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Section 4:
Behind the data

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The origin of the 'brain drain'

In the years immediately following the end of hostilities in the Second World War, large numbers of highly skilled scientists emigrated from Western Europe to the United States. In the UK, concerns over the 'loss' of British researchers began to be raised in the early 1950s, as the weight of anecdotal (and limited direct) evidence began to mount. By the early 1960s the issue had become politicized and the Royal Society was tasked with reporting on the nature and extent of the problem. Their report, 'Emigration of scientists from the United Kingdom', was published in 1963 and received much media attention, but it was the Evening Standard newspaper that subsequently coined the term that was to encapsulate the concept: 'brain drain'[1].

Over time, the concept of brain drain has shifted in meaning and complexity, and is now generally understood to describe the shift of researchers from any country (typically less scientifically developed) to any other (typically more scientifically developed). Brain drain, as fits the negative connotations of the term, was usually considered as a win-lose scenario.

New models, new approaches

In recent years, the theoretical framework surrounding scientific mobility and migration has become sufficiently developed to require the coinage of a new term: brain circulation[2]. According to this concept, nations are not considered as winners or losers but as loci in a dynamic system of human capital flows. Within this system, countries may accrue benefits to their domestic scientific capacity through diaspora effects (where the knowledge, skills and professional networks established by emigrant researchers while abroad are shared with colleagues at home) and return rates (where emigrant researchers return to their home countries after a period of working abroad, bringing with them the experiences they have gained)[3]. Such benefits are intangible and as such are difficult to quantify.

Methodologically, studies of brain circulation have traditionally drawn on census or migration data[2], surveys of researchers[4,5], CV analysis[6,7], or a combination of methods[8]. However, empirical data showed that brain circulation cannot be modeled as a purely random process, since there are barriers of language, politics, culture and so on that may act to encourage or prevent a given researcher from moving to a given country. Another more recent study offered the interesting approach of using job advertisements posted on the website of a well-known science weekly to measure brain circulation, but showed that selection bias in the advert placements ruled out the broad applicability of this method[9].

With the advent of comprehensive and sophisticated online publication databases that are populated with peer-reviewed articles with complete author affiliation (address) data, new possibilities have opened up for wide-ranging studies of brain circulation. The development of a methodological framework using these databases was pioneered by Dr. Grit Laudel, currently at the University of Twente in the Netherlands. In her 2003 article 'Studying the brain drain: can bibliometric methods help?'[10], she presented the first systematic attempt to use authors' listed addresses in published articles as a proxy for their location, so allowing tracking of their migration patterns over time. This study presented preliminary results demonstrating a net movement of 'elite' researchers to the US from the rest of the world (in a single specialty, angiotensin research).

Using the same approach, Laudel subsequently expanded her study to demonstrate that while elite migration to the US can be found at the level of individual specialties (such as angiotensin research), the proportion of elite researchers in the US remained almost constant in the period 1980–2002[11]. This finding across all subject fields appears to mask great lower-level variability, as Laudel demonstrates by contrasting the net gain over time of elite researchers by the US in angiotensin research with the relatively steady-state, US-centric elite researcher population of the vibrational spectroscopy community. Migration rates are therefore also likely to vary considerably at lower levels of aggregation than an entire country, such as at region, state, city or institution level.

Designing a novel approach to brain circulation mapping

As part of the report 'International Comparative Performance of the UK Research Base: 2011', commissioned by the Department for Business, Innovation and Skills (BIS), a fresh way of looking at researcher mobility was sought. In the report, published in October 2011, the Scopus database was used to produce a conceptual map of the stocks and flows of human capital in the UK over the 15-year period 1996–2010 (results detailed in Part II of this article in the next issue).

In an important departure from previous studies using author affiliation data as a proxy for measuring brain circulation, this work was not confined to authors belonging to an elite or to a single subject or specialty (c.f. Refs 12–13). Instead, the approach presented in the report uses Scopus author profile data to derive a history of an author's affiliations recorded in their publications and to assign them to mobility classes

defined by the type and duration of observed moves. There were several conceptual and methodological issues to be resolved before the map could be built:

1. **How can we unambiguously assign articles to their authors?**
   A longstanding problem in researcher mobility studies has been the unambiguous identification of the individual[14], as there are common family names in every language and country, and multiple variants of a given person's name in the published literature. In order to overcome these problems, Scopus has improved its author-profiling algorithm in order to identify individual researchers precisely. The Scopus Author Identifier gives each author a separate ID and groups together all the documents written by that author, matching alternate spellings and variations of the author's last name and distinguishing between authors using sophisticated algorithm based on data elements associated with the article (such as affiliation, subject area, co-authors and so on).

2. **What is a 'UK researcher'?**
   Author nationality is not captured in article or author profiling data, and there are serious methodological difficulties in using cultural indicators (such as family names) as a proxy for nationality of birth[15]. So for this study, authors were assumed to be from the first country from which they have published, or from the country where they published the majority of their articles, when looking at migratory or transitory mobility respectively (see point 4 below). These criteria may, in individual cases, result in authors being assigned to migratory patterns that may not accurately reflect the real situation, but such errors may be assumed to be evenly distributed across the groups and so the overall pattern remains valid. To define the initial population for study, UK authors were identified as those that had listed a UK affiliation on at least one publication (articles, reviews and conference papers) published across the 18,000 journals included in Scopus during the period 1996–2010. This list included about 1.5 million unique authors.

