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The International Mobility of Technical Talent

Trends and Development Implications

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Abstract

This paper charts the complex dynamics of the movement of technical talent in the world economy and assesses broadly the impact of such mobility on both sending and receiving countries. Based on secondary data and primary information from the Indian and Japanese IT industry, the study presents a global view of the movement of talent and its development and policy implications. By synthesizing disparate data and the multifaceted processes and outcomes of international mobility, the paper examines some of the distributional issues of gains and losses in both sending and receiving countries.

Keywords: international migration, education, government policy, human capital, skills, information services, computer software

JEL classification: F22, I28, J24, L86

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The Tables appear at the end of the paper.

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1 Introduction

The emergence of the new economy, in which services and information and communications technologies (ICT) play a significant role, has created new opportunities for developing countries endowed with skilled workers. Competition among firms has intensified due to rapid innovations, shorter product cycles, and quick delivery (to market) time. It is also driven by the global availability of skilled workers (Florida 2005; Desai et al. 2002). While labour markets for skilled workers are not as globalized as capital markets (Brown 2001: 26-9), growing evidence of the international mobility of technical talent (Docquier and Rapoport 2004) has raised numerous questions on the causes and consequences of such movement for both sending and receiving countries. The liberalization of cross-border movements of people, even temporarily, arguably yields far more benefits to developing countries than economic integration based on the flows of goods and capital (Rodrik 2005). Consequently, questions about supply and demand of skilled workers, citizenship, and related immigration policies have drawn considerable attention (Cornelius and Tsuda 2004). In tandem, the demand by developing countries for the temporary movement of skilled workers to OECD markets under the General Agreement in Trade in Services (GATS) Mode 4 has brought the subject of international mobility of technical talent under greater scrutiny (Mattoo and Carzaniga 2003). It is widely recognized that that mismatch in the supply and demand of technical skills is driven by recruitment of talent by multinationals, increasing global trade and investment, demographic shifts, and increasing information technology (IT) business opportunities in emerging economies.

The objective of this paper is to chart the complex dynamics of the movement of technical talent in the world economy and assess broadly the impact of such mobility on both sending and receiving countries. As more people move across borders, both temporarily and permanently, the economic and social fortunes of both poor and rich countries are bound in inextricable ways. Thus, from a developmental point of view, the distributional question of who gains from the mobility of talent and how best to capture the benefits of mobility for national development become salient. Based on secondary data, the study presents a global view of the movement of talent and its development and policy implications. It also relies on primary data from the Indian and Japanese IT industry to highlight international mobility issues. Admittedly, the data across countries are scattered and neither strictly comparable nor always reliable. A modest attempt has been made to synthesize the disparate data and multifaceted processes and outcomes of international mobility to highlight the trends and implications for development. The next section of the essay provides some definitions of variables commonly associated with the international migration literature, especially involving high-skilled workers in the IT industry. The third section describes some of the socio-economic characteristics of IT technical talent. The following section introduces some basic patterns of global migration in the world economy. The fifth section delves into the main motivations behind the movement of talent. Section six assesses the impact of mobility of technical talent on both sending and receiving countries. The next section analyzes the developmental impact of mobility on the IT industry. The final section briefly discusses some of the policy implications of the international mobility of technical talent.

2 Some basic concepts

Defining 'technical talent' is problematic as it is linked to a range of technical skills. It is difficult to measure skills as a variety of factors contribute to skill development, such as work experience, length and type of training, formal education, and the nature of economic value of the work performed. Barring exceptional talent as in athletes, artists, and entertainers, high-skilled workers possess tertiary education of at least four years beyond the twelve years of primary and secondary education (Lowell and Findlay 2001: 7). The reference to 'technical' suggests formal training and education in fields such as the sciences and engineering. Generally, a four-year university degree would be the requisite formal education to produce technical talent, but shorter vocational training could be included as well. The OECD includes technical talent under the broader category of 'human resources in science and technology' (HRST).[1] This refers to physical and life sciences, engineering, social sciences, health, education, and business. Hence, managers, doctors, economists, and other professions requiring a college degree would be classified under HRST.[2] For the purpose of this paper, technical talent will include high-skilled workers and HRST who at the minimum have a four-year tertiary *science or engineering* degree and who for all practical purposes are the key human resources for the information technology sector.

Some IT professionals become entrepreneurs and venture capitalists, who are also highly mobile, especially between their home and adopted countries (see Saxenian 2006). Most IT experts and entrepreneurs would have an engineering background in computer science, electronics, or software engineering; some may come from other broadly technical fields such as engineering and the sciences. A few could have non-technical backgrounds with either a degree in computer applications with knowledge in programming or with extensive IT training or marketing skills who are familiar with the IT market. Generally, engineers with an MBA serve as consultants and other managerial positions within the IT industry.

Two concepts are used to analyze the mobility of technical talent. They are stocks and flows. Similar to foreign direct investment (FDI), the stock of talent is measured at a given moment in time, while flows are measured over time. Also, there are both inflows and outflows of talent. Hence, net inflows (or outflows) capture better the direction of mobility of technical talent and the availability of skills for any given country over the year. Both stocks and flows are related, i.e. each year's flows cumulatively add to the stock of technical talent for the receiving countries. Net flows by level of education suggest that those with higher professional qualifications tend to be more mobile than those with less education, though global migration also selectively includes less-skilled workers. Intuitively, net inflows of technical talent are positive for most OECD economies, while for developing countries such flows tend to be negative. However, with new opportunities in sending countries, net flows do not necessarily capture the more 'circular' movements of professionals between sending and receiving countries.

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1 Research scientists form a subgroup but may overlap with other categories mentioned below (see Thorn and Holm-Nielsen 2006).

2 Nurses do not fall in this category. However, healthcare workers are a significant category in analyzing international migration issues (see Blouin 2005).

A distinction needs to be made between temporary and permanent movement of talent. Foreign students pursuing university-based technical training constitute an important supply of future talent. Technically, foreign students are considered to be temporary visitors. However, the inflows of foreign students add to the future stock of talent in the receiving country should they not return home. As the demand for technical workers has been typically higher in OECD countries than in the non-OECD ones, it is inevitable that some students from developing countries seek employment in the host economies. At the same time, as employment opportunities increase in sending countries, the incentives for foreign students to return home also increase. Moreover, as the international outsourcing of IT services and design takes on greater prominence in global business strategy, the mobility of talent takes on a combination of temporary, permanent, and circulatory character.

3 Characteristics of technical talent

3.1 Education

If technical talent is distinguished from other categories of workers by educational background in engineering and the sciences at the tertiary level, then countries with strong technical tertiary educational infrastructure are positioned well to generate technical talent. Governments explicitly pursuing industrialization with a science and technology policy have typically built up a good technical education system. As the global demand for technical professionals increases the national educational infrastructure tends to respond favourably to meet such demand. Thus science and technology spending contributes to the international mobility of technical talent (Solimano and Pollack 2004: 3).

Technical talent at its core embodies both generic training in logic, mathematics, and software programming and specialization in particular technical fields such as electronics, computer science, mathematics, physics, and life sciences. The minimum qualification is a bachelor’s degree in engineering or the sciences, although there are demands also for master’s and Ph.D. degree holders. Many engineering students from India, China, and other developing countries obtain a bachelor’s degree at home and then a master’s or Ph.D. degree abroad to work as researchers in both commercial and non-profit, public institutions.[3]

In India there are also non-engineering students who obtain technical training in IT through diploma programmes such as the Masters in Computer Applications (MCA). These graduates, along with non-engineers with mainly programming skills, also comprise technical talent. However, diploma holders tend to be less mobile internationally than engineers unless they have some solid ‘domain’ expertise such as in finance, retail, manufacturing, media and the entertainment industry, or supply chain management. Domain expertise is purely a function of work/project experience. Graduates with several years of experience in particular domains are highly sought

3 For most students from developing countries a four-year undergraduate overseas education would be financially prohibitive.

after. However, as a general rule, without a technical background entry into particular IT domains is difficult.

3.2 Socio-demographic characteristics

Technical education is expensive as it requires four additional years of training. The opportunity costs are high but it promises higher expected returns over the lifetime of the graduate. It is also expensive in terms of national resource allocation. Resources devoted to tertiary education in developing countries means fewer resources in basic primary education. A political economy analysis of higher education would suggest that a class bias is inherent in tertiary education, and especially technical training, as it requires greater resources per student. However, as a matter of public policy and higher expected social returns, promoting higher education can be justified so long as basic education is not ignored. But who gets to pursue technical education? It is intuitively clear that in market-driven economies households already enjoying higher economic and social status and pre-disposed favourably toward higher education are the main beneficiaries of tertiary education. Early socialization toward higher education, reinforced by economic and social rewards of technical education, suggests a strong middle class bias in tertiary education.

In developing countries professional training, especially technical education, is perceived as a gateway to well-paid employment. The economics of scarcity limits the entry of students in technical education as the demand for education exceeds the supply. Consequently, the premium associated with a degree from reputable technical colleges provides a generalized incentive for middle class students to pursue technical education. Given education's public good characteristics and middle class aspirations, politically governments are compelled to subsidize technical education. The worldwide expansion of IT-related industries and the growing significance of the weightless economy suggest higher enrolments in technical training, especially in developing countries.

In some countries such as India, the growth in technical education exhibits regional dimensions (D'Costa 2003a). The southern states of Karnataka, Tamil Nadu, Kerala, and Andhra Pradesh, for historical and institutional reasons, have a better record on education in general compared to northern and eastern states. Both Karnataka and Tamil Nadu have further promoted technical education by deregulating engineering education.

