

Diasporas and Technology Transfer

DEVESH KAPUR

Devesh Kapur is an Assistant Professor in the Department of Government at Harvard University

Introduction

Nearly two decades ago, an important concern of development thinking and international public policy centered on the movement of individuals with high human capital from low income countries to higher income countries — a phenomenon known as ‘reverse technology transfer’ or the ‘brain drain’. Subsequently the issue dropped out of sight, edged out by the immediacy of the problems confronting developing countries in the 1980s and new concerns, ideas and fashions. Indeed, by the mid-1990s, despite continued concerns about human capital flight (especially from Africa, Russia, the Caucasus, and the Balkans), the expression ‘brain drain’ was less in vogue, and while not replaced was certainly challenged by concepts that implied a reversal of ‘reverse technology transfer’ — ‘brain gain’, ‘brain bank’, ‘brain trust’.

Understanding this shift has assumed much greater urgency given the structural shifts that are underway in the global economy. If capital was the central mobile factor driving economic development in the past half-century, then international labor mobility is likely to play as central a role in the next half-century. The growing importance of international migration (both real and virtual) will be driven by structural factors, both demographic and technological, in both developing and developed countries. Present demographic tendencies will produce a major shift in the size and structure of populations in the European Union (EU) over the next 50 years. The population of current EU member states is expected to decline by about 12% by 2050, which is likely to have strong negative effects on living standards and government budgets. OECD estimates suggest that the cumulative effects of demographic changes in industrialized countries could be to reduce living standards in the US, EU and Japan by 10, 18 and 23%, respectively (OECD, 2000, p. 197). Without an influx of new workers, European pension systems will become unsustainable.

A growing body of opinion holds that aging European populations might be rejuvenated by inflows of migrants who would work, pay taxes and hence finance pensions, helping to avert a future pensions crunch (OECD, 1998; United Nations, 2000). A United Nations report calculated that in the case of the EU, in the absence of any other measures or changes, the net number

of immigrants required over the next 50 years to maintain the size of the total population would be about one million annually; to maintain the size of the working-age population about 1.5 million annually; and to maintain the old-age dependency ratio (the ratio of working age to over-65 population) about 13 million annually — about 15 times current net migration rates (United Nations, 2000). Unlike the 1990s when about half the immigrants to the EU came from East Europe, the migrants would not come from other European countries, since the demographic picture in East Europe is as stark as in West and South Europe (the comparable figures for Europe as a whole are double that for the EU).

The economic, political and social impact of such potentially large immigrant inflows have prompted much debate in advanced industrial countries. Since the fiscal impacts of high-skilled immigrants are very different from low-skilled immigrants, much of the debate and policy focus over opening up immigration has concentrated on the former. Immigration policy is rapidly emerging as a tool of industrial policy in advanced industrial economies as countries compete with each other to fill a severe lack of skilled workers and attract the cream of global human capital. This trend is exemplified by the success of the US information technology (IT) sector driven by talented nationals from around the world. The rich countries have been opting for more selective immigration covering particular kinds of skilled workers now in short supply, and in the case of unskilled labor admitting immigrants for a limited time with obligations or encouragement to return home. This trend is likely to strengthen in the foreseeable future since importing foreign labor ameliorates social security problems in the short- to medium-term while exacerbating the problem in the long term if the foreign labor immigrates — and hence adds to future social security payments when it in turn gets older. But to the extent that labor with low levels of human capital is in excess supply and labor with high levels of human capital is in excess demand, industrialized countries will resort to temporary migration in the case of the former and (because of competition for a scarce resource) will offer more permanent migration options to the latter.

What will be the welfare consequences of such large flows of labor — both temporary and permanent — across national boundaries on source countries? Understanding this question has taken on a new urgency not only because of the prospects of enhanced levels of international migration for reasons already mentioned, but also because of increasing transnational influences on nation states. For a variety of reasons, the greater movement of peoples across borders has greater implications for source countries today than corresponding migrations a century ago. Foremost is the rapid extension and declining cost of modern travel and communication technology (telephone, Internet), especially the latter. These lower cognitive and informational barriers on the one hand sharply increase the likelihood of increased *circulation* of people, ideas and money across borders on the other (decreased travel costs, for instance, lower costs for decision reversals). Consequently, it is important that we begin to understand how this structural

inevitability can be harnessed for development ('brain gain') and not simply leach out human capital further from the countries where it is most needed ('brain drain'). In trying to understand this shift, in particular on technology transfer, there are several issues we need to understand. What explains this shift? What are the dimensions of this shift? What are the consequences of this shift? Is the importance of diasporas greater in the current (and future) contexts than it has historically been, and if so, why?¹

Magnitude of brain drain

Estimates of international migrants — persons who take up residence or who remain for an extended stay in a foreign country both voluntarily or are forced to — total more than 150 million worldwide (International Organization for Migration, 2000). Although in the past 40 years the number of international migrants has grown steadily, fewer than 3% of the world's population has lived outside their home countries for 1 year or longer. An interesting new trend is the increasing feminization of international migration with women making up 47.5% of all international migrants.

For a variety of reasons, data on characteristics of international migrants is limited and cross-national comparisons are particularly problematic. In so far as South-North migration patterns are concerned, i.e. from least developed countries (LDCs) to OECD countries, migration rates are higher for people with levels of human capital higher than the general population in the source country. Thus, people with tertiary education (the scare factor) are more likely to migrate than those with primary education (the surplus factor).² According to one estimate, extrapolating from US census data in 1990 to other OECD countries, the migration rates for individuals with tertiary education are especially high for small countries in the Caribbean, Central America and Africa where the losses of this skill group exceed one-third (Carrington and Detragiache, 1998).³ The figures are also substantial in relative terms in Asian countries such as Iran (between one-third and one-quarter), Korea (one-sixth), and Taiwan and the Philippines (one-tenth). Turkey also has a very high migration rate (about one-half). Migration rates from South Asia are relatively lower, although the numbers are underestimated both because they exclude the substantial numbers of South Asian professionals working in the Gulf countries as well as those on non-immigrant visas in OECD countries.

