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Abstract. Relying on an original data set on international migration by educational attainment for 1990 and 2000, we analyze the determinants of the brain drain from developing countries. We start from a simple decomposition of the brain drain in two multiplicative components, the degree of openness of sending countries (as measured by their average emigration rate) and the schooling gap (as measured by the relative education level of emigrants compared to natives). Using various regression models, we put forward the determinants of these components and explain cross-country differences in skilled migration. Unsurprisingly, the brain drain is strong in small countries which are not too distant from the major OECD regions, which share colonial links with OECD countries and which send most of their migrants to host countries where quality-selective immigration programs exist. More interestingly, the brain drain increases with political instability and the degree of fractionalization at origin; it globally decreases with natives' human capital.

Keywords: international migration, brain drain, human capital, developing countries

JEL Classifications: F22, O15, J24

INTRODUCTION

The international migration of skilled workers (the so-called brain drain) has attracted considerable attention in the recent years. Industrialized countries such as Canada, the UK and Germany are worrying about the magnitude of the emigration of their talented workers. Nevertheless, it is unsurprisingly for developing countries that the detrimental consequences of the brain drain have been stressed in the literature. On the one hand, by depriving developing countries of one of their scarcest resources (human capital), the brain drain is usually seen as a curse for economic development. On the other hand, recent theoretical studies emphasized several compensatory effects of the brain drain, showing that a limited but positive skilled emigration rate can be beneficial for sending countries[1]. However, in the absence of reliable comparative data on international migration by educational attainment, the debate on the causes and consequences of the brain drain remained essentially theoretical.

Given the fast evolving process of international migration and the policy issues at stake, the international community must be prepared to address the major challenges raised by the brain drain. Assessing the economic impact of skilled emigration requires a better knowledge of the educational structure of international migration and of its determinants. The objectives of our paper are to characterize the distribution of the brain drain from developing countries in 1990 and 2000 and its main determinants.

Our analysis relies on the new harmonized and comprehensive data set on migration stocks and rates by educational attainment recently detailed in Docquier and Marfouk (2006). Generalizing the pioneering work of Carrington and Detragiache (1998), their method consists in collecting census and register data on the structure of immigration in all OECD countries. In a first step, aggregating these data allows to evaluate the stock of emigrants from all developing countries to the OECD area by level of schooling. In a second step, the number of migrants is compared to that of natives from the sending country belonging to the same education group. This comparison gives relative measures of emigration, henceforth labeled as "emigration rates" by educational attainment for 1990 and 2000.

In a first descriptive section, we present the data set on the brain drain (as measured by the emigration rate of post-secondary educated workers) and describe the average brain drain from developing countries by income group and country size. Between 1990 and 2000, the stock of

[1] See Commander et al (2004), Docquier and Rapoport (2004) and Beine et al. (2001, 2006). See Schiff (2005) for a critical appraisal of this literature.

skilled immigrants in the OECD increased by 64 percent. The rise was stronger for immigrants coming from developing countries (+93 percent), especially those coming from Africa (+113 percent) and Latin America and the Caribbean (+97 percent). Although the number of skilled workers originated from developing countries increased, emigration rates slightly decreased. What first looks as a paradox can be simply explained by the general rise in education attainment experienced by many developing countries between 1990 and 2000. We also compare the new brain drain measures to those provided in previous studies, showing that our method cures many important sources of bias.

Then, in Section II, we disentangle the brain drain into two multiplicative components, i.e. ***the degree of openness*** - as measured by the average emigration rate of working-aged natives - and ***the schooling gap*** - measuring the relative education attainment of emigrants compared to natives. On average, there is a negative correlation between openness and schooling gaps, inducing that a high brain drain usually results from either strong permeability or high schooling gap, but not both. This justifies decomposing the brain drain in these two components and investigating their own determinants. A preliminary descriptive analysis reveals interesting regularities in the data. Unsurprisingly, openness is strongly affected by country size: small countries exhibit higher average emigration rates than large countries. Interestingly, the schooling gap is closely related to the average level of schooling among natives: poor countries exhibit higher schooling gaps. Bilateral schooling gaps vary across destination countries; hence, destination choices affect the intensity of the brain drain. Ceteris paribus, the brain drain is stronger in small and poor countries sending most of their emigrants to selective countries (i.e. host countries with quality-based immigration policies).

In Section III, we use OLS and IV regression models to analyze the determinants of openness and schooling gap. On the one hand, the degree of openness increases as country size declines, as natives' human capital and political instability increase, as colonial links and geographic proximity with the major OECD countries are strong. On the other hand, the schooling gap depends on natives' human capital, on the type of destination countries (with or without quality-selective immigration programs), on distances and religious fractionalization at origin. Interestingly, a rise in human capital stimulates openness and reduces the schooling gap. The second effect dominates: ceteris paribus, the brain drain is stronger in poor countries where the average level of schooling is low. All these ingredients allow to better understand the sources of the brain drain.

I. A NEW DATA SET ON SKILLED MIGRATION

Our analysis builds on the new international migration data set developed by Docquier and Marfouk (2006)[2]. This section describes the methodology used to compute absolute and relative emigration data by educational attainment and presents the main results for developing countries for 1990 and 2000. The methodology relies on two steps. First, (absolute) emigration stocks by educational attainment are computed for all the world countries. In a second step, these numbers are expressed in percentage of the total labor force born in the sending country (including migrants themselves) with the same education level.

Skilled emigration stocks

It is well documented that emigration statistics provided by origin countries, when available, do not give a realistic picture of emigration[3]. In this context, data on emigration can only be captured by aggregating harmonized immigration data collected in many receiving countries. Usually, detailed information about the origin and skill of immigrants can be obtained from national censuses and registers. The DM06 data set is thus based on such data collected in all OECD countries. It counts as migrants all working-aged (25 and over) foreign-born individuals living in an OECD country. The total number of working-aged emigrants from country *i* of skill *s* at year *t* is denoted by $M_{i,t}^{s}$.

Three levels of schooling are distinguished. Low-skill workers are those with primary education, medium-skill workers are those with secondary education and high-skill workers are those with post-secondary education ($s=h$). The brain drain is defined as the migration of the latter.

In the DM06 data set, a special attention is devoted to the homogeneity and the comparability of the data. This induces several methodological choices. A detailed discussion of these choices is exposed in Docquier and Marfouk (2006). Let us summarize the main features:

- Considering the working-aged population (aged 25 and over) maximizes the comparability between immigration data and data on educational attainment in the source countries. It also excludes those who are still at school, i.e. a large number of students who temporarily emigrate to complete their education[4].

[2] Henceforth labeled as the DM06 data set.

[3] See Wickramasekera (2002).

[4] Carrington and Detragiache (1998) also considered individuals aged 25 and more.

