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The Brain Drain: What Do We Know?*

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Abstract / Résumé

Is the brain drain a curse or a boon for developing countries? In the face of it, what are the policy options open to international organizations and home country governments? This paper reviews what is known to date about the magnitude of the brain drain from developing to developed countries and the way such skilled migration affects the source countries. In a first, descriptive section, we characterize the determinants, evolution and spatial distribution of the brain drain. We distinguish several measures based on education attainment, age of entry and occupation. We then review the traditional literature and explain why the brain drain is a major issue of concern for origin countries. Section 3 provides a theoretical and empirical discussion of the various channels through which the brain drain positively impacts on sending countries. Finally, we discuss the implications for migration, education, and taxation policies.

La fuite des cerveaux est-elle un fléau ou un avantage pour les pays en développement ? Quels sont les outils politiques à la disposition des organisations internationales et des gouvernements des pays d'émigration ? Le papier présente les connaissances disponibles à ce jour sur l'ampleur des flux migratoires de travailleurs qualifiés et sur leurs conséquences pour les pays d'émigration. Une première partie descriptive dépeint les déterminants, évolutions et distribution spatiale de la fuite des cerveaux. Différentes mesures fondées sur le niveau atteint d'éducation, l'âge d'arrivée sur le territoire et l'emploi occupé sont distinguées. Une revue de littérature explique ensuite pourquoi la fuite des cerveaux est un enjeu crucial pour les pays d'émigration. Cette section 3 éclaire les débats théorique et empirique sur les différents canaux par lesquels la fuite des cerveaux a des retombées positives sur le pays d'origine. Enfin, nous abordons les implications pour les politiques de migration, d'éducation et de fiscalité.

1. Introduction

For the last decades, the pace of international migration has accelerated. The number of international migrants increased from 154 to 175 million between 1990 and 2000 and is nearing 200 million in the recent years. The consequences for countries of origin and destination have attracted the increased attention of policymakers, scientists and international agencies. In particular, the migration of skilled workers (the so-called brain drain) is a major piece of the migration debate. The transfer of human resources has undergone extensive scrutiny in developing countries, but also in industrialized countries such as Canada, the United Kingdom and Germany, where an important fraction of talented natives are working abroad. As part of globalization process and given the orientation of immigration policies in some receiving countries, the brain drain issue becomes more and more important.

There is a fair amount of evidence suggesting that the number of skilled migrants is now much more extensive than it was two or three decades ago. For example, Haque and Jahangir (1999) indicate that the number of highly skilled emigrants from Africa increased from 1,800 a year on average during the period 1960-75 to 4,400 during 1975-84 and 23,000 during 1984-87. These trends were confirmed in the 1990s in the face of the increasingly "quality-selective" immigration policies introduced in many OECD countries. Since 1984, Australia's immigration policy has officially privileged skilled workers, with the candidates being selected according to their prospective "contribution to the Australian economy". In November 1991, the New Zealand immigration policy shifted from a traditional "source country preference" towards a "points-system" selection, similar to that in Australia (Statistics New Zealand, 2004). The Canadian immigration policy follows similar lines, resulting in an increased share of highly-educated people among the selected immigrants; for example, in 1997, 50,000 professional specialists and entrepreneurs immigrated to Canada with 75,000 additional family members, representing 58% of total immigration. In the US, since the Immigration Act of 1990 - followed by the American Competitiveness and Work Force Improvement Act of 1998 - emphasis has been put on the selection of highly skilled workers, through a system of quotas favoring candidates with academic degrees and/or specific professional skills. For the latter category, the annual number of visas issued for highly skilled professionals (H-1B visas) increased from 110,200 in 1992 to 355,600 in 2000, the totality of this increase due to immigration from developing countries. About half of these workers now come from India.

In European Union (EU) countries, immigration policies are less clear and still oriented toward traditional targets such as asylum seekers and applicants requesting family reunion. However, there is some evidence suggesting that European countries are also leaning toward becoming quality-selective. As reported in Lowell (2002b), "European Commission President Prodi has called for up to 1.7 million immigrants to fill EU-wide labor shortage through a system similar to the US green cards for qualified immigrants". A growing number of EU countries (including France, Ireland and the UK) have recently introduced programs aiming at attracting a qualified labor force (especially in the field of information, communication and technology - ICT) through the creation of labor-shortage occupation lists (see Lowell, 2002a). In Germany in February 2000, Chancelor Schröder announced plans to recruit additional specialists in the field of information technology. Green cards came into force in August 2001, giving German ICT-firms the opportunity to hire up to 20,000 non-EU ICT-specialists for a maximum of five years. More recently, the German Sübmuth Commission recommended

the introduction of a coherent flexible migration policy that allows for both temporary and permanent labor migrants (see Bauer and Kunze, 2004). In 2002, the French Ministry of Labor established a system to induce highly skilled workers from outside the EU to live and work in France. The current French government is taking decisions in favor of an "immigration choisie" instead of "immigration subie". The purpose is to reorient the structure of immigrants towards more skilled people. Given the apparent demographic problems and aging populations, the intensity of the brain drain could increase further during the next decades.

Many economists studied the possible impact of the brain drain on origin countries and inequality across nations. The early literature dates back to the 1960s and 1970s and supports the view that skilled migration is unambiguously detrimental for those left behind. The main argument is that migrants' contribution to the social return of their country of origin was greater than their private return. Such a negative effect has been reformulated in an endogenous growth framework. More recently, some channels through which the brain drain may positively affect the sending economy have also been presented in the literature. These include a range of "feedback effects" such as remittances, return migration after additional knowledge and skills have been acquired abroad, the creation of business and trade networks, and the effect on migration prospects on the expected return to education. The debates essentially remained theoretical. The reason is that, until recently and despite some anecdotal evidence, there were no reliable databases documenting the brain drain for a large set of countries and for different years.

Understanding and measuring all the mechanisms at work requires reliable data and empirical analysis. Fortunately, it is today possible to have a more accurate vision of the size and intensity of the brain drain thank to new harmonized and exhaustive data sets on migration stocks and rates by educational attainment. These data sets enable primary assessments of the theoretical mechanisms developed in the literature. The purpose of our paper is to offer a comprehensive and accurate picture of the brain drain and to provide an updated survey of existing empirical and theoretical studies.

In Section 2, we characterize the determinants, evolution and spatial distribution of the brain drain. Our analysis relies on Docquier and Marfouk (2006) who provide a comprehensive data set on international skilled emigration for 1990 and 2000. They count as skilled migrants all foreign-born individuals with tertiary education living in an OECD country. We also discuss alternative measures, which control for the age of entry (i.e. excluding the skilled foreign-born arrived before age 12, 18 or 22).[1] Finally, by comparing emigration rates of the tertiary skilled to medical brain drain rates, we show that these average skilled emigration rates may hide important shortages in developing countries.

In Section 3, we draw on theoretical and empirical studies to explain why the brain drain is a major issue of concern to origin countries. We first discuss the role of human capital in the new growth theory and survey the traditional literature on the negative effects of skilled emigration. The subsequent sub-sections provide discussions of the various channels through which the brain drain may positively impact on sending countries. These include remittances; return migration; skilled migrants' participation to business and scientific networks[2] ; ex-ante human capital investments and improved governance.

In the last Section, we put forward the need for additional macro and micro studies. In the light of the theoretical and empirical results above, we discuss the implications for migration, education, and taxation policies.

1. Immigrants who arrived before age 12, 18 or 22 are partly or totally educated in the host country.

2. This favors exchanges of goods, capital inflows (FDI) and knowledge spillovers between the migrants' home and host countries.

2. How important is the brain drain?

Many authors underlined the lack of harmonized and consistent data on international immigration stock in receiving countries. Recently, the IOM (2005, p. 141) notes “that the exact number of migrant living in Europe is still unknown. This is partly due to the fact that, in contrast to Australia, Canada, New Zealand and the US, many European countries, use nationality, not the place or country of birth, as the standard criterion in their demographic, economic and social statistics". In such context, it is not possible to differentiate between a person who is born in a foreign country and came to the host one afterward and another who is born in the host country but does not have the citizenship. The distinction is important when dealing with the brain drain because the education of the former was paid by the origin country while the education of the latter was paid by the host country. Similarly, the official statistics in countries of origin do not distinguish between the different categories of emigration; in particular by skill levels. This may pose problems to the understanding of the brain drain phenomena if emigrants' behavior differs according to the skill levels. This issue is examined in Section 2.1 which focuses on the determinants of immigration. It shows that immigration behavior indeed differs according to skill levels. To understand the brain drain phenomena, one should, therefore, collect immigration data according to skill levels. This induces methodological issues that are discussed in Section 2.2. Taking account of such issues, leads to accurate estimates of brain drain that are examined in Section 2.3. Finally, skilled workers' immigration may harm the origin country not only because of the loss of return to education but also because it worsens the shortage of some profession in that country. This is illustrated with the medical brain drain in Section 2.4.

2.1. The determinants of the brain drain

The intensity of the brain drain can be explained by many push/pull factors and by geographical, historical and linguistic distances between countries. A large empirical literature has examined the determinants of international migration flows in aggregated models disregarding the education level of migrants. For instance, Hatton and Williamson, (2002) pointed to the following factors as determinants of migration:

- The difference in income across countries.
- The share of population between 15 and 39 years old in the origin and host countries.
- The stock of immigrants
- The extent of poverty in the country of origin.

Based on the Docquier-Marfouk data set (see Sections 2.2 and 2.3), Marfouk (2006) recently used bilateral emigration data from 153 developing countries to 30 receiving countries in 2000 to estimate the determinants of bilateral emigration stocks. Many bilateral data are equal to zero. To account for this problem, the Tobit model is used[3].

Table 1 gives the elasticity of bilateral emigration rates to all explanatory variables, distinguishing low-skill, high-skill and all migrants. The main results are the following:

- High-skill workers are more affected by differences in terms of living standards. A ten percent increase in the

3. Some variables (e.g. consumption spending or number of immigrants) take only positive values. The methodology used to forecast their evolution should take account of this characteristic. Otherwise, one may obtain forecasted values that are negative. The Tobit method addresses this problem.

income per capita gap between receiving and sending countries results in an increase of high-skill emigration rate by 7.9%, to be compared with 4.5% for low-skill workers and with 6.5% for the average migrants.

