



postnote

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INTERNATIONAL MIGRATION OF SCIENTISTS AND ENGINEERS

Global competition for scientists and engineers (S&Es) is rising as their role in economic development is increasingly recognised. Many countries are looking to S&Es from overseas to address skills gaps: in February 2008 introduction of new immigration laws favouring some categories of skilled migrant began in the UK. This note looks at the causes and impacts of migration of S&Es, focusing on the developing world, where they play a key role in tackling poverty reduction.

Background

Why scientists and engineers migrate

In this note 'scientists and engineers' refers to those working as S&Es both in academia and outside it. Many of the reasons for migration are similar to other professionals, falling into 'push factors' - reasons for leaving their home country - and 'pull factors' drawing them to a host country. Push factors include:

- Low wages and lack of career choices: a study of Polish academics showed that many had to have a second job to keep them in research.¹
- Lack of funding and/or infrastructure: in a survey of 10,000 Asian S&Es, roughly 1 in 5 cited this as a reason for migrating; only one in 20 cited salary.²
- Political instability, poor governance, corruption and persecution: for example hundreds of scientists have fled Iraq in recent years.

In addition to the above, many S&Es are sent overseas for training, as part of structured programmes, for a fixed period of time.

'Pull' factors include prestige, job satisfaction, higher wages and 'selective' immigration policies which favour certain types of migrant S&Es (Box 1). In addition, S&Es tend to be more mobile than other professionals due to the collaborative nature of their work: 85% of Royal Society fellows have worked abroad, which is often seen as an advantage in academia.

Box 1 Immigration law in the UK

In February 2008, the UK began to introduce a points based immigration system, replacing multiple routes for entry from outside the EU with a single 5-tier system. Tier 2, for 'skilled workers' with a job offer, is restricted to those whose skills match shortage areas, such as engineering, information technology, and education. Overall, the new system has been welcomed as it simplifies immigration. However the Institute for Public Policy Research says Tier 2 may prove restrictive, since skills shortages can change rapidly and are hard to predict, particularly given freedom of movement within the European Union.

The global picture

In spite of the limited data on migration of S&Es (Box 2) some broad trends are widely established.

- All migration is rising due to globalisation. A growing proportion of migrants are highly skilled (HS), or educated to tertiary level. According to one study, as of 2000, 20 million of the 59 million migrants³ in member countries of the OECD were HS.
- In many developed countries demand for S&Es is rising, but availability is falling. There is growing dependence on, and competition for, overseas S&Es. Across the developed world the picture varies widely, with Eastern and Southern European countries losing their S&Es to Western Europe and the USA (Box 2).
- The available data indicate a net flow of S&Es from developing to developed countries. The term 'brain drain' has been widely used to describe the damaging impacts of this migration of S&Es and other professionals from the developing world.
- However there is increasing awareness that migration can benefit both the 'sending' and 'receiving' country ('brain circulation' rather than 'brain drain').
- New information communications technology (ICT) is giving rise to 'virtual mobility' whereby S&Es engage in international activities without physically relocating.

Box 2: Migration statistics

Lack of data limits understanding of migration, not just in the UK but worldwide. Most studies draw on census data (in the UK this is compiled by the Office for National Statistics), work permit figures (in the UK these are supplied by the Home Office), administrative registers and surveys. What data there are can often be interpreted in several ways.

There is little standardisation in how migration is measured, so comparing datasets can be misleading. Key problems are:

- short-term migration is often underestimated: for example population statistics in the UK only include 'long term migrants' staying for a year or more;
- some countries record numbers of 'foreign-born' and others 'foreign nationals'. The latter discounts immigrants who have changed nationality;
- it is difficult to keep track of migrant's movements. For example the UK does not yet maintain a systematic register of people entering or leaving the country. Many administrative registers record arrival but not departure;
- there are few data on S&Es, who are often discussed as part of a wider class of 'highly skilled' workers.

There is no single official source of migration data in the UK. In 2006 the Inter-Departmental Task Force on Migration Statistics, set up by the National Statistician, made a series of recommendations, including collating all relevant statistics from across government into a single UK-wide report.⁴

Box 3: Migrant S&Es in the UK

The benefits of migration *into* the UK are widely recognised. Universities UK states overall, that the UK has a net *inflow* of academic staff, although the situation varies with grade. Two thirds of overseas academic staff are research grade. Migration is important for a researcher's career, but also helps institutions build networks and gain from different perspectives. Science subjects are particularly reliant on overseas staff. As of 2002/3, over a third of all non-UK nationals in academia worked in S&Es although these subjects accounted for only one fifth of the workforce.