Low-income households and rural families can access higher technical education if they have a good secondary education, resources, and the willingness to risk current income for future returns. Affirmative action programmes attempt to address the pre-existing social and economic inequality. The reservations system in India gives preferences to historically and structurally oppressed scheduled castes and tribes for admissions to public universities and institutions of higher learning.

The relative newness of high technology and the IT industry suggest that the stocks and flows of technical talent will be relatively young.[4] Although the gender composition of

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4 The average age of immigrants tends to be less than the receiving country population. However, Israel, which has immigration as a central policy for nation building, has been a recipient of older immigrants (Paltiel 2001: 167-8).

technical talent favours males over females, the IT industry is creating opportunities for women. The high education and intellectual content of software engineering, the social acceptability of white collar in general, and good remuneration make the IT industry attractive for technically trained women.

3.3 Economic characteristics

Technical talent is prized because of the economic value it generates for firms and national economies. The relationship between education and income, though inconclusive at the general macroeconomic level, is intuitively strong at the sectoral level. Professionals with technical degrees are better placed to find employment in today's globalizing economy fuelled by ICT than those with non-technical degrees. With experience the market value of technical professionals increases considerably in an industry characterized by growth and a relatively young workforce. It is evident that those with the right mix of education and skills can exploit the new opportunities.

As with any economic activity, job-specific and firm-specific training is critical to transform the raw talent to meet particular project needs. The market value of talent increases with firm reputation, years of experience, and progressively more experience with the management of complex projects. Though specific technical skills are embodied in individuals, it is the experience gained through teamwork in projects that rewards technical professionals over time. Also, the salary structure of the IT industry reflects the complexities of the tasks done by IT professionals. For example, among engineers a programmer is at the lowest end of the job hierarchy in the IT industry, while project leader, project manager, network administrator, and systems integrator will be ranked much higher. Their salaries will vary considerably, depending on the position, years of experience, and nature of projects handled. Thus engineers programming for embedded software are likely to be paid more than those programming for banking software since greater technical skills are needed for embedded software. However, project execution for banking software could be equally challenging. Furthermore, salaries also vary by firm size and reputation and the extent to which firms provide bonus and employee stock options to its employees.

High economic value for technical talent is justified by high labour productivity relative to other sectors, often measured in terms of revenues per employee. High value is also due to the increasingly ubiquitous nature of IT products and services in the new economy, which can be seen as an intermediate product and service, designed to facilitate the production of final goods and services. Furthermore, network externalities in the IT industry are also a significant driver of growth. As ICT diffuses so do the efficiencies in producing and using IT goods and services. This derived demand can be argued to be an important determinant of economic value of technical talent. High demand suggests high growth in compensation rates for talent and subsequently, *ceteris paribus*, a greater response by the technical education system to meet growing demand. This is especially the case when demand is externally generated, leading to outflows of talent, both temporarily and permanently. The large wage differential between OECD and developing countries in the context of high demand is a significant motivator of international migration.

4 Some global migration patterns

Today, roughly 2.5 per cent of the global population of 6.1 billion lives outside their home countries, compared to 2.2 per cent in 1965 (Whitwell 2002: 5). What has changed are the patterns of migration, the relative significance of sending and receiving countries, the types of migration by occupation, skill, and duration, the macro and micro processes underway, and the impact on both sending and receiving countries in the context of global economic integration. There are many reasons for the movement of talent, including political, military, and economic. The break up of the Soviet Bloc and subsequent economic instability contributed to emigration from Kazakhstan, Uzbekistan, and Ukraine and former eastern bloc countries to Russia and Russian Jews to the US, Israel, and Germany (Heleniak 2004). Military dictatorships in Latin America and the massacre in Tiananmen Square have also sparked outflows of talent (Solimano and Pollack 2004: 4; Whitwell 2002: 7). However, the mobility of highly skilled workers is increasingly determined by market demand and supply conditions and perceived economic and professional opportunities in the world economy. The IT industry is one such case. The ageing of societies is another development that is creating unprecedented demand for workers, especially in healthcare.

4.1 International migration trends

Based on the inflows of foreign population in OECD countries, the preferred destinations are Western Europe, North America, and Australia.[5] Within the OECD Germany, Japan, Australia, Canada, UK, and the US stand out as the most important destinations (OECD Migration Data Set). The main receiving countries are the larger OECD economies, while the sending countries include most of the developing world. However, not all movements of people are from non-OECD countries to the OECD. A good portion of migration for Europe is intra-European. Also, many Canadians work in the US, while engineers and computer scientists from non-OECD countries are attracted to Canada for immigration (Zhao et al. 2000: 8, 20; Wickramasekara 2002: 4). There is considerable migration within Asia and between Asia and the OECD economies (Hugo 2003: 11). Australia receives most of its permanent settlers from New Zealand followed by the UK. For Germany, Italy was the fourth largest sender of nearly 30,000 in 2001, while for the UK it was the US and Australia that were the top senders of 47,000 and 31,300 respectively. In the same year, the US sent over 20,000 people to Japan, just 5,000 less than Korea.

Barring these intra-OECD flows, the bulk of inflows to the OECD countries are from developing countries (Table 1). The patterns of inflows reflect historical, colonial, ethnic, and regional ties. It is not surprising that Morocco and Algeria are the largest sources of immigrants to France due to historic and colonial ties, and Albania is the principal supplier to Italy due to regional proximity. Due to colonial, linguistic, and regional ties Japan receives Chinese and Koreans; the UK receives Indians, Pakistanis, and Bangladeshis; while common ethnicity attracts Americans and Australians to the UK. Similarly, French-speaking North Africans prefer to emigrate to France, while English-speaking South Asians, prefer Canada, the UK, the US, and Australia.

5 The measurement methods vary by country hence the data on foreign population are not strictly comparable.

Emigration rates vary, with very poor countries sending relatively more skilled people. For example, Haiti, Somalia, Ghana, and Mozambique were the top four among 30 countries with the highest sending rates, whereas Sweden, Egypt, China, and India were ranked the top four among the group of 30 with the *lowest* rates (Docquier and Rapoport 2004: 9). Among non-OECD countries, middle-income countries display a greater propensity to send skilled migrants, while large developing countries with a larger absolute pool of talent tend to have lower emigration rates. Latin American countries such as Brazil, Paraguay, Bolivia, Venezuela, and Costa Rica fall within this group (OECD 2005: 129). However, their reasons for low rates are not necessarily because of large pools of technical talent (except perhaps Brazil) or growing professional opportunities at home. Rather it is likely influenced by the limited availability of high quality technical education infrastructures.

4.2 Migration trends of high-skilled workers

The biggest sources of non-OECD expatriate communities in OECD countries are 'the former Soviet Union (4.2 million people), former Yugoslavia (2.2 million), India (1.9 million), the Philippines (1.8 million), China (1.7 million), Vietnam (1.5 million), Morocco (1.4 million), and Puerto Rico (1.3 million)' (OECD 2005: 127). Among them, the former Soviet Union and India had the largest numbers of expatriates with tertiary education – 1.3 and 1.0 million respectively (OECD 2005: 127). The share of high-skill expatriate populations from non-OECD countries is presented in Table 2.

Countries with more than 500,000 expatriates show a range of high skill expatriate intensities (number of skilled expatriates as a share of total expatriates). In other words, not all countries with a large absolute number of expatriates have a big share of high-skilled expatriates. Conversely, countries with few expatriates could have a high concentration of the highly skilled. The reasons are simple. Wars, ethnic conflicts, and political upheavals often lead to a large expatriate population with a small share of highly skilled professionals. Bosnia-Herzegovina, the Federal Republic of Yugoslavia, and El Salvador are three such examples. Other countries such as Iran, plagued with political uncertainties, have a high share of skilled expatriates (45.6 per cent) (Table 2). Small countries such as Cuba and the Dominican Republic, with their proximity to the US, are also large sources of expatriate populations. Cuban expatriates in the US tend to be highly skilled. Mexico, on the other hand, with over 8 million expatriates in the US had a highly skilled share of only 6 per cent. Historical ties as well as earlier Japanese migration to Brazil have made contemporary Brazilian emigration directed more toward Western Europe and Japan. Turkey's easy access to the German economy through the guest worker programme has contributed to a large number of expatriates but with a low concentration of high skilled workers (6.3 per cent). Smaller countries send out fewer people but contribute a greater portion of high skills. Most former East European countries, with advanced technical education systems, would fall in this group.

The highest concentration of highly skilled expatriates is found among Asian countries. They include Hong Kong, China, India, Pakistan, Philippines, Taiwan, and Vietnam. Most of these countries are poor but have large pools of technical talent. For example, 80 per cent of Indians and 54 per cent of Chinese immigrants to OECD aged 25 and above had tertiary education (Chalamwong 2004: 5). These countries can be expected to send out large numbers of high skilled people and have a high concentration of highly skilled expatriates. India, with nearly 2 million expatriates, had a concentration of 52 per cent, the Philippines with a similar expatriate population had a concentration of 48 per cent, and China, with 1.6 million, had a share of 40 per cent. Taiwan had the highest concentration with 61 per cent due to its rapid industrial development based on technical education.