- The effect of distance is negative for both skilled and unskilled workers, and the effect of distance squared is positive, i.e. the marginal effect of distance is decreasing.
- Past colonial links are important. The impact of this variable is more pronounced for unskilled workers.
- Skilled and unskilled emigration rate are inversely related to unemployment rate at destination. High-skilled migration is more affected by job opportunities at destination than low-skilled migration.
- The population in the receiving country is a proxy of the immigration capacity and of economic opportunity at destination. Related to the income effect, skilled workers are more sensitive to economic opportunities.
- Social welfare programs affect positively both skilled and unskilled migration.
- The size of young cohorts in the country of origin is an important factor that drives South-North migration.
- Importantly, more deaths in civil wars induce more emigration for both skilled and unskilled.

Table 1. Elasticity of the emigration rate (at the mean values)
Dependent variable = emigration rate (in percentage); Tobit regressions

	Low-skilleds	High-skilled	Total
GNI, PPP adjusted, per capita "destination/origin" ratio	0.4490**	0.7876**	0.6476**
	-2.94	-5.29	-4.41
GNI, PPP adjusted (origin), 1000	0.9182**	1.1537**	1.1049**
	-4.49	-5.78	-5.61
GNI, PPP adjusted, (origin), 1000, squared	-0.2571**	-0.3267**	-0.3090**
	-3.66	-4.77	-4.56
Geographic distance (origin-destination), 1000 kms	-1.4607**	-1.2108**	-1.4648**
	-8.12	-6.85	-8.43
Geographic distance (origin-destination), 1000 kms squ.	0.4487**	0.1818	0.3987**
	-4.42	-1.81	-4.08
Former colonial ties	0.0631**	0.0404**	0.0316**
	-13.75	-9.19	-7.2
Linguistic proximity	-0.0016	0.0838**	0.0458**
	-0.14	-7.79	-4.28
Population (destination), in log	3.6510**	5.4343**	4.5875**
	-10.49	-15.56	-13.42
Unemployment rate (destination), in percent	-0.2697**	-0.3287**	-0.2574**
	-4.5	-5.6	-4.49
Level of diversity (destination)	0.1956**	0.1900**	0.2087**
	-3.87	-3.85	-4.27
Public social expenditures, (destination), in percent of GDP	1.3086**	1.1997**	1.0912**
	-10.03	-9.33	-8.65
Immigration policy (EU15)	-0.1515**	-0.2157**	-0.1846**
	-3.99	-5.74	-5
Immigration policy (CAN, AUS, NEZ, USA)	0.1082**	0.1753**	0.1287**
	-6.8	-11.21	-8.4
Religious fractionalization (origin)	0.0712	0.1328**	0.1094*
	-1.42	-2.7	-2.25
Population 15-29 (origin), in percent of the total population	1.4877**	1.5974**	2.3277**
	-6.12	-6.68	-9.97
Civil wars (origin) - battle deaths	0.0167**	0.0149**	0.1324*
	-2.55	-2.32	-2.08

*Numbers between brackets are the absolute values of the t-ratios; ** significant at 1%; *significant at 5%.*

Source: Marfouk (2006)

- Linguistic proximity is significant only for high-skill migrants. The explication is that the skills acquired prior to migration are more transferable to the destination countries sharing the same language.
- Finally, the EU immigration policy discourages both high-skill and low-skill emigration. The elasticity is particularly negative for the skilled. In contrast, the four traditional immigration nations (Australia, Canada, New Zealand, and the United States) favor all types of immigration but mainly skilled immigration.

These regressions show that the determinants of migration vary across education group. A global regression without education distinction then hides a very strong heterogeneity. All these results have important policy implications. Host countries' policy affects, in general, only the immigrant destination choice but not the willingness to immigrate according to the skill level. The resulting change in the skill composition of immigration is likely to be smaller than expected.

2.2. Measuring the brain drain: methodology issues

Controlling for the education level

The first and obvious methodology issue that one should deal with is the distinguish migrants according to the education level. The first serious effort to put together an harmonized international dataset on migration rates by education level is due to Carrington and Detragiache (1998, 1999) from the International Monetary Fund, who used US 1990 Census data and other OECD statistics on international migration to construct estimates of emigration rates at three education levels (primary, secondary and tertiary schooling) for about 60 developing countries.[4]

Although Carrington and Detragiache's (1998) study clearly initiated new debates on skilled migration, their estimates suffer from a number of limitations. In particular: i) they transposed the education structure of the US immigration to the immigration to the other OECD countries (transposition problem); ii) immigration to EU countries was estimated based on statistics reporting the number of immigrants for the major emigration countries only, which led to underestimate immigration from small countries (under reporting problem); iii) no distinction was made between immigrants arriving as children and immigrants arriving as young adults or older with source country education background, and, iv) due to lack of data, South-South migration was not taken into account which may overestimate migration from South to North.

Generalizing their work, Docquier and Marfouk (2006) provide a comprehensive dataset on international skilled emigration. The construction of the database relies on two steps: i) collection of Census and register information on the structure of immigration in all OECD countries (this solves the transposition and under reporting problems noted for Carrington Detragiache); summing up over source countries allows for evaluating the stock of immigrants from any given sending country to the OECD area by education level, and ii) the educational structure of emigration is then compared to that of the population remaining at home, which allows for computing emigration rates by educational attainment in 1990 and 2000. A similar work can be found in Dumont and Lemaître (2005).

Controlling for the age of entry

Counting all foreign born individuals as immigrants independently of their age at arrival, both Carrington-Detragiache and Docquier-Marfouk data sets do not distinguish between 'family' and 'personal' migration. Some of the skilled foreign-born obviously migrated at very young age and had their education in the receiving country. As illustrated by Rosenzweig

4. The emigration rate by skill levels from country i at time t is defined as the ratio of emigrants ($EM^s_{i,t}$) to natives, i.e. residents ($N^s_{i,t}$) and emigrants ($EM^s_{i,t}$): $m^s_{i,t} = \frac{EM^s_{i,t}}{N^s_{i,t} + EM^s_{i,t}}$, where s stands for the skill level (e.g. high or low).

(2005) using US data, children migration represents an important fraction of migrants for a couple of countries. Should those who came at young age be considered as skilled migrants? Where should we put the frontier?

Beine, Docquier and Rapoport (2006) provide alternative measures of the brain drain by defining skilled immigrants as those arrived in the receiving country after age 12, 18 or 22. They use data on age of entry collected in a sample of OECD countries and then econometrically estimate the age-of-entry structure in the remaining host countries. The countries where such information is available represent 77 percent of total skilled immigration to the OECD area.

2.3. How big is the brain drain?

Controlling for the education level

Table 2 summarizes the data from Docquier and Marfouk (2006) for different country groups in 2000. Countries are grouped according to demographic size, average income (using the World Bank classification), and region. As expected, we obtain a decreasing relationship between emigration rates and country size, with average emigration rates about 7 times higher for small countries (with population lower than 2.5 million) than for large countries (with population higher than 25 million). From the last two columns, we can see that these differences cannot be attributed to the educational structure of the home country population or to a higher 'selection bias' (ratio of skilled to total emigration rates) in small countries. Small countries simply tend to be more open to migration.

Regarding income groups, the highest emigration rates are observed in middle income countries where people have both the incentives and means to emigrate. High income countries (low incentives) and low income countries (where liquidity constraints are likely to be more binding) exhibit the lowest rates.[5] The global picture is therefore that of an inverted U-shaped relationship between income levels and (skilled) migration.

Such an assertion should be econometrically tested as it is strongly dependent on the group composition in terms of country size. Regarding the regional distribution of the brain drain, the most affected regions are the Caribbean and the Pacific, which consist of relatively small islands, and Sub Saharan and Central American countries. The difference between skilled and total emigration rates is especially strong in Africa.

Docquier, Lohest and Marfouk (2005) analyze the impact of the EU15 (European Union with 15 members) on the international mobility of skilled workers. Compared to other OECD countries, the average skills of EU15 immigrants are low. However, by attracting an important proportion of African migrants, the EU15 plays an important role in the brain drain debate. The EU15 is an important source of brain drain for countries which are strongly concerned by human capital shortages. Regarding exchanges of skilled workers with the other traditional immigration countries, the EU15 experiences a large deficit. This deficit is compensated by importing human capital from developing countries. Figure 1 illustrates this impact of the EU immigration on the losses of human capital in developing countries by comparing country-specific skilled emigration rates (X-axis) and the European contribution in these losses, measured as the share of the EU15 in the brain drain (Y-axis). We consider that the EU15 contribution is high (respectively very high) when the share of skilled emigrants living in the EU15 exceeds the share of the EU15 (respectively twice the share of the EU15) in the total OECD population. Similarly, we consider that countries suffering from the brain drain are those experiencing a loss higher than 30 percent; that is countries on the right of the

5. In this context, liquidity constraints play a role similar to the one in the Life-Cycle/Permanent-Income literature. In the absence of liquidity constraints (which is a form of capital market imperfections), a person whose return to education is higher than the cost of education can educate itself even if it lacks the financial resources to do so. It can borrow on the capital market to finance its education and reimburse once it gets the return. If capital market is imperfect, the person can not borrow and, hence, can not educate itself because of liquidity constraints.