The problem is perhaps most acute in the case of Africa. In 1990, the number of individuals with tertiary education from Africa in the US was 95 000 (Carrington and Detragiache, 1998). The estimates for OECD countries are much less reliable. However, if we extrapolate from the fact that the US accounted for about one-half of total OECD migration in 1990, the strong historical links and geographical proximity between Africa and Europe, and the continued economic and political travails of the continent, the number of Africans with tertiary education outside Africa is likely to be about 200 000. According to another estimate there are about 100 000 highly qualified Africans working in OECD countries — nearly one-third of its

TABLE 1. Estimated extent of brain drain from Africa (percentage of nationals with university education living abroad)

35%	Algeria, Benin, Burkina Faso, Cape Verde, Cote d'Ivoire, Gambia, Ghana, Guinea, Guinea Bissau, Liberia, Mali, Mauritania, Morocco, Nigeria, Senegal, Sierra Leone, Somalia, Sudan, Togo, Tunisia, Western Sahara
5-35%	Djibouti, Egypt, Eritrea, Ethiopia, Kenya, Lesotho, Malawi, South Africa, Swaziland, Tanzania, Uganda, Zambia
< 5%	Angola, Botswana, Burundi, Cameroon, Central African Republic, Chad, Comoros, Congo, DRC (formerly Zaire), Equatorial Guinea, Gabon, Sao Tome and Principe, Libya, Madagascar, Mozambique, Namibia, Niger, Rwanda, Seychelles, Zimbabwe

Source: Institute for Migration, 1999.

skilled workforce — about the same as the number of foreign experts working in Africa (International Organization for Migration, 1999). About 23 000 academics migrate out of Africa each year. The severity of the loss of human capital in African countries is illustrated in Table 1.

This data on migration excludes a category that is growing (and will increase in importance), namely 'non-immigrants', a category that is more skill intensive. In the US, this includes those with work visas and business visas, almost all of who are skilled workers. In 2000, the US approved legislation that would allow an additional 200 000 work visas to be granted annually for 3 years to skilled professionals (so-called H1-B visas). A recent profile of H-1B visa petitions approved by the US between October 1999 and February 2000 is illustrative. The number of visa petitions approved was 81 262, of which 42.3% was for nationals from India (China and Canada were second and third with 9.8 and 3.9%, respectively). More than one-half of the petitions were for computer related occupations while one-sixth were for the sciences and engineering. Of the petitions approved, 56% had a bachelor's degree while the rest had a master's degree or other additional degrees. The median income of this group was \$50 000.

The rapidly growing global demand for Indian IT professionals is a double-edged sword for the country that has in IT, for the first time, achieved a modicum of success. Current estimates put the annual output of engineers produced by India's educational institutions at 178 000, of whom about 92 000 are qualified in information technology-related disciplines.⁴ In 1998, 34 000 Indian students and 30 000 Indian professionals went to the US alone. One-quarter of students from India are undergraduates while three-quarters are graduate students. About two-thirds of Indian students studying in the US are enrolled in science and engineering.⁵ Factoring in those leaving for other countries, about one-fifth of India's annual output of engineers leaves the country.

There are plans to increase the total output of India's engineers to 500 000 by 2006. It should be noted that although the overall annual output of IT professions from India exceeds that of the US, the quality is much weaker, hamstrung by high faculty:student ratios (1:45, three times as much as the norm recommended by the All India Council of Technical Education). Moreover, increasing the output requires a cadre of well-qualified faculty that

is hemorrhaging in India. Even though the overall annual output of IT professionals in India is greater than in the US, India's output of master's and Ph.D. students is barely 3% that of the U.S. and more than 60% of post-graduate seats in engineering colleges are vacant. The consequent low output of postgraduates has serious implications for training of future generations, given that India's technical education system already suffers from about 10 000 teaching vacancies (World Bank, 2000, Annex 1, para. 23).

Consequences of migration for development and technology transfer

The impact of immigration flows on economic development in source countries is poorly understood, and that on technology transfer even less. Earlier analysis of migration of people with high levels of human capital from countries with low aggregate levels of human capital increases has emphasized several effects. It increases overall global output but also increases inter-country inequality. In so far as the human capital is financed by public funds (which it normally is in most LDCs, although this is declining) and the beneficiaries are in the upper decile/quintile of the country's income distribution, the overall impact is regressive both in terms of intra- and inter-country inequality. It is however, possible that, depending on the patterns and magnitude of migration and the structure of domestic labor markets, immigration can drive up domestic wages as was the case with the migrations from Europe to the new world in the late nineteenth century (O'Rourke and Williamson, 1999).

Discussions on the brain-drain issue have generally pitted the loss of a scarce factor that is critical for development — human capital — against the gains of another scarce factor, financial resources in the form of remittances. The latter, as evident from Table 2, are particularly important for low, and lower middle income countries. The total volume of remittances in 1998 was \$52.4 billion, about the same as net Official Development Assistance (ODA) in that year (\$52 billion). Remittances have important economic implications for a locality. Financial remittances are greater (especially as a

TABLE 2. Relative importance of remittances
(remittances as a percentage of annual average, 1991-
1998)

	Exports	Imports	GDP
Low income	25.6	11.6	2.3
Lower-middle income	97.6	16.5	4.4
Upper-middle income	14.5	4.2	1.6
High income	5.1	2.6	0.8

Data sources: Remittances, IMF balance of Payments Yearbook, 1999; Exports, Imports and Gross Domestic Product (GDP), IFS CD, June 2000. Country Groupings are as defined by World Development Indicators, World Bank, 2000.

fraction of income) for lower skilled workers who are more likely to be temporary migrants. These remittances finance consumption, liquidity for small enterprises (in the absence of well-functioning credit markets), housing and philanthropy; they are an important source of social insurance in lower income countries; and they also finance capital investments — in equipment, land, wells and irrigation works and education — with longer-term implications for economic development. It is difficult to track what percentage of remittances goes into consumption, working capital or long-term investment.

