Brain drain, brain gain or brain sharing?

New studies of the migration routes of scientists show that international mobility benefits all parties including countries that are net exporters of researchers

Philip Hunter

Scientists have always been ‘sans frontières’, driven by the need to acquire new knowledge and skills and to cooperate with colleagues irrespective of national borders or political divides. In fact, the migration of scientists between countries at all career stages has increased steadily over time. In a related but distinct trend, the incidence of co-authorship reflecting greater international collaboration has similarly been on the upswing. In the USA, a haven for researchers ever since the exodus of European scientists during the Second World War and to some extent before, the number of foreign citizens gaining a PhD has risen from 17% in the 1960s to nearly 40% in 2010 [1]. Almost 60% of postdocs now working in the USA are doing so on a foreign visa [2]. Similarly, in Europe, 43% of postdoctoral researchers in the life sciences are working in a country that is not their place of birth [3]. Until recently, this movement has been more between the EU member states than with countries outside, but growing efforts try to reach out beyond Europe’s borders—the EU–US Science and Technology Agreement, for instance, signed in 1998 has increased cooperation and regular meetings.

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Recent studies looking at scientific mobility reflect the growing awareness of how migration between countries and international collaboration confer an overall benefit for research. At one time, migration in

particular was regarded as little more than a form of trade, in which an individual country either has a surplus or a deficit. Such mobility has therefore long been encouraged in the USA, which has been a net importer of scientific talent with significant benefits to its economy. However, countries that have been net exporters of talent have viewed migration as a negative phenomenon, such as in the UK where the term ‘brain drain’ was used to describe the emigration of scientists and other professionals during the 1960s and 1970s.

The causes of the brain drain were attributed to non-competitive pay rates, poor resources and often a lack of high-calibre people in a particular research field. In response to the perceived lack of skilled people, various European countries began to invest more in research and actively encourage immigration to improve their science talent base, with considerable success in many cases according to the so-called GlobSci study [4]. The study is based on the analysis of 17,000 researchers in four fields—biology, chemistry, Earth and environmental sciences, and material sciences—across 16 countries. Although the USA used to be the leading destination for foreign researchers, it now has an incidence of foreign-born researchers of 38.4%, which puts it in fourth place just ahead of Sweden at 37.6%. Switzerland leads the pack at 56.7%, with Canada second at 46.9% and Australia third at 44.5%. Of the three main European economies, the UK is at 32.9%, Germany 23.2% and France 17.3%. Down at the bottom are Japan at 5%, Italy at 3% and India at just 0.8%. In Japan, this reflects a linguistic barrier; for Italy, it is thought to be due to the lack of resources coupled with a poor reputation tarnished by nepotism; whilst in India, cultural factors allied to low pay are probably responsible.

Beyond the raw numbers, GlobSci and several other studies have drilled deeper to identify the economic benefits of scientific migration, as well as the factors that encourage or inhibit it. There have also been efforts to sift the different levels of mobility, rather than erroneously lumping in a six-month sabbatical or a trip lasting two weeks with permanent emigration. Indeed, the discussion around scientific migration has long lacked reliable information about the various aspects of migration, which has left policy-makers unable to take account of cross-border movement and collaboration in their decision-making. According to Paula Stephen, Professor of Economics at Georgia State University in the USA and one of three authors of the GlobSci study, it was this lack of consistent data that motivated her, Giuseppe Scellato, an assistant professor at the Politecnico di Torino in Italy and Chiara Franzoni, an assistant professor at the Politecnico di Milano, to do the GlobSci survey.

The GlobSci study, one of the largest and most advanced migration studies, is based on bibliometric methods that are accepted as representative of migration data. The methodology involved downloading the bibliographic data of scientific articles in selected journals in 2009 and retrieving the e-mail addresses of the corresponding authors. They were sent a questionnaire to fill in to obtain background information about the co-authors.

