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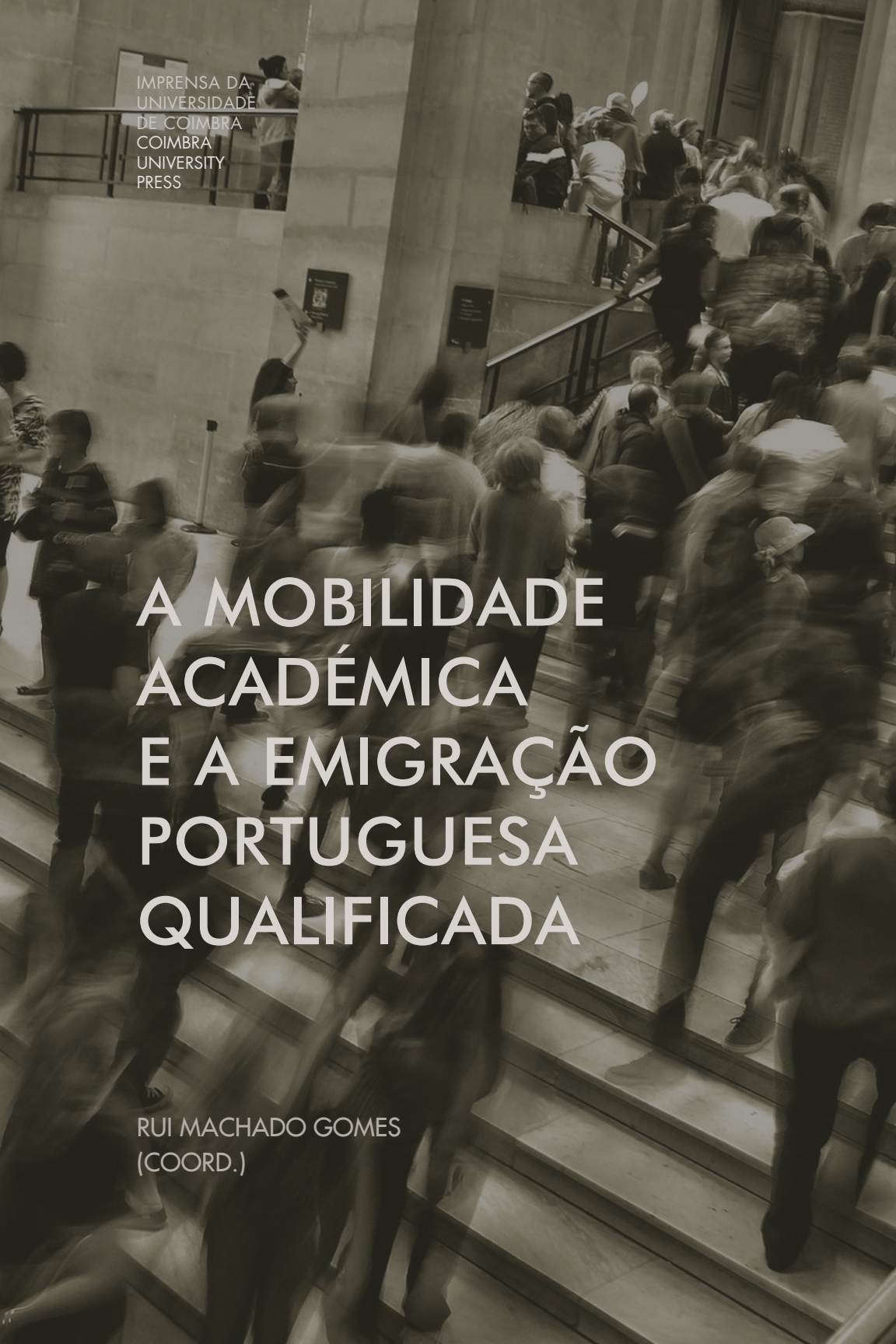

A MOBILIDADE ACADÉMICA E A EMIGRAÇÃO PORTUGUESA QUALIFICADA

RUI MACHADO GOMES
(COORD.)