The UK is the second most popular destination for students after the USA, with over 350,000 in 2006/7, over one third of whom studied science-related subjects. The total number of international students coming to the UK is rising, although a recent Royal Society paper warned that this growth might not last, as other countries were increasingly active in the 'market' for international students.⁸ This includes developing as well as developed countries.

Data on numbers of migrant S&Es in the private sector are limited. A survey by the Science, Engineering, Technology and Manufacturing sector skills council found that 22% of surveyed science and bioscience companies reported skills shortages of which 25% are now looking overseas.

Impacts of migration of S&Es

Migration is often discussed in terms of impacts on 'receiving' and 'sending' countries. The USA, where one third of all S&E postgraduates are 'foreign born', is a receiving country. The key issue is *immigration* of S&Es. Jamaica, with over 40% of its HS workers abroad, is a 'sending' country. The key issue is *emigration* of S&Es. This is a simplified model, as all countries experience immigration *and* emigration of S&Es to some extent.

Receiving countries- immigration of S&Es*Skills base*

Universities UK⁵ says foreign staff allow teaching and research to continue in areas where UK staff numbers are falling, such as chemistry, physics and mathematics, although it warns of over reliance.⁶ Overseas students can add to the skills base, if they stay on to work (Box 3). Migrant S&Es are seen as only one way to fill skills gaps. Other measures (see POSTnote 277) include encouraging more people to study S&E and making careers in S&E more attractive.

Economics

The economic benefits of immigration of S&Es are hard to quantify. As well as contributing to economic development, there is revenue from taxes and routine spending. Overseas students (in all subjects) are a key source of revenue: a 2007 study published by the British Council estimated that they contributed nearly £5bn in fees and other expenses in 2003/4.⁷ Since 2005, EU citizens living in the UK for over 3 years have 'parallel rights' to UK citizens when they start a degree. The costs (for example in terms of PhD scholarships and student loans) have yet to be quantified.

Issues for receiving countries*Competition for S&Es in the developed world*

As global competition for S&Es mounts, the UK and other

developed countries are stepping up efforts to attract S&Es from overseas. Approaches being adopted include:

- **Overseas campuses** which attract foreign students by giving them the option of paying lower fees and remaining at home, as well as facilitating other study options like sandwich courses.
- **Boosting links with other countries:** for example a key focus of the £23 million UK India Education Research Initiative is higher education and research collaborations in science and technology and social sciences.
- **Pro-active recruitment:** Germany and France actively recruit from Eastern Europe, according to a study by the Economic and Social Science Research Council. The 2004 study warned that the UK might lose out unless it also adopted more pro-active policies.
- **Selective immigration policies** (Box 1).

Recruitment policies

There is some opposition to selective immigration laws (Box 1) on the grounds that they draw skilled workers away from the developing world. 'Ethical recruitment standards' are regarded as a way of mitigating such effects. For example the EU 'Blue Card' proposal (which will make it easier for HS workers from outside the EU to take jobs that cannot be filled by EU citizens) includes measures to limit or ban active recruitment from developing countries already suffering from a serious brain drain. Guidelines such as the *Commonwealth Code of Practice for International Recruitment of Health Workers* highlight the need to balance individuals' rights against the needs of their home country.

Sending countries – emigration of S&Es

This paper focuses on effects of emigration of S&Es on the developing world. These are complex and often cannot simply be classified as 'positive' or 'negative'. Moreover 'emigration' cannot be viewed in isolation: the same S&Es who emigrate often return home with

valuable skills and experience. Cities like Bangalore in India have been described as 'corridors' both for emigration and return of S&Es.⁹ (Box 5).

Box 4 Eastern Europe

In the 1990s, many S&Es moved from Eastern European countries to Western Europe and the USA. In the UK, the proportion of eastern and central European nationals in computer sciences, engineering and mathematics more than doubled from 1995/6 to 2003/4.⁶

In recent years, EU accession and the European Research Area have created new opportunities for Eastern European S&Es. A recent ESRC study showed that while many still emigrate in search of higher wages, there has been a rise in short term migration, where S&Es maintain research careers at home by making trips overseas to use research facilities. This type of migration can help countries to retain their S&Es.¹ The ESRC study recognised the benefits of short term migration but said significant emigration of S&Es could still threaten science infrastructures. Many initiatives are underway to address this. For example UNESCO and Hewlett Packard have installed Grid computing at nine universities in South Eastern Europe to stimulate research.

There is a net movement of S&Es from the south (e.g. Italy) to the north of Europe as well as east to west. This is not discussed in depth in this note.