- By restricting the set of receiving countries to the OECD area, it focuses on the South-North and North-North migration. Obviously, a brain drain is observed outside the OECD area (to the Gulf countries, South Africa, Malaysia, Singapore, etc.). Given (less detailed) census data collected from various non-OECD countries, it is estimated that about 90 percent of high-skill international emigrants are living in OECD countries.
- To allow comparisons, the number of receiving countries is the same in 1990 and 2000. Consequently, Czechoslovakia, Hungary, Korea, Poland and Mexico are considered as receiving countries in 1990 although they were not members of the OECD. The number of adult immigrants in the OECD increased from 41.8 to 59.0 million between 1990 and 2000. In the meantime, the number of skilled immigrants increased from 12.5 to 20.4 million.
- Information about the origin country of migrants is available in all OECD countries. Migration is primarily defined on the basis of the foreign-born concept (which is time invariant and better captures the decision to emigrate) rather than citizenship. Whilst the definition of foreign born is not fully comparable across countries, an important effort was made to homogenize the concepts. However, in a limited number of cases, immigrants are only classified by citizenship. More precisely, information on the country of birth is available for the large majority of countries, representing 52.1 million immigrants in 2000 (i.e. 88.3 percent of the total). Information on citizenship is used for the remaining countries (Italy, Germany, Greece, Japan and South Korea).
- Data on educational attainment are missing in a couple of cases. In 2000, the educational structure can be obtained or estimated in 27 countries representing 57.9 million immigrants (i.e. 98.1 percent of the total)[5]. Observations are available for 24 countries. For three European countries (Belgium, Greece and Portugal), we use the Labor Force Survey which provides less detailed information about immigrants' origins. It is noteworthy that these survey data are only used to characterize 2 percent of the OECD migration stock in 2000 (and 0.7 percent in 1990). For migrants whose educational attainment is not described, we transpose the skill distribution observed in the rest of the OECD area or in the neighboring region[6].

[5] Figures for 1990 are detailed in Docquier and Marfouk (2006).

[6] More precisely, the educational structure is extrapolated on the basis of the Scandinavian countries (for Iceland) or the rest of the OECD (for Japan and Korea).

Skilled emigration rates

Relative emigration measures are obtained by comparing the emigration stocks to the total number of people born in the source country (including residents and emigrants) and belonging to the same educational category. Obviously, calculating the brain drain as a proportion of the total educated labor force is more appropriate to evaluate the pressure imposed on the local labor market. For example, the pressure exerted on the labor market by 150,000 Egyptian skilled emigrants (4.5% of their educated total labor force) is less important than the pressure exerted by about 2,500 skilled emigrants from Seychelles (56% of their educated labor force). We will use the term "emigration rate" when presenting these ratios. It should be clear that these emigration rates refer to relative stock data and not to immigration flows.

Denoting by $N_{i,t}^{s}$ the number of residents in country *i*, of skill *s* at year *t*. The skilled emigration rate $m_{i,t}^{h}$ (i.e. the emigration of workers with post-secondary education, *s*=*h*) is defined as:

$$(1) \qquad m_{i,t}^{h} \equiv \frac{M_{i,t}^{h}}{N_{i,t}^{h} + M_{i,t}^{h}}$$

Evaluating $N_{i,t}^{s}$ requires using data on the size and the skill structure of the working-aged population in the countries of origin. Population data by age are provided by the United Nations[7].

Population data are split across educational group using international human capital indicators. Several sources based on education attainment and/or enrollment variables can be found in the literature. These data sets suffer from important problems. Data sets published in the nineties reveal a number of suspicious features and inconsistencies. Second, given the variety of educational systems around the world, they are subject to serious comparability problems. Three major competing data sets are available: Barro and Lee (2000), Cohen and Soto (2001) and De La Fuente and Domenech (2002). The first two sets depict the educational structure in both developed and developing countries. The latter only focuses on 21 OECD countries.

Statistical comparisons between these sets reveal that the highest signal/noise ratio is obtained in De La Fuente and Domenech. These tests are conducted on OECD countries. Regarding developing countries, Cohen and Soto's set outperforms Barro and Lee's set in growth regressions. However, Cohen and Soto's data underestimate official statistics in many developing countries. Generally speaking, Cohen and Soto predict extremely low levels of human capital in Africa[8] (the share of

[7] See http://esa.un.org/unpp.

[8] For this reason, Cohen and Soto (2001) exclude African countries from their growth regressions.

post-secondary educated is lower than 1 percent in a large number of African countries) and in a couple of other non-OECD countries[9]. The Barro and Lee estimates seem closer to African census data we obtained for a dozen of countries. As the brain drain is particularly important in African countries, Barro and Lee indicators are invoked when available.

Consequently, the DM06 data set relies on De La Fuente and Domenech's indicators for OECD countries, Barro and Lee's measures for most non-OECD countries, adjusted Cohen and Soto's estimates for countries when Barro and Lee's data are not available. For other countries where no data are available, the skill structure of the neighboring country with the closest enrolment rates is transposed. This method gives good approximations of the brain drain rates, broadly consistent with anecdotal evidence.

The brain drain in developing countries

In this paper, we follow the 2000 World Bank country classification and exclusively focus on the group of developing countries. We distinguish 54 low-income, 58 lower-middle-income and 40 upper-middle-income countries. Among these nations we distinguish three groups of particular interest: small island developing states, landlocked developing countries, and the least developed countries as defined by the United Nations.

Table 1 gives a general overview of the absolute and relative emigration rates by country group in 1990 and 2000. In 2000, developing countries accounted for about 64.5 percent of total immigrants and 61.6 percent of skilled immigrants in the OECD, 15 points of percentage higher than in 1990.

[TABLE 1 ABOUT HERE]

About three-quarters of them is living in one of the three most important host countries conducting selective immigration policies (the US, Canada and Australia)[10]. One fifth of them is living in the 15 members of the European Union (EU15). These percentages vary across origin groups: small islands send many migrants to selective countries; least developed and landlocked countries send more migrants to the EU15. These destination choices are linked to the geographical distances and historical links. Small islands are mainly located in the Caribbean and in the Pacific, thus sending

[9] According to the South African 1996 census, the share of educated individuals amounts to 7.2 percent. Cohen and Soto report 3 percent (Barro and Lee report 6.9 percent). The Kenyan 1999 census gives 2 percent whilst Cohen and Soto report 0.9 percent (1.2 for Barro and Lee). In Cyprus, the 2001 census gives 22 percent to be compared with 4.6 in Cohen and Soto (17.1 in Barro and Lee).

[10] Labeled as selective immigration countries.

many migrants to the US or to Australia and New Zealand. Many landlocked countries are located in Africa and have strong colonial links with European countries.

In every group, the proportion of skilled among migrants (on average 33 percent for developing countries) is much higher than the proportion observed among residents (on average 6 percent). Hence, skilled emigration rates (on average 7.3 percent) are much higher than average emigration rates (on average 1.5 percent). These average levels hide a strong heterogeneity across states. The brain drain is extremely small (below 1 percent) in some countries such as Oman, Tajikistan, Bhutan, etc.; on the contrary, it exceed 85 percent in Jamaica, Grenada or Jamaica.

Between 1990 and 2000, the average emigration rate rose from 1.1 to 1.5 percent. Although the proportion of skilled migrants increased, the skilled emigration rate decreased from 7.7 to 7.3 percent. This is due to the fact that the general level of schooling increased in developing countries.

Comparing country group, the highest brain drain rates are observed in small developing islands and in the least developed countries. The lowest rates are obtained in large and landlocked developing countries. As we will show in the next sections, country size, income levels and the geographic environment are important determinants of the brain drain. Eliminating small islands, the highest average brain drain rates are observed in Latin America and the Caribbean (11%), sub-Saharan Africa (13 percent) and the Middle East and North Africa (10 percent).

