungary	Öveges József Programme	S
		Development of human resources for basic research	M
		MOBILITY	M
Czech Republic	Mobility Centre	M	
Inflow / attract foreigners	Belgium	Brussels-Capital - Research in Brussels	S
		Brussels-Capital - Prospective Research for Brussels	S
	Czech Republic	Mobility Centre	M
	Denmark	25 % Tax Scheme: Taxation of the Salaries of Well-paid Foreigners and Foreign Researchers	M
		Niels Bohr Visiting Professorship	S
	Estonia	MOBILITAS Programme	S
		Doctoral Studies and Internationalisation Programme “DoRa”	M
	Finland	Finland Distinguished Professor Programme (FiDiPro)	S
	Germany	BioFuture	S
		ExistGo-Bio	S
	Hungary	Development of human resources for basic research	M
		MOBILITY	M
	Ireland	SFI Principal Investigator Programme	M
		SFI Research Professorship programme	S
		E. T. S. Walton Visitor Awards	S
		President of Ireland Young Researcher Awards	S
Italy	Tax incentives to non residential researchers	S	
Returnees, relocation, reintegration	Austria	Brain Power Austria	S
	Belgium	Brussels-Capital: Brains (Back) to Brussels	S
		Federal - Return Grants	S
	Denmark	25 % Tax Scheme: Taxation of the Salaries of Well-paid Foreigners and Foreign Researchers	S
	France	Post- PhD initiative programme	S
	Greece	Incorporation of foreign researchers into the Greek R&T system (ENTER)	S
	Hungary	Support for outstanding young researchers	M
		Development of human resources for basic research	M
		MOBILITY	M

Source: Author’s compilation based on Trendchart Annual Reports.

Notes: S – program targeting one purpose of mobility, M – multi-purpose program that includes various types of mobility.

A special group of incoming researchers are *returnees*. There are some national programs to attract returnees back home by offering them good research conditions and assisting them in their relocation. These kinds of programs exist in Austria, Belgium, Denmark, France, Greece and Hungary⁷. However, the focus of relocation was modified in Greece and France, where measures were made more general in scope rather than merely

⁷ By the OECD (2010), several countries in Central and Eastern Europe have taken steps to encourage their citizens currently living abroad to return home. (p.62.) These returnee programs are not focusing on HRST.

focusing on the diaspora.⁸ Greece used to have a returnee policy which was subsequently modified, and returnee attraction became a part of its general inflow programme.

Table 4 Spatial limited international mobility programs

Country	Regional	Bilateral	Large geographical region
Belgium	- Wallonia - FIRST Spin-off - Brussels-Capital - Prospective Research for Brussels - Brussels-Capital: Brains (Back) to Brussels - Wallonia - FIRST PhD Enterprise International (FIRST D.E.I.) - Wallonia - START programme - Flanders: Odysseus programme - French-speaking Community - Scientific impulse mandate – ULYSSES mobility F.R.S.-FNRS	-	-
Bulgaria	-	Bulgarian-French RILA Programme	-
Ireland	-	China-Ireland Research Collaboration Fund	North-South Research Partnership Supplement
Malta	-	-	Third Country Researcher Mobility
Slovakia	-	Several bilateral mobility programmes	-

Source: Author's compilation based on Trendchart Annual Reports

Geographical mobility programmes promoting or supporting the inflow of researchers differ by their *spatial openness / limitations*. In addition to national programmes, spatially limited programmes may prioritise a given region (such as Wallonia or Flanders) and make it attractive for foreigners. (Table 4) Inflow is supported by regionally limited programs. Few Belgian programs have a strong regional focus in addition to their international dimension. Bilateral and extra EU27 mobility related programs are encouraging bi-direction mobility.

From the Trendchart reports we can identify a single program that is performing the declared EU target to facilitate brain circulation in Europe and to remove obstacles to mobility. This program introduced portable fellowships (Belgian Federal programme: post-doc fellowships for non-EU researchers).

