

PART II

BRAIN DRAIN, BRAIN GAIN, BRAIN WASTE

INTERNATIONAL MIGRATION BY EDUCATION ATTAINMENT, 1990–2000

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Introduction

For the last few years, the pace of international migration has accelerated. According to the United Nations (2002), the number of international migrants increased from 154 million to 175 million between 1990 and 2000. The consequences for countries of origin and destination have attracted the increased attention of policy-makers, scientists, and international agencies. The phenomenon is likely to further develop in the coming decades as a part of the world globalization process. The international community must be prepared to address the challenges raised by the increasing mobility of workers. In particular, the migration of skilled workers (the so-called brain drain) is a major piece of the migration debate. The transfer¹ of human resources has undergone extensive scrutiny in developing countries but also in such industrial countries as Canada, the United Kingdom, and Germany, where an important fraction of talented natives is working abroad.

When considering the consequences for countries of origin, early literature supports the view that skilled migration is unambiguously detrimental for those left behind (Grubel and Scott 1966; Johnson 1967; Bhagwati and Hamada 1974; Kwok and Leland 1982). This is the case if the migrants' contribution to the economy is greater than their marginal product or if the education of skilled emigrants was partly funded by taxes on residents. The negative effects of the brain drain for source countries have been reformulated in an endogenous growth framework (Miyagiwa 1991; Haque and Kim 1995; Wong and Yip 1999). More recently, the effects of migration prospects on human capital formation have been the focus of several studies, which suggest that such prospects may in fact foster human capital

formation and growth in sending countries (Mountford 1997; Stark, Helmenstein, and Prskawetz 1998; Vidal 1998; Beine, Docquier, and Rapoport 2001). The authors argue that if the return to education is higher abroad than at home, the possibility of migration increases the expected return of human capital, thereby enhancing domestic enrollment in education.¹ More people, therefore, invest in human capital as a result of increased migration opportunities. This acquisition can contribute positively to growth and economic performance. Along with the incentive to acquire education, other channels through which the brain drain may positively affect the sending economy have also been proposed. These include a range of “feedback effects” such as remittances (Cinar and Docquier 2004), return migration after additional knowledge and skills have been acquired abroad (Stark, Helmenstein, and Prskawetz 1997; Domingues Dos Santos and Postel-Vinay 2003), and the creation of business and trade networks (Dustmann and Kirchkamp 2002; Mesnard and Ravallion 2001). A survey on the “new economics of the brain drain” can be found in Commander, Kangasniemi, and Winters (2004) or Docquier and Rapoport (2004).

Understanding and measuring all the mechanisms at work require reliable data and empirical analysis. Regarding the size and the education structure of international migration, there is a fair amount of evidence suggesting that the brain drain 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 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 Organisation for Economic Co-operation and Development (OECD) countries. Since 1984, Australia’s immigration policy has officially privileged skilled workers, with 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” toward 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 percent of total immigration. In the United States, 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. This is accomplished through a system of quotas favoring candidates with academic degrees 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 is the result of immigration from developing countries, and 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 EU countries are also leaning toward becoming quality selective. As reported in Lowell (2002a), “European Commission President Prodi has called for up to 1.7 million immigrants to fill an 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 United Kingdom) 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 2002b). In February 2000, German 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. More recently, the German Sübmuth Commission recommended the introduction of a coherent flexible migration policy that allows for 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. Given the apparent demographic problems and aging populations, the intensity of the brain drain could continue to increase during the next decades.²

Until recently, despite numerous case studies and anecdotal evidence, there has been no systematic empirical assessment of the brain-drain magnitude. Many institutions consider the lack of harmonized international data on migration by country of origin and education level as the major problem for monitoring the scope and impact of brain drain in developing areas.³ In the absence of such empirical data, the debate has remained almost exclusively theoretical. In their influential contribution, Carrington and Detragiache (1998, 1999) provided estimates of the emigration rates of tertiary educated workers for 61 developing countries. These estimates are based on three main statistical sources: U.S. Census data on the skill structure of immigration, OECD data on immigration per country of origin, and Barro and Lee (2000) data describing the skill structure in sending countries. The estimates rely on a set of assumptions. First, for non-U.S. countries, they use OECD migration statistics, which report limited information on the origin of immigrants.⁴ Second, they transpose the skill structure of U.S. immigrants on the OECD total immigration stock. For example, migrants from Morocco to France are assumed to be distributed across education categories in the same way

as migrants from Morocco to the United States. This assumption is particularly tentative for countries that do not send many migrants to the United States. Relying on OECD statistics produced an average underestimation of 8.9 percent in skilled-worker migration rates in 2000 (this is the major source of bias, especially for small countries). Imposing the U.S. education structure on other OECD countries produced an average overestimation of 6.3 percent in skilled-worker migration rates in 2000 (the bias is obviously strong in countries sending a minor percentage of their emigrants to the United States). On average, we demonstrate that Carrington and Detragiache's (1998, 1999) method underestimated the emigration rates of skilled workers by 2.6 percent in 2000. While it seems rather small, the overall bias is heterogeneously distributed across countries. It ranges from about +51.5 percent for São Tomé and Príncipe to -51.2 percent for Mauritius.⁵ Adams (2003) used the same methodology to update the emigration rates of 24 labor-exporting countries in 2000. Beine, Docquier, and Rapoport (2003) used Carrington and Detragiache's data to predict the growth impact of the brain drain. Yet, given the assumptions, the evidence concerning the consequences of skilled migration for developing countries remains not only limited but also largely inconclusive.

The purpose of this chapter is to build an exhaustive international database on international migration by education attainment. This data set describes the loss of skilled workers (in absolute and relative terms) for all developing and developed countries. The majority of highly skilled workers go to industrial countries. We focus on the south-north and north-north brain drain. We are aware that a brain drain is evident outside the OECD area—migration of skilled workers to the six member states of the Gulf Cooperation Council (Bahrain, Kuwait, Oman, Qatar, Saudi Arabia, and the United Arab Emirates) and also to South Africa, Malaysia, Hong Kong (China), Singapore, and Taiwan (China). At this stage, however, we do not take these flows into account. According to the United Nations (2002), migration to developed countries represented 53 percent of world migration in 1990 and 60 percent in 2000. Highly skilled migration is even more concentrated. Given census data collected from various non-OECD countries, we estimate that about 90 percent of these highly skilled migrants live in 1 of the 30 member states of the OECD.