Comparison with previous studies

The DM06 data set generalizes the work Carrington and Detragiache (1998, 1999), which was the first serious effort to put together a harmonized international data set on migration rates by education level. Carrington and Detragiache used US 1990 Census data and general OECD statistics on international migration to construct estimates of emigration rates at three education levels for 61 developing countries[11]. Although their study clearly initiated new debates on skilled migration, their estimates suffer from important shortcomings:

- The numbers of immigrants by country of origin are taken from the US census and from the OECD statistics for remaining countries. Although census data give an accurate picture of the US immigration, the use of OECD statistics causes a major problem. OECD statistics only report the number of immigrants for the major origin countries only (top-10 or top-5 sending countries), which led to underestimate immigration for a large number of sending

[11] Adams (2003) used the same methodology to compute brain drain rates from 24 countries in 2000.

countries (*under-reporting bias*)[12]. This bias is reinforced by the fact that 1990 immigration data were missing for three OECD countries (Greece, Iceland, and Turkey). In addition, Mexico, Poland and Slovakia became OECD members after 1990..

- Although data based on country of birth are available from many national censuses, the OECD classifies European immigrants according to the concept of citizenship. This is another source of *under-reporting bias* as the number the number of foreign-born is usually much higher than the number of foreign citizens (twice as large in countries such Netherlands or Sweden).
- OECD statistics give no information on immigrants' age. It is then impossible to isolate those aged 25 and more. Compared to human capital indicators available for individuals aged 15+ or 25+, considering the total number of immigrants induces an *over-reporting bias*.
- Fourth, in the absence of education information in OECD statistics, Carrington and Detragiache transposed the education structure of the US immigration to the immigration to the other OECD countries (*transposition bias*). For example, Surinamese migrants to the Netherlands are assumed to be distributed across educational categories in the same way as Surinamese migrants to the US. Since the US immigration policy differs from that of many countries, this assumption is highly tentative, especially for countries with a low migration rate to the USA (Africa, many Asian countries, Oceania or Europe).

By collecting Census, Register and Survey data from all OECD countries, the DM06 study allows to evaluate the size of these biases for developing countries. The magnitude of these biases strongly varies across countries. Biases cancel each other in a couple of cases. However, the brain drain is particularly overestimated in countries such as Sao Tome and Principe, Algeria, Tunisia, Morocco, Turkey, Suriname or Algeria. By transposing the educational structure observed in the US, Carrington and Detragiache and Adams obtain high emigration rates of post-secondary educated workers for these countries (between 35 and 45 percent for North Africa and Turkey). Taking into account the low level of education observed among emigrants to Europe (where the large majority of these migrants live), the DM06 data set gives much lower skilled emigration rates for these countries (between 5 and 20 percent). On the contrary, the brain drain is largely underestimated in many sub-Saharan Africa (such as Kenya, Gambia, Seychelles, Mauritius, etc.) and in small countries sending a small number of emigrants to the OECD area (Mauritius). Typically, the bias

[12] Other origin countries cannot be identified as they are aggregated and considered as residual in the entry "other

ranges from -51.2 percent in the case of Mauritius to 51.5 percent in the case of Sao Tome and Principe.

This appears on Figure 1 which gives skilled migration rates evaluated under three measurement methods: (i) a method fully based on national census and administrative data (*Census*), (ii) the method used by Carrington and Detragiache (1998) and Adams (2003), which is based on OECD statistics and US educational attainment data (*OECD Statistics+ US sharing*), (iii) an intermediate method based on census and administrative data on the number of migrants and US educational attainment data on education (*Census + US sharing*). For graphical exposition, the measures obtained with the DM06 method are ranked in a decreasing order. In comparison to DM06, the second one clearly underestimates the brain drain for a large majority of countries. On the contrary, the third one overestimates the brain drain.

[INSERT FIGURE 1 ABOUT HERE]

II. OPENNESS AND SCHOOLING GAPS: SOME STYLIZED FACTS

As apparent from Table 1, the highest skilled emigration rates are observed in small and poor countries. Although many factors can be used to explain the intensity of the brain drain, country size and development levels are two key determinants. Let us use a simple multiplicative decomposition of the skilled emigration rate to better understand the distribution of the brain drain across countries. Denoting by $M_{i,t}^{s}$ the number of working-aged emigrants from country of skill s ($s=h$ for high-skill and $s=l$ for low-skill workers) at year t and by $N_{i,t}^{s}$ the corresponding number of residents, the skilled emigration rate $m_{i,t}^{h}$ can be decomposed as following:

$$(2) \qquad m_{i,t}^{h} \equiv \frac{M_{i,t}^{h}}{N_{i,t}^{h}+M_{i,t}^{h}} \equiv \left(\frac{\sum_{s} M_{i,t}^{s}}{\sum_{s} N_{i,t}^{s}+M_{i,t}^{s}} \right) \times \left(\frac{M_{i,t}^{h}}{\sum_{s} M_{i,t}^{s}} \Big/ \frac{N_{i,t}^{h}+M_{i,t}^{h}}{\sum_{s} N_{i,t}^{s}+M_{i,t}^{s}} \right)$$

The first multiplicative component is the ratio of emigrants to natives, i.e. the average or total emigration rate of all types of individual. It reflects the *degree of openness* of the sending country. The second multiplicative component is the division of the proportion of skilled among emigrants by the same proportion calculated among the native-born. This ratio reflects the *schooling gap*

countries".

between emigrants and natives. This ratio is always higher than one, indicating that emigrants are more educated than natives in all developing countries.

Suppose a hypothetical world in which emigration is strictly proportional to population and where the skill structure of emigration is strictly identical to the structure of the native population. The schooling gap would then be equal to one and all countries would then exhibit the same degree of openness. From our decomposition ("brain drain = openness index x schooling gap"), the brain drain would be homogenous across countries.

Obviously, observations depart from that hypothetical situation: average emigration rates and schooling gap are strongly heterogeneous. As we will show in the next section, these two components are closely related to the characteristics of sending countries as well as on proximity variables and characteristics of the main destination countries. Before conducting such an empirical analysis, let us point out four stylized facts (SE) that govern the process of skilled emigration. Table 2 and Figure 2 illustrate these empirical regularities.

[INSERT TABLE 2 ABOUT HERE]

[INSERT FIGURES 2.1 TO 2.3 ABOUT HERE]

(Stylized fact 1#) Average emigration rates and schooling gap are negatively correlated. Figure 2.1 plots the log of the percentage of emigrants and the log of the schooling gap in 2000. Both variables are expressed in difference from the sample mean. It appears that average emigration rates and schooling gaps are negatively correlated. The majority of observations belongs to the top-left (low emigration rates and high schooling gaps) or bottom-right panel (high emigration rates and low schooling gaps) of the plan. A very small number of observations belong to the top-right panel but in such cases, they are close from one of the axes.

It means that among developing countries, no country suffers from both strong openness and high schooling gap. If a country suffers from a huge brain drain it is either because it is very opened of because migrants are severely selected. This justifies our decomposition and the analysis of the specific determinants of these two components.

(Stylized fact #2) Average emigration rates decrease with country size. There is an obvious link between the population size at origin and the size of the number of migrants abroad. In absolute numbers, the main emigration countries are the largest ones (such as Mexico, Turkey, India, China, Philippines) whilst the smallest numbers are obtained for small countries (such as Palau, Vanuatu, Tuvalu, Nauru, Maldives). However, an increase in population generates a less-than-proportional increase in emigration. Hence, as it is well documented in the literature, the average or total

emigration rate decreases with the population size at origin. Such a negative relationship constitutes a first stylized fact characterizing the brain drain process: the degree of openness is decreasing in the population size at origin.