5 Main motivations behind mobility

5.1 Structural demand and supply factors

The decision to move to a new country is mostly an individual or a household one but one that is embedded in the wider structural and community context. At the individual/family level emigration is a response to better economic opportunities, significantly influenced by responses of and feedback from earlier emigrants. In neoclassical terms this is interpreted as choosing the higher returns to marginal productivity in the richer, receiving country over the lower returns in the poorer, sending country.[6] However, the global labour market does not function so smoothly. It is highly regulated through national immigration policies. Structurally, the ever-increasing technology- and knowledge-intensive activities within the ambit of a new 'weightless' economy are generating higher demand for talent. The rapid development of electronics and digital technologies (convergence technologies) and their diffusion has contributed to the global demand for technical talent and thus inflows of high-skilled workers to OECD economies.

Economic integration also influences the global supply and demand of talent. As multinational firms organize production globally they also recruit professionals globally and engage in intra-company transfers of human resources and technical talent. In 1996 the UK and the US registered 13,000 and 32,000 intra-company transfers respectively (OECD 2005: 36). In 2002, the numbers were 19,000 and 58,000. Regional free trade agreements such as the North American Free Trade Agreement (NAFTA) also encourage the movement of talent among member countries. For example, university educated Canadian workers could work in the US under a NAFTA temporary visa system (Zhao et al. 2000:13). With tight control over their subsidiaries, Japanese companies also contributed to intra-company transfers as currency appreciation and rising wage costs compelled shifting production to East and South East Asian countries in the 1980s.

Mobility is also influenced by labour shortages in OECD economies due to declining fertility rates, ageing societies, increasing dependency ratios, and tight immigration policies. High-income countries already have low population growth and are expected to fall further in the next decade (Table 3). For example, Japan is expected to witness negative population growth rate of –0.2 per cent over the 2001-15 period. The non-OCED countries have a higher population growth rate with a much younger population.[7] Those that have a large pool of technical workers are likely to remain major sending countries for the foreseeable future. Post-Second World War

6 For a critique of the neoclassical interpretation, relying on economistic 'pull and push' factors of international migration, see Massey et al. (1998).

7 In 2000, Switzerland faced a shortage of 10,000 IT workers (Page 2003: 208).

industrialization efforts by large developing countries such as China, India, and Brazil unwittingly contributed to a large technical pool. However, the exhaustion of industrialization in the context of low economic growth failed to absorb such talent in remunerative and professionally challenging assignments. Limited professional opportunities, unemployment, and low salaries led to the emigration of technical talent from most developing countries. More recently in the 1990s, the economic crisis in Latin America generated substantial underutilization of technical talent at home and the US remained the main destination for the region (Barrere et al. 2004: 29). In the context of global shortages, competition, and intensified economic integration the outflows of talent from non-OECD countries have become structurally more pronounced.[8]

Technical education and foreign degrees are perceived to enhance employment prospects in poor countries. However, unlike previous outflows of students, the magnitude of flows has increased with fewer students returning home. Thus, over time, non-OECD economies are contributing to the stocks of talent in OECD countries by immigration and student flows are adding to the future stocks. With declining enrolments in science and technology fields in several OECD countries *de facto* opportunities have emerged for foreign students (see Department of Education data in Watts 2001:149). The stocks of foreign students, from non-OECD countries in selected OECD economies, are presented in Table 4. The US remains the largest destination for students, with the UK as a distant second. Smaller European economies tend to have smaller shares of non-OECD students.[9] Latin America remains a small source for foreign students in OECD countries as not one country from the region was mentioned in a list of main countries by origin of foreign students (Tremblay 2002: 53).

The movement of technical talent is visible from the increasing number of foreign-born scientists and engineers (S&E) in the US civilian labour force (Espenshade 2001: 137). In 1970, foreign-born scientists and engineers represented 7.6 per cent compared to 11.4 per cent in 1990 and 14.8 per cent in 1997. Between 1970 and 1997, the total number of native-born and foreign-born S&E increased by 124 per cent and 373 per cent respectively (Espenshade 2001: 137). Based on National Science Foundation data, over 50 per cent of science and engineering students of Indian nationality planned to remain in the US, suggesting a growing stock of (Indian) talent in the US. Such expansion reflects the structural shift in the US economy, skill shortages, and the corresponding demand increases in technical talent.[10]

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8 Even western Germany, not known for Chinese immigrants, is increasingly employing highly skilled workers in auto and electrical engineering industries (Giese 2003: 169).

9 The US is attractive for students because of excellent, post-baccalaureate science and engineering programmes in large, well-endowed university systems, financial assistance for students, professional opportunities, and, until recently, a very receptive attitude toward foreign students based on the broader liberal political culture. English-speaking students find it easy to adjust to the American social environment. Nearly 50 per cent of permanent residents do not become citizens, indicating few differences in benefits for citizens and non-citizens (Cornelius and Tsuda 2004: 21).

10 It is difficult to estimate labour shortages but rising wage growth could reflect such shortages. But the ready availability of technical talent from abroad could check the rise in US salaries. Alternatively, if wages for technical talent are rising in India, which is an important supplier of talent to the US, then shortages in the US can be indirectly inferred.

It is not clear why most Latin American countries had higher rates of return than both India and China. For example, in 2001 Brazil had 70 per cent rate of return of its 1996 US-trained Ph.D.s, while Chile, Mexico, Colombia, Peru, and Argentina all exceeded Indian and Chinese rates as well (Thorn and Holm-Nielsen 2006). Economic opportunities at home alone cannot explain this as recent Latin American economic performance has been unremarkable. Most likely, technical education is not as popular as in Asia as evidenced by few Latin American students in OECD countries. Of the nearly 600,000 foreign students in the US in 2001-02, only 12 per cent came from Latin America compared to 56 per cent from Asia (Barrere et al. 2004: 36). Possibly, language affinity makes it more attractive for Latin American students to selectively go to Spain, where 15 per cent of foreign students were from Latin America (ibid: 35). Also, there may be greater cultural disposition toward the US by Chinese and Indian technical talent and their ethnic-based networks may further reinforce this bias. Alternatively, the small number of highly qualified professionals in Latin America makes it easier for them to return or they are crowded out by a larger, and often better qualified, pool of Asian talent. This is evident from US data on human resources in science and technology R&D. It shows that less than 1 per cent of the total R&D workforce is from South America compared to more than 10 per cent from Asia (Barrere et al. 2004: 37).[11]

Salary differentials alone do not explain international mobility. Challenging assignments, favourable working conditions, and access to relevant peer groups are significant professional factors that influence mobility. For example, the huge disparity in research and development expenditures between rich and poor countries, roughly to the tune of 16 per cent versus 84 per cent respectively, is a strong incentive for talent to emigrate (Solimano and Pollack 2004: 5). Budget cuts in science and technology areas have compelled Russian talent to emigrate to Germany and Israel (Solimano 2002: 10). Foreign scientists in Italy have sought professional opportunities and invitations from their colleagues partly because of professional peers (Brandi and Cerba 2004: 2). Also, rigid business regulations may also drive out entrepreneurial talent to more business-friendly environments. Of the many Indian business families operating overseas two groups who have made their mark by leaving India are the Mittal brothers and Swaraj Paul of Caparo Industries based in the UK. Both are in metals-based industry, with the Mittal family owning the world's largest steel company (see D'Costa 1999). The presence of highly successful Indian and Chinese entrepreneurs in Silicon Valley also testifies to the significance of professional peers, networking, a conducive business climate, and commercial opportunities available in global settings (Saxenian 2003).

5.2 Immigration policies

The relaxation of immigration policies for skilled workers in recent years is also encouraging mobility (Cornelius and Espenshade 2001: 3-7).[12] Many OECD countries have special programmes for recruitment and permanent residence for students and workers (OECD 2003: Annex 1). Australia, Canada, France, Germany, Ireland, Korea,

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[11] As noted by Barrere et al. (2004: 30), generally 'Latin American emigrants to the US are less educated than natives, and than [sic] Asian, African, and European immigrants'.

[12] However, Indian IT professionals continue to face a host of barriers to work abroad (Parikh 2003).

the Netherlands, and the UK have special programmes or simplified procedures for permanent immigration or extended temporary stays specifically for IT and software engineers. The UK gives preferential treatment for IT workers and fast tracks permits for them (Martineau et al. 2002: 14). As of 2001, holders of student visa in Austria, France, and Korea who graduate in IT fields can favourably change their residency status. Canada also targets high-skilled workers, as evidenced by a higher proportion of advanced engineering degrees held by foreigners than by Canadian-born (Boyd and Thomas 2001: 117). Germany introduced its Green Card Programme in 2001 specifically for ICT workers (Giese 2003: 170) and Lufthansa established a direct flight between Bangalore and Frankfurt.[13] Even Japan has relaxed visa regulations for Indian IT workers from a single entry, three-month visa to a multiple entry three-year visa (personal interviews with Japanese embassy staff, New Delhi, March 2005).

The US is the most important player in attracting global talent. It has a permanent immigration programme through an employment-based system of professionals with advanced degrees in science and technology. Under this category of employment there is a quota of 140,000 entries per year, including the reunion of family members. To meet the demand for IT workers, the US also has several temporary work visa programmes. Under the American Competitiveness and Work Force Improvement Act of 1998 temporary inflows of technical talent are facilitated through the H-1B visa programme. The visa is employment-based, valid for a maximum of six years; the applicant must have a bachelor's degree. The Immigration Act of 1990 permits the adjustment of temporary H-1B visa to an immigrant status as the applicants continue to be in jobs that are permanent (Lowell 2001: 50). The annual quotas are politically determined, with 65,000 visas distributed annually prior to 1999. The quota was increased to 115,000 in 1999 and 2000, 107,500 in 2001, and back to 65,000 thereafter. But it was raised to 195,000 for 2001, 2002, and 2003 before reverting back to 65,000 (Watts 2001: 144, Desai et al. 2003: 7). The actual number of H-1B visas granted has increased significantly in recent years (Table 5).