We use data on the immigration structure by education attainment and country of birth from all OECD receiving countries. Census and register data are available in nearly all OECD countries. This chapter clearly builds on Release 1.0 (Docquier and Marfouk 2004), which was the first attempt to evaluate migration stocks and rates by education attainment on an exhaustive scale.⁶ In comparison to Release 1.0 (which built on survey data for 12 European countries), we significantly extend the quality of the data. Special attention has been paid to the homogeneity

and the comparability of the data (definition of immigration, comparability between immigration and human capital indicators, treatment of the dependent territories, homogeneity of the data sources). Consequently, we characterize (on a very homogeneous basis) the country of origin and education attainment of more than 98 percent of the OECD stock of working-age adults in 2000. Focusing on tertiary educated migrants (defined as working-age migrants with more than a secondary school diploma), our calculations reveal that the stock of educated immigrants has increased by about 800,000 a year between 1990 and 2000 (the total stock of migrants has increased by about 1.7 million a year). Our country measures can be used to examine the changes in the international distribution of migration rates, to test for the (push-and-pull) determinants per skill group, or to evaluate the macroeconomic consequences of migration on source and destination countries.

The remainder of this chapter is organized as follows. The second section describes the methodology. Results for 1990 and 2000 are presented in the third section. The fourth section focuses on OECD countries and provides the net gains and losses of skilled workers (in percentage of the working-age population). The fifth section concludes this chapter. Country classifications, and comparisons with previous studies are given in annex 5.A.

Definition, Principles, and Data Sources

This section describes the methodology and data sources used to compute emigration stocks and rates by education attainment and origin country in 1990 and 2000. In what follows, the term “country” usually designates independent states while “dependent territory” refers to other entities attached to a particular independent state. Our 2000 data set distinguishes 192 independent territories (Vatican City and the 191 UN member states, including Timor-Leste, which became independent in 2002) and 39 dependent territories. Stocks are provided for both types of territories while rates are only provided for independent countries as well as three dependent territories, which are treated as economies—Hong Kong (China), Macao SAR, and Taiwan (China)—and one occupied territory (Palestine). Because most of the Korean migrants to the United States did not accurately report their origin, we cannot distinguish between the Republic of Korea and Democratic People’s Republic of Korea (estimates are provided for Korea as a whole). We distinguish 174 countries in 1990, before the secession of the Soviet bloc, the former Yugoslavia, the former Czechoslovakia, the independence of Eritrea and Timor-Leste, and the German and the Republic of Yemen reunifications.⁷

For economic and statistical reasons, working on stocks is more attractive than working on flows. Stock variables are more appropriate to analyze the endogeneity

and the dynamics of migration movements (the equilibrium values are often expressed in terms of stocks). Regarding statistics, it has long been recognized that migration flow data are less reliable than stock data, because of the impossibility of evaluating emigration and return migration movements.

We count as migrants all working-age (25 and over) foreign-born individuals living in an OECD country.⁸ Skilled migrants are those who have at least tertiary education attainment wherever they completed their schooling. Our methodology proceeds in two steps. We first compute emigration stocks by education attainment from all countries of the world. Then, we evaluate these numbers in percentage of the total labor force born in the sending country (including the migrants themselves). This definition of skilled migrants deserves two main comments.

First, the set of receiving countries is restricted to OECD nations. Compared with existing works (such as *Trends in International Migration*, OECD 2002), our database reveals many insights about the structure of south-north and north-north migration. Generally speaking, the skill level of immigrants in non-OECD countries is expected to be very low, except in a few countries such as South Africa (1.3 million immigrants in 2000), the six member states of the Gulf Cooperation Council (9.6 million immigrants in Saudi Arabia, the United Arab Emirates, Kuwait, Bahrain, Oman, and Qatar), and some Eastern Asian countries (4 million immigrants in Hong Kong (China) and Singapore only). According to their census and survey data, about 17.5 percent of adult immigrants have tertiary education in these countries (17 percent in Bahrain, 17.2 percent in Saudi Arabia, 14 percent in Kuwait, 18.7 percent in South Africa). Considering that children constitute 25 percent of the immigration stock, we estimate the number of educated workers at 1.9 million in these countries. The number of educated immigrants in the rest of the world lies between 1 and 4 million (if the average proportion of educated immigrants among adults lies between 2.5 and 10 percent). This implies that, focusing on OECD countries, we should capture a large fraction of the worldwide educated migration (about 90 percent). Nevertheless, we are aware that by disregarding non-OECD immigration countries, we probably underestimate the brain drain for a dozen developing countries (such as the Arab Republic of Egypt, Sudan, Jordan, the Republic of Yemen, Pakistan, or Bangladesh in the neighborhood of the Gulf states, and Swaziland, Namibia, Zimbabwe, and other countries that send emigrants to South Africa, and so on). Incorporating data collected from selected non-OECD countries could refine the data set.

Second, we have no systematic information on the age of entry. It is therefore impossible to distinguish between immigrants who were educated at the time of their arrival and those who acquired education after they settled in the receiving country; for example, Mexican-born individuals who arrived in the United States

at age 5 or 10 and graduated from U.S. higher-education institutions are counted as highly skilled immigrants. Hence, our definition of the brain drain is partly determined by data availability. Existing data do not allow us to systematically eliminate foreign-born individuals who arrived with completed schooling or after a given age threshold. In the United States, the proportion of foreign-born individuals who arrived before age 10 represents 10 percent of the immigration stock (16 percent for those who arrived before age 16). This average proportion amounts to 13 percent among skilled immigrants (20.4 for age 16). Important differences are observed across countries. The share is important for high-income and Central American countries (about 20 percent). It is quite low for Asian and African countries (about 9 percent). Having no systematic data for the other receiving countries, we cannot control for familial immigration. Our database includes these individuals who arrived at young age. Our choice is also motivated by several reasons: (a) our numbers are comparable to traditional statistics on international migration, which include all migrants whatever their age of entry; (b) it is impossible to quantify the share of these young immigrants who were partly educated in their birth country and/or who arrived with foreign fellowships; and (c) young immigrants who spent part of their primary or secondary schooling in the origin country or who got foreign schooling fellowships induced a fiscal loss for their origin country.