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BRAIN DRAIN–BRAIN GAIN: AN INTERNATIONAL PERSPECTIVE

1. Introduction

Recent data and indicators will be presented to help place discussions of brain drain–brain gain in current context, in Portugal and on the international scene. Cost and benefit analyses of brain drain–brain gain remain a challenge as does the need to move the development of measures and understanding of human resources in S&T higher on the priority list of policy makers and data collection agencies. Examples of efforts, developments and obstacles will be given.

2. The setting

Context is everything, so it is useful to look at some science and technology (S&T) indicators to remind us of the situation here in Portugal, as well as that of its neighbours and competitors.

Overall, Portugal's R&D expenditures have been declining since 2009 (OECD, 2014). The OECD data suggests that this decline could put Portugal's capacity to innovate at risk. For example, if we look at R&D expenditures by

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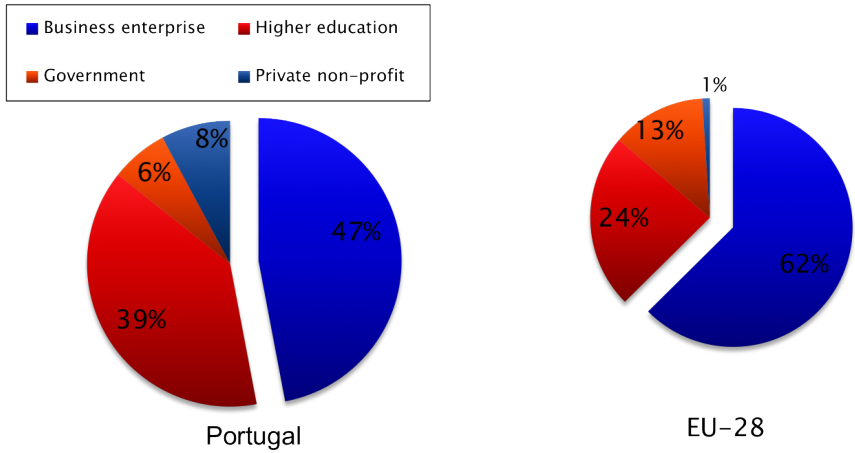
sector, Portugal shows the *higher education* sector with a substantial 39% share compared with only 24% for the EU-28 overall.

FIGURE 1: R&D expenditure by sector, Portugal and the EU-28, 2012

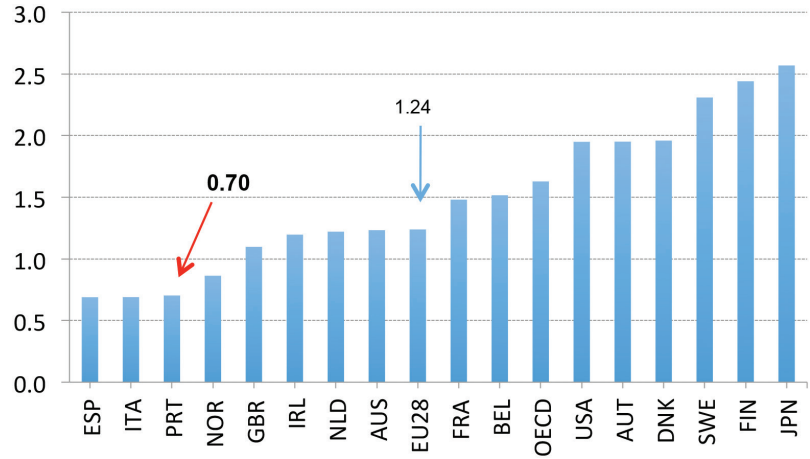


Source: Based on Figure 1.24, OECD Economy Surveys: Portugal 2014, OECD, 2014.

This is not good news given the fact that a large share of R&D is taking place in universities which reportedly have weak linkages with industry. In Portugal, for example, the number of new high-tech firms coming out of academia is low. At the same time, many of the PhDs choose to stay in the university environment rather than entering the private sector. If the universities are losing top talent to overseas destinations, then the picture may become even bleaker for the business enterprise sector.