The temporary H-1B visas contribute directly and immediately to the concerned industries deploying such talent. Asians have been significant in the US IT industry (Espenshade 2001: 138). In 2003, roughly one-third of H-1B visas were granted to Europeans and 40 per cent to Asians. The principal recipients among Asian countries were India, China, Japan and the Philippines. India garnered 21 per cent of the total and 54 per cent of the Asian share of H-1Bs, far ahead of other competing Asian countries (Table 6). Indian firms have successfully leveraged the US immigration system, exporting talent in large numbers. Of the 331,206 H-1B visas approved in 2001, 49 per cent went to Indian professionals, and of these 92 per cent were IT related (Hira 2004: 842). The Indian experience contrasts sharply with the Mexican and Brazilian ones (Alarcón 2001: 248). In 1994, India received 16 per cent of all H-1B visas compared to Mexico's 2.6 per cent and Brazil's 2.2 per cent.[14] In 2002, South America as a whole

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13 However, Germany has been unsuccessful in attracting Indian IT professionals due to cultural barriers and rigid conditions attached to temporary movement of talent (Cornelius and Espenshade 2001: 11-12). Evidently other countries are more attractive to Indian professionals (Cornelius and Tsuda 2004: 28).

14 More telling is the data on immigrants admitted by occupation and country of birth. Under the 'professional and technical' and 'executive, administrative, and managerial' groups, India's shares in

received less than 2 per cent of IT-related H-1B visas compared to Asia's 83 per cent (Barrere et al. 2004: 33). The Immigration Act of 1990 permits holders of a temporary H-1B visa to change to immigrant status if they continue in permanent jobs (Lowell 2001: 50).

Immigration policies have been also relaxed with increased trade and FDI, allowing more intra-company transfers under the L1 visa programme. Though small in absolute terms, Latin American countries during 1996-2002 increased talent outflows through intra-company transfers nearly four times to 37,082 (Barrere et al. 2004: 35). Argentina, Brazil, Chile, Colombia, and Venezuela increased such outflows nearly four, two, four, seven, and four times during this period. However, strong commercial ties with the US meant that the UK, Japan, Germany, and increasingly India (IT-based) secured the highest numbers of US visas for intra-company transfers (ibid: 34). Akin to the L1 programme, albeit on a smaller scale, trade-related Trade NAFTA (TN) work visas for professionals are extended to NAFTA members such as Mexico and Canada. However, visas are waived for Canadian TN professionals (Lowell 2001: 40).

Visas quotas both for students in academic programmes and for professionals coming to work have been high, albeit lower since 11 September 2001. Students contribute to the stock of high skills and set the movement of talent in motion (Wickramasekara 2002: 4). Asian students dominate technical education in OECD economies. For example, in 2001, nearly 47,000 Indian students went to the US, accounting for 78 per cent of all Indian students enrolled in OECD countries (Khadria 2004: 29). In 1999 Indians had the largest number of science and engineering degree holders among foreign residents in the US and 30,000 science and engineering doctorates.[15] Europe's share of foreign students in the US was 18 per cent compared to Asia's 55 per cent. Among Asian countries, Japan had 24 per cent, Korea 21 per cent, China 16 per cent, and India 15 per cent (US Department of Homeland Security 2004: 89-92). The share of Central and South America was only 9 per cent, with Brazil, Colombia, and Venezuela contributing 50 per cent of the regions' share. Mexico, on the other hand, despite its proximity to the US, sent about twenty-three thousand students in 2003, with very few in the high technology areas (see Alarcón 2001: 240). Even US born Hispanics have the lowest rates of participation in technical occupations in the US. Together India and China account for roughly 25 per cent of all non-native scientists and engineers in the US (Espenshade 2001: 138).

5.3 Business models and the movement of technical talent

While international mobility of technical talent is partly explained by immigration policies, foreign student enrolments, and different types of visas granted, the adoption of a particular business model also explains the temporary movement of talent in the IT industry. For example, outsourcing of software services to India by mainly American companies is illustrative. It began with on-site services in the US, where workers temporarily moved to the client's site and provided software programming services,

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1994 were 17.8 and 5.1 per cent respectively compared to Mexico's 0.8 and 0.4 per cent (Alarcón 2001: 256).

15 Additionally, as Indians are prominent in higher education establishments in the US, it also suggests a visible and influential talent pool.

conversions, maintenance of software and hardware, debugging, testing and limited systems integration (D'Costa 2002). However, profits for the Indian firm was not high since pricing was based on time and materials costs, which included the high cost of living incurred by Indian talent living at the foreign client's site (D'Costa 2003b: 67).

This model of outsourcing gave way to more software development in India. Gradually on-site services decreased due to reduced Y2K needs and due to India's growing technological maturity. The new export model is offshore development whereby Indian companies develop the software in India and transfer it via satellite to their US clients abroad. Between 1999 and 2003, the share of offshore delivery of services increased from 35 per cent to 58 per cent, while on-site services fell from 57 per cent to 39 per cent (NASSCOM 2004), thus reducing the movement of people. However, with the absolute increase of nearly 90 per cent in the volume of on-site services during this period, the temporary movement of workers to market, develop, test, implement, maintain, upgrade services, and interface with clients became significant. As overseas markets become more mature the near-permanent presence of highly skilled marketing and technical professionals abroad becomes critical to offshore development. This heightens demand for IT workers and correspondingly encourages mobility. Hence, the rise in H-1B and L1 visas in the US is very much tied to the business models adopted in the IT industry. The mobility of technical talent to clients' sites, while temporary in nature, creates professional opportunities for on-site engineers to remain permanently.[16] The growth of offshore business model suggests that technical talent will increasingly remain in the sending country but the increasing volume of total global business suggests that absolutely more workers will be needed for on-site services. Consequently, as the diaspora network expands, greater learning is possible by both expatriates and residents as mobility among them heightens (Kuznetsov and Sabel 2006; Thorn and Holm-Nielsen 2006).

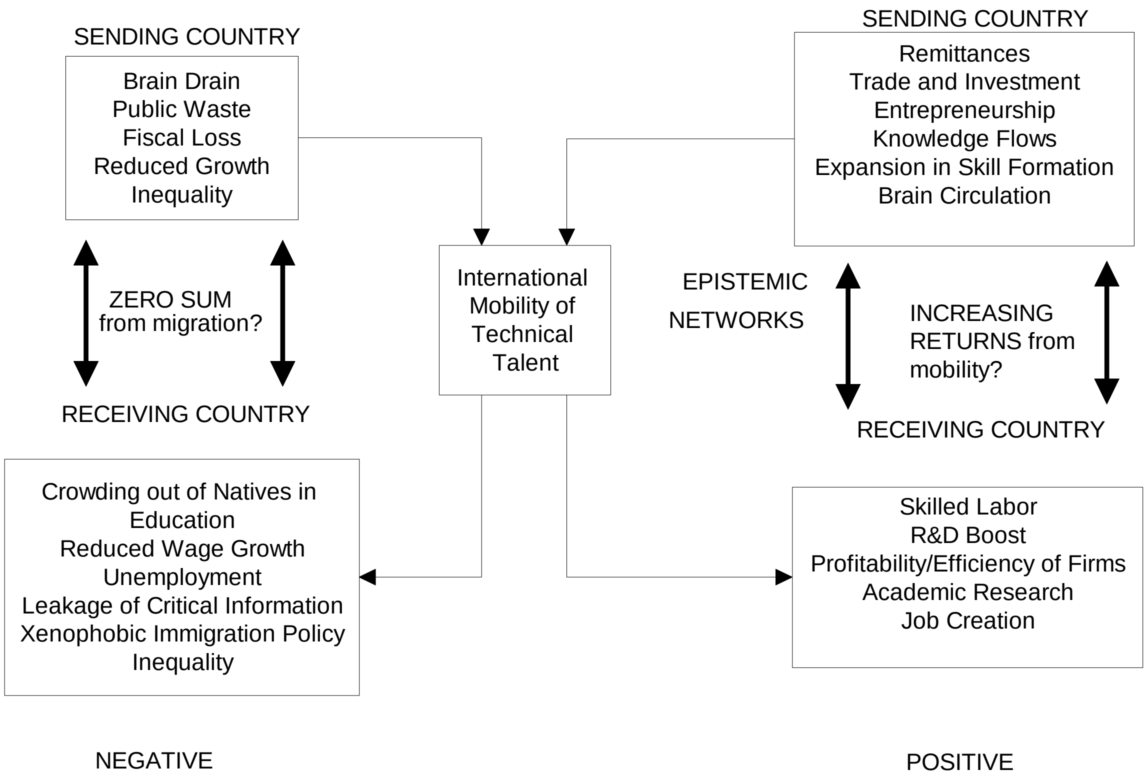
6 The impact of mobility on the IT sector

Without detailed empirical investigation it is difficult to predict the long-term effects of mobility (see Winters 2003). The impacts of the mobility of highly skilled workers in both receiving and sending countries are felt at many levels (Solimano and Pollack 2004: 13), and quite negatively in some sending countries (Wickramasekara 2002: 7). There are three kinds of broadly interrelated effects on both sending and receiving countries—economic, political, and social. Under the first there are income, wealth, human capital, and innovative capability effects. These are felt both in the short- and medium-term and can be both positive and negative (see Figure 1). The political effects in the receiving countries can result in jingoist posturing and job losses, especially if non-OECD talent is perceived as taking away high-skill jobs in the rich countries. There

16 In Japan, I came across many Indian IT professionals who came as on-site engineers for an Indian vendor and later joined the Japanese client as an employee. There is another institutional reason by which international mobility of IT workers is influenced. For example, Japanese businesses have a greater propensity to interact with their suppliers and vendors, hence should Japanese firms decide to outsource internationally they would prefer to have more Indian workers on-site. Consequently, there would be greater temporary movement of talent, *ceteris paribus*. Anecdotal information suggests a 10 per cent on-site ratio for US offshore projects in India compared to Japan's 20 per cent (field research, Japan, April–June 2005).

are several social effects of the movement of talent but three deserve scrutiny, namely the formation of epistemic networks, their links to sending countries' innovative capability, and inequality.