Emigration Stocks

It is well documented that statistics provided by origin countries do not provide a realistic picture of emigration. When available, they are incomplete and imprecise.⁹ While detailed immigration data are not easy to collect on an homogeneous basis, information on emigration can only be captured by aggregating consistent immigration data collected in receiving countries. Information about the origin and skill of natives and immigrants is available from national population censuses and registers. More specifically, country i 's census usually identifies individuals on the basis of age, country of birth j , and skill level s . Our method consists of collecting census or register data from a large set of receiving countries, with the highest level of detail on birth countries and (at least) three levels of education attainment: $s=h$ for high-skilled, $s=m$ for medium-skilled, $s=l$ for low-skilled and $s=u$ for the unknowns. Let $M_{i,s}^{i,j}$ denote the stock of working-age individuals born in j , of skill s , living in country i , at time t .

Low-skilled workers are those with primary education (or with 0 to 8 years of schooling completed); medium-skilled workers are those with secondary education (9 to 12 years of schooling); high-skilled workers are those with tertiary education (13 years and above). The unknowns are either the result of the fact that

some immigrants did not declare their education attainment or the result of the absence of data on education in some receiving countries. Education categories are built on the basis of country-specific information and are compatible with human capital indicators available for all sending countries. A mapping between the country education classification is sometimes required to harmonize the data.¹⁰ Some statistics offices have difficulties determining the education level of their immigrants.¹¹ By focusing on census and register data, our methodology does not capture illegal immigration for which systematic statistics by education level and country of origin are not available.¹² According to the U.S. Immigration and Naturalization Services, the illegal population residing in the United States amounted to 3.5 million in January 1990 and 7.0 million in January 2000. It is even possible to identify the main countries of origin (in 2000, 68.7 percent were from Mexico, 2.7 percent from El Salvador, 2.1 percent from Guatemala, 2.0 percent from Colombia and Honduras, and so on).¹³ However, there is no accurate data about the education structure of these illegal migrants. For the other member states of the OECD, data on illegal immigration are less reliable or do not exist. By disregarding illegal migrants, we probably overestimate the average level of education of the immigrant population (it can be reasonably assumed that most illegal immigrants are uneducated). Nevertheless, this limit should not significantly distort our estimates of the migration rate of highly skilled workers.

As far as possible, we turn our attention to the homogeneity and the comparability of the data. This provides a few methodological choices:

- To allow comparisons between 1990 and 2000, we consider the same 30 receiving countries in 1990 and 2000. Consequently, the former Czechoslovakia, Hungary, the Republic of Korea and Democratic People's Republic of Korea, Poland, Mexico, and Turkey are considered as receiving countries in 1990 despite the fact that they were not members of the OECD.
- Migration is defined on the basis of the country of birth rather than citizenship. While citizenship characterizes the foreign population, the concept of foreign-born individuals better captures the decision to emigrate.¹⁴ Usually, the number of foreign-born individuals is much higher than the number of foreign citizens (twice as large in countries such as Hungary, the Netherlands, and Sweden).¹⁵ Furthermore, the concept of country of birth is time-invariant (contrary to citizenship, which changes with naturalization) and independent of the changes in policies regarding naturalization. The OECD statistics report that 14.4 million foreign-born individuals were naturalized between 1991 and 2000. Countries with a particularly high number of acquisitions of citizenship are the United States (5.6 million), Germany (2.2 million), Canada (1.6 million), and France (1.1 million). Despite the fact that they are partially reported

in traditional statistics (OECD 2002), the number of foreign-born individuals can be obtained for a majority of OECD countries. In a limited number of cases, the national census only gives immigrants' citizenship (Germany, Italy, Greece, Japan, and the Republic of Korea and the Democratic People's Republic of Korea). As indicated in table 5.2, 88.3 percent of working-age immigrants can be characterized in terms of country of birth in 2000 (11.7 percent in terms of citizenship). Contrary to common belief, data availability is not significantly different in 1990, even among European states. We obtain information about country of birth for 88 percent of working-age immigrants in 1990 (12 percent in terms of citizenship).

- It is worth noting that the concept of foreign born is not fully homogeneous across OECD countries. As in many OECD countries, our main criterion relies on country of birth and citizenship at birth: we define foreign born as an individual born abroad with foreign citizenship at birth. For example, the U.S. Census Bureau considers as natives children who are born in the United States (as well as in Puerto Rico or U.S. dependent territories, such as the U.S. Virgin Islands and Guam), or who are born abroad from a U.S. citizen.¹⁶ Other residents are considered foreign born. France and Denmark use a similar concept. Statistics Netherlands defines first-generation immigrants as people who are born abroad and have at least one parent who is also born abroad (Alders 2001). However, in a few countries (for example, Australia, New Zealand, and Belgium), the foreign-born concept used by the Statistics Institute essentially means "overseas born," that is, an individual simply born abroad. While it is impossible to use a fully comparable concept of immigration, we have tried to maximize the homogeneity of our data sources. It is worth noting that our definition clearly excludes the second generation of immigrants. A couple of countries offer a more detailed picture of immigration, distinguishing the foreign born from those with foreign backgrounds (basically immigrants' descendants born locally from one of two foreign-born parents).¹⁷
- As discussed above, emigration rates are provided for 195 territories in 2000 (191 UN member states, Vatican City, Palestine, Hong Kong (China), Taiwan (China), and Macao SAR minus the Democratic People's Republic of Korea). The world configuration has changed between 1990 and 2000. The former Czechoslovakia divided and became the Czech Republic and the Slovak Republic; the former Soviet Union collapsed, leading to the formation of 15 countries (7 on the European continent and 8 on the Asian continent); the former Yugoslavia broke into 5 countries; Eritrea and Timor-Leste emerged as independent countries in 1993 and 2002. East and West Germany and the Democratic Republic and the Republic of Yemen were each unified. Consequently, for this study, we distinguished 174 countries in 1990 (the former Soviet Union

replaces 15 countries, the former Yugoslavia replaces 5 countries, and the former Czechoslovakia replaces 2 countries). For homogeneity reasons, we aggregated East and West Germany as well as the Democratic Republic and the Republic of Yemen in 1990. In 1990, the former Soviet Union totally belonged to the European area.¹⁸