In 2000, the average emigration rate to the OECD ranges from 0.1 percent (in Oman, Chad, Lesotho, Turkmenistan, Niger, Bhutan, Swaziland) to 53.7 percent in Grenada. The correlation rate between the log of native population size and the average emigration rate amounts to –53 percent (using the population of residents, we obtain –56 percent). Figure 2.2 depicts the relationship between these variables. In 2000, seven countries had average emigration rates above 40 percent (Grenada, Samoa, Saint Kitts and Nevis, Suriname, Tonga, Guyana and Dominica): their average size was 0.237 million and none of them had population above 1 million. On the contrary, among the 8 largest countries with population above 100 million (China, India, Indonesia, Brazil, Russia, Pakistan, Bangladesh, Nigeria), the average emigration rate is lower or equal to 1 percent.

As shown in Table 2, the highest emigration rates are obtained for small countries. Small developing islands (average population of 1.3 million) exhibit an index of openness of 13.8 percent, to be compared with 1 percent for large developing countries (average population of 40 million). Obviously, country size is not the unique determinant of openness, as revealed by the strong dispersion of the scatter plot on figure 2.2. However, differences in country size are important and explain an important fraction of the disparities across income groups. Average country sizes respectively amount to 38, 40 and 15 million for low-income, lower-middle-income and upper-middle-income countries. Unsurprisingly, upper-middle-income countries exhibit the highest openness index.

(Stylized fact #3) Schooling gaps decrease with natives' human capital. An interesting major regularity concerns the educational structure of emigration. It is natural that the proportion of educated among emigrants increases with the general level of education of the native population. The most educated diasporas originated from countries where the proportion of educated natives is between 10 and 20 percent (such as the Philippines, Oman, South Africa, Mongolia, Venezuela, Panama, Jordan or Libya). On the contrary, less educated diasporas mainly come from very poor countries (such as Mozambique, Angola, Guinea-Bissau, Tuvalu, Mali, etc). Six countries had schooling gap above 30 (Niger, Rwanda, Malawi, Mozambique, Lesotho, Uganda): their average proportion of educated was 0.6 percent. On the contrary, among the 10 countries where the schooling gap is below 1.5, the average proportion of skilled amounts to 16 percent (much higher than the average proportion observed in developing countries, i.e. 6 percent).

An increase in education level of native populations generates a less-than-proportional increase in the education level of emigrants. Hence, the schooling gap decreases with the human capital level at origin. This decreasing relationship constitutes a second major stylized fact characterizing the brain drain process.

In 2000, the schooling gap ranged from 1 in Turkey and Mexico to 92 in Niger. The correlation rate between the log of the schooling gap and the log of the proportion of educated among natives amounts to –90 percent (the correlation rate with the log of the proportion of educated among residents amounts to –85 percent). Figure 2.3 depicts the relationship between these variables.

Table 2 shows the average schooling gap is obviously decreasing in income. Low-income and least developed countries exhibit indices of 10.4 and 13. Upper-middle-income countries are at 1.7 (slightly above the average level obtained for high-income countries). This second regularity explains why, ceteris paribus, poor countries tend to suffer more from the brain drain.

(Stylized fact #4) Schooling gaps depend on destination choice. Finally, Table 2 also reveals that the choice of destination affects the size of the brain drain. Remember that Table 1 indicated that about three-quarters of skilled emigrants from developing countries are living in selective countries (the US, Canada and Australia). Hence, average emigration rates to selective countries are unsurprisingly stronger than those to the EU15 and the rest of the OECD where immigration policies are mostly focused on family reunion and asylum seeking.

We also observe that "bilateral" schooling gaps also vary across destinations. On average, the schooling gap observed in selective countries was about twice as large as the gap observed in EU15 and other OECD countries in 2000. Hence, countries which send many migrants to North America and Australia are likely to exhibit stronger schooling gaps than the others. Although many economic and institutional factors may explain these differences (skill premium, welfare programs, etc), increasingly “quality-selective” immigration policies introduced in selective countries are likely to play an important role. Since 1984, the Australian immigration policy has officially privileged skilled workers, with the candidates being selected according to their prospective “contribution to the Australian economy”. 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 the annual immigration flow. 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. As argued in Antecol et al (2003), except for immigrants from Central American countries, the US selection rate is higher than the Canadian or Australian ones.

In 1990, the differential between selective countries and the EU15 was even stronger. The evolution of the differential is partly due to the fact that a growing number of EU15 countries (including Germany, 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, 2002). The trend is likely to be confirmed in the future. In Germany in February 2000, Chancellor 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. 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 adopting a new policy of "immigration choisie" (selective immigration policy) rather than of "immigration subie" (passive immigration policy).

III. EMPIRICAL ANALYSIS OF THE DETERMINANTS OF THE BRAIN DRAIN

This section examines the determinants of average emigration rates and schooling gap using empirical regressions. In our system of two equations, the dependent variables are the logistic transformation of the average emigration rate[13] and the log of the schooling gap.

Potential explanatory variables

The vast economic literature on international migration distinguishes many potential determinants of labor mobility. In our regressions, we use five sets of explanatory variables, which are commonly used in the empirical literature and capture traditional proximity and push/pull factors. As current emigration stocks depend on present and past decisions about migration, we use the average level observed on a long period for each explanatory variable, at least when data are available.

The first set concerns **country size** at origin. We use the log of the *native population* (including residents + emigrants), and a dummy equal to one for *small developing islands*. For population, we average the annual number of people residing in the home country (1985-2000) and the total number of working-aged emigrants living in an OECD country in 1990 and 2000. Data on population size are taken from the World Development Indicators (2005) whilst data on emigration come from the DM06 data set. Although emigrants are likely to exhibit specific mortality and fertility patterns compared to natives, using the native population (rather than resident population) minimizes the risk of endogeneity. An obvious reverse causality occurs between migration and the resident population. It is worth noticing that our concept of residents includes the immigrant population since we cannot split immigrants by age group and education level in non-OECD countries. The small islands dummy is based on the recent United Nations classification[14].

A second set of variables accounts for the **level of development** of the sending country. We use the log of the percentage of *post-secondary educated among natives*. Working on natives (rather than residents) reduces the risk of endogeneity. However, the recent literature on brain drain and human capital formation suggests that natives' human capital may depend on emigration prospects (see Mountford 1997, Stark et al. 1997 or Beine, Docquier and Rapoport 2001, 2006). The risk of a reverse causality is important and requires using instrumentation techniques. We also consider the log of the *Gross National Income* (GNI) per capita in purchasing power parity, a dummy equal to one for the *least developed countries* and a dummy for *oil exporting countries*. The native proportion of skilled comes from the DM06 data set. Data on GNI per capita are taken from the WDI (2005) and are averaged on 1985-2000. The dummy for "least developed countries" is based on the United Nations recent definition.

The third set captures the **socio-political environment** at origin. We mix two data sets on governance and fractionalization. These data sets provide many insights on the potential push factors that induce people to leave their country. Data on governance are given in Kaufmann et al. (2003) for 1996, 1998, 2000, 2002 and 2004. From the six available indicators in this data set, we use "*political stability* and absence of violence" and "*government effectiveness*"[15]. The first indicator measures "perceptions of the likelihood that the government in power will be destabilized or overthrown by possibly unconstitutional and/or violent means, including domestic violence and

[13] The dependent variable is $ln[m/(1-m)]$ where $0<m<1$ is the emigration rate. This increasing monotonic transformation expands the range of the variable from $(0,1)$ to $(-inf,+inf)$.

[14] See http://www.un.org/special-rep/ohrlls/ohrlls/default.htm.