Complementing Trendchart information on geographical mobility from another source shows how countries try to select the best and most appropriate job-seekers for inflow through a point-based system. OECD Migration Outlook (2010) provides some useful information on HRST migration and related policies. The Outlook focuses not only on researchers but on any kind of HRST. According to this report (OECD 2010, p. 58), three European countries have introduced a point-based system for managing labour immigration: the *United Kingdom* (October 2008), *Denmark* (July 2008) and *the Netherlands* (January 2009). A part of this system is HRST focused, such as in the United Kingdom, the point-based system operates under Tier 2, for highly skilled workers who are on a shortage occupation list, are recruited after a resident labour market test or are intra-company transferees. An independent Migration Advisory Committee (MAC) was created to identify

⁸ According to OECD Migration Outlook 2010 (p. 62) Lithuania designed a project to encourage the return of highly qualified personnel engaged in scientific research abroad to Lithuania, through organised visits to Lithuanian educational and scientific institutions.

skill shortages, but saw its mandate extended in 2009 to look into broader issues. Shortage occupation lists – an element of the points system – are revised every six months.

The pilot phase of a *Czech* project to *bring in young, qualified people* who are interested in permanent resettlement in the country has ended and the project is now open to nationals of most non-EU countries. *Germany*, too, has sought to *attract more highly-qualified migrants* in the context of international competition for skills and increasing shortages of skilled workers in some sectors, in the framework of an action programme. Measures in 2009 included exemption from the labour market test for all migrants from the new EU member countries holding a tertiary degree, as well as any others with a tertiary degree from a German institution. The latter, however, must have an employment offer commensurate with their qualification level.

In August 2009 Lithuania simplified the *immigration of family members of highly-qualified specialists*, for scientists and researchers and for some other categories of employees; family members may now accompany the workers in these categories, rather than wait two years. It also simplified employment procedures for highly-qualified workers from non-EEA countries by removing the need for work permits in some occupations, while speeding up their processing for others.

Virtual mobility

Virtual mobility has always been present throughout the history of science. However, the age of information technology has significantly increased its opportunities and its roles. Virtual mobility is increasingly taking precedence over other forms of mobility. 'Virtual inflow' is an additional tool that can mobilize the involvement of the best non-European researchers in FP7. Pure virtual mobility programs are still rare (Finland's MOTIVE program with China; Sweden's Global links for Strong Research and Innovation Milieus).

Mixed mobility

Mixed mobility is more and more common in Europe, and the number of national schemes supporting collaborative projects is increasing. All of these programs have recurring short-term mobility elements. Networks and platforms are important for the development of international connections and for supporting conferencing and publication opportunities and inter-disciplinarily as well as, from the perspective of supervisors, institutional links. Research collaboration programmes implicitly or explicitly include virtual mobility.

Sectoral mobility

By employers both inter-sectoral and intra-sectoral mobility are present in the programmes.

Inter-sectoral mobility

Important mobility programmes are the Industry-Academia Partnerships and Pathways in FP7. In the majority of cases, national programmes serve to stimulate inter-sectoral mobility, that is, collaborations between academia (university) and industry including start-ups and spin-offs for commercialising research findings. Although these programmes usually support domestic collaborations, they do not exclude foreign collaboration. Most of the multi-purpose programmes supporting industry-academia collaborations include mobility for shorter or longer terms. The mobility issue is only one of the tools that can support stronger relationships between industry and academia; however its specificity is its *recurrent character*.

Intra-sectoral mobility

As for programmes supporting *intra-sectoral mobility*, these relate to geographic (international) mobility. Several old and new programmes are encouraging cross-country mobility inside the academic circle.

Naturally there are no intra-sectoral governmental supporting programmes for B2B mobility. In this respect, the most important role of the governments is to eliminate or at least to decrease the number of factors impeding mobility.

Attracting to sectors

Any mobility program may focus on all *fields of science/economy* or may select a few fields that are faced with a shortage of human resources or skills. Over the last decade, one such field was information technology. In this decade, biotechnology or food and health industry researchers are the most sought after. Because of differences in the balance of the researcher labour market, several national programmes encourage inflow in *selected economic fields/sectors*. Some countries prefer the inflow of researchers with sector-relevant skills. In a broad sense, these programmes are performing the task of attracting appropriate HRST.

Table 5 gives a summary of those programs which focus on a specific scientific field and/or economic sector.