In Portugal, business expenditures on R&D, the BERD, are only 0.7% of GDP compared to the EU-28 with 1.24%. Only Italy and Spain (each with 0.69%) generate lower BERD/GDP than Portugal, among the countries examined.

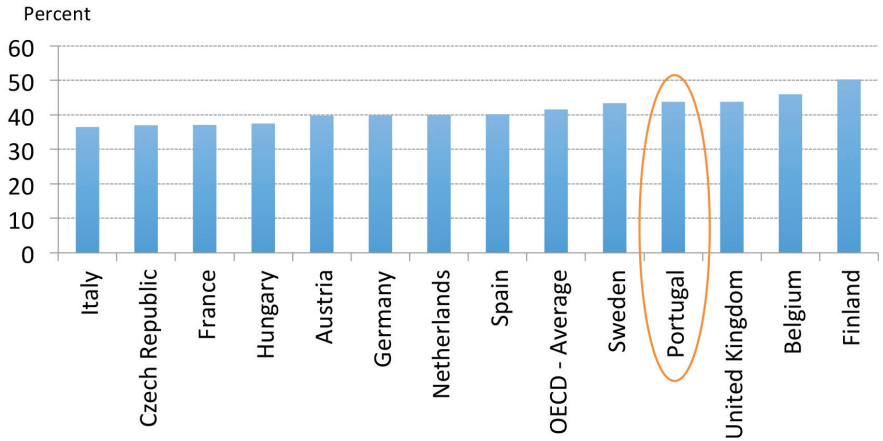
FIGURE 2: Business expenditures on R&D as a percent of GDP, selected countries, 2012



Source: Based on OECD Economy Surveys: Portugal, 2014, Figure 1.24.

Geo-political, social and cultural environments can influence flows of talented human resources. So, one can wonder: how are women doing in universities in Portugal? For example, to what extent are women represented in the teaching ranks in Portugal?

FIGURE 3: Women as a percent of teachers (tertiary level), selected countries, 2012



Source: Based on OECD data from https://data.oecd.org/eduresource/women-teachers.htm #indicator-chart.

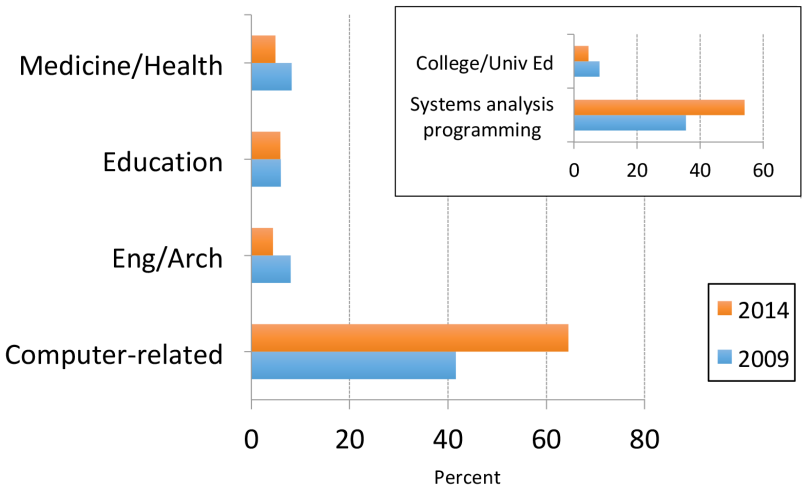
Women have substantial representation in teaching at the postsecondary level. In Portugal in 2012, women accounted for 44% of teachers at the post-secondary (tertiary) level, a percentage higher than that of their southern neighbours like Spain (40%) and Italy (36%). In fact, the representation of women among teaching ranks in Portugal at the tertiary level is higher than the OECD average (42%), and indeed higher than in countries like France (37%), Germany (40%) and the Netherlands (40%) where one might expect to see strong representation of women in academic ranks.