[15] They are strongly correlated with the four remaining variables as well as with the corruption perception index published by Transparency International (see http://www.icgg.org/corruption.cpi_2003.html).

terrorism". The second indicator measures "quality of public service provision, the quality of the bureaucracy, the competence of civil servants, the independence of the civil service from political pressures, and the credibility of the government's commitment to policies". Both are normally distributed between -2.5 (bad governance) and 2.5 (good governance)[16]. For each country, we average all the available scores. We also use Alesina et al. (2003) indicators of religious fractionalization. This variable gives the probability that two random individuals from a given country share the same religion. This indicator ranges from about 1 to 83 percent. In developing countries, religious diversity often gives rise to conflicts (Hindus and Muslims in India; Christians, Orthodox and Muslims in former Yugoslavia; etc.) or to discrimination. Although some studies consider governance as an endogenous variables, we treat political and governance indices as exogenous.

The fourth set of variables accounts for **geographical and cultural proximity** between developing and OECD countries. Since Greenwood (1969), many papers have stressed the role of distance as a proxy for migration monetary and psychic costs. We distinguish the *minimal distance from selective countries* (the US, Canada and Australia) and the *minimal distance from the EU15* members. We use a dummy variable characterizing *landlocked developing countries*, i.e. countries suffering from the lack of territorial access to the sea, remoteness and isolation from world markets. By providing better information and knowledge on the destination country and thus lowering migration costs, colonial links also affect the cultural distance between former colonies and their colonizer(s). We introduce a dummy equal to one if the sending country is a *former colony of an OECD country* and a dummy equal to one if it shares *the same language as one of the selective countries*. Our data come from the CEPII data set exposed in Clair et al. (2004). Finally, we also control for the choice of destination by including a dummy equal to one if the *main destination* is a selective country and a dummy equal to one if the main destination is one of the EU15 member states.

Econometric issues

Our empirical model consists of two equations, one for the average emigration rate and one for the schooling gap. Although dependent variables are available for 1990 and 2000, most or our explanatory variables are time-invariant (either by nature or because we average levels observed on a long period) . A panel regression model with country fixed effects would then make impossible to

[16] However, under very specific circumstances, a country's rating might exceed these thresholds.

understand the effect of time-invariant variables. As we are primarily interested in the effect of these variables, we estimate cross-section empirical models estimated on 2000 data[17].

In a first stage, we estimate the general model with all potential determinants described above in both equations. We use the OLS standard regressions with White-corrections for heteroskedasticity (model OLS-1). Eliminating non-significant variables gives the first set of OLS-robust estimators (model OLS-2). To accounts for the potential endogeneity of the natives' proportion of educated, the parsimonious model is then estimated using a two stage least square procedure with instrumentation of natives' human capital (model IV-1). Our excluded instruments are the lagged proportion of educated among natives, and the amount of public education expenditures[18]. To allow comparisons between these models, we use the same sample size of 108 cross-country observations. Finally, we provide a new parsimonious model obtained with the IV technique when the sample size is maximized. This model IV-2 is based on 125 observations for the first equation and 123 for the second.

Empirical findings

Results are presented in Table 3. The first two parsimonious models provide very similar and robust results. The sign and significance levels of all coefficients are stable and the respective R-squared are around 70 and 90 percent. The exogeneity test[19] in the IV-1 model reveals that the natives' proportion of skilled cannot be considered as exogenous in the first equation. This is consistent with the new brain drain literature, which puts forward the positive impact of migration prospects on human capital formation in developing countries. On the contrary, there is no endogeneity problem in the second equation. The Sargan test and Hansen J-test of overidentification confirm that our excluded instruments (lagged proportion and the log of public education expenditures) are both relevant and valid.

[17] We have estimated our model using random-effect panel techniques and using seemingly unrelated regressions (SURE). Results are very similar and can be obtained upon request to the authors. The Hausman test rejects the random-effect hypothesis compared to the fixed-effect model. Hence, the random-effect model is clearly a second-best option. Pooling 1990 and 2000 data or working on 1990 data also gives very similar results.

[18] We use public expenditures in primary education (in US$). Other tests based on expenditures in secondary and tertiary education gives similar results.

[19] We use a Durbin-Wu-Hausman test for the first equation. Since our regressions indicate the presence of heteroskedasticity in the second equation of schooling gap, we use the C-test to obtain a valid endogeneity statistic in a heteroskedastic-robust context (see Baum et al, 2002).

Consequently, the IV model seems appropriate for the first equation of openness. The OLS models provide good results for the second equation. The parsimonious model IV-2 uses the largest number of observations. Adding 20-40 percent of additional observations gives very similar predictions for the majority of variables. Nevertheless, it affects the significance of a couple of variables. By eliminating explanatory variables in the parsimonious models, we retrieve observations from many countries particularly affected by poverty and political instability.

We recommend using the model IV-2 for the first equation. Model OLS-2 provides interesting insights for the second equation. We checked for multicollinearity in all regressions. All our regressions reveal small values for the VIF (variance inflation factor), indicating that there is no real collinearity problem in our regressions[20]. The main results are the following:

- Our empirical analysis confirms that *country size is a key determinant of openness* (see stylized fact #1), but has no effect on the schooling gap. The average emigration rate decreases with population size and is significantly larger in *small developing islands*. This confirms empirical finding #2 described in the previous section.

- The level of development has a very strong effect on openness rates and schooling gaps. Although some collinearity is observed between natives' level of schooling, GNI per capita, the oil exporting dummy and the least developed dummy, the VIF is below the tolerated value. The *natives' proportion of skilled* is the more robust and best predictor of the degree of openness. In developing countries, the higher the proportion of skilled, the higher is the average rate of emigration. This effect can be explained by the fact that educated people can afford paying emigration costs (self-selection) and are more likely to be accepted in host countries given quality-selective immigration policies (out-selection). On the contrary, that proportion of skilled has a negative impact on the schooling gap. This is compatible with stylized facts #1 and #2 discussed in the previous section. The effect on the schooling gap is quantitatively more important than the effect on openness. A simulation exercise reveals that the marginal impact of natives' human capital on the brain drain is always positive, whatever the country size. The lower the natives' proportion of educated, the higher is the brain drain. It explains why poor regions such as sub-Saharan Africa and South-Asia suffer from the brain drain. Controlling for human capital, the *GNI per capita* have a moderated negative impact on the schooling gap under some specifications. Model IV-2 also reveals that *oil exporting countries* exhibit lower emigration rates. The least developed dummy is never significant.

[20] The strongest collinearity concerns the main destination dummies (EU15 and selective countries).

- The socio-political environment has a significant impact on openness. In all regressions, the *religious fractionalization* indicator has a positive and significant impact on the schooling gap. As fractionalization often induces conflicts in developing countries, it suggests that skilled migrants are more sensitive to ethnic and religious tensions. From model IV-2, average emigration rates are also higher in *politically unstable countries*. Government effectiveness as well as many other variables introduced in alternative specifications did not prove to be significant. Fractionalization and political instability are particularly strong in sub-Saharan African countries.

- Proximity significantly affects openness and schooling gap. The *geographic distance* between origin countries and the major host regions reduces the emigration rate and augments the schooling gap (also comforting stylized fact #1). Skilled migrants are less sensitive to distance. We also confirm that the lack of territorial access to the sea, remoteness and isolation from world markets strongly reduce the degree of openness of *landlocked developing countries*. Proximity has a strong impact on the brain drain from Central America, Caribbean and Pacific islands and, to a lower extent, Northern Africa.