The other side of the ledger was generally viewed with alarm as a 'brain drain'. More recently, diasporas are seen not just as a net loss, but as 'brain banks', 'brain trusts' and the like. The experience of Ireland, Korea and Taiwan, all of whom have had substantial out migration of skilled workers, demonstrate that the effects need not necessarily be detrimental to a country's long-term growth. Recent work on 'ICs' (Indians and Chinese) in Silicon valley has provided interesting insights on the economic effects on India, Taiwan and China (Saxenian, 1999).

In general, there is little understanding of the dynamic effects of migration that may be more important. The broader spillover effects of diasporas may be occurring through several mechanisms. There is anecdotal evidence that 'social remittances' may be playing an important role in reshaping individual and social preferences as well as social norms and expectations in the country of origin with attendant political and economic consequences (Levitt, 1998).

One interesting positive effect of diasporas is the role as a reputational enhancement mechanism. Firms and institutions in LDCs are severely handicapped in the global arena because of reputational reasons. LDC academics toil away in obscurity unless they publish in (reputable) western journals or are vouched for by foreign academics or association with foreign universities — all of which serve as reputational enhancement devices. Most LDC institutions, be they be manufacturing firms, health or educational institutions, face severe reputational handicaps arising from a 'country-of-origin' effect.

By 'reputation', I mean the prior beliefs of buyers of products and users of services. These prior beliefs affecting a current transaction can be based on information stemming from previous transactions and experience, in which case the reputation, whether good or bad, will be deserved. On the other hand, the buyer's priors may be based on his experience with other firms similar to the firm in question — for instance, the reputation that a particular Nigerian firm is 'stuck with' may derive not from its own past performance, but from the past performance of other Nigerian firms. A second aspect of these prior beliefs is how precise they are. If prior beliefs are based on past experience, the thicker the nexus of transactions the more precise the buyer's priors. A risk-averse buyer will care about the precision of his priors and hence a seller who is a newcomer into a market will be at a disadvantage simply because he has no 'reputation' (this is analogous to the widely-observed phenomenon of individuals not being able to get credit unless they already have a credit history).

LDC firms face reputational barriers to entry in export markets resulting from limited information that buyers may have about the quality of their products and service reliability. Because, by definition, buyers in major export markets will have had little prior experience of dealing with these firms, the former may be reluctant to do business with them. This places newcomers at a reputational disadvantage relative to established firms, effectively creating a reputational barrier to entry. The reputational barriers to entry faced by LDC firms are principally twofold: situations where an individual firm is unfairly 'stuck with' an unfavorable reputation because of the poor performance of other firms with which it is thought to be similar, and situations where a firm is at a disadvantage simply because little is known about it because it is a late entrant.

The importance of reputational barriers is likely to vary across industries and across segments within industries. Reputational barriers are likely to be greater in sectors where:

- quality is more tacit and *ex ante* determination of quality of the product or service is consequently more difficult. Most tradable services fall into this category, software being a good example;
- the risk of extreme adverse outcomes associated with poor quality is high. Food products and health care are good examples. The cost of a cataract operation in India (even including travel costs) is substantially less than in Europe in comparable facilities, but the general reputation of Indian hospitals is unlikely to make this a commercial proposition given what is at stake;
- the greater the difficulties of designing contractual mechanisms to mitigate information asymmetries; and
- the greater the importance of timely, reliable supply.

Role of diasporas

The role of diasporas in contemporary economic life can be better understood if markets are seen not just as price-making mechanisms but in the broader Coasian sense of markets as social institutions that facilitate exchange. Networks imbedded in social institutions mimic market structures through signaling and informational exchange among participants. Networks affect the flow of information in fundamental ways, shaping content, access and credibility of information. Their role in employment and labor markets is well documented as well as in immigration and immigrant entrepreneurship. Once in place, networks create self-sustaining migratory flows that gradually delink from the conditions that generated immigration in the first place. The resulting 'chain migration' is an important explanation why ethnic groups with very small numbers in the overall population concentrate spatially and in occupations/trades. Employers have strong reasons to hire individuals with a credible imprimatur and referral by existing employees is an important mechanism. Hiring new employees or contractors from networks that have delivered reliability in the past reduces search costs. In

addition to employment, these networks provide access to resources, either informational or financial.

It would seem, however, that the 'private' informational advantages of being members of networks may be less important in the information age. This however, is not true for two reasons. One, knowledge and technology continues to have a tacit element and its social context continues to be critically important in how it is transmitted and received (Brown and Duguid, 2000). And second, the problem facing economic agents today is not one of a lack of information but a deluge. And as with all deluges, agents create dykes and embankments to have some way to control the flood. Consequently social networks continue to be important in modern economic life.

Given the multitudes of diasporic networks, however, why are some seeming more important than others? Large countries have larger diasporas and hence larger networks. Since the benefit of networks increases rapidly with network size, for a given rate of immigration, large countries are more likely to benefit from the network advantages of diasporas. But network size is just one factor. The strategic location of diasporas is equally important because of the brokering the role they play. The Chinese diaspora played that role in labor-intensive manufacturing exports from China and the Indian diaspora is playing a similar role in the labor intensive segment of IT — namely software and IT-related services. Diasporas seem to be playing an important role in the diffusion of knowledge and technologies — as well as fads, fashions and 'inappropriate technologies'.

Recent work on 'ICs' in Silicon valley has provided interesting insights on the economic effects on India, Taiwan and China (Saxenian, 1999). The Indian diaspora's success in Silicon Valley has influenced how the world views India, reflecting the reputational spillover effects of success in a leading sector in a leading country. And networks have been an important part of this story.