Table 2. Data by country group in 2000

	% of world pop.	% of OECD immigration stock		Rate of emigration			Share of skilled workers	
By country size	**in %**	**Total**	**Skilled**	**Total**	**Skilled**	**Selection bias**	**In residents**	**In migrants**
Large countries (Pop>25 million)	84.2%	60.6%	63.9%	1.3%	4.1%	3.144	11.3%	36.4%
Upper-Middle (25>Pop>10)	10.0%	15.8%	15.2%	3.1%	8.8%	2.839	11.0%	33.2%
Lower-Middle (10>Pop>2.5)	5.2%	16.4%	15.7%	5.8%	13.5%	2.338	13.0%	33.1%
Small countries (Pop<2.5)	0.6%	3.7%	3.7%	10.3%	27.5%	2.666	10.5%	34.7%
By income group	**in %**	**Total**	**Skilled**	**Total**	**Skilled**	**Selection bias**	**In residents**	**In migrants**
High Income countries	16.0%	30.4%	33.7%	2.8%	3.5%	1.238	30.7%	38.3%
Upper-Middle Income countries	10.3%	24.3%	17.7%	4.2%	7.9%	1.867	13.0%	25.2%
Lower-Middle Income countries	15.6%	26.6%	27.2%	3.2%	7.6%	2.383	14.2%	35.4%
Low Income countries	58.1%	15.1%	19.8%	0.5%	6.1%	12.120	3.5%	45.1%
By region	**in %**	**Total**	**Skilled**	**Total**	**Skilled**	**Selection bias**	**In residents**	**In migrants**
AMERICA	13.6%	27.2%	22.9%	3.3%	3.3%	1.002	29.6%	29.7%
- USA and Canada	5.2%	2.9%	4.7%	0.8%	0.9%	1.127	51.3%	57.9%
- Caribbean	0.5%	5.3%	5.8%	15.3%	42.8%	2.807	9.3%	38.6%
- Central America	2.2%	14.2%	6.7%	11.9%	16.9%	1.418	11.1%	16.6%
- South America	5.7%	4.9%	5.7%	1.6%	5.1%	3.219	12.3%	41.2%
EUROPE	11.9%	37.0%	33.3%	4.1%	7.0%	1.717	17.9%	31.7%
- Eastern Europe	5.0%	8.1%	7.9%	2.2%	4.3%	1.930	17.4%	34.2%
- Rest of Europe	6.9%	28.9%	25.4%	5.2%	8.6%	1.637	18.3%	31.0%
incl. EU15	6.2%	23.8%	21.9%	4.8%	8.1%	1.685	18.6%	32.5%
incl. EU25	7.4%	28.5%	26.5%	4.9%	8.7%	1.789	17.6%	32.8%
AFRICA	13.1%	7.9%	6.9%	1.5%	10.4%	7.031	4.0%	30.9%
- Northern Africa	2.8%	4.0%	2.2%	2.9%	7.3%	2.489	7.5%	19.6%
- Sub-Saharan Africa	10.3%	3.9%	4.7%	1.0%	13.1%	13.287	2.8%	42.5%
ASIA	60.8%	26.4%	35.1%	0.8%	5.5%	7.123	6.3%	46.8%
- Eastern Asia	24.7%	7.3%	11.5%	0.5%	3.9%	8.544	6.3%	55.5%
- South-central Asia	24.4%	6.3%	9.3%	0.5%	5.3%	10.030	5.0%	52.5%
- South-eastern Asia	8.5%	7.3%	10.6%	1.6%	9.8%	5.980	7.9%	51.4%
- Near and Middle East	3.2%	5.5%	3.6%	3.5%	6.9%	1.937	11.4%	22.9%
OCEANIA	0.5%	1.4%	1.8%	4.3%	6.8%	1.578	27.8%	45.0%
- Australia and New Zealand	0.4%	1.0%	1.4%	3.7%	5.4%	1.479	32.7%	49.2%
- Other Pacific countries	0.1%	0.4%	0.4%	7.6%	48.7%	6.391	3.1%	35.2%

Source: Docquier and Marfouk (2006)

vertical bold line in Figure 1. We observe that the EU15 contribution is high in 75 cases, and very high in 20 cases. Some of these countries are strongly affected by the brain drain (The Gambia, Cyprus, Cape Verde, Sierra Leone, Mauritius, Seychelles, Malta, Ghana, Somalia, Uganda, Kenya). The EU15 is the main source of human capital flight from Suriname, Mozambique, Angola, Sao Tome et Principe, Republic of Congo, Guinea-Bissau, Togo or Comoros).

It is important to ask whether the brain drain problem is more serious than a couple of decades ago. Certainly, during the 1990s, the brain drain has increased in magnitude as part of the general movement towards economic globalization. This is reflected, for example, by the fact that the stock of highly skilled immigrants residing in the OECD area has been multiplied by 1.7 between 1990 and 2000 against only 1.3 for unskilled immigrants (Docquier and Marfouk, 2006). However, the last decade is also characterized by a drastic rise in educational attainment all over the world. Consequently, we observed a slight increase in the rate of skilled migration over the last decade (from 5.0 to 5.4 percent). Is this still true if we take a longer time horizon and compare the current situation, say, to that prevailing in 1975?

Figure 1. Contribution of the EU15 in the international brain drain

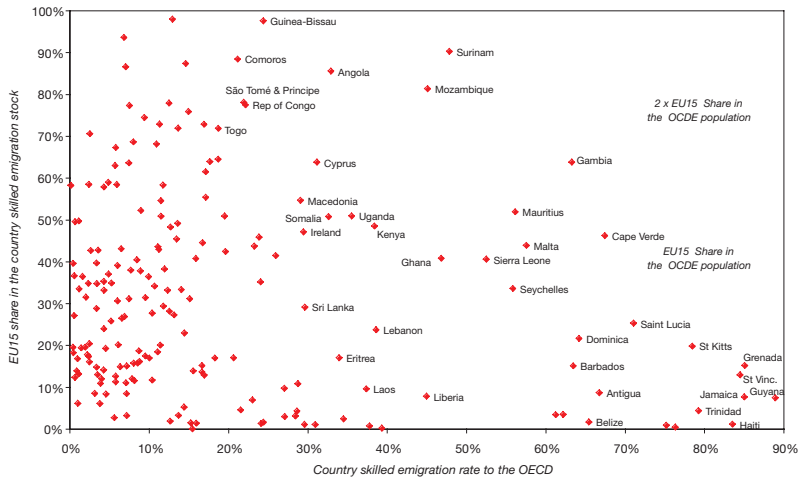
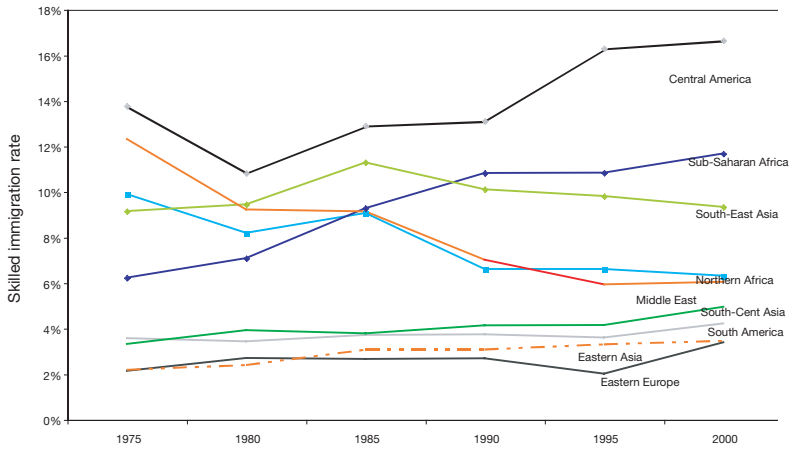


Figure 2. Long-run trends in skilled emigration



Focusing on the six major destination countries (USA, Canada, Australia, Germany, UK and France), Defoort and Docquier (2005) have computed skilled emigration stocks and rates from 1975 to 2000 (one observation every 5 years). Figure 2 presents skilled emigration rates by region using this longer perspective. At the world level, the average skilled migration rate has been rather stable over the period. As argued above, this apparent stability is the product of two opposing forces: on the one hand, the number of skilled migrants has increased in all regions; and on the other hand, there is a general progress in educational attainments in all parts of the world.

We observe that some regions have experienced an increase in the intensity of the brain drain (Central America, Eastern Europe, South Central Asia and Sub Saharan Africa) while significant decreases were observed in other regions (notably the Middle East and North Africa).

Controlling for the age of entry

Section 2.2 emphasized the importance of controlling for the age of entry to get a better estimate of the brain drain. To address this issue, Beine, Docquier and Rapoport (2006) focused on skilled immigrants that arrived in the receiving country after age 12, 18 or 22. These are skilled immigrants who have been educated in the origin country. Their number is lower than the total skilled immigrants, which include also those who have been educated in the receiving country because, for instance, they arrived at age 5 or 8. Such a correction gives a better idea of the investment in human capital "lost" by the origin country. The results give "corrected" brain drain rates that are, indeed, below the global rates calculated by Docquier and Marfouk (2006). For example, the average brain drain computed on those arrived after age 22 represents 73 percent of the global brain drain. Nevertheless, the correlation coefficient between global rates and corrected rates (12+, 18+ and 22+) are respectively 99.7, 99.3 and 98.7 percent. Cross-country differences are well maintained in the corrected data sets. To illustrate this result, Table 3 gives the stock and rates of skilled migration in the 30 most affected countries.

Column 1 shows that, in terms of magnitude, the main international suppliers of brains are the Philippines (1.126 million), India (1.037 million), Mexico (0.923 million) and China (0.816 million). Note that the UK (1.441 million) and Germany (0.848 million) complete the top of the list. In terms of intensity, small countries are obviously most affected. In column 2, skilled emigration rates exceed 80 per cent in Latin American countries such as Guyana, Jamaica or Haiti, and are higher than 50 per cent in small African countries. Counting migrants arrived in the host country after age 22 reduces the brain drain by about 10 percentage points. However, the country ranks are well preserved.