- Unsurprisingly, being a *former colony* has a positive effect on openness. It has no significant impact on the schooling gap. It is worth noticing that the effect of colonial links is only obtained in the large samples, but is then highly significant.

- Countries which send most of their migrants to selective countries suffer from stronger schooling gaps. When the *main destination* is the EU15, a positive but less important effect is obtained; this effect is not significant when the sample size is maximized. The literature on migrants' economic assimilation reveals that migrants get a precious return to their language skill. Although Chiswick and Miller (1995) among others found a strong correlation between the language skill and the earning of educated migrants, the effect of linguistic proximity with selective countries on the brain drain is seldom significant.

[INSERT TABLE 3 ABOUT HERE]

IV. CONCLUSION

This paper presents new estimates of the brain drain experienced by developing countries. The new data set relies on census and register data collected in all OECD countries. It provides consistent and reliable information about the loss of human capital in developing regions. We start from a simple multiplicative decomposition of the brain drain in two components. The first one is the

degree of openness of sending countries, as measured by the average or total emigration rate. The second one is the schooling gap, as measured by the relative education level of emigrants compared to natives. We first notice that no country suffers from both strong openness and high schooling gap. We also show that these two variables vary with specific determinants. This justifies our approach based on such a decomposition.

Using OLS and IV regression models, we put forward many significant determinants of these two components. The degree of openness increases with country smallness, natives' human capital, political instability, colonial links and geographic proximity with the major OECD countries. The schooling gap depends on natives' human capital, on the type of destination countries (with or without quality-selective immigration programs), on distances and religious fractionalization at origin. Geographic proximity and natives' human capital have ambiguous effects on the brain drain (they increases openness and reduce the schooling gap). On the whole, the brain drain is stronger in countries which are not too distant from the OECD and where the average level of schooling of natives is low.

Putting these results together allows understanding the causes of the brain drain. Small islands of the Pacific and the Caribbean clearly suffer from their smallness and proximity. Proximity is also a key determinant of the Central American brain drain. Regarding sub-Saharan African countries, they combine various disadvantages such as a low level of development, high political instability and religious/ethnic fractionalization. These results show that the brain drain results from multiple possible causes. Many of them cannot be affected by public interventions (such as proximity, historical links, country size or fractionalization); others could be controlled (such as political indicators and human capital accumulation). Promoting education and improving the political climate at origin are two relevant policy options to reduce the brain drain.

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Table 1: Descriptive statistics by country group (1990-2000)

Group of origin	*Emigration structure*			*Skilled by destination*			*Labor force structure (region of origin)*			*Emigration rates*	
YEAR 2000	Total emigrants (a)	Skilled emigrants (a)	*Share of skilled (in %)*	In selective countries (in %)	In EU15 countries (in %)	In the rest of OECD (in %)	Total Labor Force (a)	Skilled Labor Force (a)	*Share of skilled (in %)*	Total (in %)	Skilled (in %)
World (b)	59,022	20,403	*35*	73	21	6	3,187,233	360,614	*11*	1.8	5.4
High-income countries	19,206	7,547	*39*	68	24	8	666,246	200,607	*30*	2.8	3.6
Developing countries	38,083	12,576	*33*	76	19	5	2,520,987	160,008	*6*	1.5	7.3
Low-income countries	6,544	2,948	*45*	77	21	1	898,768	36,332	*4*	0.7	7.5
Lower medium-income countries	17,053	6,089	*36*	77	17	6	1,298,233	76,981	*6*	1.3	7.3
Upper-medium-income countries	14,486	3,539	*24*	75	20	5	323,987	46,694	*14*	4.3	7.0
Least developed countries	2,510	853	*34*	69	29	2	245,974	5,635	*2*	1.0	13.1
Landlocked developing countries	1,271	470	*37*	63	33	4	129,988	8,892	*7*	1.0	5.0
Small developing islands	4,001	1,504	*38*	90	9	1	24,979	2,041	*8*	13.8	42.4
Large developing countries (>40M)	19,828	6,926	*35*	82	13	5	2,050,014	117,433	*6*	1.0	5.6
YEAR 1990	Total emigrants (a)	Skilled emigrants (a)	*Share of skilled (in %)*	In selective countries (in %)	In EU15 countries (in %)	In the rest of OECD (in %)	Total Labor Force (a)	Skilled Labor Force (a)	*Share of skilled (in %)*	Total (in %)	Skilled (in %)
World (b)	41,845	12,462	*30*	76	17	7	2,369,431	209,225	*9*	1.6	5.0
High-income countries	18,165	5,613	*31*	74	17	9	586,069	139,458	*24*	3.0	3.9
Developing countries	19,402	5,804	*30*	79	17	4	1,783,362	69,767	*4*	1.1	7.7
Low-income countries	3,454	1,267	*37*	77	21	1	677,539	21,291	*3*	0.5	5.6
Lower medium-income countries	8,740	2,883	*33*	81	14	5	938,974	34,948	*4*	0.9	7.6
Upper-medium-income countries	7,208	1,654	*23*	77	19	4	166,848	13,528	*8*	4.1	10.9
Least developed countries	1,384	373	*27*	70	29	2	185,034	3,092	*2*	0.7	10.8
Landlocked developing countries	444	150	*34*	69	29	3	73,330	1,613	*2*	0.6	8.5
Small developing islands	2,595	866	*33*	91	9	1	19,371	1,059	*5*	11.8	45.0
Large developing countries (>40M)	9,312	2,890	*31*	83	13	4	1,430,178	50,707	*4*	0.6	5.4

Notes. (a) Numbers of emigrants aged 25+ in thousand. (b) The world aggregate stock of emigrants sums up emigrants from high-income countries, developing countries, dependent territories and emigrants who did not report their country of birth. Source: Docquier et Marfouk (2006).

Table 2. Decomposition of skilled emigration rates (1990-2000)