Before going on to information and discussion of international mobility and related issues, it is time to take a look at the master purveyor of foreign talent – the United States.

The U.S. is a world leader when it comes to tapping foreign sources for teachers and filling occupation demand for skills in key sectors. One simply cannot discuss the issue of brain drain and brain gain without being aware of this 'elephant in the room'. One might be tempted to observe that the U.S. hunger for talent has little direct impact on countries like Portugal, Italy and Spain. But of course, pressure on the supply of highly skilled human resources in S&T in one region of the EU can result in a ripple effect in other regions – someone has to make up for the loss of skilled persons if U.K. or German sources are tapped.

The H-1B visa is used for persons entering the U.S. to work in a 'specialty' occupation on a temporary basis. This is the visa used, for example, for a scientist or engineer or technician or university professor to take up temporary employment in the U.S. There is a set job, salary, length of stay and location of employment.

FIGURE 4: Distribution of H-1B petitions approved, selected occupations, U.S., 2009 and 2014



Source: Based on data from *Characteristics of H-1B Specialty Occupation Workers*, U.S. Citizenship and Immigration Services, February 2015, p. 13.
Note: Computer-related includes systems analysis, programming and other computer-related occupations; Eng/Arch includes engineering, architecture and surveying.

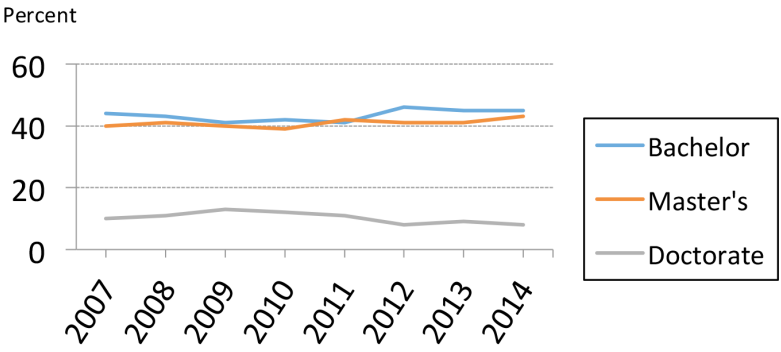
The U.S. continues to meet occupation demands with foreign-born. In 2009, 42% of the 214,274 H-1B petitions approved in the U.S. were in computer-related occupations; five years later, in 2014, this occupation's share had expanded to account for 63% of the 315,857 petitions approved. If we dig deeper we see that in 2014 more than half of the H-1B petitions approved were in systems analysis programming compared with just over one third in 2009.

Today the U.S. economy is recovering and demand for highly talented scientists and engineers is likely to expand once again. In fact, the projection for occupations in computer systems analysts is a 25% increase from 2012 to 2022.

Before leaving the U.S. setting, it is worthwhile to look at a trend that set in at the beginning of this decade when it comes to level of degree of the foreign-born talent the U.S. is bringing in under the H-1B visas. The share with a doctorate entering the U.S. to work on the H-1B visa is shrinking as the Bachelor- and Master's qualified cohorts undergo expansion. This is perhaps

not unexpected when one considers the expansion of computer and computer-related occupations and computer systems analyst occupations where the working degree level is more typically the Bachelor or Master's level.

FIGURE 5: Degree level of H-1B petitions approved, U.S., 2007 to 2014.