The right part of the table focuses on countries where the population exceeds 4 million. Columns 4 to 7 compare the alternative measures of brain drain computed by Beine, Docquier and Rapoport. The top of the list mainly includes middle sized countries from all regions: Africa (Sierra Leone, Ghana, Mozambique, Kenya), Central America (Haiti, El Salvador, Nicaragua, Cuba), South and South Eastern Asia (Laos, Sri Lanka, Hong Kong, Vietnam), and also Europe (Portugal, Slovakia, and the UK)

Table 3. Top-30 most affected countries :

Full sample						Sub-sample (Population > 4 Million)							
Stock of skilled emigrants		Skilled emig. Rate - All		Skilled emig. rate - 22+		Skilled emig.rate - All		Skilled emig.rate - 12+		Skilled emig.rate - 18+		Skilled emig.rate - 22+	
United Kingdom	1441307	Guyana	89.0%	Guyana	81.5%	Haiti	83.6%	Haiti	81.9%	Haiti	78.3%	Haiti	73.6%
Philippines	1126260	Grenada	85.1%	Grenada	76.1%	Sierra Leone	52.5%	Sierra Leone	49.2%	Sierra Leone	46.7%	Sierra Leone	42.6%
India	1037626	Jamaica	85.1%	St Vinc & Grens	74.1%	Ghana	46.8%	Ghana	43.6%	Ghana	41.4%	Ghana	38.3%
Mexico	922964	St Vinc & Gren	84.5%	Jamaica	73.9%	Mozambique	45.1%	Mozambique	38.0%	Mozambique	34.0%	Mozambique	30.1%
Germany	848414	Haiti	83.6%	Haiti	73.6%	Kenya	38.4%	Kenya	33.1%	Kenya	29.8%	Somalia	26.3%
China	816824	Trinidad Tobago	79.3%	Trinidad Tobago	67.3%	Laos	37.4%	Somalia	30.4%	Somalia	28.5%	Kenya	25.9%
Korea	652894	Saint Kitts Nevis	78.5%	Saint Kitts Nevis	63.9%	Uganda	35.6%	Uganda	29.9%	Uganda	26.8%	Uganda	23.3%
Canada	516471	Samoa	76.4%	Samoa	59.9%	Angola	33.0%	Laos	29.6%	Laos	24.6%	Sri Lanka	22.4%
Vietnam	506449	Tonga	75.2%	Tonga	57.7%	Somalia	32.6%	El Salvador	28.0%	Sri Lanka	24.4%	Rwanda	21.3%
Poland	449059	Saint Lucia	71.1%	Saint Lucia	57.3%	El Salvador	31.0%	Nicaragua	27.1%	Angola	23.7%	Laos	20.9%
United States	431330	Cape Verde	67.4%	Cape Verde	54.3%	Sri Lanka	29.6%	Angola	26.9%	Rwanda	23.2%	Angola	20.6%
Italy	408287	Antigua Barbuda	66.8%	Gambia, The	52.0%	Nicaragua	29.6%	Sri Lanka	26.5%	El Salvador	23.1%	Afghanistan	19.9%
Cuba	332673	Belize	65.5%	Dominica	49.5%	Hong Kong	28.8%	Hong Kong	24.6%	Nicaragua	22.5%	Croatia	19.1%
France	312494	Dominica	64.2%	Antigua Barbuda	48.9%	Cuba	28.7%	Rwanda	24.4%	Afghanistan	21.2%	Nicaragua	19.0%
Iran	308754	Barbados	63.5%	Barbados	47.0%	Papua N. Guinea	28.5%	Vietnam	23.0%	Croatia	20.7%	Hong Kong	17.6%
Jamaica	291166	Gambia, The	63.2%	Suriname	46.5%	Vietnam	27.1%	Afghanistan	22.5%	Hong Kong	20.6%	El Salvador	17.5%
Hong Kong	290482	Fiji	62.2%	Belize	45.3%	Rwanda	25.8%	Cuba	22.4%	Vietnam	18.7%	Cuba	16.6%
Russia	289090	Bahamas, The	61.3%	Fiji	43.8%	Honduras	24.4%	Papua N. Guinea	22.0%	Honduras	18.7%	Papua N. Guinea	15.6%
Taiwan	275251	Malta	57.6%	Seychelles	43.3%	Guatemala	24.2%	Honduras	22.0%	Cuba	18.6%	Vietnam	15.0%
Japan	268925	Mauritius	56.1%	Sierra Leone	42.6%	Croatia	24.1%	Croatia	22.0%	Papua N. Guinea	18.5%	Honduras	15.0%
Netherlands	256762	Seychelles	55.8%	Mauritius	42.4%	Afghanistan	23.3%	Guatemala	21.6%	Guatemala	18.2%	Guatemala	13.8%
Ukraine	246218	Sierra Leone	52.5%	Malta	42.0%	Dominican Rep.	21.6%	Dominican Rep.	19.2%	Togo	16.1%	Togo	13.8%
Colombia	233536	Suriname	47.9%	Bahamas, The	41.0%	Portugal	19.5%	Togo	17.4%	Dominican Rep.	15.6%	Portugal	12.7%
Pakistan	222372	Ghana	46.8%	Ghana	38.3%	Togo	18.7%	Portugal	16.0%	Cameroon	14.4%	Dominican Rep.	12.7%
Ireland	209156	Mozambique	45.1%	Liberia	37.4%	Malawi	18.7%	Cameroon	15.4%	Portugal	14.3%	Senegal	12.1%
Romania	176393	Liberia	45.0%	Mozambique	30.1%	Cambodia	18.3%	Senegal	15.2%	Senegal	13.7%	Cameroon	11.8%
Turkey	174043	Marshall Islands	39.4%	Marshall Islands	29.3%	Senegal	17.7%	Slovakia	15.1%	Slovakia	13.2%	Serbia Mont.	11.8%
Brazil	168308	Lebanon	38.6%	Lebanon	26.9%	Cameroon	17.2%	Malawi	14.7%	United Kingdom	13.0%	United Kingdom	11.6%
South Africa	168083	Kenya	38.4%	Somalia	26.3%	Morocco	17.0%	Cambodia	14.7%	Morocco	12.9%	Morocco	11.4%
Peru	163750	Micronesia F.S.	37.8%	Eritrea	25.9%	Zambia	16.8%	Morocco	14.3%	Malawi	12.5%	Poland	11.1%

2.4. Emigration by occupation - medical brain drain

General emigration rates may hide important shortages in some occupations. In many poor countries, shortages are particularly severe in the medical sector where the number of physicians per 1000 inhabitants is far below the acceptable threshold of 2 defined by the World Health Organization. The brain drain of physicians and nurses to countries such as the US, Australia, Canada and the UK is one of the multiple causes of shortage. For instance, Faini (2006) reported that Jamaica had to train five doctors to retain just one, Grenada 22. To illustrate this phenomenon, we have collected data on doctors with foreign qualification working in the 17 main OECD countries. Aggregating these data and comparing them to the total number of doctors who qualified in their country, we have computed medical emigration rates for all the world countries. Figure 3 gives the rate observed in the 25 most affected countries. It shows that small countries are strongly affected, including some industrialized countries with efficient education systems (Ireland, Luxemburg). Among the 25 most affected countries, we have 11 African countries (Cape Verde, Sao Tome and Principe, Liberia, Ethiopia, Somalia, Ghana, Uganda, Malawi, Zimbabwe, Gambia, South-Africa) where the health care staff is lacking.

Figure 4 presents the relationship between medical and general brain drain. We see that the correlation coefficient between the medical brain drain and the general brain drain is about 41 percent.[6] Moreover, the elasticity of medical brain drain to general brain drain amounts to 46 percent. This means that when the general brain drain increases by 100% the medical brain drain increases by 46%. However, many observations are far from the general trend. Despite moderate general rate of skilled migration, some countries suffer from a strong medical brain drain.

Figure 3. Rate of medical brain drain - 25 most affected countries in 1990 and 2000

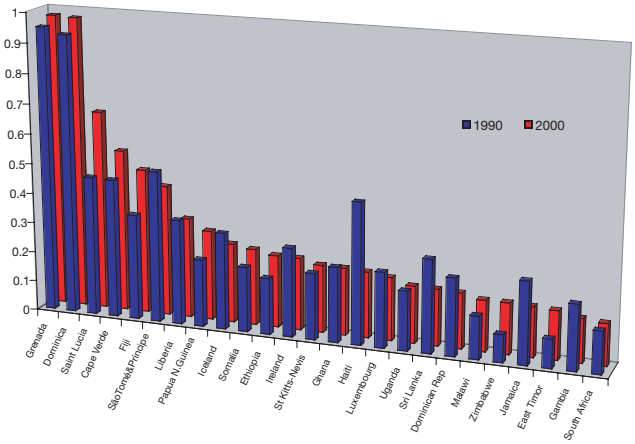
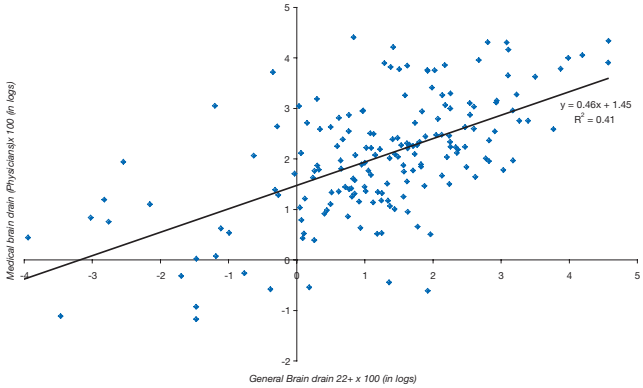


Figure 4. Medical and general brain drain



6. The correlation coefficient gives the percentage of the evolution of a given variable (in our case this is the medical brain drain) that is associated with the evolution of another variable (in our case this the general brain drain). A coefficient equal to 0 implies no association while a coefficient of 1 implies a complete association. The reported coefficient implies that 41% of the medical brain drain is associated with the general brain drain phenomena.

3. Should we eliminate the brain drain?

As described in Section 1, early research supported the view that skilled migration is unambiguously detrimental for those left behind. In contrast, more recent research argues that the brain drain may positively affect the sending economy. This section offers a non technical discussion of the debate and summarizes the existing empirical evidence. It starts with a discussion (Section 3.1) of the relationship between the brain drain, human capital and growth which provides a general framework for the debate. It then examines separately each of the main mechanisms at play. These include the impact on human capital formation (Section 3.2), the role of remittances (Section 3.3), the impact of return migration (Section 3.4), the effects of diaspora externalities (Section 3.5) and the impact on governance and corruption (Section 3.6). The latter constitutes a very recent development in the literature and examines whether brain drain incites the country of origin to improve its institutional framework and governance.

3.1 Brain drain, human capital and growth

As generations of economists and other social scientists have argued, the emigration of the most talented workers is likely to reduce the average level of human capital of the labor force. All other things equal, such a decrease in human capital has a direct negative impact on output per capita. By increasing the marginal productivity of human capital, it also induces redistributive effects from the low-skill to the high-skill workers. In the medium and long-run, a decrease in human capital seriously affects the country capacity to innovate and adopt modern technologies. Hence, the brain drain impacts negatively on growth.