- A related issue concerns the dependent territories. Each dependent territory is linked to a nation. Individuals born in these territories have the unrestricted right to move to and to live in the nation. We naturally consider them as natives of the sovereign nation. Once the category of foreign born is chosen, it means that these individuals should not be considered as immigrants if they move to the sovereign state (internal migration). They should only be considered as immigrants if they move to another independent state (external migration). This criterion is especially important for U.S. dependent territories (Puerto Rico, Guam, and so on), U.K. overseas territories (Bermuda, Anguilla, and so on), French dependent territories (Guadalupe, Reunion, and so on), Denmark (Greenland and the Faroe Islands, and so on), or around Australia and New Zealand (Cook Islands, Niue, Tokelau, and so on). For example, in accordance with the U.S. Census Bureau definition, we consider that the 1 million Puerto Ricans living in the United States are U.S. natives but not immigrants. This considerably reduces the total stock of Puerto Rican emigrants. We have computed on the same basis the emigration stock for the other dependent territories—except for Taiwan (China), Hong Kong (China), and Macao SAR—which are assimilated to independent countries. Then, given the small numbers obtained, we have eliminated the Northern Mariana Islands and Western Sahara (a disputed rather than dependent territory) and have summed up Jersey and Guernsey (forming the Channel Islands).
- Because the second step of our analysis consists of comparing the numbers of emigrants and residents by education attainment, we have to consider homogeneous groups. Working with the working-age population (age 25 and over) maximizes the comparability of the immigration population with data on education attainment in source countries. It also excludes a large number of students who temporarily emigrate to complete their education. We cannot control for graduate students age 25 and over completing their schooling.¹⁹ As shown in table 5.1, this age group is slightly different in a limited number of countries.

Building an aggregate measure of emigration per education attainment requires a rule for sharing the unknown values. At the OECD level, the number of migrants whose education attainment is not described amounts to 1.287 million, that is, 2.2 percent of the total stock. Two reasonable rules could be considered:

either unknown values can be distributed in the same way as the known values, or they can be assimilated as unskilled. We combine both rules depending on the information available in the receiving country. For receiving countries where information about immigrants’ education is available, we assimilate the unknowns to unskilled workers.²⁰ For example, Australian immigrants who did not mention their education attainment are considered unskilled. In receiving countries where no information about skill is available, we transpose the skill distribution observed in the rest of the OECD area or in the neighboring region. For example, if we have no information about the skill structure of immigrants to Iceland, Algerian emigrants to Iceland are assumed to be distributed the same way as Algerian emigrants to all other Scandinavian countries. The assumptions will be discussed below.

Formally, the stocks of emigrants of skill s from country j at time t ($M_{t,s}^j$) are obtained as follows:

$$\begin{aligned}
 M_{t,h}^j &= \sum_i M_{t,h}^{i,j} + \sum_i M_{t,u}^{i,j} \gamma_t^{i,j} \frac{\sum_i M_{t,h}^{i,j}}{\sum_i [M_{t,l}^{i,j} + M_{t,m}^{i,j} + M_{t,h}^{i,j}]} \\
 M_{t,m}^j &= \sum_i M_{t,h}^{i,j} + \sum_i M_{t,u}^{i,j} \gamma_t^{i,j} \frac{\sum_i M_{t,m}^{i,j}}{\sum_i [M_{t,l}^{i,j} + M_{t,m}^{i,j} + M_{t,h}^{i,j}]} \\
 M_{t,l}^j &= \sum_i M_{t,h}^{i,j} + \sum_i M_{t,u}^{i,j} \gamma_t^{i,j} \frac{\sum_i M_{t,l}^{i,j}}{\sum_i [M_{t,l}^{i,j} + M_{t,m}^{i,j} + M_{t,h}^{i,j}]} + \sum_i M_{t,u}^{i,j} (1 - \gamma_t^{i,j})
 \end{aligned}
 \tag{5.1}$$

where γ_t^j is a (time- and country-dependent) binary variable equal to 1 if there is no data on the immigrants’ skill in country i , and equal to 0 otherwise.

Table 5.1 describes the data sources. In 2000, we use census, microcensus, and register data for 29 countries. European Council data are used in the case of Greece. Information on the country of birth is available for the majority of countries, representing 88.3 percent of the OECD immigration stock. Information on citizenship is used for the remaining countries (Germany, Italy, Greece, Japan, and the Republic of Korea and the Democratic People’s Republic of Korea). The education structure can be obtained in 24 countries and can be estimated in 3 additional countries (Belgium, Greece, and Portugal) on the basis of the European

TABLE 5.1 Data Sources

Country (age group)	1990 (+)		2000 (+)	
	Origin	Education	Origin	Education
Australia (25+)	Census (#)	Census (#)	Census (#)	Census (#)
Austria (25+)	Census	Census	Census	Census
Belgium (25+)	Census	Census	Improved EC (**)	LFS
Canada (25+)	Census (#)	Census (#)	Census (#)	Census (#)
Czech Republic (25+)	Census (#)	—	Census (#)	Census (#)
Denmark (25+)	Register	Register	Register	Register
Finland (25+)	Register	Register	Register	Register
France (25+)	Census (#)	Census (#)	Census (#)	Census (#)
Germany (25–65)	Microcensuz* (Cit)	Microcensuz* (Cit)	Microcensuz* (Cit)	Microcensuz* (Cit)
Greece (25+)	EC (Cit)	LFS (Cit.)	EC (Cit)	LFS (Cit.)
Hungary (All;25+)	EC (Cit)	—	Census	Census
Iceland (All)	Register	—	Register	—
Ireland (25+)	Census	Census	Census	Census
Italy (25+)	EC (Cit)	—	Census (Cit)	Census (Cit)
Japan (All/25+)	Register (Cit)	—	Census (Cit)	—
Korea, Rep of (All)	Register (Cit)	—	Register (Cit)	—
Luxembourg (25+)	Census (#)	Census (#)	Census (#)	Census (#)
Mexico (25+)	Ipums (+) 10%	Ipums (+) 10%	Ipums (+) 10.6%	Ipums (+) 10.6%
Netherlands (All)	Census*	Census*	Census*	Census*
New Zealand (15+)	Census	Census	Census	Census
Norway (25+)	Register	Register	Register	Register

