

## Migration and Development Brief 4

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### International Migration and Technological Progress

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International migrants are an important channel for the transmission of technology and knowledge. The so-called “brain drain” associated with better educated citizens of developing countries working in high-income countries is acute in some developing countries. Developing countries benefit, however, from the temporary migration of managers and engineers; the return of well-educated emigrants; and contact with a technologically sophisticated diaspora. Remittances sent by migrants also promote technology diffusion by making investments more affordable.

Along with international trade and foreign direct investment (FDI), international migration is an important channel for the transmission of technology and knowledge. However, the directional and scale of technology flows that result from international migration are less clear than for FDI and trade.

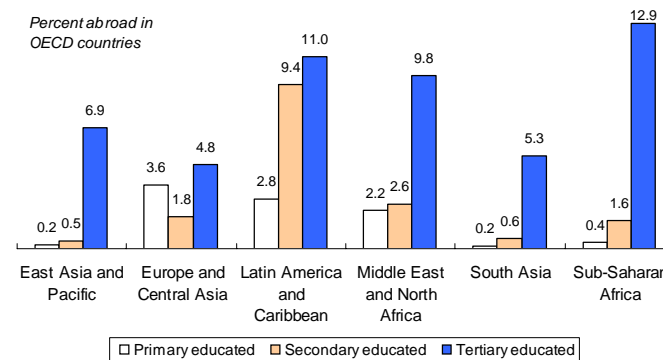
On the one hand, the out-migration of better educated citizens of developing countries can result in the so-called “brain drain”, which is acute in some (mainly smaller) developing countries. On the other hand, return migration and the immigration, albeit often temporary, of managers and engineers that often accompanies FDI and contact with a country’s technologically sophisticated diaspora are positive sources of technology transfer.

#### Brain drain

Emigration rates of the university-educated tend to be higher than for the general population in developing countries (figure 1). This is even greater for scientists, engineers, and members of the medical profession. For example, in India, the emigration rate for those with a tertiary education is 4 percent, but the rate for graduates of the elite Indian Institutes of Technology ranged from 20 to 30 percent in the 1980s and 1990s (Docquier and Marfouk 2004, Khadria 2004).

High rates of skilled out-migration from developing countries imply a net transfer of human capital and scarce resources (in the form of the cost of educating these workers) from low- to high-income countries (UNCTAD 2007, World Bank 2006). For some countries, the brain drain represents a significant problem: emigration

Figure 1. Emigration rate tends to be higher for the tertiary-educated population



Source: Authors’ calculations based on Docquier and Marfouk (2004).

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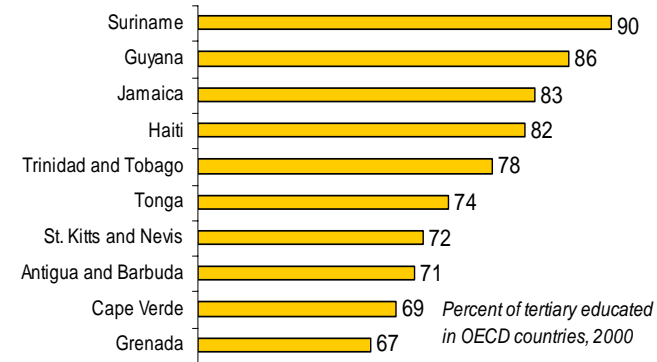
rates of highly educated individuals exceed 60 percent in some small countries (figure 2). In addition, the emigration of professionals who make a direct contribution to production, such as engineers, may result in reduced rates of domestic innovation and technology adoption (Kapur and McHale 2005a). However, given the lack of opportunities in many developing countries, the contribution that out-migrants would have made had they stayed home is uncertain.

### Brain gain

In countries with more moderate out-migration rates, the creation of a vibrant and technologically sophisticated diaspora may be beneficial in net terms, especially when domestic opportunities are limited, because of technological transfers from the diaspora and because most migration is not a one-way flow. For example, a large number of foreign students from developing countries who earn their doctorates in the United States return home, bringing with them a great deal of technological and market knowledge that represents an important technological transfer in favor of the developing country.