Figure 1: The Effects of the International Mobility of Technical Talent



Note: Inequality is possible under increasing returns as well.

6.1 Impact on sending economies

The most discussed impact of the outflow of technical talent on sending countries has been brain drain.[17] It arguably entails a loss of skills and thus future innovative capability and waste of public investments because of the relatively high cost of subsidized tertiary technical education (Solimano and Pollack 2004: 13).[18] The 1970s had already witnessed a serious drain of talent from developing countries and today many African countries suffer from the emigration of technical professionals and healthcare workers. For example, between 1985 and 1990 Africa lost 60,000 professionals through emigration (Wickramasekara 2002: 5). With the collapse of the former Soviet Union and Eastern Europe, there has been an outflow of scientists, engineers, and academics abroad. Between 1989 and 2002, roughly 22,000 scientists from Russia's R&D sector emigrated abroad (Nekipelova and Ledeneva 2004; Wolberg 2000: 11). The OECD economies absorbed most of the Russians, with the US,

17 For a review of models of brain drain see Commander et al. (2004: 241-5).

18 However, waste is reduced if, training and education costs are borne privately, as it is often the case with Indian IT workers (Gayathri 2001).

Germany, and France accounting for nearly 55 per cent of Russian scientific workforce abroad. In 2000 Germany and Israel accounted for 86 per cent of science and technology Russian emigrants (Gokhberg and Nekipelova 2001: 180).[19]

One favourable effect of mobility on sending countries is remittance income flows (Table 7).[20] Low-income and small economies tend to benefit the most from remittances as they contribute substantially to national income, complement sparse FDI, and in general provide scarce foreign exchange, which could be used for economic development purposes (D'Costa 2004). Female workers from Sri Lanka and Philippines contribute considerably to remittance income (Hugo 2003: 15). A recent World Bank estimate put the total remittance inflows to developing countries at $126 billion in 2004.[21] However, the propensity to remit is likely to be inversely related to skill levels as evidenced by Mexican workers and Indian IT workers in the US and from Indian unskilled and semi-skilled workers in West Asian countries. There is little economic compulsion to send money home by middle-class Indian IT professionals (Kapur 2003: 14).

However, as OECD demand for talent grows the large-scale emigration of high-skilled workers could lower economic growth and raise poverty in the sending country, especially if the share of outflows relative to the stock of the sending country's talent is high. India and China, which contribute temporary workers through employment visas and to the permanent stocks as students, do not feel the negative impact of migration because they are among the 15 countries with the *smallest* shares of highly skilled aged 15-plus expatriates in OECD countries with 3.1 per cent and 3.2 per cent respectively, (OECD 2005:129). Emigration of the highly skilled could lower productivity and lower economic growth, if the ratio of expatriate skilled population to the stock of sending country is very high. Related, there could be increasing inequality as wages for those who remain in skill-demanding sectors rise relative to the less skill-demanding sectors (Lowell and Findlay 2001: 7; D'Costa 2003a, 2003c).

Several other outcomes are possible. If the movement of talent translates into higher incomes for those who emigrate, the resulting relative scarcity of local talent could also lead to an upward wage spiral. This is a good outcome as higher income growth is likely to contribute to economic growth. However, given the industry structure of the IT sector in India, a wage-cost push can create competitive pressures on small and medium enterprises, who could get crowded out by the larger domestic and multinational firms. The second effect of emigration of talent or student outflows is the high elasticity of local educational infrastructure to respond to the needs of the IT industry at home and abroad. A cursory examination of the technical education system in India, and

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19 The share of highly skilled immigrants relative to all immigrants (skill ratio) has been high for Eastern European countries (Straubhaar 2000: 12-13; also Malaha 2004: 3).

20 At the community level large remittance incomes could increase dependency and encourage excessive consumption (Kapur 2003: 20).

21 The inflow of remittances received by developing countries is highly uneven and tend to be centred in a handful of economies. Most of the remittances to developing countries are received by a small number of them. National central bank data shows that in 2000, India, Mexico, Philippines, China, Turkey, and Egypt secured the bulk of remittances to their corresponding regions (Orozco 2003 in Sorensen 2004). Together they received 50 per cent of all remittances, with India capturing 15 per cent of the global share (D'Costa 2004).

particularly in Karnataka state, suggests that emigration and its subsequent economic rewards creates the incentives for workers to seek higher skills (D'Costa 2005; Winters 2003). This is also evident in the Philippines where the share of mathematics and computer science graduates between 1995 and 2000 increased from 7 to 10 per cent of all tertiary graduates (Chalamwong 2004: 24). The outflow of talent also suggests increased links with export markets and research institutions abroad and significant gains in managerial and technical experience.

There is a fiscal impact on sending countries. Thus for India, it has been estimated that 'net fiscal loss associated with the Indian-born resident population ranges from 0.24 per cent to 0.58 per cent of Indian GDP in 2001' (Desai et al. 2003). However, the economic benefits derived from network effects could outweigh fiscal losses. Consider the resident Indian technical talent in Silicon Valley, which has been instrumental in creating an Indian brand name in IT services. Consequently, with the spread of the offshore model these Indian engineers are also spearheading investments in India (FDI) and exporting software services from India (trade). Investments and exports of software services combined with domestic market growth have contributed roughly 4 per cent of Indian GDP (NASSCOM 2005). India's reputation in IT services is also recognized in Japan, a country still not quite ready for large-scale immigration, as many Indian engineers are training their Japanese counterparts in software engineering and quality processes (field research, Japan, May–June 2005).

6.2 Effects on receiving countries

The immediate impact on receiving countries is the meeting of shortages with subsidized technical talent and maintaining industry profitability. There is considerable debate over IT worker shortages. In Canada the shortages were estimated at 20,000 in the mid-1990s compared to US-estimated shortages of 190,000 (Zhao et al. 2000: 9). Other countries such as Australia and Singapore also exhibit shortages of IT labour as evidenced by inflows of IT workers from Malaysia, China, and other neighbouring countries (Solimano and Pollack 2004: 4). Receiving countries more than make up for their inability to generate talent at home and enhance the quality of the national workforce, as the Russians did for Israel (Solimano 2001: 9). The inflows of numerous students, such as in the US, also add to the future stock of talent and entrepreneurship (Solimano 2002: 9). In early 2001 it was estimated that there were one million Indian-born individuals in the US and more than 75 per cent of the working age population had a bachelor's degree or better (Desai et al. 2003: 1). Thirty-eight per cent of India-born US working age residents had post-graduate degrees compared with 9 per cent of US-born residents. It has been estimated that the US government annually collects nearly $22.5 billion in payroll taxes from Indian H-1B visa holders alone (Desai et al. 2002).

Indian and Chinese engineer-entrepreneurs in Silicon Valley have generated considerable employment (Lowell 2001: 34-5; Saxenian 1999). The availability of foreign talent also facilitates the upgrading of economic activities from low-value production to high-value activities consistent with the new economy. These include research and development, design and development, and entrepreneurship. Receiving countries such as the US, UK, and Australia also benefit from foreign students who pay for their education. Earlier estimates show that inflows of over $7 billion went into the US education system each year (Straubhaar 2000: 8). The export of education services by the US also means that it is setting up the preconditions for future brain gain.

When it comes to political impact, even liberal governments are acutely sensitive to local pressures for protectionist policies. An election year, a slow growing economy, widening trade deficits, and rising unemployment could all contribute to xenophobic sentiments and be attributed to foreign workers. The benefits of inflows of foreign talent are not visible to those who might lose their jobs. The argument that job losses could result from structural, cyclical, and technological factors rather than simply from foreign competition is not appreciated by those who become unemployed in the new economy. Relying on foreign talent could depress compensation of OECD IT workers. Many labour groups in the US argue that there are no shortages by pointing out to layoffs in the IT industry. But this interpretation overlooks the fact that it is older workers experienced in older technologies that face the brunt of layoffs. Foreign workers such as Indian software professionals are keeping abreast with recent IT technologies such as java and dot.net, while older workers in receiving countries are not. The strategy of US firms is to rely on new skills rather than experienced talent because of short product cycles, whereas India, as a follower, needs more experienced talent. India as a latecomer has the advantage of an abundance of young engineers trained in new technologies. Consequently, multinational IT companies prefer to hire young, technologically savvy professionals rather than retrain existing workers (Watts 2001: 145, 151).

Receiving countries can also experience increasing inequality although the precise mechanisms for this outcome are complex. On the one hand, hyper-competition associated with globalization means only those with the appropriate technical and commercial skills can be absorbed in the new economy while the less educated, unskilled, and semi-skilled are likely to remain at the bottom of the economic hierarchy (Castells 1998; D'Costa 2003c). But the inflows of technical talent could stem wage growth in receiving countries and contribute to salary convergence at the global-sectoral level. For certain high level IT professionals the salary gap between Silicon Valley and Bangalore has narrowed. The net effect of this double movement is *global* polarization in which the divide between the best IT professionals worldwide (along with other high-skilled professionals) and the rest becomes acute. This polarization is further accentuated by greater returns to business and shareholders in receiving countries through global outsourcing arrangements.