Group of origin	*Decomposition*			*Openness by destination (in %)*			*Schooling gap by destination*		
YEAR 2000	Brain drain (in %)	= Openness (in %)	x Schooling gap	To select. countries	To EU15 countries	To the rest of OECD	To select. countries	To EU15 countries	To the rest of OECD
World (a)	**5.3**	1.8	2.99	*1.0*	*0.6*	*0.2*	*3.81*	*1.88*	*1.94*
High-income countries	**3.6**	2.8	1.29	*1.4*	*1.1*	*0.3*	*1.72*	*0.83*	*0.89*
Developing countries	**7.3**	1.5	4.90	*0.9*	*0.5*	*0.1*	*6.14*	*2.97*	*2.95*
Low-income countries	**7.5**	0.7	10.38	*0.4*	*0.3*	*0.0*	*12.98*	*6.18*	*6.24*
Lower medium-income countries	**7.3**	1.3	5.65	*0.7*	*0.4*	*0.1*	*7.73*	*2.94*	*3.18*
Upper-medium-income countries	**7.0**	4.3	1.65	*2.8*	*1.2*	*0.3*	*1.87*	*1.22*	*1.24*
Least developed countries	**13.1**	1.0	13.02	*0.5*	*0.5*	*0.0*	*16.93*	*8.55*	*9.91*
Landlocked developing countries	**5.0**	1.0	5.19	*0.5*	*0.4*	*0.1*	*6.73*	*3.97*	*2.43*
Small developing islands	**42.4**	13.8	3.07	*11.4*	*2.3*	*0.1*	*3.34*	*1.76*	*2.63*
Large developing countries (>40M)	**5.6**	1.0	5.81	*0.7*	*0.2*	*0.1*	*6.77*	*3.57*	*4.54*
YEAR 1990	Brain drain (in %)	= Openness (in %)	x Schooling gap	To select. countries	To EU15 countries	To the rest of OECD	To select. countries	To EU15 countries	To the rest of OECD
World (a)	**5.2**	1.6	3.32	*0.9*	*0.5*	*0.1*	*4.55*	*1.68*	*2.41*
High-income countries	**3.9**	3.0	1.29	*1.6*	*1.0*	*0.4*	*1.79*	*0.65*	*0.93*
Developing countries	**7.7**	1.1	7.14	*0.6*	*0.4*	*0.1*	*9.69*	*3.68*	*5.03*
Low-income countries	**5.6**	0.5	11.08	*0.3*	*0.2*	*0.0*	*16.37*	*5.55*	*6.43*
Lower medium-income countries	**7.6**	0.9	8.26	*0.5*	*0.3*	*0.1*	*11.81*	*3.60*	*5.26*
Upper-medium-income countries	**10.9**	4.1	2.63	*2.7*	*1.3*	*0.2*	*3.21*	*1.69*	*2.44*
Least developed countries	**10.8**	0.7	14.51	*0.3*	*0.4*	*0.0*	*22.25*	*8.80*	*11.29*
Landlocked developing countries	**8.5**	0.6	14.14	*0.3*	*0.3*	*0.0*	*19.30*	*9.51*	*12.78*
Small developing islands	**45.0**	11.8	3.81	*9.6*	*2.6*	*0.1*	*4.43*	*2.55*	*5.41*
Large developing countries (>40M)	**5.4**	0.6	8.34	*0.4*	*0.2*	*0.0*	*10.63*	*3.87*	*6.98*

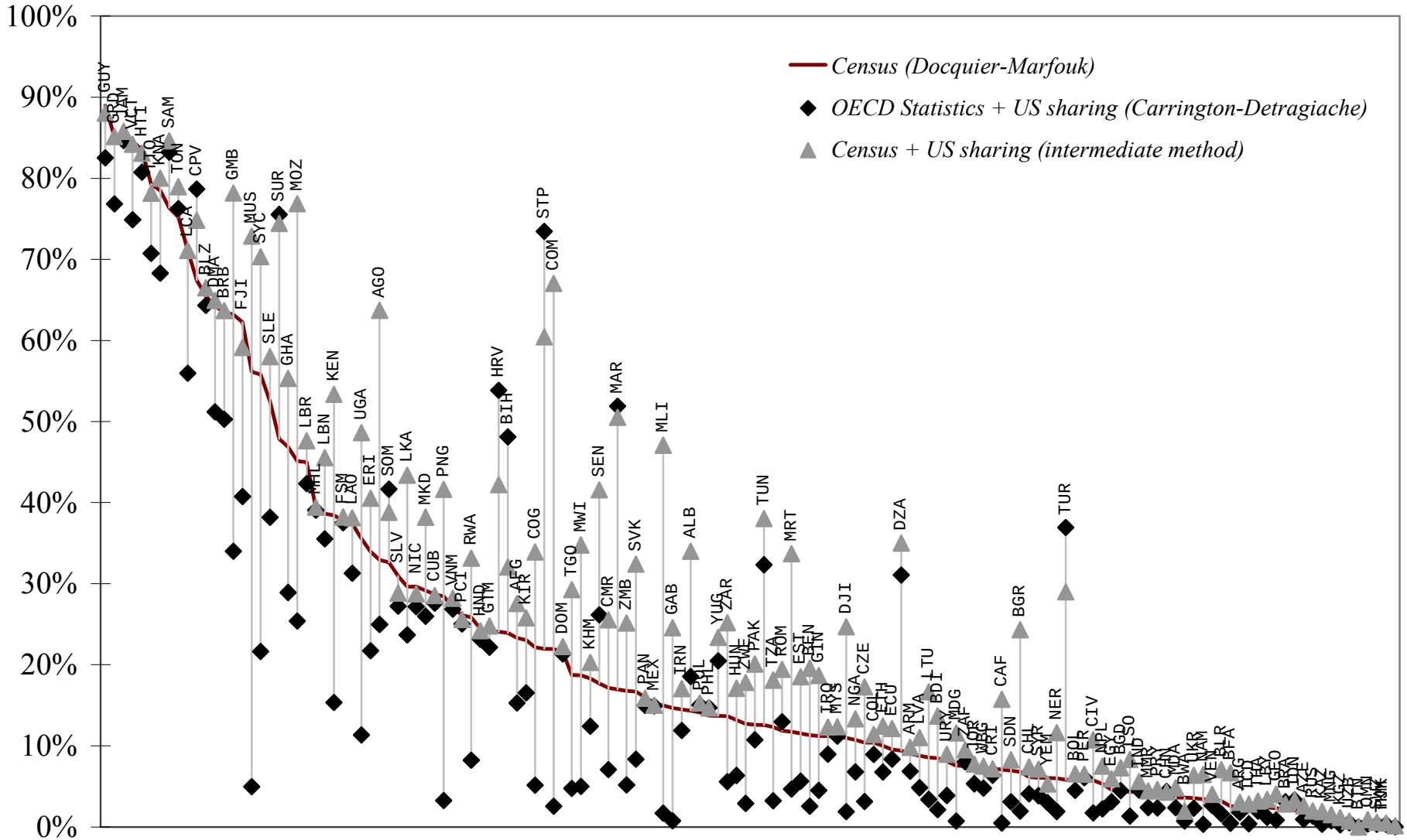
Notes. (a) The world aggregate stock of emigrants sums up emigrants aged 25+ from high-income countries, developing countries, dependent territories and emigrants who did not report their country of birth. Source: own calculations based on Docquier and Marfouk (2006)

Table 3. Cross-section regression results (2000 data)