Interestingly, in the 1960s the economic literature (for example, Grubel and Scott 1966, Johnson 1967) had a tendency to downplay the negative externalities imposed on those left behind (Grubel and Scott even termed them 'negligible') and insisted on the role of remittances and other potential positive feedbacks. With standard trade theoretic frameworks in mind, this literature generally emphasized the welfare gains from free migration at a global level and rejected concerns about negative static and dynamic effects of the brain drain on the ground that they were inspired by 'nationalistic' and 'outdated' views. During the 1970s, a series of models (for example, Bhagwati and Hamada 1974, McCullock and Yellen 1975, 1977) based on more realistic institutional settings (domestic labor markets rigidities, imperfect information, technological complementarities between skilled and unskilled labor, etc.) were then developed to emphasize instead the negative consequences of highly skilled emigration for developing countries. They supported that the brain drain is a negative externality imposed on those left behind and that the game is of a zero sum type; with the rich countries getting richer and the poor countries getting poorer. From a policy perspective, they ask the international community to implement a mechanism whereby international transfers could compensate the origin countries for the losses incurred. This may take the form of an income 'tax on brains' (known as 'Bhagwati Tax') to be redistributed internationally.

Bhagwati and Hamada (1974) developed an interesting model in which the increasing international integration of the market for skilled workers induces a loss for the poor countries. They did not use the externality argument presented in the previous section but assumed that educated elites bargain for

high wages. A higher integration of the skilled labor market makes international skilled wages observable and induces the educated elite to bargain for higher wages. Unskilled workers adjust their wage requirements on skilled wages. Hence, the higher integration of the skilled labor market generates some leapfrogging effects on low wages. In conclusion, although skilled emigration reduces unemployment of the educated and stimulates education, it also yields two detrimental responses: higher public education expenditures and taxes; higher wages and unemployment of the uneducated. On the whole, Bhagwati and Hamada derive the conditions under which integration induces a decrease in per capita income in poor countries.

Modern theories of endogenous growth have considerably renewed the analysis of the relationships between education, migration and growth. Unsurprisingly, the first models to address the issue of the brain drain in an endogenous growth framework also emphasized its negative effects (e.g., Miyagiwa, 1991, Haque and Kim, 1995). Some of the models emphasized shortages in specific knowledge field that can be strongly harmful for developing countries. Lucas (2004), focusing on the choice of major field of study (medicine, nursing, maritime training) among Filipino students, reported that their choice responds more to shifts in international demand than to national needs. When foreign and national countries have different needs, the perspective of migration can lead to important shortages in some sectors.

Specific shortages can be strongly harmful for developing countries. Remind that the space shuttle Challenger exploded because of malfunctioning of small components called O-rings. This illustrates the strong complementarity of different components and inputs of a production process. Kremer (1993) proposed such an "O-ring theory" of economic development in which the production process consists of a series of tasks. Deficiencies in any of those tasks can lead to substantial reduction in the value of output. In an attempt to transpose this O-ring theory to the brain drain issue, suppose that human capital H_t consists of a series of necessary and heterogeneous skills k (engineers, doctors, nurses, teachers, economists, etc.)

$$H_t = \prod_k H_{k,t}^{a_k}$$

where a_k is a parameter denoting the importance of skill-specialization k in the aggregate stock of human capital; $H_{k,t}$ is the proportion of worker with skill k ; H_t is the aggregated stock of "efficient" human capital.

If one component $H_{k,t}$ falls to zero, the aggregate stock also tends to zero. In other words, sector's shortages cause a substantial reduction of efficient level of human capital and in output per capita. This effect can be reinforced by the fact that individual governments have less incentive to provide internationally applicable education when graduates leave their country. Poutvaara (2004) addresses this important issue in a theoretical model where the possibility of a brain drain distorts the provision of public education away from internationally applicable education towards country-specific skills. Country-specific skills may include both tertiary education with national emphasis, like degrees in law and certain humanities, and also secondary education which is less mobile. Correspondingly, internationally applicable education may include, in addition to science-based, commercial and other internationally applicable degrees in tertiary education, those held in secondary education (like nurses) which are internationally mobile. In order to avoid the loss of a part of its investment in human capital, the government has the incentive to offer more education which is national specific (e.g. law) than education that can be valued abroad (e.g. science or commercial). At the end, this means educating too few engineers, economists and nurses and doctors, and too many lawyers. Poutvaara shows that such an outcome could be avoided by introducing graduate taxes or income-contingent loans, collected also from migrants. By giving the providers of internationally applicable education a stake also in efficiency gains earned elsewhere, graduate taxes would encourage sending countries to invest more in internationally applicable education.

The negative impact of the brain drain on the country of origin reported in the above studies is closely linked to specific assumptions that are "(i) Migrants self-selected themselves out of the general population, (ii) There is free international mobility of skilled labor and, hence, no uncertainty regarding future migration opportunities for the educated and, (iii) There is a complete disconnection between emigrants and their country of origin once they have left. Is such conditions, clearly,

skilled emigration can only affect negatively the proportion of educated in the remaining population." (Docquier and Rapoport, 2004; p. 9). The following sections examine how relaxing such assumptions may mitigate the negative impact or even reveal a positive impact of the brain drain on the country of origin.

3.2. Ex-ante human capital formation

Before 1965, the US immigration policy was based on country-specific quotas. This quota system is now abolished but various types of requirements and restrictions imposed by the US and other country's immigration authorities render the migration decision very uncertain. Implicit or explicit size-quotas are effectively in place, and receiving an immigration visa, whether temporary or permanent, requires being in a close relationship either with relatives or employers who must then demonstrate that the migrant's skills can hardly be found among native workers. Moreover, in some countries, point-systems are used to evaluate the potential contribution of immigrants to the host economy. This means that at all stages of the immigration process, there is a probability that the migration project will have to be postponed or abandoned. Individuals engaging in education investments with the prospect of migration must therefore factor in this uncertainty, creating the possibility of a net gain for the source country.

Theoretical foundations

The conditions required for this possibility to materialize have been the subject of a number of theoretical contributions (Mountford, 1997, Stark et al., 1998, Vidal, 1998, Beine et al., 2001). These papers all develop probabilistic migration models in which the probability of migration depends solely on the achievement of a given educational requirement, which is observable, and not on individuals' ability, which is not perfectly observable (i.e., migrants are assumed to be randomly selected among those who satisfy some kind of prerequisite with informational content regarding their ability - in our case, education). They all suggest that since the return to education is higher abroad, migration prospects can raise the expected return to human capital and induce more people to invest in education at home. Note that Bhagwati and Hamada (1974), as well as McCulloch and Yellen (1977), take into account the incentive effects of the brain drain on education decisions, with the increase in the expected-wage for skilled workers stimulating human capital investments. In a context of probabilistic migration, it is possible under certain conditions detailed in these models that the incentive (or brain gain) effect dominates that of actual emigration, which creates the possibility of a net gain for the source country .[7] The crucial assumption is that skilled workers have a much higher probability to emigrate than unskilled workers. This hypothesis is strongly supported by Docquier and Marfouk's (2006) data which reveal that emigration propensities are five to ten times higher for workers with more than twelve years of education than for workers with less than twelve years of education.

Empirical evidence

What is the empirical evidence on this "prospect" channel? The first study to attempt at estimating the growth effects of the brain drain using cross-country comparisons is that of Beine, Docquier and Rapoport (2001); in a cross-section of 37 developing countries, and after controlling for remittances, they found that migration prospects have a positive and significant impact on human capital formation at origin, especially for countries with low initial GDP per capita levels. This was a first but imperfect try since they used gross migration rates as a proxy measure for the brain drain due to the lack of comparative data on international migration by education levels.

7. Using a slightly different perspective, Stark et al. (1997) elaborate on the possibility of a brain gain associated with a brain drain in a context of imperfect information with return migration. McCormick and Wahba (2000) also obtain the result that more highly-skilled migration may benefit those left behind, but in a trade-theoretic model where migration, remittances and domestic labor-market outcomes are jointly determined and multiple equilibria arise, with the high-migration equilibrium Pareto-dominating the low-migration equilibrium.

In a subsequent study, Beine et al. (2003) then used the Carrington-Detragiache estimates of emigration rates for the highest (tertiary) education as their measure of brain drain; after instrumenting, they again found a positive and highly significant effect of migration prospects on gross human capital formation, this time in a cross-section of 50 developing countries.[8] By contrast, Faini (2003) finds a depressing but not significant effect of tertiary emigration on domestic enrollment in higher education, a finding he attributes to the choice by would-be migrants to pursue

Table 4. **Brain drain and human capital in developing countries**
Counterfactual experiment: skilled emigration rate = unskilled emigration rate

	Labor Force (LFx1000)	Nb of skilled workers (Yx1000)	In % of the labor force (y=Y/LF)	Labor Force (LF'x1000)	N. of skilled workers (Y'x1000)	In % of the labor force (y'=Y'/LF')	Change in the nb. of skilled (Y-Y')	Change in % of (Y')	Change in the % of skilled (y-y')
By country size (in 2000)									
Large (>25 million)	2001110	97370	4.9%	2006533	93081	4.6%	4288	4.6%	0.2%
Large (>25 million)	2001110	97370	4.9%	2006533	93081	4.6%	4288	4.6%	0.2%
Upper-Middle (from 10 to 25)	181152	11968	6.6%	182472	12066	6.6%	-97	-0.8%	0.0%
Lower-Middle (from 2.5 to 10)	80638	6525	8.1%	81752	7104	8.7%	-578	-8.1%	-0.6%
Small (<2.5 million)	10026	632	6.3%	10419	946	9.1%	-313	-33.1%	-2.8%
By Income Group (in 2000)									
Upper-Middle	244175	26917	11.0%	245441	26064	10.6%	853	3.3%	0.4%
Lower-Middle	274867	29990	10.9%	278272	30356	10.9%	-367	-1.2%	0.0%
Low-Income	1753884	59589	3.4%	1757464	56776	3.2%	2813	5.0%	0.2%
Least Developed	278320	6801	2.4%	279192	6939	2.5%	-137	-2.0%	0.0%
By region									
- China	759550	20508	2.7%	760291	19067	2.5%	1441	7.6%	0.2%
- India	480422	23060	4.8%	481364	21547	4.5%	1514	7.0%	0.3%
- Indonesia	103980	5199	5.0%	104079	4748	4.6%	451	9.5%	0.4%
- Turkey	33130	2816	8.5%	33134	2757	8.3%	59	2.1%	0.2%
- Other Middle East	62404	5494	8.8%	62964	5478	8.7%	16	0.3%	0.1%
- Other Asian	344538	23927	6.9%	347308	24045	6.9%	-118	-0.5%	0.0%
ASIA	1721620	75510	4.4%	1726177	72163	4.2%	3347	4.6%	0.2%
- Egypt	29266	3131	10.7%	29401	2929	10.0%	202	6.9%	0.7%
- Other Northern Africa	33560	2264	6.7%	33722	2322	6.9%	-58	-2.5%	-0.1%
- Nigeria	40174	1245	3.1%	40310	1247	3.1%	-2	-0.1%	0.0%
- South Africa	19914	2071	10.4%	20066	1997	10.0%	74	3.7%	0.4%
- Other Sub-Sahara	174178	3164	1.8%	174747	3387	1.9%	-222	-6.6%	-0.1%
- Sub-Saharan Africa	234266	6480	2.8%	235123	6630	2.8%	-150	-2.3%	-0.1%
AFRICA	296842	11870	4.0%	297995	11876	4.0%	-5	0.0%	0.0%
MENA	158360	13705	8.7%	159220	13486	8.5%	219	1.6%	0.2%
- Mexico	45226	5111	11.3%	45528	5290	11.6%	-180	-3.4%	-0.3%
- Carribbean	16577	1545	9.3%	17520	2304	13.1%	-759	-32.9%	-3.8%
- Other Central-America	14499	1498	10.3%	14833	1665	11.2%	-167	-10.0%	-0.9%
- Central America	76302	8154	10.7%	77882	9259	11.9%	-1105	-11.9%	-1.2%
- Brazil	87063	7313	8.4%	87215	6688	7.7%	625	9.3%	0.7%
- Argentina	20151	3970	19.7%	20241	3678	18.2%	292	7.9%	1.5%
- Other South-America	53887	7410	13.8%	54473	7232	13.3%	177	2.5%	0.5%
- South America	161101	18693	11.6%	161929	17598	10.9%	1095	6.2%	0.7%
LATIN AMERICA	237403	26846	11.3%	239811	26856	11.2%	-10	0.0%	0.1%
TOTAL	2272926	116495	5.1%	2281177	113196	5.0%	3299	2.9%	0.2%