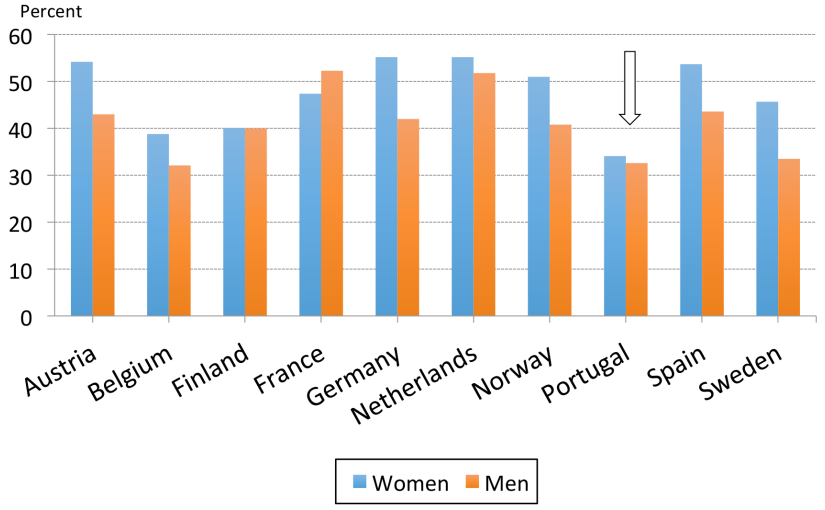
Source: Based on data from *Characteristics of H-1B Specialty Occupation Workers*, February 2015, U.S. Citizenship and Immigration Services.

So why is it that some scientists and researchers have their travel cases at the ready to go to the U.S. or other countries to work while others choose to stay in their native countries? Why is it that some absences are temporary while others become permanent? What factors influence international mobility – are scientists and researchers pushed into leaving – cessation of funding, political shifts and change in domestic priorities? Or are they pulled away with the lure of funding, access to top quality labs and facilities or big salaries and benefits?

In 2008/09, information was collected on choices of doctoral candidates across Europe – some 8,900 doctoral candidates answered the survey of the Eurodoc project. Respondents were enrolled in doctoral programmes and/or working on their degree as academic and research assistants. The intent was to develop a comparative database for institutional staff and policy and decision makers for a wide audience from institutional planners to funding agencies. Of particular significance is the gender variable that provides for a look at different behaviours and intent among Portuguese doctoral candidates.

When asked about time abroad for study prior to their doctorate, about one third, men and women, in Portugal said they had spent time abroad for study purposes. These were some of the lowest figures reported among the countries examined.

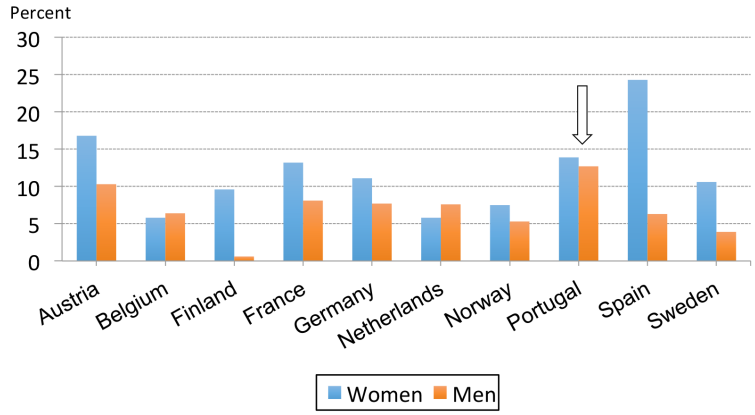
FIGURE 6: Percent of doctorate candidates who *spent time abroad during course of study prior to doctorate*, selected countries



Source: Based on data from Table II-206, *Eurodoc Survey I*, 2011.

Questions were posed to probe reasons for going abroad. For example, to what extent were the doctoral candidates interested in going abroad for *teaching activities*? For Portugal, some one third or so of women and men alike reported they were *not at all interested* in going abroad to teach. However, it is at the other end of the scale, the *to a very high extent* variable, where Portuguese men and women are in the middle or higher range of a potential signal for brain drain. For example, 14% of the women and 13% of the men doctorates said they were interested in going abroad to teach to *a very high extent*…that's more than one in ten doctorate candidates, women and men, who are very interested in teaching abroad.