Poland (13+)	Census (#)	—	Census (#)	Census (#)
Portugal (25+)	Census	LFS	Census	LFS
Slovak Republic (25+)	See Czech Republic	See Czech Republic	Census (#)	Census (#)
Spain (25+)	Census	Census	Census	Census
Sweden (25+)	Census	Census	Census	Census
Switzerland (18+)	Census (#)	Census (#)	Census (#)	Census (#)
Turkey (15+)	Census (#)	Census (#)	Census (#)	Census (#)
United Kingdom (15+)	Census*	Census*	Census*	Census*
United States (25+)	Ipums (+) 5%	Ipums (+) 5%	Census 100%*	Census 100%*

Source: Various statistical sources and agencies.

Notes: EC = European Council (register data); LFS = Labor Force Survey; (*) = limited level of detail. (**) European Council data corrected by the country-specific "foreign born/foreign citizen" ratio in Census 1991. (+) Year around 1990 and 2000 (for example, the Australian censuses refer to 1991 and 2001) (#) Data available in Release 1.0. (+) See Ruggles et al. (2004) on the United States and Sobek et al. (2002) on the Mexican sample.

TABLE 5.2 International Mobility by Education Attainment—An Overview

	1990		2000	
Total stock of migrants in OECD countries	41.845	% of stock (*)	59.022	% of stock (*)
Information about country of origin	41.845	100.0%	59.022	100.0%
including information about country of birth	36.812	88.0%	52.145	88.3%
including information about citizenship	5.033	12.0%	6.878	11.7%
Information about educational attainment	38.169	91.2%	57.900	98.1%
including "education not described"	1.576	3.8%	1.287	2.2%
including Labor Force Survey data	0.283	0.7%	1.181	2.0%
Migrants with tertiary education	12.462	29.8%	20.403	34.6%
including skilled migrants to the United States (*)	6.203	49.8%	10.354	50.7%
including skilled migrants to Canada (*)	1.879	15.1%	2.742	13.4%
including skilled migrants to Australia (*)	1.110	8.9%	1.540	7.5%
including skilled migrants to the United Kingdom (*)	0.570	4.6%	1.257	6.2%
including skilled migrants to Germany (*)	0.556	4.5%	0.996	4.9%
including skilled migrants to France (*)	0.300	2.4%	0.615	3.0%
Migrants with secondary education	10.579	25.3%	17.107	29.0%
Migrants with less than secondary education	18.804	44.9%	21.512	36.4%
World total labor force (independent territories only)	2568.229	% of labor force	3187.233	% of labor force
World labor force with tertiary education	234.692	9.1%	360.614	11.3%
World labor force with secondary education	755.104	29.4%	945.844	29.7%
World labor force with less than secondary education	1578.433	61.5%	1880.775	59.0%
World average emigration rate - tertiary education	5.0%	—	5.4%	—
World average emigration rate - secondary education	1.4%	—	1.8%	—
World average emigration rate - less than secondary education	1.2%	—	1.1%	—

	657.718	% of all groups	750.089	% of all groups
OECD total labor force				
OECD labor force with tertiary education	144.050	21.9%	207.352	27.6%
OECD emigrants with tertiary education	6.094	26.7%	8.533	30.2%
OECD average emigration rate - tertiary education	4.1%	—	4.0%	—
Non-OECD total labor force	1910.511	% of all groups	2437.144	% of all groups
Non-OECD labor force with tertiary education	90.642	4.7%	153.262	6.3%
Non-OECD emigrants with tertiary education	6.367	33.5%	11.870	38.6%
Non-OECD average emigration rate - tertiary education	6.6%	—	7.2%	—

Source: Various statistical sources and agencies.

Note: (*) Percentage of the stock of skilled immigrants only.

—not available.

Labor Force Survey. As shown in table 5.2, data built on the Labor Force Survey represent only 2 percent of the OECD migration stock in 2000 (0.7 percent in 1990). In the three remaining countries, the education structure is extrapolated on the basis of the Scandinavian countries (for Iceland) or the rest of the OECD (for Japan and the Republic of Korea and the Democratic People's Republic of Korea). In 1990, European Council data were used for Hungary and Italy. These data are based on the concept of citizenship. Compared with 2000, education attainment was not available in Italy, the Czech Republic, and Hungary. The Italian education structure is based on the rest of the EU-15. For the other two countries, we use proportions computed from the rest of Europe. Information from the Belgian 1991 Census is available and provides complete data by country of birth and education attainment.

Emigration Rates

In the spirit of Carrington and Detragiache (1998) and Adams (2003), our second step consists of comparing the emigration stocks with the total number of people born in the source country and belonging to the same education category. Calculating the brain drain as a proportion of the total educated labor force is a better strategy to evaluate the pressure imposed on the local labor market. The pressure exerted by 1,037,000 Indian skilled emigrants (4.3 percent of the educated total labor force) is less important than the pressure exerted by 16,000 skilled emigrants from Grenada (85 percent of the educated labor force).

Denoting $N_{t,s}^j$ as the stock of individuals age 25 or over, of skill s , living in country j , at time t , we define the emigration rates by the following.

$$m_{t,s}^j = \frac{M_{t,s}^j}{N_{t,s}^j + M_{t,s}^j} \quad (5.2)$$

In particular, $m_{t,s}^j$ provides some information about the intensity of the brain drain in the source country j . It measures the fraction of skilled agents born in country j and living in other OECD countries.²¹

This step requires using data on the size and the skill structure of the working-age population in the countries of origin. Population data by age are provided by the United Nations.²² We focus on the population age 25 and older. Data are missing for a couple of countries but can be estimated using the Central Intelligence Agency *World Factbook* Web site.²³ Population data are split across education groups using international human capital indicators. Several sources based on attainment and/or enrollment variables can be found in the literature. These data sets suffer from two important limits. First, data sets published in the 1990s reveal

a number of suspicious features and inconsistencies.²⁴ Second, given the variety of education 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 education structure in both developed and developing countries. The latter data set focuses only on 21 OECD countries (De la Fuente and Domenech 2002). Statistical comparisons between these sets reveal that the highest signal/noise ratio is obtained in De la Fuente and Domenech. These tests are conducted in OECD countries. Regarding developing countries, Cohen and Soto's set (2001) outperforms Barro and Lee's set (2000) in growth regressions. However, Cohen and Soto's data for Africa clearly underestimate official statistics. 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 reports the share of educated individuals at 2 percent, while Cohen and Soto report 0.9 percent (1.2 percent for Barro and Lee).