The IndUS Entrepreneur (TiE) — a networking group of Indian IT entrepreneurs and network professionals founded in 1992 — has emerged in less than a decade, as an extremely successful networking organization.⁶ From its core North American and Indian markets, TiE has expanded and has now 25 chapters (including five in India) extending to the UK, Singapore and Switzerland where south Asian communities are seeking to be part of the TiE phenomenon. TiE's *modus operandi* applies India's classic guru-shishya, or teacher-student, relationship, to a business context with the 'guru' role played by experienced entrepreneurs and the 'shishya' the start-up managers. At the core of the Indian network is a group of angel investors, who got rich by starting companies and are now recycling some of their wealth as venture capitalists both in the US as well as in India. While most of their wealth goes to US companies, they are also funneling funds into a new generation of start-ups in India as well as hybrid companies and investment funds that operate in both India and the US. The identity, business plans and capitalization of these new ventures are unusually fluid.⁷

The mentoring role and serving as role models have been important for India as well in several important ways: first, it has boosted India's confidence

as well as the confidence of overseas investors about India's potential despite India's innumerable problems. Companies like Yahoo, Hewlett Packard and General Electric have opened R&D centers in India largely because of the confidence engendered by the presence of many Indians working in their US operations. This points to the cognitive effects arising from the projection of a coherent, appealing, and progressive identity on the part of the diaspora that signals an image of prosperity and progress to potential investors and consumers.

Second, it has helped unleash an entrepreneurial culture in a country whose cultural (and later bureaucratic) ethos was long regarded as inimical to capitalism. The diffusion of knowledge is through a variety of mechanisms. Given the technological frontier in the US there is substantial skill upgradation when Indian technology professionals work in the US, through learning by doing. To the extent that some return while others circulate between the two countries, technological diffusion occurs through imitation, mimicry being an effective way to reduce search costs. Just as Korea climbed up the technological ladder by importing capital equipment of recent vintage (which embody frontier technologies), diasporic networks embody technologies in human (rather than physical) capital.

The importance of networks has been amplified by changing logic of production and industrial organization in global markets. Models of large vertically integrated firms dominant in sectors with slow-changing technologies and markets are being supplanted by interorganizational networks of suppliers, production facilities and collaborative R&D ventures. The new logic of production, which emphasizes flexibility over hierarchy, is a response to shortening product cycles and much more rapid technological change. This decentralized production system, characterized by dense social networks and flexible labor markets, collective learning among specialized producers of complex interrelated knowledge where firms simultaneously compete intensely and collaborate, has a strong spatial dimension manifest in industrial clusters. The importance of spatial concentration is underlined by the IT sector's spatial clustering, despite it being the one industry where production can be theoretically decentralized the most (since there is very little physical movement of intermediate goods). The success of TIE is both cause and consequence of the more than 200 000 Indians in Silicon valley, and this clustering effect in turn creates networks between the US cluster and the Indian cluster in Bangalore.

Diasporic networks act as reputational intermediaries and as credibility enhancing mechanisms that may be particularly important in economic sectors where knowledge, especially *ex ante* knowledge of quality, is tacit. For instance the Indian diaspora's success in Silicon Valley appears to be influencing how the world views India, reflecting the reputational spillover effects of success in a leading sector in a leading country. It has created a 'brand-name', wherein an 'Indian' software programmer sends an *ex ante* signal of quality just as a 'made in Japan' sends an *ex ante* signal of quality in consumer electronics. India's IT talent is being courted not just in the US, but in other countries of the EU where Indian emigration had slowed to a

trickle (UK) or had been very small to begin with (Germany, Finland, Japan and South Korea). The courting of Indian software professionals by an increasing number of countries stems from a combination of three factors: the relative shortage of domestically trained workers relative to demand in industrial countries; the relative excess supply of well-trained workers in India relative to domestic demand at international wage rates; and a sense globally that IT is a critical sector of the economy that no country can afford to be left behind.

On the other side of the balance sheet, the losses of scarce human capital may be more debilitating in view of recent advances in endogenous growth theories that emphasize the critical importance of human capital for growth (Lucas, 1988; Barro, 1991). There is at least one study that develops an endogenous growth model in which the migration of highly skilled workers reduces income levels and long-term economic growth (Haque and Kim, 1995). In contrast, a more inimical effect may be possible negative institutional effects of the 'brain drain' on countries of origin. Despite the emphasis on institutions as the *sine qua non* of development, there is still little understanding of how successful institutions actually develop. It can be argued that other factors notwithstanding, the origins of successful institutional development all too often lie in a critical mass of individuals with high levels of human capital. This group is crucial in the *initial* stages of institution development even though the yardstick to judge successful institutions is that their fortunes are independent of the behavior of particular individuals. To the extent that this is valid (an issue that itself needs to be analyzed), the most inimical consequences of the 'brain drain' may be on institutional development in the country of origin, making it more difficult for LDCs to retain the very individuals critical for institutional development (those with high levels of human capital) as their reservation wages are increasingly being set globally. The data in Table 3 is suggestive that this is occurring, as LDCs with *lower* levels of inequality appear most threatened with human capital flight. If so, LDCs may well be caught between a rock and a hard place — either suffer the loss of the very human capital so essential to institutional development or, alternatively, tolerate much higher levels of income inequality, with the political and economic consequences that follow.

The factors that shape the role of diasporas in technology transfer are related to the broader set of factors that affect the forms and degree of engagement of the diaspora with the source country. The role of the Chinese diasporic networks (the 'bamboo network') in channeling investment into China (in particular in the southeastern provinces of Guangdong and Fujian) has been well documented (Weidenbaum and Hughes, 1996). The Chinese Business Sphere (consisting of business populations in the People's Republic of China, Taiwan, Hong Kong, Macao, ASEAN countries, and Indochina) — where Chinese are doing business using contact networks — has become a major international player and one of the world's economic power blocs.⁸ But why do some diasporas invest back in the country of origin (China) while others send remittances (India)? For instance, the ratio of foreign investment by the Chinese diaspora is nearly 20-fold that of the Indian

TABLE 3. Emigration and Inequality

	Tendency for the well educated to emigrate abroad (10 = lowest; 0 = highest)	Percentage share of income or consump- tion of top decile
<i>Latin America</i>		
Chile	7.43	46.1
Brazil	5.66	47.9
Argentina	5.54	37.0
Mexico	5.49	42.8
Colombia	4.61	46.9
Venezuela	4.24	35.6
<i>Asia</i>		
Thailand	5.94	37.1
Malaysia	5.56	37.9
China	4.39	30.9
Philippines	4.35	33.5
India	4.02	25