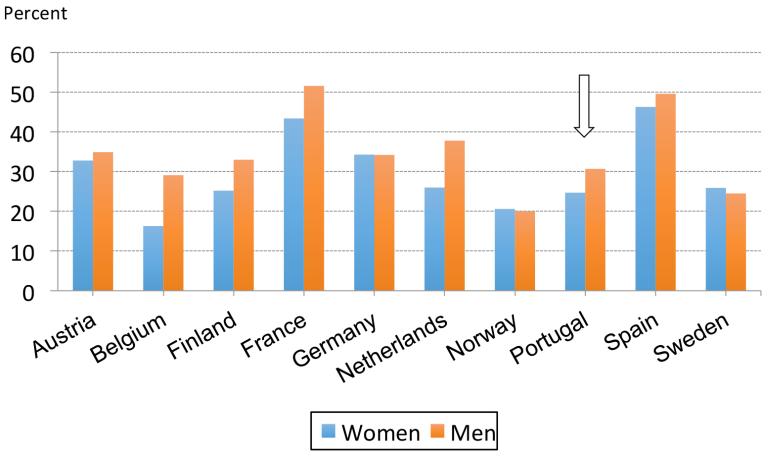
FIGURE 7: Percent of doctorate candidates who are interested *to a high extent in going abroad to teach*, selected countries.



Source: Based on data from Table II-212, *Eurodoc Survey I*, 2011.

Doctorate graduates are mobile. When questioned about plans to move abroad, results for Portugal reveal that one quarter of the women and almost one third of the men plan to move abroad or stay abroad for work. Results like this may ring alarm bells. Almost half of the women and men in Spain reported plans to leave and work abroad.

FIGURE 8: Percent of doctorate candidates who *intend to move abroad or stay abroad for work*, selected countries.



Source: Based on data from Table II-226, *Eurodoc Survey I*, 2011.

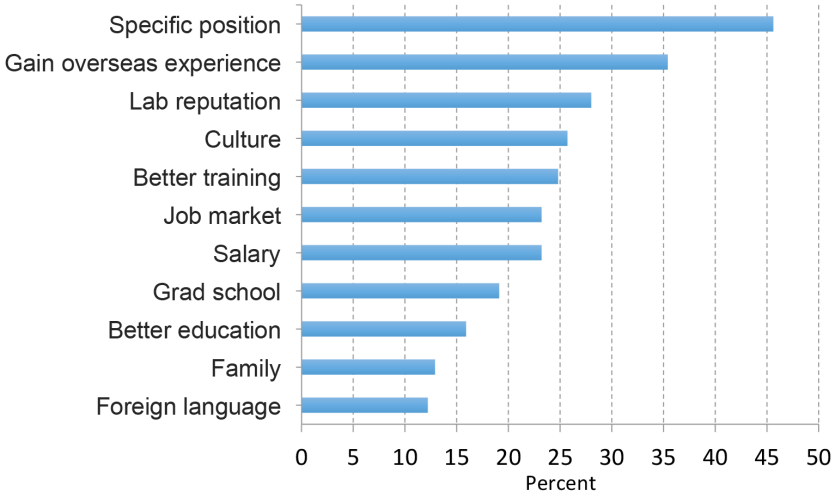
In the spring/summer of 2011, the Italian government and the U.S. National Bureau of Economic Research funded GlobSci – a web-based survey of more than 17,000 authors in four fields (biology, chemistry, earth and environmental sciences, and materials science) in sixteen countries including countries of Europe, the Americas and Asia (Franzoni, Scellato e Stephan, 2012). Respecting limits of the survey, findings suggest that foreign-born scientists perform at a higher level than scientists who have never experienced mobility, and returnees perform at a higher level than home-grown nationals who have not been abroad).

In 2012, *Nature* published results of its survey that probed for incentives and barriers to international mobility. Some 2,300 readers were surveyed – almost one third were women. Among those surveyed, one in four was a postdoc and one in five a research/staff scientist; at least one in ten of the respondents were either a full professor or an associate professor; and, using years since highest degree was obtained as a measure of 'experience', some two in five had had their highest degree for at least 11 years, and one in four for 11 years or more.