Source: Beine, Docquier and Rapoport (2006)

8. With a coefficient of about 0.05, that is, increasing migration by 10 percentage points increases gross human capital formation by half a percentage point. This is not negligible in countries where the proportion of highly educated typically lies in the 2-8% range. Note that the value of the migration coefficient proved to be quite stable

their studies abroad. As he acknowledges himself, however, these results must be taken with caution as they are based on enrollment data known to raise measurement problems.

Very recently, Beine et al. (2006) used Docquier and Marfouk's data and find evidence of a positive effect of skilled migration prospects on gross (pre-migration) human capital levels in a cross-section of 127 developing countries. More precisely they find that doubling the migration propensity of the highly-skilled induces a 5 percent increase in the proportion of highly-educated among the native population (residents and emigrants together). This is not negligible for countries where the average proportion of educated is typically between 5 and 10 percent. For each country and region, they estimate the net effect of the brain drain using counterfactual simulations (equating the skilled emigration rate to the unskilled rate). Table 4 summarizes their results. They find that countries combining relatively low levels of human capital and low skilled emigration rates are likely to experience a net gain, and conversely. There appears to be more losers than winners, and in addition the former tend to lose relatively more than what the latter gain. The situation of many small countries in Sub-Saharan Africa and Central America, in particular, is extremely worrisome. In contrast, the main globalizers (e.g., China, India, Brazil) all seem to experience relatively modest but non-negligible gains. It follows that the brain drain has important distributional effects among developing countries, a dimension that has so far been absent from policy debates.

3.3. Remittances

Migrants' remittances constitute an important channel through which the brain drain may generate positive indirect effects for source countries. It is well documented that workers' remittances often make a significant contribution to GNP and are a major source of income in many developing countries. According to the recent Global Economic Prospects of the World Bank (2006), recorded remittances to developing countries amounts to about $US 150 billion in 2004, roughly the same amount than foreign direct investments and about three times as large as the official development aid.

Remittances have a strong impact on poverty and economic activity. They impinge on households' decisions in terms of labor supply, investment, education (Hanson and Woodruff, 2003, Cox Edwards and Ureta, 2003), migration, occupational choice, and fertility, with potentially important aggregated effects. This is especially the case in poor countries where capital market imperfections (liquidity constraints) reduce the set of options available to members of low-income classes (see footnote 4).

Who are the main remitters?

The literature on migrants' remittances shows that the two main motivations to remit are altruism, on the one hand, and exchange, on the other hand. Altruism is primarily directed towards one's immediate family, and then decreases in intensity with social distance. By contrast, in principle, no such proximity is required in the case of exchange; the exchange-based theory of remittances posits that remittances simply "buy" various types of services such as taking care of the migrant's assets (e.g., land, cattle) or relatives (children, elderly parents) at home. Such transfers are typically observed in case of a temporary migration and signal the migrants' intention to return. A particular type of exchange takes place when remittances are de facto repayments of loans used to finance the migrants' investments in education and/or migration, with altruism and social norms and sanctions making the intergenerational contract self-enforcing.

Hence, it is a priori unclear whether educated migrants would remit more than their uneducated compatriots; the former may remit more because of higher income or to meet their implicit commitment to reimburse the family for funding of education investments, but on the other hand, educated migrants tend to emigrate with their family, on a more permanent basis, and are therefore less likely to remit (or are likely to remit less) than someone moving alone on a temporary basis. At an aggregate level, Faini (2006) shows that migrants' remittances decrease with the proportion of skilled individuals among the emigrants. He concludes: "this result suggests that the negative

impact of the brain drain cannot be counterbalanced by higher remittances".

This does not imply that remittances by skilled migrants are negligible, especially if the proportion of temporary migrants increases; for example, Kangasniemi et al. (2004) show that nearly half (45%) of Indian medical doctors working in the UK remit income to their home country and that remitters transfer on average 16% of their income.

Economic consequences

McCormick and Wahba (2000) obtain the result that highly-skilled migration may benefit to those left behind in a trade-theoretic model where migration, remittances and domestic labor-market outcomes are jointly determined and multiple equilibria arise, with the high-migration equilibrium Pareto-dominating the low-migration equilibrium. In another setting, Cinar and Docquier (2004) develop a stylized model where skilled emigrants altruistically remit part of their earnings to relatives in the source country. They assume that each remaining resident receives an identical amount of remittances (which depends on the proportion of migrants, the inter-country wage gap, and the altruistic rate) and characterize the transition path (i.e., the dynamics of transfers) and the long-run equilibrium of this economy.

In a recent book published by the World Bank, Adams (2006) finds that both internal and international remittances typically reduce the level, depths, and severity of poverty in Guatemala. The greater impact is on the severity of poverty, because households in the lowest decile group receive between 50 and 60 percent of their total income from remittances. Yang and Martinez (2006) confirm that result and show that an appreciation of currency in destination countries leads to an increase in remittances and to a reduction of poverty in the Philippines.

3.4. Return migration

As documented in international reports (e.g., OECD, 1998), most receiving countries have recently made admission conditions for candidate immigrants more restrictive. On the one hand, as detailed in the introduction, selective procedures have been put in place; on the other hand, most new specific immigration programs targeting the educated and skilled (for example, the H1 B visas in the U.S.) are designed for temporary immigrants, the general trend being towards an increase in the share of temporary visas relatively to permanent visas. Therefore candidate immigrants are allowed to spend only a fraction of their working life in the destination economy. Although the magnitude of return migration is badly known, the fact that migrants accumulate knowledge and financial capital in rich countries before spending the rest of their career in their origin country may generate beneficial effects on productivity and technology diffusion.

Consequences of return migration

Dos Santos and Postel-Vinay (2003) argue that a beneficial brain drain could emerge even if the share of educated workers decreases. This is shown in a setting where growth is exogenous at destination and endogenous at origin, with the sole engine of growth there being knowledge accumulation embodied in migrants returning from the more advanced country. Their caveat relies on knowledge diffusion, that is, on the idea that the more advance technology spillovers to the developing country as it is in a way carried out by returning migrants. To the extent that returnees contribute to the diffusion of the more advanced technology they experienced abroad, emigrants' return is therefore a potential source of growth for their home country.

In a similar paper, Dos Santos and Postel-Vinay (2004) show that a shift in immigration policy, with an increase in the share of temporary visas, may benefit to the sending countries of educated migrants. Two effects of the proposed shift in immigration policy are described: a decrease in the incentives to acquire education, which reduces the pre-migration stock of human capital at origin, and a higher proportion of returnees among emigrants, which increases the country's stock of knowledge, a complement of human

capital. Their paper derives the theoretical conditions required for an overall positive effect to occur.

Using a different perspective, Stark et al. (1997) elaborate on the possibility of a brain gain associated with a brain drain in a context of imperfect information with return migration. In their setting, workers' productivity is revealed at destination only after a certain period of time during which people are paid according to the average productivity of their group. Some relatively low-skill workers will therefore find it beneficial to invest in education so as to migrate and be pooled at destination with high-skill workers; once individuals' ability are revealed, the low-skill workers return to their home country, which may therefore benefit from their educational investments.

The above discussion illustrates circumstances where return migration can mitigate the negative impact of the brain drain. Much of the evidence concerning return migration concerns low-skill workers. Empirical results pertaining to different countries (e.g. Mesnard, 2004, and Mesnard and Ravallion (2001) for Tunisia, Dustmann and Kirchkamp (2002) for Turkey, Ilahi (1999) for Pakistan, Woodruff and Zenteno (2001) for Mexico, or McCormick and Wahba (2001) for Egypt) confirm that low-skill workers migrate with the aim of accumulating enough savings so as to access to self-employment and entrepreneurship. McCormick and Wahba (2001) offers useful insights in that it shows that in the case of literate migrants, both the amount of savings and the migration duration have a significant positive effect on the probability of entrepreneurship upon return, while the first proposition only holds true for illiterate migrants; this suggests that skill-acquisition may be more important for relatively educated migrants than the need to overcome liquidity constraints.

Who are the return migrants?