Source: World Competitiveness Report 1998 for survey data on emigration tendencies; World Development Indicators 1999 for inequality data. Inequality data for Argentina is for greater Buenos Aires region from Fundacion Capital, 'Informe de Coyuntura Mensual', No. 45, Dec. 1999.

diaspora. However, remittances by the Indian diaspora are about seven times that of the Chinese diaspora (\$49.8 billion and \$7.6 billion, respectively between 1991 and 1998). The reasons behind these starkly different numbers are complex. The Indian diaspora was largely professional while the Chinese diaspora was more entrepreneurial. Hence, although the former was well off in the aggregate (for instance, it is one of the wealthiest ethnic groups in the US), it did not have substantial numbers of high net worth individuals who would serve as potential investors. Second, India was hostile to foreign investment until the early 1990s while China opened up a decade earlier. Third, China, unlike India, did not have a strong domestic capitalist class when it opened up — and hence faced little domestic opposition to incentives granted to the diasporic investors. Finally, local governments have played a much more proactive role in China relative to India, although this is changing in the latter.

The different patterns of engagement with the country of origin have implications for technology transfer. In the Chinese case, the technology transfer has been principally at the firm level, especially in export led manufacturing. In the Indian case, it has been at a more macro policy level as well — for instance in the formulation of information technology policies, and venture capital and in the service sector, especially IT-enabled services. China's success in manufacturing exports and India's in software can at least in part be explained by the strategic role played by their respective diasporas, stemming from the position of these diasporas in global production networks

in these sectors. In both cases, diasporic networks played two key roles — an informational role and a reputational role.

Broadly, the following factors seem to be the most important in affecting a diaspora's role in technology transfer.

- (1) Factors that contribute to the *potential* importance of diaspora — its size, education/skill, income, the activities in which it is engaged (skilled versus non-skilled labor; tradable sector versus non-tradable; hierarchy in the product cycle life — new industries versus mature industries) and the income gap between the host and the destination country. An immigrant from Ghana to the US is likely to have different effects than an immigrant from the same country to Nigeria.
- (2) Factors that contribute to the *realized* influence of a diaspora — host country characteristics such as the global importance of the host country and the particular reasons for leaving the country. The behavior of immigrants will differ according to the reasons they left their country, whether they are political or economic refugees; their vintage (first, second or third generation); and the country's prospects. The contrasting experiences of Africa and China point to an obvious reality: the home country has to be prepared to make use of the remittances and/or investments of the diaspora, which means that its political stability and economic policies have to be conducive for economic development. The diaspora attitude is likely to change along with the evolution and prospects of the country of origin. Timing, and therefore chance, plays an important role in the economic effect a diaspora can have on its home country.⁹ Two examples are the behaviors of the Indian and Chinese diasporas that both modified their attitude towards the source country when the prospects of these two countries had improved.
- (3) To the extent that diasporas are an informal channel of influence, their influence is likely to be greater the *weaker* formal institutional structures are. Intra-EU diasporas are less likely to be consequential than diasporic networks straddling the EU and North Africa.
- (4) Finally, the actual influence of the diaspora will depend on the demand side stemming from the source country's openness/willingness to outside influence. Small countries might perforce be more open to influence (for the same reason that they also more open to trade).

At least some degree of sentiment or patriotism seems to work with regard to encouraging diaspora investment and involvement. This may be through concrete status allocations (as with the Person of India Origin status in India, dual nationality in Mexico, appointment to government positions). It may also be a direct appeal to national solidarity and an invitation to become part of a larger national (often development) goal.¹⁰ It is difficult to assess the success of such appeals, as they are often presented in conjunction with economic opportunities. Related to sentiment are the ties of family and society that may encourage an emigrant to return regardless of better economic opportunities abroad. The ability of this to influence diaspora

populations may depend on the proportion of the population that has married and had children abroad.¹¹

Issues of technology transfer are closely linked to the economic implications that a diasporic community may have on its home country. There is relatively little comparative work on the effect that diasporic activity can have on the home country, or on the mechanisms by which an effect might take hold. Work that has been carried out on the concrete effect that a diasporic network may have on the economy (and under what conditions) is largely focused on country studies. Two important implications from the literature are worth emphasizing. One, it presents an alternative image and working system for the multinational business enterprise, placing greater emphasis on connections between smaller units rather than on the amalgamation of smaller units into large entities. This model presents a picture of capitalism that allows for small firms to link up (rather than be swallowed up) and become multinational (but not monolithic) enterprises. The smaller company size and the system's dependence on relatively horizontal inter-firm networks allows diaspora-based business a degree of flexibility, rapidity, and breadth of knowledge of different situations that may not be attainable for larger multinationals, although the theoretical rationale is murky. Consequently this form of business networks and industrial organization seem particularly well suited for situations of uncertainty and relative unfamiliarity, as is the case with many LDCs. It seems that the smaller firms make the initial steps into the home country, opening the way for larger firms with which they have contact.

A second implication of the diaspora-linked businesses is that, in contrast to 'Western' capitalism's claims of universality and impartiality/impersonality, diasporic capitalism grants (relatively) greater importance to family control and relies on long-term, trust-based relationships (Ip, Lever-Tracy and Tracy, 1999). This diaspora capital can also affect the type of national market that emerges. Diaspora businesses have less incentive to press for a fully open or universally accessible economy to emerge and the family control and long-term, trust-based relationships that have served diaspora network capitalism well could be viewed by others as unfairly preferential, nepotistic, or collusive. This may have ramifications for state policy (and state rhetoric) as well. The networks of capital may flourish in part as a result of conscious state sponsorship, but it may also succeed largely on its own. This form of network-based capitalism can have ramifications for the eventual economic make-up of the state. As the diaspora belongs to no state, it is difficult to regulate the financial capital (and knowledge) that flows through multinational ethnic networks. Given this situation, it may be difficult for inter-state negotiations to have a lasting effect on fairly flexible diasporic network capital.¹²

To the extent that diasporas have a greater knowledge of their countries of origin, are the technologies transferred more appropriate? While this may seem intuitively likely, caution is warranted. Three examples from India are illustrative. The flight of physicians from India, trained largely at public expense, has been a considerable brain 'drain' for the health sector in India. More than 30 000 physicians are providing quality healthcare across the US. The loss of their services to the country where they were initially trained is

substantial, especially given the paucity of health services in a poor country such as India. More recently, the American Association of Physicians from India (AAPDI), via the AAPI Foundation in India, has been trying to bring in a system of quality control in the medical field in India including accountability of doctors and improving hospital records and the quality of care and responsibility, especially in small nursing homes. However, given the emphasis on curative health there are some questions regarding the 'appropriateness' of the technology transfer, particularly important in a country where the health system is already biased against preventive and public health care.