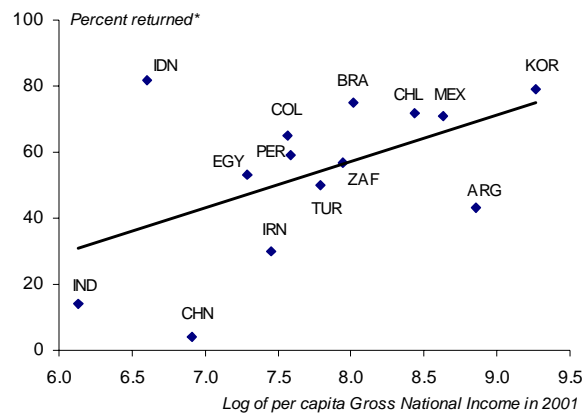
The share of recent doctoral graduates from developing countries who remain in the host country varies significantly across countries of origin. In part, these cross-national differences reflect differences in opportunity costs. The likelihood that a student remains in the United States after graduation falls as average per capita incomes in the home country rise (figure 3). However, even at a given income level, the length of stay varies significantly across countries, with fewer graduates returning home to countries such as Argentina, China, India, and Iran than would be expected based on income alone. Other factors explaining high retention rates include the quality of living conditions and research facilities in high-income countries, as well as the density of research networks and the size of the preexisting diaspora. Factors favoring a return include proximity to family, cultural affinities, and emigrants' desire to contribute to technological progress in their native country (Kuznetsov, Nemirovsky, and Yoguel 2006).

Figure 2. High-skilled emigration is acute in some countries



Source: Authors' calculations based on Docquier and Marfouk (2004).

Figure 3. Rates of return increase with origin country per capita income



\* Share of PhD students returning from the United States within 5 years after graduation.

Source: Authors' calculations based on Finn (2003).

## The diaspora as a brain bank

Repeated waves of emigration have led to the creation of vibrant diasporas that possess cutting-edge technology, capital, and professional contacts. For example, developing countries accounted for three-quarters (approximately 2.5 million) of the 3.3 million immigrant scientists and engineers living in the United States in 2003.<sup>2</sup> Moreover, because out-migration rates are higher for high-skilled individuals than for low-skilled individuals, on average, the diaspora is much more skilled than the home country population and represents an important concentration of expertise. Notwithstanding the size of the diaspora, relatively little rigorous empirical research exists on whether and to what extent it influences technology adoption and creation in emigrants' home countries. The primary evidence of diaspora contributions to knowledge transfers comes in the form of case studies. At a minimum, the technical, market, and marketing knowledge of national diasporas is a huge potential technological resource.

Returning migrants can be a major source of entrepreneurship, technology, marketing knowledge, and investment capital (Brinkerhoff 2006a and 2006b, Kapur 2001). Migrants returning to Egypt tend to have higher levels of human capital than non-migrants and are likely to be more entrepreneurial the longer they work abroad (McCormick and Wahba 2003, Wahba 2007). Returning migrants or members of national diasporas who are still abroad have made major contributions to technological progress in their home countries.

The diaspora also contributes to technology transfers and adoption by strengthening trade and investment linkages. The high-skilled diaspora of countries such as India has contributed to the growth of the information technology sector, outsourcing (Kapur and McHale 2005b, Pandey and others 2006), and FDI in their home countries. The flow of outward FDI from the United States is strongly correlated with the stock of migrants from the origin country (Javorcik, Ozden, Spatareanu, and Neagu 2006). Nearly half of the \$41 billion in FDI that China received in 2000 may have originated from its diaspora abroad (Wei 2004). Similarly, 60 percent of the increase in bilateral trade in differentiated products within Southeast Asia may be attributable to ethnic Chinese networks (Rauch and Trindade 2002).<sup>3</sup> Moreover, technology appears to diffuse more efficiently through culturally and nationally linked groups, and shared ethnicity appears to counteract the kind of home bias effects that underpin the geographic network or the cluster effects that give high-density R&D zones an innovation advantage (Agrawal, Kapur, and McHale 2004).