Table 5 Field / sector specific mobility programs

Country	Programs	Open for
Cyprus	DIDACTOR - PhD Degrees in Cooperation with Enterprises	Manufacturing, tourism and services
Denmark	Research programme for substances similar to hormones	Food and health industry
Finland	- The Research Programme on Nutrition, Foods and Health (ELVIRA) - Ubiquitous computing and diversity of communication (MOTIVE) cooperation between Academy of Finland and National Natural Science Foundation, China	- Nutrition, food and health industry - ICT
Germany	- BioFuture - The Humanities in the Social Dialogue - ExistGo-Bio	Biotechnology Humanities Biotechnology
Hungary	- Development of human resources for basic research - MOBILITY	Technical, natural, life, social sciences Technical, natural, life sciences
Ireland	- SFI Principal Investigator Programme - SFI Research Professorship programme - President of Ireland Young Researcher Awards	Biotechnology and ICT

Source: Author's compilation based on Trendchart Annual Reports

As the table 5 shows, Germany and Ireland are focusing on biotech experts, while the inflow of ICT experts is still important for Finland and Ireland. Food and health experts are preferred in Denmark and Finland, while the preferences of Cyprus and Hungary diverge from global trends.

There are two different layers of mobiles who merit special attentions: women and students. Mobility of *women HRST* is a delicate issue for the European labour market. Well-educated European female doctorate holders are still a great potential pool of HRST. The national programmes are rarely attempt to tap this reservoir. Trendchart annual reports contain only one programme that is devoted to female mobility (VINNMER in Sweden).

Students are a potential source of HRST, particularly at the PhD level. In recent years the international migration of students has played a growing role in the global mobility system. Student mobility supports cross-cultural education and communication: the new generation can adapt to globalised knowledge economies, and will be more open-minded with respect to working abroad or cross-border collaborations. Brain circulation may become a

routine experience for them. International student migration can be a win-win situation for both hosting and sending countries.

Post graduates are often viewed as creators of new knowledge who have the potential to contribute directly or indirectly to economic growth. Both during and after their studies, doctoral students contribute to the advancement of research in the host country. When returning home, they bring back with them new competencies and connections with international research networks. In both their home and host countries, students are an important prospective source of supply for hiring foreign S&E. The international mobility of students gives potential employers a good opportunity to attract the best and brightest candidates with whom they have become acquainted through their networking activities.

As the OECD has stated (2010 p. 62): ‘There is evidence that increasing numbers of global firms are actively targeting international students for recruitment. Overall international student policy has now become a tool in the international competition for high level skills. As the most popular destination countries of foreign students can make good income for educational institutions and they are in better position to become employer for post-study work, policy focus must be different in favourite student destination countries from student launching countries.’”

FP7 creates a good framework for student circulation within Europe and between Europe and other large regions. One of the aims is to make more institutions relevant destination places and offer good education opportunities to all students and the best possibilities to gifted talents. One of the positive impacts of the student mobility: introduces healthy competition among academic institutions, which contributes to improved levels of education. (Students are voting their feet.)

There is hardly any information on doctoral mobility programs in Trendchart reports. Various studies on higher education clearly show that member states are continuing their traditional programs for supporting studying abroad while non-traditional host countries are paying growing attention to attract foreign students. These programs are increasingly reflecting the targets of the European Higher Education Area rather than those of the European Research Area.⁹

Resource allocation for mobility programs

The allocation of *budgetary resources* supporting mobility is a delicate issue. It is still a dream to include mobility as part of the total European budget (EU + National budgets). In particular, difficulties may emerge because mobility measures are frequently just a part of the multi-purpose programmes and that it is hard to separate the mobility content as only the overall budgets are known.

Taking into account only those programs whose main purpose is to support HRST mobility, 37 programs can be identified within 19 EU member states. It is not easy to add up their budgets, given that, in accordance with the national budgeting practice, overall budgets are only partially available for single purpose programmes. The budget is known for the

⁹ EU launched student mobility program (Erasmus) has important role in many EU MSs. Student mobility has grown very fast in NMSs since 1995 (started with Socrates I. program). The number of participating students was 7 times more in 2007-08 (LLP-Erasmus) than between 1995-2000 (Socrates I) from NMSs. The share of NMSs in Socrates-I was only 3% to EU27 and became 19% in LLP Erasmus by 2007-08. The growth rate of student mobility was much slower in EU17 however the increase was remarkable between Socrates-I and Socrates-II. The proportion of yearly mobile student is much more stable in EU17 than in EU10. For further analysis it is important to accumulate more facts.

majority of the single purpose, close-ended programmes. However, some countries make budgeting decisions only on an annual basis even if the program is close-ended.

Financial support may have other form than budgetary allocations. Two countries (Denmark and Italy) apply tax incentives for encouraging mobility that are hard to calculate in advance. Table 6 gives a summary of the known budgets of mobility-focused national programmes.