3. **What is an 'active researcher'?**
   The 1.5 million UK researchers identified includes a large proportion of authors with relatively few publications (with UK or non-UK affiliations) over the entire 15-year period of analysis. As such, it was assumed that they are not likely to represent career researchers, but individuals who have left the research system. As such, a productivity filter was put in place to restrict to those authors with at least 1 article in the latest 5-year period (2006–2010) and at least 10 articles in the entire 15-year period (1996–2010), or those with fewer than 10 articles in 1996–2010 but more than at least 4 articles in 2006–2010. After applying the productivity filter, a set of 210,923 active UK researchers was defined and formed the basis of the study.

4. **How should long- and short-term mobility be defined?**
   The study of brain circulation is complicated by the difficulties in teasing apart the related phenomena of long-term migration from short-term mobility (such as doctoral research visits, sabbaticals, secondments and so on), which might be deemed a form of collaboration. Defining a time period for a stay abroad over and above which it should be considered a permanent migration (migratory mobility), and below which should be deemed a short-term research visit (transitory mobility), is difficult. Drawing on the definition by Crawford et al.[16], stays abroad of 2 years or more were considered migratory and were further subdivided into those where the researcher remained abroad or where they subsequently returned to their original country. Stays abroad of less than 2 years were deemed transitory, and were also further subdivided into those who mostly published under a UK or a non-UK affiliation. Researchers without any apparent mobility based on their published affiliations were treated as a separate group.

5. **What indicators were applied to understand the groups better?**
   To better understand the composition of each group defined on the map, two aggregate indicators were calculated for each to represent, in a relative sense, the publication productivity and seniority of the researchers they contain. Relative Productivity represents a measure of the articles per year since the first appearance of each researcher as an author during the period 1996–2010, relative to all UK researchers in the same period, while Relative Seniority represents years since the first appearance of each researcher as an author during the period 1996–2010, relative to all UK researchers in the same period. Both Relative Productivity and Relative Seniority are calculated for each author's entire output in the period (i.e., not just those articles listing a UK address).

Part II of this article (to be published in the next issue of Research Trends) will present the brain circulation map of the UK in which these methodological issues have been addressed, and its interpretation.

References:

1. Balmer, B., Godwin, M. & Gregory, J. (2009). The Royal Society and the 'brain drain': natural scientists meet social science. Notes Rec. R. Soc. 63, pp. 339–353.

2. Johnson, J.M. & Regets, M.C. (1998). International mobility of scientists and engineers to the United States—brain drain or brain circulation? Issue Brief (National Science Foundation), No. [?], pp. 98–316.

3. Ciumasu, I.M. (2010). Turning brain drain into brain networking. Science and Public Policy, Vol. 37, pp. 135–146.

4. Marceau, J. et al. (2008). Innovation agents: the inter-country mobility of scientists and the growth of knowledge hubs in Asia. Paper presented to the 25th DRUID conference, Copenhagen, June.

5. Auriol, L. (2010). Careers of doctorate holders: employment and mobility patterns. OECD Science, Technology and Industry Working Papers doi: 10.1787/5kmh8phxvvf5-en

6. Dietz, J.S. et al. (2000). Using the curriculum vitae to study the career paths of scientists and engineers: an exploratory assessment. Scientometrics, Vol. 49, pp. 419–442.

7. Cañibano, C. et al. (2008). Measuring and assessing researcher mobility from CV analysis: the case of the Ramón y Cajal programme in Spain. Research Evaluation, Vol. 17, pp. 17–31.

8. Fontes, M. (2007). Scientific mobility policies: how Portuguese scientists envisage the return home. Science and Public Policy, Vol. 34, pp. 284–298.

9. Luwel, M. (2005). Job advertisements as an indicator for mobility of researchers: Naturejobs as a case study. Research Evaluation, Vol. 14, pp. 80–92.

10. Laudel, G. (2003). Studying the brain drain: can bibliometric methods help?. Scientometrics, Vol. 57, pp. 215–237.

11. Laudel, G. (2005). Migration currents among the scientific elite. Minerva, Vol. 43, pp. 377–395.

12. Ioannidis, J.P.A. (2004). Global estimates of high-level brain drain and deficit. The FASEB Journal, Vol. 18, pp. 936–939.

13. Hunter, R.S. et al. (2009). The elite brain drain. The Economic Journal, Vol. 119, pp. F231–F251.

14. Qiu, J. (2008) "Scientific publishing: Identity crisis" Nature 451 pp. 766-767.

15. Jonkers, K. (2009). Emerging ties: factors underlying China's co-publication patterns with Western European and North American research systems in three molecular life science subfields. Scientometrics Vol. 80, pp. 775–795.

16. Crawford, E. Shinn, T. and Sörlin, S. (1993) The Nationalization and Denationalization of the Sciences: An Introductory Essay, in Crawford, E. Shinn, T. and Sörlin, S. (eds.), Denationalizing Science (Dordrecht: Kluwer).