Generally speaking, the Cohen and Soto data set predicts extremely low levels of human capital for African countries²⁵ (the share with tertiary education is lower than 1 percent in a large number of African countries) and a few other non-OECD countries.²⁶ The Barro and Lee estimates seem closer to the African official statistics. As the brain drain is particularly important in African countries, Barro and Lee's indicators are preferable. Consequently, data for $N_{i,s}^j$ are taken from De la Fuente and Domenech (2002) for OECD countries and from Barro and Lee (2000) for non-OECD countries. For countries where Barro and Lee measures are missing (about 70 countries in 2000), we transpose the skill-sharing level of the neighboring country with the closest human development index regarding education. This method gives good approximations of the brain drain rate, which are broadly consistent with anecdotal evidence.

The Database 1990–2000

World Migration—An Overview

Table 5.2 depicts the major trends regarding the international mobility of the working-age population. The number of working-age individuals born in one country and living in another country increased from 42 million in 1990 to 59 million in 2000, that is, by 1.7 million a year. Regarding the education structure of migrants, skilled workers are much more concerned with international migration. At the world level in 2000, highly skilled immigrants represented 34.6 percent of the OECD immigration stock, while only 11.3 percent of the world labor force

had tertiary education. Between 1990 and 2000, the percentage of skilled workers among immigrants increased by 4.8 percentage points (from 29.8 percent to 34.6 percent). In 2000, the number of migrants with tertiary education living in the OECD countries amounted to about 20.4 million.

The share of migrants who completed their secondary school degree increased from 25.3 to 29.0 percent. Consequently, low-skilled migration becomes increasingly less important in relative terms (44.9 percent in 1990 and 36.4 percent in 2000). In absolute terms, the size of all groups has increased. More than 85 percent of OECD skilled immigrants live in one of the six largest immigration countries. About half of these immigrants are living in the United States; 13.4 percent live in Canada, 7.5 percent in Australia, 6.2 percent in the United Kingdom, 4.9 percent in Germany, and 3 percent in France. Contrary to other major receiving countries, the proportions of high-skilled migrants have decreased in Canada and Australia between 1990 and 2000.

Such a change in the education structure of migration can be related to the global change observed in the world labor force structure. The world potential labor force (defined as the population age 25 and more, including retirees) has increased from 2.6 billion to 3.2 billion between 1990 and 2000. Over this period, the share of workers with tertiary education increased by 1.8 percentage points and the share of low-skilled workers has decreased by 2.5 points. Comparing immigrants with the rest of the population, the world average emigration rate increased from 5.0 to 5.4 percent among the highly skilled and from 1.4 to 1.8 percent for the medium skilled. A slight decrease (from 1.2 to 1.1 percent) was observed for low-skilled workers.

These global trends hide important differences across countries and country groups. Table 5.2 distinguishes emigrants from OECD and non-OECD countries. Between 1990 and 2000, the number of highly skilled emigrants from OECD countries increased less than the number of working-age highly skilled residents. The average emigration rate of OECD highly skilled workers decreased from 4.1 to 4.0 percent. Regarding non-OECD countries, the number of highly skilled emigrants increased more than the number of highly skilled residents. The skilled migration rate increased from 6.6 to 7.2 percent in non-OECD countries.

Clearly, the international mobility of skilled workers is a crucial issue for middle- and low-income countries, mainly because their share of tertiary educated workers remains low compared with high-income countries. Antecol, Cobb-Clark, and Trejo (2003) also confirm these results by comparing the stock of immigrants who arrived after 1985 in the United States, Canada, and Australia. They show that low-income countries have been strongly affected by the recent brain drain. In all OECD areas, the percentage of skilled immigrants coming from

low-income countries (such as India, China, Vietnam, Pakistan, and Indonesia) increased between 1990 and 2000, especially in North America.

Stylized Facts by Country Group

Let us now focus on more detailed figures by country group. Table 5.3 provides basic indicators of migration and education attainment by country group in 2000 (the definition of these groups is provided in annex 5.A):

- Countries are classified by country size on the basis of total population data (more than 25 million for large countries, between 10 and 25 million for upper-middle countries, between 2.5 and 10 million for lower-middle countries, and less than 2.5 million for small countries).
- They are classified by income group: we use World Bank classifications distinguishing high-income, upper-middle income, lower-middle income, and low-income countries.
- They are classified by geographic area: we distinguish four American areas (North America, the Caribbean, Central America, and South America), four European areas (Northern Europe, Western Europe, Eastern Europe, and Southern Europe), five African areas (Northern Africa, Central Africa, Western Africa, Eastern Africa, and Southern Africa), four Asian areas (Western Asia, South-Central Asia, South-Eastern Asia, and Eastern Asia) and four areas in Oceania (Australia and New Zealand, Melanesia, Micronesia, and Polynesia).
- Some groups of political interest are also provided: Middle East and North African countries (MENA), economies in transition, the EU-15 members, Sub-Saharan African countries, Islamic countries (members of the Organization of Islamic Countries, OIC), Arab countries (members of the Arab League), the least developed countries (UN definition), landlocked developing countries (UN definition), and small island developing countries (UN definition).

For these groups, we compute their share in the total OECD immigration stock (total and skilled migrants), their average emigration rate (total and skilled migrants), and the share of skilled workers among emigrants (a measure of selection) and residents.