There is limited evidence that return migration is significant among the highly-skilled, or that skilled returnees largely contribute to technology diffusion. We know that in general, return migration is characterized by negative self-selection (i.e. the less competent migrants return first; see Borjas and Bradsberg, 1996) and is seldom among the highly skilled unless sustained growth preceded return. For example, less than a fifth of Taiwanese PhDs who graduated from US universities in the 1970s in the fields of Science and Engineering returned to Taiwan (Kwok and Leland, 1982) or Korea, a proportion that rose to about one half to two-thirds in the course of the 1990s, after two decades of impressive growth in these countries. Is it due to the economic boom at origin or to changes in the immigration policy at destination? Recent evidence is quite mitigated.

On the one hand, the figures for Chinese and Indian PhDs graduating from US universities in the same fields during the period 1990-99 are fairly identical to what they were for Taiwan or Korea 20 years ago (stay rates of 87% and 82%, respectively) (OECD, 2002). This would seem to be confirmed by a recent survey which shows that in the Hsinchu Science Park in Taipei, a large fraction of companies have been started by returnees from the USA (Luo and Wang, 2001). In the case of India, Saxeenian (2001) shows that despite the quick rise of the Indian software industry, only a fraction of Indian engineers in Bangalore are returnees. According to these papers, return skilled migration appears relatively limited, however, and is often more a consequence than a trigger of growth.

On the other hand, a more recent and comprehensive survey of India's software industry reached more optimistic and confirmed the presence of network effects and the importance of temporary mobility (strong evidence of a brain exchange or a brain circulation), with 30-40% of the higher-level employees having relevant work experience in a developed country (Commander et al., 2004). In their survey on medical doctors working in the UK, Kangasmieni et al (2004) found that "many" intend to return after completing their training.

3.5. Diaspora externalities

A large sociological literature emphasizes the creation of migrants' networks that facilitate the movement of goods, factors, and ideas between the migrants' host and home countries. In this section we consider two types of network effects: networks that facilitate further migration, and networks that facilitate trade, FDI and technology diffusion.

Chain migration

An important socio-economic literature has emerged recently to analyze the consequences of the constitution of migrants' network on migration patterns. For example, Massey, Goldring and Durand (1994) outline a cumulative theory of migration, noting that the first migrants usually come from the middle ranges of the socioeconomic hierarchy, and are individuals who have enough resources to absorb the costs and risks of the trip, but are not so affluent that foreign labor is unattractive. Family and friends then draw on ties with these migrants to gain access to employment and assistance in migrating, substantially reducing the costs and risks of movement to them. This increases the attractiveness and feasibility of migration for additional members, allowing them to migrate and expanding further the set of people with network connections. Migration networks can then be viewed as reducing the cost, and perhaps also increasing the benefits of migration (Munshi, 2003, and McKenzie and Rapoport, 2004, find strong evidence of such network effects); in other words, migration incentives become endogenous once network effects are introduced.

Building on this idea, Kanbur and Rapoport (2005) introduce networks effects at destination in a standard model of selective migration. In the spirit of Carrington et al. (1996), they assume that migration costs, , are decreasing with the size of the network at destination, that is, with the number of migrants already emigrated abroad. As explained above, the role of migrants' networks is to diffuse information on job availability and provide hospitality and help in job search. Hence, past migration progressively raises the expected return to education (net of migration costs) and the domestic enrollment in education. This raises the optimal number of individuals engaging in education and the share of educated workers remaining in the country. In this sense, migrant networks have positive effects on human capital formation and serve to mitigate the short-run detrimental effects of the brain drain.

Trade and business network

Another type of network effect consists in the creation of business and trade networks; such a "Diaspora externality" has long been recognized in the sociological literature and, more recently, by economists in the field of international trade (Rauch and Trindade, 2002, Rauch and Casella, 2003). In many instances indeed, and contrarily to what one would expect in a standard trade-theoretic framework, trade and migration appear to be complements rather than substitutes (e.g., Gould, 1994, Lopez and Schiff, 1998). Interestingly, such a complementarity has been shown to prevail mostly for trade in goods which are specific to the country of origin. In this case, ethnic networks help overcoming information problems linked to the very nature of the goods exchanged (Rauch and Casella, 2003, Rauch and Trindade, 2002). How is the relationship of substitutability or complementary between trade and migration impacted by the skill composition of migration, however, remains unclear. In the same vein, whether FDI and migration are substitutes (as one would expect) or complements remains an unanswered question, although many case-studies suggest that migrants' networks favor what sociologists have labeled "brain circulation" or "brain exchange" (e.g., Saxeenian, 2001, Arora and Gambardella, 2004).

Using the cross-section data presented in Section 2, Docquier and Lodigiani (2006) find evidence of important network externalities in a dynamic empirical model of FDI-funded capital accumulation. Their analysis confirms that business networks are mostly driven by skilled migration. Skilled migration thus stimulates FDI inflows in the origin country. In a cross-section model focusing on the period 1990-2000 and 114 countries, the elasticity of the FDI-funded capital growth rate to skilled migration is around 2 percent.

These network effects are stronger in democratic countries as well as in countries exhibiting intermediate corruption index. Very corrupted regimes face strong difficulties to attract foreign investments. Using the panel migration data presented in Section 2, they provide a panel extension with 83 countries and 4 periods. The panel analysis confirms the existence of business network externalities. The elasticity of the capital growth rate to the stock of skilled emigrants is between 2 and 3 percent. This means that a 1 percent increase in the stock of skilled emigrants results in 2 to 3 percent increase in capital inflows.

Consequently, diaspora externalities constitute an important channel through which the brain drain positively affects sending countries. Even when the brain drain depresses the average level of schooling, it is likely to increase FDI inflows. The size of the diaspora matters. Business externalities are likely to be stronger in large countries. On the contrary, small countries are less likely to benefit from skilled migration.

3.6. Governance and corruption

A couple of studies also examine the impact of skilled migration on governance, corruption, rent-seeking and ethnic discrimination.

In a political economy model of ethnic discrimination in developing countries, Docquier and Rapoport (2003) assume a rent-extraction basis for discrimination. They model discrimination as a financial penalty levied on each educated minority member and equally redistributed among the majority. There are, therefore, two sources of ethnic inequality in the model: on the one hand, discrimination lowers the return to human capital for the minority group; on the other hand, this, in turn, decreases the number of minority members who invest in education. Focusing on the impact of migration prospects on the level of rent-seeking from the majority's perspective, they find the following results:

First, taking the closed-economy (no mobility) as a benchmark case, they find the intuitive result that if there are unlimited exit options to a discrimination-free country (full mobility case), such migration prospects are likely to protect the minority via a decrease in the equilibrium domestic level of discrimination (providing that migration costs are sufficiently low). Under such circumstances, investment in education is fostered among the minority, and ethnic inequality decreases.

Second, the equilibrium discrimination rate under full mobility has been shown to be such that the minority member with the highest ability is indifferent as to whether to emigrate. Consequently, no migration outflows are observed at equilibrium when there is free international mobility.

Third, compared to the free migration case, they find that highly restrictive quotas are likely to increase the level of discrimination imposed on the minority group, thus inducing emigration from among its ranks. In such cases, immigration restrictions have the paradoxical effect of increasing ethnic discrimination in the source country and creating migration flows which would otherwise have remained latent.

Extending the corruption model of Murphy, Shleifer and Vishny (1991), Mariani (2006) develops a new mechanism through which the brain drain reduces corruption in the origin country. Agents have two possibilities of career, acting as rent-seekers or engaging in productive activities. The latter may have the possibility to export their human capital to a rent-free foreign country. Hence, the probability of migration reduces the relative return to rent-seeking, thus decreasing the fraction of skilled workers who opt for parasitic activities. Although the result can be inverted in case productive workers may invest endogenously in security and self-protection, Mariani shows that the correlation between brain drain rates and the fraction of students opting for "productive" fields of study is positive.

3.7 Summary

The above sub-sections offered a review of the theoretical and empirical literature on the impacts of skilled migration on the origin countries. There may be negative impacts because the emigration of the most talented workers reduces the average level of human capital which is an important driver of growth. Skilled migration can also lead to important shortages of some activities such as physicians, engineers or commercials that play a crucial role in economic development. There are also positive impacts however. Migration prospects can raise the expected return to human capital and induce more people to invest in education at home. Moreover, the return of migrants, that have accumulated knowledge and financial capital in rich countries, may generate beneficial effects on productivity and technology diffusion. A similar effect can stem from migrants' remittances when they complement the origin country own resources for consumption and investment. The existence of diasporas may also benefit the origin country trough the creation of business and trade networks. Finally, a recent strand of the literature suggests that skilled migration may discipline the functioning of the origin country institutions (i.e. corruption, rent-seeking and ethnic discrimination). All in all, the final impact of skilled migration on the origin countries is, a priori, undetermined and further research is needed to better understand it.

4. Policy discussion

What do the theoretical and empirical findings of the recent brain drain economic literature teach us that can guide policy making? From Section 2 and given the presence of externalities related to human capital, the brain drain is clearly a threat for economic development. However, in Section 3, we put forward many mechanisms through which the brain drain positively affects sending countries. Although new data sets can now be used to assess the magnitude of these effects, these data rely on many assumptions and are available for a limited number of years. Hence, the empirical literature remains too poor to draw any clear cut policy conclusions. Anyway, we would like to focus here on three policy issues that are closely related to the debates above: immigration policies at destination and origin, the education policy at origin, and the taxation of skilled migration.

4.1. Immigration policy

If the brain drain induces positive effects on sending country, the optimal skilled emigration rate needs not be equal to zero. As skilled emigrants generate more remittances, more FDI inflows, more investment in human capital, a limited degree of openness can be beneficial for the source country. However, as the skilled migration rate goes up, the marginal cost of the brain drain increases and is more likely to exceed the induced benefits.