Hindi films provide another example. Exports constitute an increasingly important component of the market for Hindi films, catering in considerable part to the Indian diaspora. In catering to this more technologically sophisticated market, the technical quality of Hindi films has improved markedly — an analog to the technological upgrading that occurs through feedback effects when LDC firms enter global export markets. However, at the same time, the content of Hindi films has also changed — even though India is still largely a rural country, rural India is barely visible in Hindi films, since that does not 'sell' in the export markets that the industry is aiming at. The increasing cognitive dissonance between Indian cinema and the country's realities may or may not matter in a material sense but perhaps does matter on other aspects.

Finally, there is a danger that the very euphoria engendered by the Indian diaspora's success in IT and the resulting imitation in India is sucking technologically savvy talent from many other important development areas by bidding up the price of talent. This is as it should be. Talent should go where it is most productive, and higher wages in the IT sector reflect the potentially higher productivity of this human capital. But at the same time this means that, in many other sectors that are critical for the well-being of the majority of the population, be it health research or agricultural technology development, the supply pool of talent is running dry.

The technology transfer problem is more acute in the case of the large numbers of unskilled and semi-skilled labor that forms a significant fraction of overseas migration. There is little learning in the many domestic care jobs that are performed by immigrants from South Asia in the Gulf or from Central America in the US. A more interesting question is agriculture, both because many immigrants work in this sector, but also because much of the labor is seasonal. Examples include Romanian farm labor in France, North Africans in Spain, or Mexicans in California. One might think that this could lead to diffusion of agricultural technologies from the host to the source country. There is little systematic evidence however, that this is happening. It is likely that, in so far as the movement of such agricultural labor is across ecological zones (South-North migration), the technologies may simply be inappropriate to the home country's soils and climates. Equally, it is possible that there are no systematic programs that provide the complementary inputs (credit, roads, extension services) that could harness the technological skills acquired by learning-by-doing by large numbers of agricultural laborers.

Policy options and strategies

Although many countries have adopted strategies designed to encourage diaspora linkage with the home country, there is little analytical work that critically examines the relative merits of these programs. Some country examples are described in the following.

Taiwan and South Korea. Although the particularities of the 'brain drain' in Taiwan and South Korea are different, the strategies the two countries have used to take advantage of their diasporic populations are similar. Their efforts have focused more on a 'reverse brain drain' model, i.e. physical relocation and networking than on trying to encourage investments from their diasporas (given their high savings rates, this is perhaps not surprising). Taiwan set up a government agency to coordinate efforts at encouraging return, the National Youth Commission (Chang, 1992). South Korea seems to have focused more effort on the return of its diaspora (often more established) to upgrade its research institutions, such as the Korea Institute for Science and Technology (KIST) (Yoon, 1992).¹⁵ The programs of the two countries entailed substantial efforts in easing reentry of which financial subsidies (travel subsidies, business loans) were an important but not dominant component. The National Youth Commission of Taiwan (ROC) runs job placement programs that refer applicants to potential employer organizations, and acts as an information clearinghouse on returning scholars seeking employment as well as potential employers and an annual report of employment needs in Taiwan that is distributed abroad. Both countries have tried particularly hard to attract scholars and researchers. The National Science Council can also make temporary (1 year) research appointments to scholars waiting for suitable employment. A visiting professor/expert program (sweetened by high salaries) allows the countries to tap valuable expertise of those who are unwilling or uncertain regarding re-emigration offer appointments. Returnees joining KIST are given a large amount of research and managerial autonomy mimicking the research environment in the US. Both countries have intensive recruiting programs that search and try to attract older professionals and scholars, by offering salaries competitive with overseas incomes, improved working conditions (research facilities, equipment, organizational autonomy), as well as housing facilities/financing, and help with children's schooling. During the 1990s, the two countries have also sought to create spatial high technology clusters such as science-parks, that provide one-stop plug-in business facilities.

During the 1960s, just 16% of Korean scientists and engineers with doctorates from the US returned to South Korea. In the 1980s, the figure had jumped to about two-thirds. Clearly, it was not direct policies by the Korean state designed to reverse the brain drain but the sharp difference in economic conditions and prospects of Korea in these two time-periods (Song, 1997). Instead of simply trying to physically attract back their pool of technological talent abroad, there has been a shift in strategy whereby the diaspora that is seen to be much more plugged into the technological and

business frontier in high-technology sectors is being integrated into cross-national networks. Both countries have focused on organizing networks of professionals overseas and linking them with the source country. This allows government and domestic business an opportunity to share knowledge and to network. Taiwan organizes national development conferences with panels on all areas involving overseas Taiwanese (at the government's expense). In the case of Korea, the Ministry of Science and Technology utilizes the contacts of repatriated scientists as access points to develop overseas networks. The ministry then organized professional associations of hyphenated Korean (especially American) scientists as a pool for expertise and future 'return brain drain' (RBD).