Table 6 National budgets for mobility-focused programs

Countries	Number of programs	Budget in million EUR	
		Known	Not available
Austria	1	1.5	
Belgium	8	26.9	(+)
Bulgaria	2	1.3	(+)
Cyprus	1	0.4	
Czech Rep.	1		+
Denmark	3	45.4	
Estonia	1	20.3	
Finland	1	32.5	
France	2		+
Germany	-	-	+
Greece	1	3.3	
Hungary	2	13.2	
Ireland	5	60.9	
Italy	1	0	
Latvia	-	-	+
Lithuania	1		+
Luxemburg	1	6.3	
Malta	2		+
Netherlands	2	4.5	(+)
Poland	-	-	+
Romania	-	-	+
Slovakia	1		+
Slovenia	1	4.0	
Spain	-	-	
Sweden	1	32.0	(+)

Source: Author's compilation based on Trendchart Annual Reports.

Note: + = no any budget data are given (+) = budget data are not complete

The problem for fact-based policymaking is the lack of consistency across countries and the failure to collect adequate data for constructing comparable indicators.

Conclusions

Europe as a whole has seen a remarkable growth in the numbers of mobile science and technology professionals during the last decade, but this growth has not been strictly due to European dynamism. The EU is still lagging behind the USA, which continues to appear much more attractive to researchers and to enjoy a significantly higher inflow than EU Member States. Since 2000, the mobility of researchers outside of the EU27 has grown around 11%, while the mobility of researchers holding EU27 citizenship has grown by about 8%. There are important differences among the EU27 Member States in their attractiveness for researchers and for doctoral students. Intra-European flows dominate mobility in European countries, and this process is still strongly characterised by westward mobility. Overall, researchers within the countries of the EU15 are still more mobile than those within the ten new Member States. A further harmonisation of efforts is required to improve and to balance the attractiveness of the various regions within the EU.

The successful development of the European Research Area largely depends on how Member States implement the actions and budgets for the common European goals in the national legislations. In many cases, there is significant crossover between the EU and national levels

with respect to the creation of the relevant conditions for mobility. European nations are making progress in the creation of mobility framework conditions.

Surveying the programmes on the basis of Trendchart country reports may help to identify those national policies/programmes that are national partners to FP7 mobility related actions. As regards the internationalisation of academia/industry mobility, the majority of national programmes merely include an international dimension but do not focus on it.

Although there are more and more opportunities for virtual mobility that may be observed as an additional tool in research collaboration programmes, only two programmes in Nordic countries focus directly on virtual mobility.

The mobility of European researchers is not only a research policy matter. It requires the collaboration of different EU policies (labour market, migration, innovation, education) as well as the support of national and regional policies. In addition to the ERA-NET scheme, it may be necessary to create another appropriate instrument to foster a significant shift within Member States towards a real coordination of regulations and programmes.

It may be stated that the majority of national programmes are rather quantity- than quality-based. Countries are seeking to attract a lot of well-educated, highly skilled people and are paying less attention to getting the best highly skilled ones. Only a few programmes focus directly on finding the best and most appropriate researchers through programme screening. The inflow related programmes can be described as soft recruiting programmes that are supported in some countries by selection criteria among job-seekers.

Based on the screening of information, we can state that more investment is required in the development of relevant HRST and especially that of researcher mobility statistics. The scarcity of reliable data constitutes a significant obstacle to the efforts to analyse mobility processes and to develop a fact-based mobility policy at either the national or the EU levels. The present lack of good mobility indicators and the scarcity of relevant data on cross-country and cross-sectoral mobility in human resources in science and technology (HRST) point towards the need for more investment in the development of relevant HRST mobility statistics. To improve the competitiveness of Europe in attracting the best and brightest researchers and for the most appropriate HRST, it is necessary to assess trends over time. Strengthened and continued efforts are necessary to facilitate the monitoring of ERA mobility related national policies and regulations.

Policy implications

Although intra-EU mobility is vital for ERA, third countries are also important actors in the European mobility landscape. Thus, it is essential to continue ‘opening up the ERA to the world’ via further policy and programme adjustments aimed at reinforcing mobility policy and actions.

There are different levels of policy implications.

- At the European level, it is important to improve the attractiveness of Europe for star scientists by offering them more competitive research conditions – from well-equipped modern research laboratories to trust-based risk-taking research funding systems.
- It has to further develop the links between the programmes at the EU and Member State levels.

At the national level, there are different challenges: typical European host countries have to maintain and further develop their hosting capabilities, while typical sending countries have to upgrade their networking capabilities and their attractiveness.

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