No one will disagree that salary is an important consideration when choosing a position but it does not rank as high a 'pull' factor compared to the ability to gain overseas experience, the reputation of the lab or institute or the quality of training offered in a foreign nation.

'Showing the money' doesn't guarantee full advantage when it comes to attracting top talent. The top reason was to take up a specific job or position (46%). Thirty-five percent cited gaining overseas experience as the 'pull' factor. The reputation of the lab or institute was ranked third (28%) when it came to incentives for the move, followed by the opportunity to experience a new culture (26%), and prospects for better training (25%). Salary, in fact, ranked 6th (23%) along with better job market.

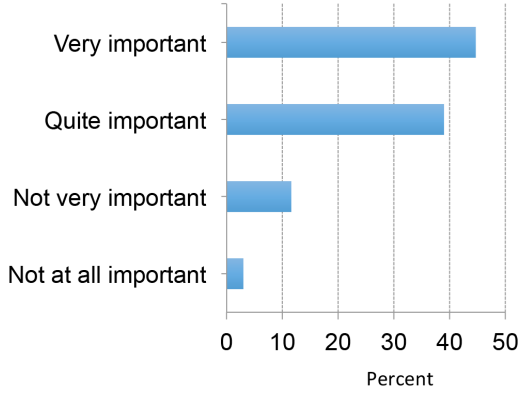
FIGURE 9: Incentives for international mobility



Source: Based on data from 'Science on the Move', "Nature, 490(7420)", 2012.

When asked about the importance of the drivers of relocation, the message is in harmony. For example, when it comes to *increased availability of research funding*, 45% reported it was *very important*, and another 39% that it was *quite important*.

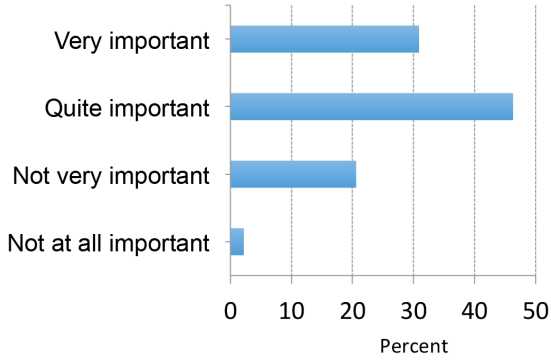
FIGURE 10: Increased availability of research funding



Source: Based on data from 'Science on the Move', "Nature, 490(7420)", 2012.

When it comes to salary, only 31% said it was *very important* compared with 46% who said it was *quite important*.

FIGURE 11: Increased salary.



Source: Based on data from 'Science on the Move', Nature Vol 490, 18 October 2012.

What about the costs and benefits? What can we suppose about the countries that lose their talented people and the countries that take advantage of the foreign-trained talent?

Potential costs and benefits of international mobility of human resources in S&T.

Source country	Receiving country
Cost ◦ **Brain drain -** loss of productivity capacity ◦ Public funds for education and research shrink	**Benefit** ◦ **Brain gain -** increase of R&D and economic activity ◦ Access to foreign top talent through networks – knowledge flows and collaboration enhanced. ◦ Growth in S&T areas help secure funding and help programmes survive.
Benefit ◦ Knowledge flows and collaboration extend national resources ◦ Return of seasoned and internationally experienced scientists and teachers ◦ Support from diaspora.	**Cost** ◦ Nationals could be 'crowded out' of learning, R&D, jobs ◦ Tech transfer and IP agitations.

Source: Based on notes from "Research and Policy Issues in High-Skilled International Migration", M. C. Regets, 2001, IZA Discussion Papers No. 366., and other sources.

What about the bigger picture – international mobility in a world of globalised scientific, economic, social and cultural activity? Cost/benefit analyses for sending and receiving countries include:

– International mobility of human resources encourages international flow of knowledge.
– Scientists have more options to 'match' their skills and interests with occupation and sector of interest.
– Greater funding options for researchers may become available.
– Employers are in a better position to recruit top talent for their needs – a global marketplace for skilled persons.
– International clusters emerge – research is shared and markets are opened.
– Reduction of waste of talented scientists and engineers – can lower rates of underemployment and unemployment.