However, according to Grit Laudel, a sociologist at the University of Twente in the Netherlands, further work is needed to improve the granularity of the data to distinguish better between the categories of migration, analyse mobility within individual target disciplines and distinguish

different levels of skill. Laudel points out, however, that studies still fail to distinguish between the causes of migration or eventual return to a home country, such as family reasons, financial incentives, the influence of leading people in the field and the resources available at the institution concerned. She also commented that studies need to filter cases of migration by duration, ranging from short stays, through career phases lasting perhaps two years, to permanent migration. Another point that is not captured is the disproportionate impact of the movement of leading members of a field. "The movements of elite members of a certain research field are of particular interest to science policy," Laudel explained. "Losing [sic] them might have a large impact on the future of a certain field in a certain country." But, she added, it remains difficult using current methods to filter out the key people, unless crude measures of definition are used such as number of citations.

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Laudel also commented that GlobSci has further to go to identify movement within the specialized global communities working on particular areas of research, rather than just targeting four broad disciplines. "The biggest problem is that the disciplines are not the right unit to study mobility," said Laudel. "Researchers work and move in smaller communities within specialties. Biology and the environmental sciences for example contain very different fields with very different practices."

The other large-scale study of scientific migration is being conducted on an ongoing basis by Elsevier (<http://www.researchtrends.com/issue-31-november-2012/international-scientific-migration-analysis-generates-new-insights/>) and also uses bibliometric methods based on Scopus, Elsevier's own bibliographic database, which contains 20,500 titles. "Our analysis is based on authors' profiles," said Gali Halevi, Senior Research Analyst and Programme Director at Elsevier. "An author profile in Scopus contains a researcher

affiliation history and enables us to track their movement from country to country throughout their careers. It has its many limitations and challenges, but these are relatively minor when dealing with large numbers."

The Elsevier study is similar in scale to GlobSci, covers 17 countries and has reached similar conclusions. One of the most important findings is how migration stimulates the quality of research by exchanging ideas beyond any net gain of talent, so that even an exporter of people can benefit. "The most important issue is the effect of migration and collaboration upon research performance," said Halevi, who suggested that individuals themselves probably gained from migration and ultimately achieved more in their careers than if they had stayed at home. "A case study conducted some years ago on the performance of researchers at one of the Dutch universities, Leiden University, revealed that those who after attainment of their PhD in the Netherlands conducted their post-doc training at prestigious foreign universities performed better than those who remained in the Netherlands," Halevi explained.

"Our method also enables policy-makers at the national level to track researchers who started their career in a country, but who moved abroad and continued their careers in foreign institutions. This information can play an important role in programmes aimed to invite researchers who went abroad to return to their home country." He added that Elsevier would be able to drill down into sub-disciplines, in the way that Laudel has suggested, to analyse how migration affects each field. "We do expect to have more to offer decision-makers when we identify migration by discipline. For example, if we see that most of the researchers who leave the USA are stem cell researchers who go, let's say, to China to do their research, that's something policy-makers can learn from. By analysing the disciplinary movement we will also be able to identify strengths and weakness in the research infrastructure—where we are lacking and where we are strong based on the draw for researchers."

According to Stephen, the GlobSci study has already shown that migration delivers overall benefits by stimulating research networks and knowledge exchange. "Scientists who migrate are more likely to have international collaborations, and some of these collaborations

are with scientists in the home country, so the home country benefits in this way even if they do not return," she said, noting that 40% of the migrant scientists surveyed in GlobSci have retained research links with their country of origin.