## Diaspora networks and returnees help promote technology adoption

The diaspora's political engagement in home countries can also improve local technological absorptive capacity, both through return and by exercising pressure on home country politicians from afar. Many leaders of developing countries were educated abroad and have returned to strengthen political institutions in their countries of origin (Easterly and Nyarko 2005). In addition, migrants have often played a valuable role in the transfer of market-based institutions, such as venture capital, entrepreneurship, and corporate transparency, to their countries of origin.<sup>4</sup> Overseas Taiwanese engineers and returnees, for example, worked closely with policy makers to establish a successful venture capital industry, helping finance high-risk entrepreneurial activities in the technology sector (Kuznetsov 2007).

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<sup>2</sup> Of these technologically sophisticated émigrés, 56 percent were born in Asia, with Latin America and the Caribbean accounting for another 15 percent (Kannakutty and Burrelli 2007).

<sup>3</sup> Similarly immigrant ties have been important determinants of U.S and Canadian bilateral trade (Gould 1994, Head and Ries 1998, Wagner, Head, and Ries 2002).

<sup>4</sup> Kuznetsov (2007) argues that diasporas can act as global search networks by identifying research capabilities, availability of technical manpower, and business-friendly local governments.

Expatriate knowledge networks have been created to foster regular contacts; transfers of skills; and opportunities for business with researchers, scientists, and entrepreneurs in the country of origin. Brown (2000) identifies 41 such networks for 30 different countries. These networks tend to be rich depositories of talent with high concentrations of members with advanced degrees, many earned in the host countries. Colombia's Red Caldas network, set up with government assistance in 1991, was one of the first diaspora networks that succeeded in promoting collaborative research between domestic scientists and Colombian researchers abroad through workshops and symposiums, joint research programs, visiting researchers, scientific events, publications, and research and training opportunities (Chaparro, Jaramillo, and Quintero 2006). Less formal networks played an important role in the transition of Korea and Taiwan, China, from developing to high-income economies.<sup>5</sup> Some diaspora networks have failed, principally because they were too ambitious, particularly in cases where the policy and institutional environment in the home country were not supportive. Research suggests that the most successful models start small to build up trust and credibility before attempting to sponsor a major research project or cooperative agenda (Kuznetsov 2006).

Remittances can promote technology diffusion by making investments more affordable

Remittances to developing countries have grown steadily in recent years, reaching an estimated \$240 billion in 2007, and are now larger than FDI and equity inflows in many countries, especially small, low-income countries. Remittances can support the diffusion of technology by reducing the credit constraints of receiving households and encouraging investment and entrepreneurship (Fajnzylber and López 2007, Puri and Ritzema 1999, Woodruff and Zenteno 2007, World Bank 2006). A survey of self-employed workers and small firms in Mexico found that remittances were responsible for a fifth of the capital invested in microenterprises in urban Mexico (Woodruff and Zenteno 2001). In the Philippines, households work more hours in self-employment and become more likely to start relatively capital-intensive household enterprises in response to an exogenous increase in remittances (Yang 2006).

Remittance flows have also contributed to the extension of banking services (often by using innovative technologies), including microfinance, to previously unserved, often rural sectors. This has improved household and firm access to financial services (see Gupta, Pattillo, and Waugh 2007), and their ability to purchase and invest in technology. For example, remittance revenues may have enabled Ghana's ApexLink and Mongolia's XAC banks to expand their networks and services (Isern, Donges, and Smith 2006). Cell phone money transfers, such as Smart Padala in the Philippines, and card-based remittances are becoming prevalent in a number of countries, including Mozambique, South Africa and the United Arab Emirates, and are likely to expand to other countries in the coming years (Helms 2006, Jordan 2006). Remittances have also helped domestic banks foster links with banks in high-income countries. In turn, such links have fostered technology transfers as banks in high-income countries have helped local partners to upgrade their systems to comply with the anti-money-laundering, antiterrorism and know-your-customer regulations in developed countries.

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<sup>5</sup> The Taiwanese diaspora and returning migrants were active conduits for technology transfers. For example, in 2000, 113 out of 289 companies at the Hinschu Science-Based Industrial Park in Taiwan, China, were started by U.S.-educated Taiwanese (O'Neil 2003).

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