China (People's Republic of China). Between 1978 and 1994, the People's Republic of China's (PRC's) policies to encourage investment were specifically directed towards its diaspora (since then it has broadened its efforts to larger, potentially non-diaspora investors). Preferential strategies included allowing diasporic Chinese to purchase real estate and reducing land use fees (Bolt, 1996). In general, the PRC's appeal on patriotic grounds seems to work more for investment (in conjunction with economic factors) than long-term return, even for those born and raised in the PRC. Those living abroad may be reluctant to return for the long run due to political and economic conditions in the mainland. Better housing and income overseas encourage against it, as do fears of political instability, a general lack of freedom, and the possible difficulties in leaving the PRC for a second or third time.¹⁴

India. Much of the efforts of the government have been to attract remittances and portfolio investments. Although these efforts have been quite successful (remittances more than cover India's trade deficits), India has failed to attract investment from its diaspora for reasons already mentioned. The success of overseas Indians in Silicon Valley has had a marked effect in shaping India's strategies. Unlike the PRC, whose efforts at attracting its nationals back and reversing the brain drain in high-technology are centralized and state driven, in India it is more decentralized, with overseas Indians rather than the government playing an important role. In education, this has translated itself into efforts at raising endowments and financially bolstering some of India's higher education institutions as well as an effort currently underway to establish five global institutes of science and technology with a corpus of \$1 billion.

But it is in IT that the decentralized technology transfer arrangements are most notable. The emerging model is firms with operations in both the US and India, with the former acting as the 'front' office and the latter the 'manufacturing facility'. At a time when IT talent has been scarce, the competitive advantage of Indian launched IT-related firms in the US stems from an unusual factor: they were up and running in a shorter time than their rivals simply because they could hire technical people faster drawing from the large pool of transnational networks. This created a rapidly growing demand for IT personnel from India, and in turn led to a rapid expansion of

IT training, increasingly by the private sector. Although the education most of these people received was of modest quality, they quickly upgraded their skills by joining firms either in the US or in India, which served US markets. Just as East Asian countries began their technological ascent in labor-intensive manufacturing (such as garments, textiles and leather products), many of India's IT firms were largely in the 'body-shopping' business. But the process allowed for learning-by-doing and gave both the firms that hired them as well as the 'bodies' the confidence that they could do more technologically sophisticated work.

The Indian model has one interesting lesson for industrial policy in developing countries. Success in a new technological area has strong cognitive externalities, in terms of confidence both within the country and outside it as well. That can set forth a virtuous cycle that gradually infects other parts of the economy. Although it is too early to tell just much and to what degree India's IT success will have positive effects on other sectors, one should recall that, just a decade ago, India was seen as a classic case where ISI-led strategies had made it a technological backwater. This is especially true in the case of IT and other so-called 'general purpose' technologies (biotech is another example).

Mexico. In contrast to migrants from Asian countries, migrants from Mexico (and other Latin American countries) have lower human capital (as measured by years of schooling) than the average for the host country population (the US). Consequently, this group was largely ignored by home country elites until quite recently. What efforts existed were directed at encouraging the diaspora to send remittances and lend political support for Mexico (or Mexican parties), rather than toward direct RBD. In 1990, efforts to strengthen ties with its diaspora materialized into the Program for Mexican Communities Abroad, run through the 47 Mexican consulates in the US. This program is designed to foster a sense of Mexican identity in people of Mexican origin living abroad. It works primarily through exchange programs, Spanish language instruction, cultural awareness activities, and the formation of regional clubs. In addition to strengthening ties with its diaspora (and so establishing the social networks helpful for future possible migration in a North American open-trade area), the program hopes to improve the conditions of its diaspora in the US (Gutierrez, 1999; Shain, 2000).

Africa. The problem is quite different in countries where the pool of well-trained professionals is low to begin with. The "Return of Qualified African Nationals Programme", run by the International Organization for Migration, has tried to return and reintegrate qualified nationals. It has had moderate success reintegrating 1857 nationals between 1983 and 1999 (Institute for Migration, 1999), slightly more than 100 annually. Given the high incidence of the brain drain from Africa, this effort is unlikely to make a big difference. Moreover, as long as political instability continues to be severe in Africa, even in hitherto stable countries relatively well endowed with human capital

such as Cote d'Ivoire, Kenya, Zimbabwe and Zambia, it will be hard to attract back talent.

On the other hand, it is an expensive irony that Africa needs and gets massive amounts of technical assistance (often of dubious quality) even as many talented Africans live abroad. One suggestion worth considering is to consider technical assistance and brain-drain repatriation as alternative strategies for transferring scarce skills to skill-poor countries. The former relies primarily on expatriates from donor countries while the latter would seek to return the skills lost through migration. It appears that, under a wide range of scenarios, brain-drain repatriation may be a more cost-effective and efficient instrument to provide technical assistance (Haque and Khan, 1997).

*Fiscal options: taxing international human capital flows*¹⁵

Given the large outflows of human capital from skill-poor countries to skill-rich countries in the foreseeable future, there is need to revisit some of the ideas in the proposals laid by Bhagwati in the 1970s regarding a brain-drain tax (Bhagwati and Partington, 1976). Unlike the past, when these flows were primarily supply driven, demand factors are becoming relatively more important. A recent paper, for instance, calculates that the net present value of a highly skilled immigrant in the 40–44 age group is \$96 000 against minus \$88 000 for a new born in the US (Storesletten, 2000). The paper uses these figures to argue that fiscal problems associated with the aging of the baby boom generation in the US can be resolved through selective immigration policies. In particular, the author argues that allowing 1.6 million highly skilled immigrants in the 40–44 age group annually (against 1.1 million of all skills and ages at present) would eliminate the need to raises taxes because of demographic changes in the US. Global tax policies that allow LDCs to share in these gains therefore need revisiting.

What realistic tax mechanism design options exist and what would be their likely fiscal and behavioral consequences? Alternative regimes for taxing flows of human capital are laid out in Table 4. These include the following.