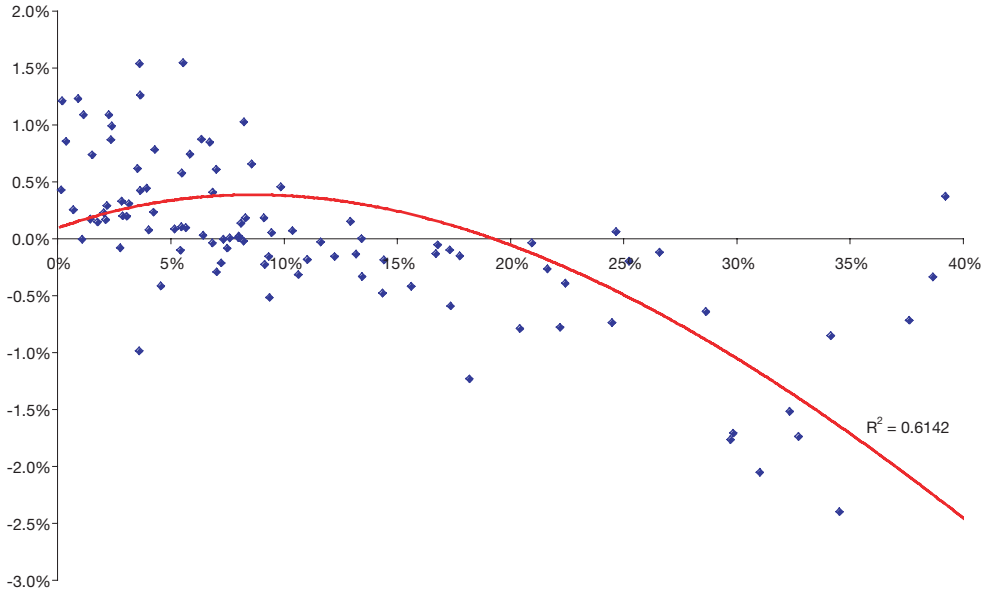
Letting other possible feedback effects aside and focusing on the incentive effect, Beine et al. (2006) find that the brain drain stimulates human capital accumulation among residents in some countries. It appears that the countries experiencing a positive net effect (the 'winners') generally combine low levels of human capital and low skilled migration rates (below 20%), whereas the 'losers' are typically characterized by high skilled migration rates (above 20%) and/or high enrollment rates in higher education (above 5%). Building on Beine et al. (2006), Figure 5 gives the reduced-form impact of the brain drain on residents' human capital.

A quadratic adjustment function fits well the effect; the correlation coefficient is of 64%.

How can we interpret these results? A gain is obtained in countries where the incentive effect is sufficiently strong. The 'production' of such an incentive effect combines wage differentials and emigration probabilities and requires unbinding credit constraints. At low levels of wage differentials (for relatively rich country), there is no incentive effect, and at too high levels of wage differentials (for very poor countries), there is no incentive effect either. Hence, a necessary but not sufficient condition for a country to take advantage of skilled emigration is to be not too poor and not too rich. For relatively rich origin countries such as the UK or Germany and for newly industrialized countries such as Korea or Taiwan, the brain drain is most certainly a bad thing unless significant feedbacks in the form of knowledge, technology diffusion and 'brain circulation' serve as compensations. For poor countries, on the other hand, the incentive effect is limited by the credit constraints and in this case too, skilled emigrants' departure is a net loss unless

9. For instance Indonesia, Ghana, China, Pakistan, Guyana, Jamaica or Trinidad-Tobago.

Figure 5. Simulated contribution of skilled migrants rate (X axis) to human capital (Y axis)



feedback effects - mainly in the form of remittances this time - are derived.

Second, a gain is obtained if the emigration rate of skilled workers is not too high. Assuming there is an incentive effect, then at any given wage differential, higher migration possibilities will lead to more incentives to educate but at the same time increase the number of skilled emigrants; the net effect will at first be positive and then negative. Hence, the origin country will capture some gains as long as emigration rates are not too high. Where do we observe relatively modest emigration rates? In relatively big countries in terms of demographic size.

Combining the two conditions, one can therefore predict that notwithstanding potential feedback effects, the countries which will take advantage of having skilled emigrants are middle income countries with large or middle sized population. From a national point of view, the objective of many immigration countries is to select immigrants in order to maximize their contribution to growth and public finance. If many migrants come from a small subset of countries (especially small countries), the cost of the brain drain will be high. If migrants' origin is more or less proportional to the country supply of skilled, the effect of the brain drain will be equally shared and is more likely to be positive.

In the 1970s Bhagwati proposed the adoption of an international 'tax on brains' (also known as the "Bhagwati tax") to compensate the origin countries for the losses incurred as a result of the brain drain. At that time, it was taken for granted that the brain drain was detrimental to source countries. As explained at length in this paper, this is not necessarily the case. In the event of a beneficial brain drain, the concept of surplus sharing would be more appropriate than the concept of compensation to describe the principles that should guide international tax cooperation. An important difficulty is that the international taxation of skilled migrants requires cooperation between host and home countries government, which is not easy to achieve. Bilateral agreements are certainly unrealistic for some pairs of countries (for example, the U.S. and Cuba) so that in most instances such cooperation requires the mediation of international bodies. We do not discuss here the feasibility of the Bhagwati tax and refer the interested reader to Desai, Kapur and McHale (2004).

Notwithstanding these 'feasibility' issues, are we sure that a Bhagwati tax would benefit the source country? Docquier

and Rapoport (2004) explore this question formally. They show that the tax would have a beneficial impact on human capital formation at origin only in case of a detrimental brain drain (compensation principle) or, in the event of a beneficial brain drain, only if this is obtained with binding credit constraints. In contrast, in the case of a beneficial brain drain with unbinding credit constraints, the effect of the tax will be to decrease the incentive effect; for given migration probabilities, this can only harm the migrants' home country.

Another possibility is that the immigration policy should select immigrants according to their country of origin in order to minimize the losses (or maximize the gains) experienced by sending countries. However, this implies that the destination countries can discriminate among migrants of different origins - which undoubtedly raises legal and moral questions well beyond the scope of this survey. The difficulty is then to design quality selective immigration policies that can address the differentiated effects of the brain drain across origin countries without distorting too much the whole immigration system; this could be achieved, at least partly, by designing specific incentives to return migration to those countries most negatively affected by the brain drain, and promote international cooperation aiming at more brain circulation.

4.2. Education policy

One of the main complaints against the brain drain is the loss of investment of public spending in the education of emigrants. How do developing countries adjust their education policies to skilled migration? What should they do? What is the resulting effect on human capital accumulation?

By affecting the return to schooling in developing countries, skilled migration interacts with local education policies. It is commonly accepted that human capital accumulation induces externalities of various sorts. Since individual decisions about education are only driven by individual costs and returns, the market choice is inefficient because it does not take account of externalities. The traditional recipe to restore efficiency is to introduce a subsidy that makes education less costly. By affecting the cost of acquiring skills, an appropriated mix of lump-sum taxes and education subsidies can restore the optimality. In a context of beneficial brain drain, Stark and Wang (2002) suggested an alternative policy option. Letting a controlled proportion of skilled individuals immigrates to a richer country, the government can reach the socially desirable level of human capital without subsidies. Since international migration flows are essentially governed by self-selection processes and by immigration policies at destination, it is very unlikely that sending countries have a perfect control on emigration rates. However, the higher the skilled emigration rate, the lower is the rate of subsidy required to decentralize the social optimum: in the absence of distortion, the emigration policy acts as a perfect substitute for public subsidies.

The proposition of Stark and Wang (2002) is drawn from a simple model with homogenous agents and perfect credit markets. When agents have heterogeneous ability to respond to migration prospects (due to heterogeneous ability to educate or to credit market imperfections), results are more subtle. One the one hand, migration prospects (at least if liquidity constraints are not binding) raise the proportion of individuals engaging in education (ex-ante brain gain). On the other hand, some of the educated are leaving the country (ex-post brain drain). A negative impact on human capital can be obtained when the brain drain effects dominates the brain gain effect, i.e. when the ex-post proportion of educated workers falls with skilled migration.

Endogenizing education subsidies in a dynamic model of human capital accumulation, Docquier et al (2006) examine the optimal emigration and education subsidy rates. Although migration prospects boost human capital formation, it is always welfare improving for the government to use internal subsidies and non distorting taxes. When tax distortions are sufficiently large, a controlled and restrictive emigration rate becomes attractive. Hence, resorting to the brain drain must be considered as a second best policy option that reflects the inability of the government to use domestic instruments

without costs. In that case, skilled migration becomes a substitute to public subsidies, i.e. there exists a negative correlation between the second best subsidy and the controlled emigration rate.

It is also demonstrated that such a negative relationship holds when the emigration rate is exogenously set by the receiving country. The brain drain reduces the social return to local human capital investments. Such a social return being reduced, the possibility of education subsidies is also reduced. Investigating the empirical relationship between education subsidies and migration prospects, Docquier et al. (2006) obtain a significant and negative relationship in a sample of 107 countries. This means that skilled migration reduces the possibility of education subsidies which reduce, in turn, local human capital investments and, then, the potential gain from the brain drain.

As shown in Section 3, the brain drain can also distort the allocation of public education subsidies. Governments have less incentive to provide internationally applicable education when graduates leave their country. As shown in Poutvaara (2004), the brain drain distorts the provision of public education away from internationally applicable education (such as science-based, commercial and other internationally applicable degrees) towards country-specific skills (such as degrees in law and certain humanities, and also secondary education). At the end, this means educating too few engineers, economists and nurses and doctors, and too many lawyers.

4.3. At the agenda

The main general conclusion to draw from the above analysis is that for a given developing country, the optimal migration rate of its highly educated population is likely to be positive. Whether the current rate is greater or lower than this optimum is an empirical question that must be addressed individually. In many instances, countries that would impose restrictions on the international mobility of their educated residents, arguing for example that emigrants' human capital has been largely publicly financed, could in fact decrease the long-run level of their human capital stock. This also suggests that rich countries should not necessarily see themselves as free riding on poor countries' educational efforts. The difficulty, however, is to design quality-selective immigration policies that would address the differentiated effects of the brain drain across origin countries without distorting too much the whole immigration system; this could be achieved, at least partly, by designing specific incentives to return migration to those countries most negatively affected by the brain drain, and promote international cooperation aiming at more brain circulation.

Nevertheless, it is important to underline that what seems crucial at this stage is to extend the empirical research on the growth effects of highly skilled migration for source countries. Two main directions are required: case-studies on the sectoral impact of the brain drain, as suggested by Commander et al. (2004); and extension of the cross-country comparisons. In particular, due to data limitations, existing empirical studies are based on cross-sectional regressions; that is regressions over a sample of countries for a given year. The absence of the time dimension (i.e. regressions over several years) means neglecting the dynamics of migration rates as well as the dynamics of education levels. In addition, in the absence of a time series dimension, it is impossible to control for country-fixed effects in the regression estimates. Given the strong heterogeneity of developing countries in terms of sizes, levels of development, etc., such fixed effects are likely to play some role in the value of the estimates.

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