3. Enduring Challenges

The *measurement of human resources in science and technology remains a daunting endeavour* for a number of reasons. Despite the rhetoric of the importance of S&T knowledge workers, the critical role scientists and researchers play in today's economic, health and social well-being, the subject area remains a 'poor cousin' compared with other members of the innovation data and indicator family such as R&D investment, trade and performance. In 2016, 25 years have passed since the discussions initiated in an OECD meeting in Rome to produce a manual dedicated to data collection and measurement of human resources in science and technology. The OECD revises its definition and measurement manuals for scientific and technological activities and innovation on a regular and timely basis, yet the one manual dedicated to measuring human resources remains in draft form for for some twenty years now. But organizations like the OECD cannot be held responsible – they respond to priorities set by policy and decision makers. Perhaps we as social scientists have to make more efforts to improve funding and support for data develop-

ment on human resources in S&T. And perhaps we as social scientists need to generate more evidence-based narratives to secure this funding and support[2].

Lack of timely and consistent data time series – resources for data collection and indicator development are linked to national priorities and this introduces disparities in availability in terms of scope, coverage, timeliness and access. Surveys come and go based on political will and associated funding (Hansen, 2015).

Policies of remit organizations can limit access to aggregate data. Access limitations multiply when seeking discipline-based data or more specialized data. Limitations of confidentiality block access to micro-data. Add to this the complication of different rules and regulations across different countries and one can start to appreciate the magnitude of the task at hand.

Data development and acquisition costs – there is a lot of information on the Internet and sometimes the availability of data and reports can be overwhelming. However, when it comes to micro-data or more targeted data needs, cost can quickly become a barrier.

There is a lot of *inaccessible data* – if it could be made available to researchers, more insights might be secured (Auriol et al., 2012).

There needs to be a move away from narrow focus on doctorates and consideration of other degree levels – doctorate graduates account for a small proportion of the overall postsecondary population and S&T workforce but their skills and knowledge are highly regarded because of their contribution, technology and innovation. The role and contribution of PhD-trained human resources is irrefutable, however, science and research is a team sport and more resources need to be directed at information on other members of the team – those persons with a Bachelor or Master's degree.

We have lots of little studies on particular groups of scientists, but *no world bank of data* – there is no organization of the volumes of information gathered and analysed through reports generated at great cost to the tax payer. I have mentioned only several of virtually hundreds and perhaps thou-

[2] Reference(s) in this section, refer to W. Pearson, L. M. Frehill, C. L. McNeely, (Eds.) (2015). Advancing Women in Science – An International Perspective. (Chap. 4). New York: Springer.

sands (I suspect) of different studies and approaches under the umbrella of human resources in science and technology.

Valuable work like that of this BRADAMO project relies upon conferences like this, the press and the communication strategy of the authors and the networking of social scientists to share the findings and keep discussions moving ahead on this critical subject. Science is global and science is about networking. If we consider the resources and efforts expended around the world, it behooves us as social scientists to think on how all of this information might be brought together at a global level.

4. Moving Forward

A monitoring system capable of monitoring flows across a range of geo--political, social, cultural and economic landscapes including:

– Flows within the EU – flows in and out of the EU.
– Types of flows.
– Factors of flows.

Build a knowledge base for timely cost/benefit analyses of international mobility of scientists and engineers that:

– Adheres to international definitions and standards for data collection and indicator development.
– Enhances comparability.
– Increases access to data and indicators.

Develop methodology for measurement and analysis of international mobility:

– Indicators for flow of human resources in S&T.
– Indicators to explore cost/benefit impacts.

Joint initiatives with international organizations like the OECD, Eurostat, UNESCO to:

– Enhance access, timeliness and comparability.
– Build on work already done.
– Avoid duplicative efforts and wasting of resources.
– Pool resources for common objectives.

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