- (1) An *Exit Tax* where an exit fee is paid by employee or firm at the time of granting of visa with no further obligations. One behavioral consequence of an exit tax could be that people would try to slip under

TABLE 4. Alternative regimes for taxing flows of human capital

Tax regime	Enforcement/ compliance costs	Behavioral consequences	Revenue collection
Exit tax (one-time fee on human capital)	Low	Intermediate	Moderate (single-shot)
Flat tax (% of wages)	High	Intermediate	Moderate to high (continuous)
American model (nationality not residence)	High	Intermediate	Low
Cooperative model (sharing payroll taxes)	Medium	Low	High

Source: Desai *et al.* (2000).

the barrier, i.e. leave at an early age as students and stay on. Moreover, this group is likely to be the children of the country's elites, in which case their political support and commitment to institutions of higher education could well weaken. One option could be to provide all students in tertiary education with loans equivalent to the subsidy provided by the state. The loan has to be repaid if the student leaves the country. However, a unilateral decision by one country (unless it has monopsony power), could weaken its attractiveness relative to other sources of labor supply.

- (2) A *Flat Tax* where overseas nationals pay a small fraction of their income (say 1%). The administrative feasibility of this option would however be tenuous.
- (3) The *American Model* where individuals are taxed on the basis of nationality not residence. However, unlike the US whose nationals are likely to return at some point thus creating strong incentives for tax compliance, this is not the case with nationals of many LDCs. Consequently, LDCs would need to negotiate bilateral tax treaties to enforce this tax mechanism and even then the administrative problems would not be inconsiderable.
- (4) The *Cooperative Model* where a multilateral regime would allow automatic inter-governmental transfers of payroll taxes or income taxes paid by nationals of other countries. Ideally, the windfall gains to the host country should be equally shared between home and host country under a bilateral arrangement. The financial gains to the home country would still be quite substantial. From the point of view of both global welfare and administrative feasibility, this would be the optimal solution. However, since the *status quo* favors rich countries (who can get all the gains of such flows), their political incentives are weak.

Liberalizing policies to attract human capital

The importance of attracting human capital for economic reasons is leading industrialized countries to loosen their erstwhile onerous requirements for immigration and work permits. Given that human capital is much more limited in poor countries, one might assume that LDCs would be even more liberal in their policies related to work permits and immigration of foreigners with high human capital to attract this scarce factor. There is, however, little evidence that this is the case. LDCs must realize that immigration — especially of those with high levels of human capital — is becoming an instrument of industrial policy. Consequently, LDCs policies geared towards foreign citizens with high levels of human capital should be even more, not less, liberal than industrialized countries.

Conclusion

The foreseeable future will witness a much greater movement of people across borders. Under the General Agreement on Trade in Services, adopted

as part of the Uruguay Round trade accords, there are new opportunities for expansion of trade in services and liberalizing such trade-related temporary movement of persons. Policy measures that can better manage international migration such as a harmonized special visa regime to facilitate and monitor trade-related temporary movements would enable skilled personnel from developing countries to raise their earnings and skills through increased participation in trade in services (Ghosh, 1997). Potentially, this could reduce pressures to migrate on a longer-term or permanent basis. A harmonized international tax regime for human capital flows would considerably compensate LDCs in the short-term for the loss of their scarcest resource: human talent. But long-term benefits will not materialize unless LDCs themselves create the political and economic environment that will allow them to tap into overseas networks of their nationals so as to ensure that the 'brain drain' turns into 'brain gain' for these countries.

Notes

1. A diaspora is a system of personal networks, shared culture and language, imaginary relation to the homeland with a diasporic identity — self-recognition of the network of communities as a diaspora oriented toward a homeland, with related traits and interests. This seems to have implications for politicization of the community with regard to security/international relations, electoral politics, and the success of patriotically rather than economically or civil society-based strategies employed by the home country for encouraging diaspora involvement.
2. Central America is an exception.
3. The migration rate is the ratio of immigrants from country 'i' with skill level 's' to the number of individuals in country 'i' with skill level 's'.
4. <http://www.education.nic.in/htmlweb/itdiscussionpaper1.htm>JHD0220004troduction n
5. Institute of International Education, *Opendoors 2000*, 13 November 2000, available at: <http://www.opendoorsweb.org/>
6. In May 2000, *Fortune* magazine ('The Indians of Silicon Valley', 15 May 2000) estimated that the combined market value of the valley's Indian-run firms was \$235 billion.
7. *Wall Street Journal*, 2 May 2000.
8. The term Chinese Business Sphere as well as this estimation is taken from Yamaguchi (1993).
9. Ip, Lever-Tracy, and Tracy (1999), in *The Chinese Diaspora and Mainland China*, emphasize the importance of timing for the opportune economic relations between China and its diaspora. "Had it delayed a decade, it is possible that diaspora capitalism, with too limited investment opportunities, would have by then lost its industrializing drive and degenerated too deeply into paper shuffling and speculation" (p. 284). Presumably, this is because they would have followed on the tail end of the larger corporations that China is now trying to attract.
10. Both Shirley Chang and Paul Bolt, in their analyses of Taiwan and the PRC, respectively, mention patriotic appeal as a key factor. Chang emphasizes normative/patriotic reasons as primary in encouraging return; she argues that returnees identify with and want to encourage Taiwan's development goals. Paul Bolt's consideration of China between 1978 and 1994 presents the PRC as principally appealing to the shared ancestry of overseas Chinese in encouraging investment. While the entrepreneurs insist that profit was their primary motive, Bolt suggests that sentiment was involved, as patterns of investment closely follow the investors' original family locales.
11. For example, Shirley Chang's analysis of Taiwan notes that family pressure and social relations also play a central role. David Zweig's and Parris Chang and Zhiduan Deng's

analyses of the PRC mention that often family pressure (from within the PRC) not to return in to the mainland may factor into decisions.

12. Laura Tyson's article in *Asiamoney* (September 1995), 'Adventurous investors with plenty of cash', briefly illustrates the interconnected nature of diaspora firms. In particular, she notes that Taiwanese firms often establish subsidiaries in foreign countries through which they make investments in third countries — "the Taiwanese penchant for moving capital via circuitous and opaque channels".
13. Yoon argues that South Korea's massive heavy and chemical industrialization drive in the 1970s created the demand for RBD, and was crucial to its relative success.
14. Zweig (1997) bases his conclusions on 273 personal interviews with students, scholars, and former residents of China in the United States in 1993. Parris Chang and Zhiduan Deng (1997) reach similar conclusions.
15. This discussion draws on Desai *et al.* (2000).

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