Poverty reduction

A shortage of S&Es in developing countries, particularly in the private sector, limits progress in poverty reduction, affecting areas as diverse as sanitation, energy, and agriculture. This shortage arises from emigration but also from the 'internal brain drain' of S&Es who opt to work in better paid areas such as finance. The need to "maximise the benefits and minimise the risks of migration for poor people and developing countries" was highlighted in the UK Department for International Development (DFID)'s paper *Moving out of poverty - making migration work better for poor people* in 2007.

Skills base and knowledge transfer

The quality of scientific work conducted overseas can often be higher than at home, as S&Es have access to better infrastructure. This is beneficial from the individual's perspective. It can also be beneficial to the home country, particularly if the work has developmental relevance. The *diaspora*, or network of S&Es abroad, can be a key asset for the home country (page 4). Some countries bring expatriates home for short periods to help to address skills gaps. Those S&Es who return, often stimulate developments at home. This is particularly the case in India and China (Box 5).

Economics

Some say money spent in training S&Es is 'lost' when they emigrate, and that this impacts on economic development (although this is hard to quantify). Others say returning migrant S&Es can *stimulate* economic development. It is also pointed out that the value of remittances sent back to developing countries (by all migrants) amounts to hundreds of billions of dollars, although some point out that these are private funds and do not necessarily contribute to development goals.

Box 5 India and China

In India, in areas such as IT and pharmaceuticals many S&Es are returning. This is largely driven by the growth of opportunities in the private sector. Some employers actively recruit NRIs (Non Resident Indians), as they see them as having wider experience than local counterparts. The think tank DEMOS says that NRIs provide "the leadership and management skills, financial and risk capital that are giving momentum to Indian science and innovation".¹⁰ However some sectors still suffer from a 'brain drain'. At New Delhi's International Centre for Genetic Engineering and Biotechnology, an estimated 90% of postgraduates move to the USA on graduation, causing shortages of junior staff.

In China, almost 25% of students who went abroad from 1978- 2005 (over 930,000) have now returned. Government policies as well as market forces are thought to have been a key factor in bringing this about. Science and Technology Parks such as Zhongguancun Science Park, set up in 1988 with government support, and home to 6000 high tech companies, are thought to play a key role in attracting S&Es back to China. However according to the International Labour Organisation unemployment is a growing problem, as many returnees lack the locally relevant knowledge that employers expect.¹¹

Issues for sending countries

Managing the impacts of migration

In spite of growing recognition of the benefits of migration of S&Es, there are still concerns over the impacts on sending countries, particularly in sub-Saharan Africa (Box 6). Countries with highest *proportions* of S&Es overseas are thought to be worst affected. India and China 'lose' the highest *numbers* of HS workers, but this accounts for less than 5% of their total HS population. Gambia, with fewer HS workers to start with, has over 60% overseas. Some policy options are discussed below.

Returning migrants

Government, private sector and individual institutes all play a role in attracting migrants home (Box 5). Some institutes encourage staff to return, by holding their jobs open, although this can cause problems when absent staff are not replaced. However, sometimes the skills gained overseas cannot be used due to lack of infrastructure or funding. Problems can arise when the returnee's expectations do not match those of the home employer: for example some returning researchers are over focused on continuing the research they were doing overseas, and neglect other commitments.

Making use of the diaspora

Diaspora networks vary widely in their organisation and the activities they undertake. Activities range from holding conferences and focus groups, to collaborative research with scientists in the country of origin. However such networks are useful only if the country in question has the capacity to exploit them. There are concerns that less developed countries are not benefiting fully from their diaspora. They can also be hard to sustain as scientists are often more willing to form part of networks based on their own specialism rather than nationality. Recent work shows how cooperation between home and host country can increase sustainability, and that governments can play a crucial role.¹²

Box 6 Sub-Saharan Africa

In recent years many high profile reports have drawn attention to the emigration of S&Es from Africa (particularly Sub Saharan Africa). In 2004, the House of Commons Science and Technology Committee cited that "the emigration of technically skilled people has left 20,000 scientists and engineers in Africa, servicing a population of about 600 million".¹³ The weakness of many African higher education institutions is seen as a key issue. This has arisen from low investment in higher education, and coupled with political and economic instability in many countries, has exacerbated the brain drain.

Awareness of the importance of S&T is increasing, driven by bodies such as the Commission for Africa, an international commission set up in 2004, the African Union or AU (an organisation of 53 African states, founded in 2002) and the New Partnership for African Development (a pan African development initiative established in 2001). S&T was the theme of the 8th AU summit in Addis Ababa in 2007. Heads of State agreed on a number of steps including:

- "strongly urging" Member States to allocate at least 1% of Gross Domestic Product (GDP) to research and development by 2010;
- encouraging youth to take up science and engineering;
- ensuring the enhanced role and the revitalisation of African universities and other institutions of higher education as well as scientific research institutions.