Regarding size groups, the share in the OECD stock is obviously increasing with the country size. It is noteworthy that the share of lower-middle-size countries exceeds the share of upper-middle-size countries. In relative terms, we obtain a decreasing relationship between emigration rates and country population sizes. The average rate in small countries is seven times larger than the average rate in

TABLE 5.3 Data by Country Group in 2000

	Share in the OECD stock (*)		Rate of emigration		Share of skilled workers	
	Total	Skilled	Total	Skilled	Among residents	Among migrants
By country size						
Large countries (Pop > 25 million)	60.6%	63.9%	1.3%	4.1%	11.3%	36.4%
Upper-middle (25 > Pop > 10)	15.8%	15.2%	3.1%	8.8%	11.0%	33.2%
Lower-middle (10 > Pop > 2.5)	16.4%	15.7%	5.8%	13.5%	13.0%	33.1%
Small countries (Pop < 2.5)	3.7%	3.7%	10.3%	27.5%	10.5%	34.7%
By income group						
High-income countries	30.4%	33.7%	2.8%	3.5%	30.7%	38.3%
Upper-middle income countries	24.3%	17.7%	4.2%	7.9%	13.0%	25.2%
Lower-middle income countries	26.6%	27.2%	3.2%	7.6%	14.2%	35.4%
Low-income countries	15.1%	19.8%	0.5%	6.1%	3.5%	45.1%
By group of particular interest						
Middle East and Northern Africa	6.5%	6.0%	2.8%	8.9%	9.4%	32.0%
Economies in transition	12.3%	10.8%	2.7%	4.8%	17.1%	30.3%
European Union (EU-15)	23.0%	21.6%	4.8%	8.1%	18.6%	32.5%
Sub-Saharan Africa	3.8%	4.7%	0.9%	12.9%	2.8%	42.6%
Islamic countries	14.4%	11.9%	1.6%	7.1%	5.9%	28.7%
Arab countries	5.5%	4.2%	2.6%	7.8%	8.5%	26.4%
UN least developed countries	4.2%	4.2%	1.0%	13.2%	2.3%	34.0%
UN landlocked developing countries	2.1%	2.3%	1.0%	5.0%	6.8%	37.1%
UN small island developing states	6.8%	7.4%	13.8%	42.4%	8.2%	37.6%
By region						
America	26.3%	22.6%	3.3%	3.3%	29.6%	29.7%
North America	2.8%	4.6%	0.8%	0.9%	51.3%	57.9%

Caribbean	5.1%	5.7%	15.3%	42.8%	9.3%	38.6%
Central America	13.7%	6.6%	11.9%	16.9%	11.1%	16.6%
South America	4.7%	5.6%	1.6%	5.1%	12.3%	41.2%
Europe	35.7%	32.8%	4.1%	7.0%	17.9%	31.7%
Eastern Europe	7.9%	7.8%	2.2%	4.3%	17.4%	34.2%
Northern Europe	7.9%	9.9%	6.8%	13.7%	19.9%	43.2%
Southern Europe	12.4%	6.5%	6.6%	10.7%	10.8%	18.2%
Western Europe	7.5%	8.6%	3.3%	5.4%	23.4%	39.3%
Africa	7.6%	6.8%	1.5%	10.4%	4.0%	30.9%
Eastern Africa	1.4%	1.7%	1.0%	18.6%	1.8%	40.8%
Central Africa	0.5%	0.5%	1.0%	16.1%	1.6%	30.9%
Northern Africa	3.9%	2.2%	2.9%	7.3%	7.5%	19.6%
Southern Africa	0.5%	0.8%	1.0%	6.8%	8.7%	62.1%
Western Africa	1.3%	1.6%	1.0%	14.8%	2.4%	42.0%
Asia	25.5%	34.5%	0.8%	5.5%	6.3%	46.8%
Eastern Asia	7.1%	11.3%	0.5%	3.9%	6.3%	55.5%
South-Central Asia	6.0%	9.2%	0.5%	5.3%	5.0%	52.5%
South-Eastern Asia	7.0%	10.5%	1.6%	9.8%	7.9%	51.4%
Western Asia	5.3%	3.5%	3.5%	6.9%	11.4%	22.9%
Oceania	1.4%	1.8%	4.3%	6.8%	27.8%	45.0%
Australia and New Zealand	1.0%	1.4%	3.7%	5.4%	32.7%	49.2%
Melanesia	0.2%	0.3%	4.5%	44.0%	2.7%	45.0%
Micronesia	0.0%	0.0%	7.2%	32.3%	7.1%	43.6%
Polynesia	0.2%	0.1%	48.7%	75.2%	7.1%	22.7%

Source: Various statistical sources and agencies.

Note: (*) Contrary to country groups, the total OECD stock includes the unknowns and the dependent territories. The sum of regional shares is slightly lower than 100 percent.

large countries. From the last two columns, these differences cannot be attributed to the education structure of residents or to a stronger selection in migration flows. Smaller countries simply tend to be more open to migration. Hence, differences in skilled migration are more or less proportional to differences in total migration rates. This explains why small island developing countries exhibit particularly high migration rates while landlocked countries exhibit lower rates.

As for income groups, their share in the OECD stock is variable. Nevertheless, the highest average rates are clearly observed in middle-income countries. High-income countries (less incentives to emigrate) and low-income countries (where liquidity constraints are likely to be more binding) exhibit the lowest rates. As reported in Schiff (1996), liquidity constraints in poor and unequal societies explain the increasing relationship between income and migration at low-income levels. Papers by Freeman (1993), Faini and Venturini (1993), Funkhouser (1995), and World Bank (1994) have shown that emigrants essentially do not come from the low-income group. This inverted-U-shaped relationship between skilled migration and income is rather stable even if, between 1990 and 2000, the situation clearly improved in lower-middle-income countries and deteriorated in low-income countries. Nevertheless, the reality is more complex than this global picture shows. Sub-Saharan African countries and the least developed countries exhibit a high rate of skilled migration (13 percent). The latter groups exclude large low-income countries (such as India, China, and Indonesia) with low emigration rates. While our indicators suggest that country size and gross domestic product (GDP) per capita are potential determinants of emigration, formal tests are required to assess their real contribution, as well as the relative effect of selection policies; networks; and economic, cultural, historical, or political determinants of emigration. Whether these push-and-pull factors play differently across skill groups is a crucial issue.