But the biggest gainers from migration could be the labs that attract people from different backgrounds and disciplines to create a dynamic team

But the biggest gainers from migration could be the labs that attract people from different backgrounds and disciplines to create a dynamic team. This seems to be the case at the neuroscience lab run by husband and wife Yuh Nung Jan and Lily Jan at the University of California, San Francisco, which has spawned many publications and 92 primary investigators out of 128 former lab members. The Jans were themselves migrants from Taiwan in the 1970s, and, on setting up the lab, initially hired home-born scientists in the early 1980s. But they have increasingly hired a wider variety of foreign researchers, from Germans to Indians to Canadians. The crucial point is mobility, according to Yuh Nung Jan, rather than the origin of the scientists, because the mix of nationalities brings dynamism, collaborative links and a wider talent pool on which to draw. "Mobility of scientists is very important, both for my lab and the success of US science," he said. "On the one hand, we have been very fortunate to have a continuous stream of wonderfully talented students and postdocs, both American-origin and foreign-born, coming through our lab. [...] On the other hand, most of them went on to become principal investigators, namely faculty members or group leaders, all over the world, and their research groups have made substantial contributions to science." But Jan also emphasized that an international team provides benefits that are perhaps not measurable. "Having a very international lab enriches the experiences, both scientifically and culturally, for all of us."

One benefit that might be measurable is the extent to which cultural diversity within a lab enhances the level of collaboration. However, the Elsevier study has shown that whilst migration and collaboration, measured by co-authorship between institutions

and across borders, are related both conceptually and statistically, they are distinct aspects of globalization that are influenced by different factors. "Our study of 17 countries has shown that there is a difference between co-authorship and migration trends," Halevi said. "From the data available, it is apparent that common language and geographical proximity drive international migration more strongly than it drives co-authorships. In addition, it seems that the effect of political tensions is smaller on

migration than it is on co-authorship. For example, there is migration from Iran to the USA, despite the political tensions between the two countries. However, there is less co-authorship between the two. When you think about it, that makes sense. Authors are bound by the institutions they work for and are subject to guidelines and restrictions. However, migrating is often a personal decision and as such not bound by politics."

Halevi also noted the impact of language and geography on migration, which

is why Japan failed to attract many foreign scientists according to the GlobSci study. In addition, some countries tend to have more temporary migration, whereby researchers move to a different country to complete an academic degree or residency but return to continue their career and subsequent work. "This type of migration supports the development of the country's professional skills levels and infrastructure, and there are rising numbers of such exchanges," Halevi said.

Another aspect of globalization relating to collaboration, rather than migration, is the link between basic and applied research. There was a view, promoted for example by the UK's prime minister Margaret Thatcher in the 1980s, that a country could afford to neglect fundamental research and let others do that, to concentrate on technology transfer and applied work of more immediate apparent economic benefit. This view has since been totally refuted, according to Daniel Calto, Director of Solution Services Institutional Markets, Academic and Government at Elsevier. "There have been a variety of economic studies that have shown fairly conclusively that both basic and applied research have strong net positive payouts for national economies which invest in them," he said. Thatcher's view failed to take account of the stimulating effect of basic research and its interplay with applied development and technology transfer.

"Most fundamental discoveries continue to be made where basic science activity is strongest, and having a strong basic science core is a fairly reliable proxy

for the overall level of innovation in an economy," Calto said. "If one looks at the densest and most productive technology and innovation nodes globally, including Silicon Valley, Route 128 in Massachusetts, the biomedical complexes in Boston and Maryland, the biology/genetics core in Orange County/San Diego, Cambridge's 'Silicon Fen' in the UK, London's innovation hub, the computer sciences corridor in Tel Aviv, or newer R&D nodes like Beijing, Bangalore and Berlin, almost without exception there is a strong core of leading universities doing fundamental basic science research in those areas."

Moreover, a strong basic research core also helps to attract the best scientists, which comes back to the migration question. Calto is therefore convinced that his data is telling him that 'brain circulation', as it should now be called, rather than 'brain drain', is a great stimulus for global scientific progress. "My interpretation is that our data indicate pretty clearly that scholars who circulate outside of their own countries are more productive than those who do not, whether they have a short-term stay of less than two years or a longer

one," he said. "This holds true regardless of the country analysed."

CONFLICT OF INTEREST

The author declares that he has no conflict of interest.

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EMBO reports (2013) **14**, 315–318; published online 15 March 2013; doi:10.1038/embo.2013.33