Since less-privileged minorities such as African-Americans and Hispanics in the US are already handicapped in terms of tertiary technical education and high skills, it is possible that a shift in social and ethnic balance might become more pronounced with the inflows of technical talent (D'Costa 2003c). Many foreign students take up underpaid postdoctoral work thereby compressing wage growth for such activities, which could discourage natives from taking up science and engineering education. But just as there is little evidence that immigrants lower wages or employment (Martin et al. 2002: 9-10), it remains to be empirically verified whether minorities are discouraged from long-term postdoctoral science and engineering education due to the prevalence of foreign-born technical talent working for low economic returns.

7 The principal developmental effects

The key developmental effects are economic but some of them work through non-economic processes such as human capital development and epistemic networks. Three major developmental effects, remittance income, human capital development, and epistemic communities are discussed below.

7.1 Remittance income

The outflows of talent could result in some inflows of remittance income in the form of foreign exchange (Lucas 2004; Hugo 2003: 19-20). Such income could complement domestic resources and boost the overall investment climate. The investment and entrepreneurship relationship is best evidenced by the fact that overseas Chinese contribute nearly 50 per cent of China's FDI (Hugo 2003: 15). The ability to meet international debt obligations also suggests that more resources are available for developmental purposes. Export IT products and services have similar favourable outcomes. However, a rapid rate of foreign exchange accumulation could in the short-term lead to an appreciation of the local currency and thus reduce international competitiveness (the Dutch disease syndrome) of other export sectors. Both India and China are increasingly faced with upward pressures on their currencies. However, few countries are in such an envious position.[22] Their development problems stem less from excessive foreign exchange reserves and more from uncompetitive industries due to poor technology, education, and skills.

At the household level remittances have a significant impact on the standard of living through increased consumption expenditures, which include children's education and better healthcare (Raihan 2004). The downside to this development could be the government's reliance on private remittance income to finance social expenditures such as basic healthcare. Remittance income could also contribute to local entrepreneurship based on the substantial savings from overseas employment. For example, in both Mexico and Egypt, savings from remittance income have contributed to local business development (Latapi 2004; Wahba 2003). However, these activities are likely to remain small, scattered, and inconsequential beyond the immediate households, their extended families, and local markets. Additionally, remittance income is like windfall gain relative to those who do not have remittance earnings from abroad. This could encourage increased consumerism and induce social inequality (D'Costa 2003c; Ratha 2003). It could also result in localized inflation, especially for housing.

7.2 Human capital development

The outflows of talent could have a favourable impact on local wages if the local labour market is already tight. Nayyar (1994) argues that the macroeconomic impact of emigration from India is insignificant due to the large number of educated unemployed. However, particular regions and sectors could face labour shortages if the rate of worker

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22 Lucas (2004) suggests that the Dutch disease was in operation for countries such as Albania and Moldova due to large inflows of remittances during their transition to market economies. D'Costa (2003b) hints at this possibility with India's success with IT service exports.

outflow is high.[23] The exodus of young Indian engineers to the US and other OECD economies and the massive demand for such professionals in India and abroad could put an upward pressure on wages and salaries, even beyond the IT sector. There is a migration premium, which predicts that more years of education and the prospect of working abroad enhance expected income two to five times in purchasing power parity values (Commander et al. 2004). More importantly, there are positive spillovers (technological externalities) with skill development since not all knowledge can be internalized or privatized (Straubhaar 2000: 17).

The high demand for technical and managerial talent in the world market, marked by emigration, contributes to several externalities. On the positive side, international mobility sets off a virtuous cycle of increased demand for technical talent, which prompts growth in the tertiary education system and thus raises the local skill base of the economy. From the demand side there is an overall increase in economic activities due to remittance flows and high incomes earned. On the negative side, not all sectors or social groups participate with the same intensity, thereby experiencing unequal outcomes (D'Costa 2003a). The growth of the IT sector in the context of bottlenecks in the supply of talent suggests that in the short and medium term the non-IT sectors could be crowded out. But in the long haul, the continued permanent emigration and the temporary movement of technical talent are likely to make individuals seek technical training and the educational system to meet the demand for both global and local technical talent. Many Asian sending countries, especially China, India, and Taiwan have responded favourably toward higher technical education by establishing education and research centres as well as technology parks.

Since 1990 India's employment of IT professionals has increased from 56,000 to 522,250, a nearly ten-fold growth (NASSCOM 2002: 63). Technical education in India has consistently expanded throughout the 1990s, with engineering admissions increasing five-fold between 1992 and 2004. The number of IT admissions based on capacity increased from 73,000 students in 1992 to 342,000 in 2004, while the number of professionals with an engineering degree is expected to increase from 43,000 in 1997 to nearly 100,000 in 2004. Such growth is a major contributor to the stock and flows of Indian talent.

7.3 Epistemic communities

In contrast to earlier brain drain arguments, today international mobility of technical talent is optimistically viewed as contributing to epistemic (knowledge) networks (Solimano and Pollack 2004: 12). They are seen as repositories of talent to be secured in the future. For example, non-resident Indians (NRIs) are perceived as important sources of remittance income, investment funds, and technical knowledge for India. Rather than anticipate a permanent loss, emigrants are perceived as possible return migrants or in circulation between the receiving and sending countries. In the IT industry, The Indus Entrepreneurs (TiE) is one such formal organization. Started in Silicon Valley in 1992 by Indian entrepreneurs it has grown into a global organization with over 40 chapters

[23] Thus outmigration of workers from certain villages in Kerala (India) and Bangladesh illustrates the pressure on local labour markets. In the case of South Africa the emigration of nurses is a good example of the negative impact it might have on the provisioning of health services to AIDS patients.

and 6,000 members worldwide. Similarly the Chinese Institute of Engineers in the US collaborates frequently with its counterpart in Taiwan. Epistemic communities have members who are professionally well connected to the high technology industry. For example, within East Asia the MNC-driven mobility of highly skilled workers results in technology transfer and human capital development (Chalamwong 2004: 9). Thus the movement of talent can also act as a conduit for the diffusion of market knowledge.

Return migrants contribute to national productivity due to their work experience abroad (Lowell and Findlay 2001: 8). Epistemic communities can be productively deployed should economic opportunities in sending countries emerge. The chances of expatriate talent returning temporarily or permanently increase as the demand for high-skilled workers increase at home. Thus the circulation of talent among and within Silicon Valley in California, Sao Paulo in Brazil, Hsinchu in Taiwan, Singapore, Bangalore in India, Eindhoven in the Netherlands, Frankfurt in Germany, and Shanghai in China for example could be a harbinger of brain gain for developing countries such as Brazil, China, and India. The developmental implication of this circulation of talent is significant especially if expatriates bring back new knowledge, domain expertise for the IT industry, market information, and investment capital. The retention of professional contacts with their clients and peers can also contribute to business development at home. With growth at home the demand for highly trained and experienced talent would increase and so would the chances of expatriates returning to sending countries.[24]

Taiwan and China, and to a limited degree India, have been witnessing the return of high skilled migrants (Saxenian 2003; Khadria 2004). India's rate of return migrants has been only one thirtieth of Taiwan's (OECD 2003). Most South Koreans who obtained a doctorate in science engineering in the US returned home (89 per cent), whereas the corresponding figures for China and India were 12 per cent and 21 per cent respectively (National Science Foundation 1998 cited in Solimano 2002: 34). Between 1978 and 2001 roughly 37 to 50 per cent of Chinese students returned from Japan, Australia, and various West European countries and only 14 per cent from the US (Zhang 2003: 80). More recent figures for the Indian IT industry indicate that about 30-40 per cent of experienced Indian software professionals returned (Commander et al. 2004). Among returnees there are entrepreneurs and venture capitalists as well. The technology boom of the 1990s created many opportunities for immigrant entrepreneurs in the US for new start-ups, which were later sold to larger companies. Some professionals quit major multinational employers; some returned home to start new businesses in Taiwan and India. For example, of the top 20 Indian software firms ten were launched by non-resident Indians (NRIs) from the US and many joint ventures were between NRIs and Indian partners (Hunger 2002: 10-11). However, they maintained close technical and commercial links with receiving countries.

The fundamental policy question is under what conditions such return of migrants can be sustained over the long haul. There are several possibilities, all aimed at tapping the expatriate communities (diaspora) living overseas. There are private, industry initiatives such as Chile Global, which designs and finances business innovation projects (Kuznetsov and Sabel 2006). Governments can also play important roles in attracting talent back home. It has been observed that for Latin American countries the rate of

24 There are of course family and social reasons for the return of technical talent to their home countries.

return is higher than India and China. This is partly due to greater involvement of national governments to support studies and professional training abroad and their ability to impose the condition that such recipients return home. Colombia's COLFUTURO programme for overseas graduate studies requires students to return home within 90 days after completion of studies (Thorn and Holm-Nielsen 2006). Similarly, Mexico's Presidential Fund for Retention in Mexico is aimed at bringing back talent, while Mexico's Ministry of Science and Technology is targeting its overseas talent. In the end, the return of technical talent is predicated on global networks, state encouragement, institutional support for professional development in the home country, and national economic development.