Analysts welcome the dialogue but say that initiatives have met with mixed success and coordination between different organisations does not always go according to plan. Targets can also be over-ambitious: for example to date, only South Africa is close to achieving the 1% GDP target.

Capacity building in science and technology

'Capacity building' activities in S&T (Box 7) aim both to increase *numbers* of S&Es (for example by creating more jobs or university places) and to strengthen the *capabilities* of existing S&Es (for example with training). Such activities strengthen a country's science base, and by doing so, help to maximise the benefits of migration of S&Es, as well as creating fewer 'push' factors deterring S&Es from staying at home, and more 'pull' factors to attract them back. There are many approaches to capacity building and levels of success vary. As well as supporting broader activities related to migration, DFID funds capacity building in science and technology, focusing on research partnerships. A new 5 year research strategy is expected this year. Around £650 million will be available to fund new research programmes in the forthcoming strategy period (2008 - 2013).

Overview

- Global competition for scientists and engineers (S&Es) is increasing and countries are adopting a variety of measures to attract migrant S&Es.
- Some parts of the developing world still lose significant proportions of their S&Es to the developed world. Capacity building initiatives aim to address both the causes and the impacts of migration of S&Es.
- The potential benefits of migration of S&Es to both 'sending' and 'receiving' countries are increasingly recognised.
- Lack of data severely limits understanding of migration. Initiatives are underway both in the UK and globally to address this issue.

Box 7 Examples of S&T capacity building

The International Aids Vaccine Initiative (IAVI), a public private partnership to create and distribute a preventative AIDS vaccine, is an example of a **research partnership**. IAVI has helped to strengthen links between developing country institutions, and has invested in training and infrastructure, all of which contribute to capacity building. Analysts say focussing on a product is more effective than initiatives with broader goals. DFID has committed £38 million to date.

The African Institute of Mathematics (AIMS), set up in 2003, is an example of a **centre of excellence**. Staffed by international volunteers, AIMS attracts students from all over Africa who come to complete postgraduate diplomas. While there are some successes, Centres of Excellence can be hard to sustain, and can divert resources from existing institutes. There is increasing focus on setting up **networks of excellence** between existing institutes.

There is growing awareness of role of **higher education institutions** in building S&T capacity. For example over 4000 students have graduated in S&Es subjects from the Kigali Institute of Science, Technology and Management in Rwanda since it was established in 1997, with funding from the Rwandan government as well as the UNDP and the German Agency for Technical Co-operation (GTZ).

Recent initiatives also focus on strengthening the interface between **S&T and policy making**. For example under the Millennium Science Initiative supported by the World Bank, the Ugandan government will dedicate \$15 million towards improving the ability of institutions to create and implement appropriate and effective policies for the S&T sector. Although capacity building provides valuable opportunities, paradoxically it may also create more opportunities for S&Es to migrate, thus exacerbating the 'brain drain'.

Endnotes

- 1 *Moving People and Knowledge: Scientific Mobility in an Enlarging European Union, Summary Report*. H.L.Ackers, B.Gill, J.Guth, 2007.
- 2 *Training, networks and mobility of scientists in the Asia Pacific region*. T.Turpin, J.Marceau, R.Woolley, Centre for Industry and Innovation Studies, University of Western Australia.
- 3 In this note 'migrant' implies a foreign born person of working age.
- 4 *InterDepartmental migration task force executive summary, Office for National Statistics*.
- 5 An organisation representing all universities in the UK.
- 6 *Talent wars: the international market for academic staff, Universities UK*, 2007.
- 7 *Global value - The value of UK education and training exports: an update*, Dr Pamela Lenton, published by the British Council, 2007.
- 8 *A higher degree of concern*, Royal Society, 2008.
- 9 *Migration of Highly Skilled Indians: case studies of IT and Health Professionals*, B. Khadria, STI working papers, OECD 2004/6,
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- 12 *Building Sustainability: the new frontier in diaspora knowledge networks*, J.B. Meyer, Bielefeldt, COMCAD, 2007.
- 13 *The Use of Science in UK International Development Policy*. House of Commons Science & Technology Select Committee, 2004.

POST is an office of both Houses of Parliament, charged with providing independent and balanced analysis of public policy issues that have a basis in science and technology. POST is grateful to all contributors and reviewers. For more information on this subject please contact Dr Chandy Nath at POST.

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