	OLS-1 *General model*		***OLS-2*** *Parsimonious*		***IV-1*** *Parsimonious*		***IV-2*** *Larger sample*	
	OP (#)	SG (§)	OP (#)	SG (§)	OP (#)	SG (§)	OP (#)	SG (§)
Native population (logs)	-0.156 (1.79)*	0.019 (-0.58)	-0.178 (2.84)***	-	-0.173 (2.51)**	-	-0.153 (2.21)**	-
Small developing islands	0.779 (1.89)*	0.001 (0.00)	0.971 (2.90)***	-	1.013 (2.57)**	-	0.693 (1.81)*	-
Natives' proportion of skilled x 100 (logs)	0.744 (3.06)***	-0.883 (10.1)***	0.526 (4.05)***	-0.871 (11.4)***	0.663 (4.82)***	-0.795 (8.57)***	0.854 (5.01)***	-0.893 (14.8)***
GNI per capita (logs)	-0.129 -0.56	-0.144 (1.67)*	-	-0.091 -1.6	-	-0.135 (1.85)*	-	-
Least developed country	-0.083 (-0.17)	-0.040 (-0.28)	-	-	-	-	-	-
Oil exporting country	-0.650 (-1.57)	0.239 (1.81)*	-	0.161 (-1.23)	-	0.152 (-1.38)	-0.853 (2.67)***	0.188 (1.66)*
Political stability	-0.082 (-0.39)	-0.002 (-0.03)	-	-	-	-	-0.300 (2.19)**	-0.061 (-1.66)*
Government effectiveness	0.007 (-0.03)	0.115 (-1.08)	-	-	-	-	-	-
Religious fractionalization	0.376 (-0.83)	0.545 (3.06)***	-	0.578 (3.88)***	-	0.585 (4.05)***	-	0.509 (3.49)***
Distance from selective countries (logs)	-1.143 (3.17)***	0.358 (2.35)**	-1.078 (3.01)***	0.445 (5.18)***	-0.924 (2.86)***	0.475 (5.09)***	-1.105 (3.82)***	0.479 (5.63)***
Distance from EU15 countries (logs)	-0.428 (3.23)***	0.113 (2.06)**	-0.389 (3.83)***	0.130 (2.39)**	-0.377 (2.96)***	0.139 (2.77)***	-0.398 (3.16)***	0.126 (2.37)**
Landlocked developing country	-0.872 (2.49)**	0.137 (-1.19)	-0.793 (2.37)**	-	-0.721 (2.51)**	-	-0.710 (2.47)**	-
Former colony of an OECD country	0.318 (-1.00)	-0.024 (-0.22)	-	-	-	-	0.553 (2.12)**	-
Main destination = selective countries	-0.001 (0.00)	0.757 (4.17)***	-	0.902 (5.89)***	-	0.920 (2.43)**	-	0.381 (3.80)***
Main destination = EU15	0.154 (-0.38)	0.403 (1.80)*	-	0.537 (3.01)***	-	0.614 (-1.59)	-	-
Same language as selective countries	0.122 (-0.39)	0.154 (-1.63)	-	-	-	-	-	0.136 (1.80)*
Constant	11.672 (2.96)***	-0.794 -0.48	10.863 (3.31)***	-1.942 (1.89)*	9.052 (2.56)**	-2.100 (1.84)*	9.849 (2.93)***	-2.431 (2.38)**
Observations	108	108	108	108	108	108	125	123
Adjusted R-squared	0.67	0.88	0.68	0.88	0.69	0.89	0.68	0.89
Over identif. test (a)	-	-	-	-	0.12	0.13	0.33	0.88
Instrument relevance : p-value of F stat	-	-	-	-	0.000	0.000	0.000	0.000
Exogeneity test(b)	-	-	-	-	0.07	0.26	0.07	0.27

Notes. (#) Logistic transformation of the average emigration rate; (§) schooling gap in logs.
*P-value: * p<0.1, **p<0.05, ***p<0.01; heteroskedastic-robust standard errors for OLS.*
Due to heteroskedasticity, the IV method for the equation of schooling gap is a GMM estimator.
(a) Over identification test : p-value of statistic (Sargan test for the openness and Hansen J test for the schooling gap);
(b) Exogeneity test of natives of proportion skill :p-value of Chi(2) (Durbin-Wu-Hausman test for the openness and C-test for the schooling gap).. List of instruments : lagged level + public expenditures in primary education (in logs)

Figure 1: Skilled emigration rates under 3 measurement methods - all developing countries (2000)



Note. Country codes follow the standard ISO classification (see http://www.iso.org/)

Figure 2. Stylized facts on openness and schooling gaps in 2000

Figure 2.1. Average emigration rate and schooling gap

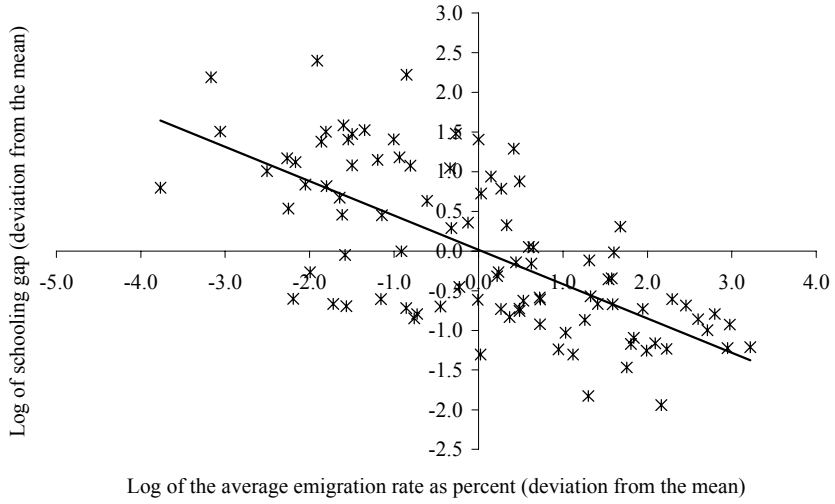


Figure 2.2. Average emigration rate and country size

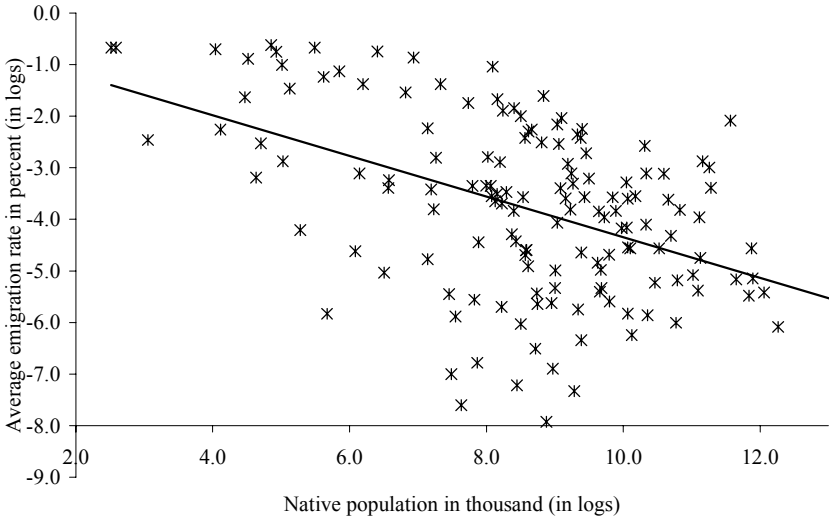
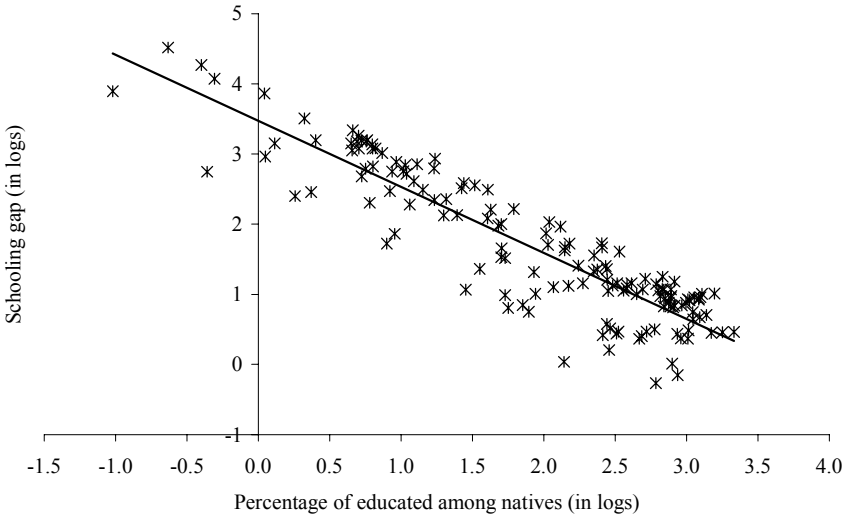


Figure 2.3. Schooling gap and natives' human capital



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