8 Policy implications of technical talent migration

The key issues facing both sending and receiving countries today are the imbalances in the supply and demand for technical talent, their political abilities to manage the flows of people, and their ability to harness the technical expertise of expatriate communities for national economic development. Political constituencies in receiving countries are right to be concerned if their labour markets are destabilized by lower wage growth and unemployment due to inflows of foreign technical talent. However, jingoist immigration policies or blanket protectionism are unlikely to be effective in an integrating world, especially in the context of serious demographic problems in many OECD economies. The availability of foreign workers in these countries will be critical to sustain high technology industries and social support for the elderly. Russia suffers from both massive emigration of young talent and an ageing population (Heleniak 2004: 16). Even China is witnessing an ageing population, while India foresees shortages of IT workers as it meets its own demand and the needs of the global economy (NASSCOM 2003). If labour shortages are real and the competition for technical talent intense then it behoves receiving countries to boost enrolments in technical education and come up with flexible immigration policies. East Asian countries such as Japan and South Korea suffer from both declining fertility rates and resistance to large-scale immigration. These are also countries that rely heavily on IT-related high technology industries.

There is also the issue of reciprocity. If sending countries are compelled to alter their economic policies in favour of liberalization to facilitate greater global economic integration, often with massive adjustment costs, it is incumbent upon receiving countries to create the economic space for a smoother transition for sending countries. Nearly all the evidence of mobility of talent points to receiving countries benefiting greatly from immigrant labour (see Figure 1). Hence, on both economic and ethical grounds it is in the interest of receiving countries to maintain a liberal immigration system.[25]

Sending countries also benefit from talent mobility via remittance income, often exceeding official aid and FDI. More importantly, expatriate technical communities could be a vital link for acquiring technology, market knowledge, and domain expertise.

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25 From a global redistribution point of view a wage convergence is necessary but convergence induces inequality with sending and receiving countries because of skill- and technology-based employment growth.

There is of course a danger that the outflows of talent may haemorrhage the local talent pool to the point where the dynamic costs of human capital development outweigh the dynamic benefits. Smaller countries such as those in Africa are likely to suffer more due to a narrow economic base and limited educational opportunities for most. Hence, sending countries must also have proactive and forward-looking nuanced policies to retain talent at home and tap the expatriate population for their expertise. This is a tall order but expanding economic and professional opportunities at home, which are in any case integral to national development, would be critical to encourage potential emigrants to stay and expatriates to return, even if on a circulatory basis (see Thorn and Holm-Nielsen 2006). Since emigration of talent leads to greater investment in education and raises the average skill level of the population, it would be prudent to promote local industry to deploy such talent. Taiwan provides a good example of how the government can play a role in inducing expatriates to return home, either permanently or temporarily. The Indian experience illustrates how state-driven technical education and first-comer advantage in software exports can act to encourage the mobility of talent and induce growth in education. The challenge for India and other developing countries is how to induce large-scale return or circulatory migration and investments by expatriate talent.[26]

The international mobility of talent is inevitable and today states are less effective in regulating the flows of people (Bhagwati 2003). The General Agreement on Trade in Services (GATS) Mode 4, which seeks to facilitate the temporary international movement of workers, is an acknowledgement of this inevitability. Yet the OECD has been biased toward other modes and is hesitant about implementation, confusing the temporary migration of Mode 4 with permanent migration. Emigration that is too easy may cause political problems in receiving countries as well as reduce incentives for education and lower average skills in sending countries. However, the temporary movement of talent implies migrants will return and thus contribute to better stocks of human capital (see Dos Santos and Postel Vinay 2004: 20).

The International Labour Organization has identified six ‘R’s as a way to stem the outflows of technical talent. They go beyond ‘recruitment, remittances, and return’ to include ‘restriction, reparation, and resourcing’ (Wickramasekara 2002: 9, see also Lowell and Findlay 2001: 18-19). For various reasons, restriction and reparation are difficult to implement. Recruitment and return of talent are challenging but show promise for the IT industry. As the IT industry exhibits high growth, global hubs in China, India, Taiwan, Russia, and the Philippines become feasible sites for expatriate talent. Effective science and technology policies in sending countries are also likely to encourage return migrants. Furthermore, dual citizenship, academic and professional exchanges, and promotion of knowledge networks are all likely to impact brain circulation more favourably for both sending and receiving countries. The best way to retain technical talent is through service exports, policy reform for attracting FDI, domestic market growth, export market diversification toward underserved Japan, and the continued emphasis on technical training (D’Costa 2003b, 2004, Lowell and Findlay 2001: 2).

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26 To ensure generally that temporary workers return home a portion of their earnings could be held until their departure (Rodrik 2005: 210). Consequently, returnees will also have savings on arrival. This approach may be more useful for un-skilled and semi-skilled workers who might need greater support to transition back home rather than technical talent.

The IT industry in India displays high salary growth, narrowing the global gap, suggesting greater possibilities for retention and return.[27] However, runaway growth in salaries is compelling Indian IT companies to seek low-cost sites in China. High investments in research and development in South Korea were responsible for bringing back many Koreans. Taiwanese science and technology policies have led to circulation of Chinese talent between the US and Taiwan and now China. It is evident that retention and return of talent is effective when there is a perceived high quality of life, professional opportunities at home, and access to international professional networks. For sending countries these are significantly determined by more mundane macroeconomic factors of economic growth, investment, and infrastructure development, and at the sectoral level, FDI, education, and science and technology policies.

The importance of return migrants and thus circulation should not be overemphasized. Once abroad expatriate populations need not be tied to home country expectations. However, temporary visits must be of long enough duration to make it attractive for highly skilled workers from non-OECD countries. Also, a longer-term temporary visit is likely to result in a greater professional contribution of technical talent in the receiving and sending countries, after their return. Currently the H-1B visa programme for temporary movement of talent in the US is flawed since foreign workers cannot freely move between employers (Watts 2001).[28] It would be important to grant temporary visa holders greater latitude in choosing their professional outlets.

9 Conclusion

This survey of international mobility of technical talent suggests the need for workable economic development policies to meet demands in the information-driven economy, to address demographic challenges in receiving countries, and to harness the expertise of expatriate talent. Uncontrolled immigration is neither politically feasible nor socially acceptable in receiving countries. For sending countries the challenge is to retain talent and lure previous emigrants back to further national development. Managed but liberal immigration is consistent with globalization. In an era of foreign aid fatigue there is greater reason to promote development in labour-abundant countries so that 'brain drain' is transformed to 'brain gain,' making international migration over the long haul a temporary process. Technical and entrepreneurial skills from the expatriate communities can be mobilized for domestic development and at the same time the export of skilled labour be accommodated by receiving countries.

By examining the process of international migration and some of the economic costs and benefits of the movement of technical talent, this study provides a window to the

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27 In a recent field survey of Indian IT companies, I met several high-level IT professionals who have either returned or decided to remain in India (field research Bangalore, Chennai, Delhi, Gurgaon, NOIDA, Kolkata, February–March 2005).

28 Her argument that a free market solution would be better rather the current H-1B visa system is somewhat problematic for it assumes a relatively closed 'free market' to the mobility of foreign talent (Watts 2001: 152). If the US was completely open to foreign workers it would be inundated with technical talent.

workings of the global economy and how the structural relationship between rich and poor countries might be altered. The flexibility of the global economic system creates opportunities and imposes costs on national economies. Only those countries that have a well-educated workforce, high-quality physical and technological infrastructures, and relatively pragmatic policy-making capabilities tend to integrate well. Global competition demands flexibility and technological capacity. This means that high-value service providers such as doctors, computer scientists, geneticists, managers, accountants, engineers, chip designers, etc. will be recruited globally to exploit emerging opportunities. Labour shortages in many ageing societies will dictate the direction and magnitude of flows of technical talent. Already Indian students and professionals are in high demand in the IT industry in the US, the UK, and other European countries (Silicon.India 2004). The challenge will be to regain part of the growing expatriate technical community.

Government incentives to lure professionals back and the rapid development of the home market can contribute to the return flow of talent. Many other professionals, though settled abroad, could 'circulate' between sending and receiving countries, not just between India and the US but between India, the US, Western Europe, and Japan, thereby creating multiple nodes of global epistemic communities and transfer knowledge gained overseas to their home economies. A substantial responsibility will have to be placed on sending and receiving country governments to create dynamic national economies, which are expected to absorb skilled professionals by creating, retaining, and gaining back talent.

A more balanced global economic governance policy recognizes that labour mobility cannot be contained but skilled labour can be retained or encouraged to return. This 'circulation' of talent will be critical for future innovative capability. The receiving countries will have to revisit their immigration policies to ensure that the gains of economic integration also accrue to poor economies that send them skilled labour. Future institutional research following from this basic investigation on the mobility of technical talent must be directed toward obtaining industry and firm level data from countries that are on the threshold of relying on foreign workers. There is a dire need for more systematic collection of data. Intergovernmental agreements in data collection methods will be critical. Also, significant differences among different professions and skills call for more sector-specific investigations. A more systematic analysis of labour shortages and the future growth of IT-related industries will be crucial to understand the extent of shortages and the ability of sending countries to fulfil that need.

India, China, and a few other countries are faced with a historic opportunity to generate the kind of technical talent that will be demanded by the IT sector as a whole. As the mobility of labour increases the pressures to open up OECD economies under GATS will also increase. Rather than simply lose the talent permanently or rely on remittances, sending countries must rethink their development and education strategies. Receiving countries will need to be more receptive to poor countries with immigration reforms as they utilize technical talent temporarily and permanently from non-OECD economies. In the end a fine balance between high rates of economic growth and structural change, social policies for the marginalized groups; and a relatively open world economy for both high- and less-skilled workers must be found. Only then can the international mobility of technical talent benefit both sending and receiving countries.

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Table 1 Inflows of permanent settlers by selected receiving and sending countries, 1992-2003 (thousands)

AUSTRALIA	**1992**	**1995**	**2000**	**2003**	**ITALY**	**1992**	**1998**	**2000**	**2002**
New Zealand	7.2	10.5	21.9	12.4	Albania		11.2	31.2	39.1
United Kingdom	14.5	10.7	9.2	12.5	Romania		5.9	20.7	50.2
China	3.4	3.7	6.8	6.7	Morocco		7.3	24.7	26.1
South Africa	1.3	2.8	5.7	4.6	China		3.4	15.4	15.4
India	5.6	3.9	4.6	5.8	Poland		3.9	7.1	15.3
Total	107.4	87.4	91.9	93.5	Total		110	271.5	388.1
CANADA	**1992**	**1995**	**2000**	**2002**	**JAPAN**	**1992**	**1995**	**2000**	**2002**
China	10.4	13.3	36.7	33.2	China	52.4	38.8	75.3	88.6
India	12.7	16.3	26.1	28.8	Philippines	57.5	30.3	74.2	87.2
Pakistan	..	4.0	14.2	14.2	Brazil	19.2	11.9	45.5	22.7
Philippines	13.3	15.2	10.1	11.0	South Korea	26.0	27.0	24.0	22.9
South Korea	..	3.2*	7.6	7.3	USA	29.3	18.8	24.3	21.5
Total	252.8	212.9	227.3	229.1	Total	266.9	209.9	345.8	343.8
FRANCE	**1992**	**1995**	**2000**	**2002**	**UNITED KINGDOM**	**1992**	**1998**	**2001**	**2002**
Morocco	16.4	6.6	16.9	21.4	USA	43.9	39.4	13.0	..
Algeria	12.3	8.4	12.4	23.3	Australia	25.0	26.6	34.0	..
Turkey	9.2	3.6	6.6	8.5	India	9.2	11.6	16.0	..
Tunisia	4.0	1.9	5.6	7.6	South Africa	2.3	11.1	13.0	..
USA	..	2.4	2.6	3.4	New Zealand	10.6	12.0	12.0	..
China	..	0.9	1.8	1.7	Pakistan	8.3	7.2	10.0	..
Total	..	77.0	126.8	144.4	Total	175.0	228.0	373.0	..
GERMANY	**1992**	**1995**	**2000**	**2002**	**USA**	**1992**	**1995**	**2000**	**2002**
Poland	131.7	87.2	74.1	81.6	Mexico	213.8	89.9	173.9	219.4
Turkey	80.6	73.6	49.1	58.1	India	36.8	34.7	42.0	71.1
Russian Federation	24.6	33.0	32.1	36.5	China	38.9	35.5	45.7	60.3
Italy	30.1	48.0	32.8	25.0	Philippines	61.0	51.0	42.5	51.3
Fed. Rep. of Yugoslavia	..	54.1	33.0	36.9	El Salvador	26.2	11.7	22.6	31.2
Total	1207.6	788.3	648.8	658.3	Cuba	11.8	17.9	20.8	..
					Total	974	720.5	849.8	1 063.7

Note: * 1996 data. Source: OECD (2003: 312-23; 2005: 297-310).

Table 2 Expatriates and percentage share of highly skilled expatriates by selected country of birth

	Total no. of expatriates	% of highly skilled expatriates
Algeria	1,301,076	16.4
Argentina	266,070	37.8
Bangladesh	275,770	27.9
Bosnia-Herzegovina	536327	11.5
China	1,649,711	39.6
Colombia	682,156	25.1
Hong Kong	587,400	42.8
India	1,928,199	51.9
Iran	632,980	45.6
Jamaica	796,046	24.0
Morocco	1,364,754	14.8
Pakistan	655,162	30.8
Philippines	1,816,418	48.1
Russia	580,570	43.0
Vietnam	1,507,164	23.6

Source: OECD (2005: 148-9).

Table 3 Demographic shifts in a global context

	Total population			Average annual growth rate (%)		Population age composition (%)			Dependency ratio		Crude DR	Crude BR
						2001	2001	2001	2001	2001	per 1000	per 1000
	1980	2001	2015	1980-2001	2001-15	0-14	15-64	65+	Young	Old	2001	2001
World	**4,429.6**	**6,130.1**	**7,093.9**	**1.5**	**1.0**	**29.6**	**63.4**	**7.0**	**0.5**	**0.1**	**9**	**21**
Low income	*1,613.4*	*2,505.9*	*3,090.9*	*2.1*	*1.5*	*36.4*	*59.2*	*4.4*	*0.6*	*0.1*	*11*	*29*
Middle income	*1,988.8*	*2,667.2*	*3,001.1*	*1.4*	*0.8*	*27.1*	*66.0*	*6.9*	*0.4*	*0.1*	*8*	*17*
Lower middle income	1,626.4	2,163.5	2,413.0	1.4	0.8	26.7	66.4	6.9	0.4	0.1	8	17
Upper middle income	362.4	503.6	588.1	1.6	1.1	29.0	64.4	6.6	0.4	0.1	7	20
Low & middle income	*3,601.6*	*5,172.3*	*6,091.9*	*1.7*	*1.2*	*31.6*	*62.7*	*5.7*	*0.5*	*0.1*	*9*	*23*
East Asia & Pacific	1,359.4	1,822.5	2,041.3	1.4	0.8	26.8	66.8	6.4	0.4	0.1	7	17
Thailand	46.7	61.2	66.3	1.3	0.6	23.6	70.1	6.3	0.3	0.1	8	15
Philippines	48.0	78.3	98.2	2.3	1.6	36.9	59.2	3.9	0.6	0.1	6	26
China	981.2	1,271.8	1,392.6	1.2	0.6	24.8	68.1	7.1	0.4	0.1	7	15
Japan	116.8	127.0	124.1	0.4	-0.2	14.5	67.9	17.6	0.2	0.3	9	9

Europe & Central Asia	425.8	474.6	476.6	0.5	0.0	21.4	67.6	11.0	0.3	0.2	12	12
Latin America & Caribbean	359.9	523.6	625.7	1.8	1.3	31.3	63.2	5.5	0.5	0.1	6	22
Middle East & N. Africa	174.0	300.6	387.7	2.6	1.8	36.2	59.8	4.0	0.6	0.1	6	26
South Asia	901.3	1,377.8	1,680.0	2.0	1.4	34.6	60.8	4.6	0.6	0.1	9	26
India	687.3	1,032.4	1,227.9	1.9	1.2	33.1	61.9	5.0	0.5	0.1	9	25
Sub-Saharan Africa	381.7	673.9	880.6	2.7	1.9	44.0	53.0	3.0	0.8	0.1	17	39
High income	*827.4*	*957.0*	*1,001.9*	*0.7*	*0.3*	*18.4*	*67.3*	*14.3*	*0.3*	*0.2*	*9*	*12*
Europe EMU	286.7	306.7	306.0	0.3	0.0	16.2	67.3	16.5	0.2	0.2	10	10

a. Estimate does not account for recent refugee flows. DR=death rate, BR=birth rate
Source: World Bank Development Indicators.

Table 4 Stocks of non-OECD students in selected OECD economies (thousands)

	2001	% from non-OECD	2002	% from non-OECD
USA	475.2	63.4	583.0	64.3
UK	225.7	41.1	227.3	44.6
Germany	199.1	48.0	219.0	50.8
France	147.4	71.9	165.4	74.8
Australia	121.0	77.6	179.6	76.5
Japan	63.6	66.6	74.9	69.1

Source: OECD 2003: 36; 2005: 37.

Table 5 US inflows of high-skilled workers, including H-1B visa holders

	1985	1990	1995	2000	2001	2002	2003
Academic students	251,234	319,467	356,585	648,793	688,970	637,954	617,556
Specialty occupations (H1B)	47,322	100,446	117,574	355,605	384,191	370,490	360,498
Professional workers NAFTA (TN)	..	..	23,904	91,279	95,486	73,699	59,446
Intra-company transferees (L1)	65,349	63,180	112,124	294,658	328,480	313,699	298,054

Source: US Department of Homeland Security (2004)

Table 6 The distribution of H-1B visas among leading Asian countries (% share of total)

	1990	1995	2003*
China	0.9	2.9	3.5
India	4.1	23.9	21.1
Japan	5.8	3.2	3.7
Philippines	11.2	15.4	1.6
Total issued	65,000	65,000	360,498

Source: US Department of Homeland Security (2004)
*Fiscal Year

Table 7 Remittances received by developing countries, 2001 (billions of US dollars)

	All developing	Low income	Lower middle income	Upper middle income
Total remittance receipts	72.3	19.2	35.9	17.3
as % of GDP	1.3	1.9	1.4	0.8
as % of Imports	3.9	6.2	5.1	2.7
as % of domestic investments	5.7	9.6	5.0	4.9
as % of FDI inflows	42.4	213.5	43.7	21.7
as % of total private capital inflows	42.9	666.1	44.9	20.2
as % of official flows	260.1	120.6	361.7	867.9
Other current transfers	27.2	6.1	14.0	7.1
Total remittances and other transfers	99.5	25.3	49.9	24.4

Source: IMF, Balance of Payments Yearbook 2001, World Bank, World Development Indicators 2001, in Ratha (2003: 157).