Regarding the regional distribution of skilled migration, the most affected continent is Africa (10.4 percent on average). The lowest-skilled migration rates are observed in America (3.3 percent) and Asia (5.5 percent). Oceania and Europe exhibit an intermediate rate of about 7 percent (note that European data include migration between EU countries). Data by detailed area exhibit stronger disparities. The most affected regions are the Caribbean and areas in the Pacific Oceania, which are groupings of small islands. Other remarkable areas are Eastern, Middle, and Western Africa and Central America. The difference between skilled and total emigration rates is especially strong in Africa. This is essentially the result of the low level of education in that part of the world.

Finally, data by area of particular interest shed light on the situation of particular developing zones. Islamic and Arab countries are not strongly affected by the brain drain. We note that Arab countries (a subset of Islamic countries) are more

affected by the brain drain than Islamic countries as a whole. On the contrary, Sub-Saharan African countries are strongly affected. The MENA zone exhibits an 8.9 percent rate. On average, landlocked nations are less affected by the brain drain.

Remarkable Country Facts

The distribution of emigration rates is strongly heterogenous within groups. For example, the disparities between the Caribbean countries and the United States are tremendously high in America; large differences are observed between high-income countries such as Malta, Ireland, Hong Kong (China), Australia, or Japan.

Table 5.4 depicts the situation of the 30 most affected countries in 2000 regarding skilled migration. The brain-drain intensity differs if it is measured in absolute or relative terms. In absolute terms (number of educated emigrants), the largest countries are obviously strongly affected by the brain drain. The stock of skilled emigrants is high in the Philippines (1.136 million), India (1.037 million), Mexico (0.922 million), China (0.816 million), and Vietnam (0.506 million), as well as in developed countries, such as the United Kingdom and Germany, the Republic of Korea and the Democratic People's Republic of Korea (mainly the Republic of Korea), Canada, and Italy.

In relative terms (in proportion of the educated labor force), small countries are the most affected. The emigration rate exceeds 80 percent in nations such as Guyana, Jamaica, Haiti, Grenada, and St. Vincent and the Grenadines. One could argue that the distance from the United States is a key element explaining the high emigration rates from these countries. Nevertheless, we believe that the reality is much more complex. Migration decisions of skilled workers are likely to be less dependent on distances. It also appears that some African countries exhibit high rates of skilled migration. The rate of skilled migration exceeds 50 percent in five African countries (67.5 percent in Cape Verde, 63.3 percent in The Gambia, 55.9 percent in the Seychelles, 56.2 percent in Mauritius, and 52.5 percent in Sierra Leone). Excluding small countries (population below 5 million), column 5 stresses the importance of the brain drain in Africa and Central America. On the western and eastern coasts of Africa, tremendous rates of emigration are found in nations such as Ghana, Mozambique, Sierra Leone, Kenya, Uganda, Angola, and Somalia. In Asia, the countries most affected by migration are the Lao People's Democratic Republic, Sri Lanka, Hong Kong (China), Vietnam, Afghanistan, and Cambodia. Regarding Europe, emigration rates are particularly strong in Portugal, the Slovak Republic, and the United Kingdom. The last column in table 5.3 reveals that countries from the former Soviet Union and the Gulf States exhibit small rates of migration. This is also the case of OECD countries, such as Japan, France, Sweden, Australia, and the United States. Finally, it is worth noting that developing countries

with large stocks of skilled emigrants may exhibit low rates of emigration. This is the case in India (4.3 percent), China (3.8 percent), Indonesia (2.1 percent), and Brazil (2.2 percent).

Many economists have demonstrated that immigrants are not randomly selected. An interesting selection indicator is given by the proportion of skilled emigrants in the total emigration stock. Table 5.4 gives the 30 highest and lowest selection rates among emigrants. The highest selection rates are observed in Asian countries where the rate of brain drain is rather low. Interestingly, Qatar, Oman, the United Arab Emirates, Bahrain, and Kuwait exhibit drastic selection rates despite a low brain drain. Other high-education countries are affected—Taiwan (China), Japan, Hong Kong (China), Canada, and Israel—as well as a few African countries—including Nigeria, Swaziland, South Africa, and Zambia. At the other extremity of the distribution, selection rates are low in traditional unskilled emigration countries such as Turkey, Mali, Portugal, Algeria, Morocco, Tunisia, and Mauritania. Several OECD countries also exhibit low selection rates (such as Portugal, Mexico, Italy, the Slovak Republic, and Spain). The selection is rather low in a few poor countries characterized by an important brain drain (for example, Senegal, The Gambia, Samoa, Suriname, and Mozambique).

Gains and Losses in OECD Countries

Our data set produces information about the gains and losses of skilled workers in OECD countries. The issue of gains and losses has attracted considerable attention in the recent years given the efforts to turn the brain drain into a net brain gain. There are many examples of countries that explicitly replace their personnel loss with highly skilled foreigners attracted from less developed countries. Akbar and Devoretz (1993) provide an interesting discussion of the Canadian immigration policy in the nineties.

Tables 5.5 and 5.6 draw a picture of the net impact of the international mobility of skilled workers in 1990 and 2000. The first three columns of tables 5.5.A and 5.6.A shed light on the relative contribution of immigrants on the working-age population.

It appears that immigrants represent about 25 percent of the labor force in three countries (Australia, Luxembourg, and Switzerland). Other countries such as New Zealand and Canada are also strongly affected. Conversely, migration has a minor effect in Mexico, Turkey, Greece, Japan, the Republic of Korea and the Democratic People's Republic of Korea, and Italy. Columns 4 through 6 of tables 5.5.A and 5.6.A describe the education structure of immigrants. Immigrants are particularly well educated in Canada, Australia, New Zealand, the United States, and the United Kingdom. On the contrary, the proportion of tertiary educated

TABLE 5.4 Top-30 Skilled Emigration Countries, 2000

All countries	Highest emigration stocks	All countries	Highest emigration rates, %	All countries	Highest selection rates, %
United Kingdom	1 441 307	Guyana	89.0	Taiwan (China)	78.0
Philippines	1 126 260	Grenada	85.1	Qatar	69.6
India	1 037 626	Jamaica	85.1	Kuwait	67.8
Mexico	922 964	St. Vincent and the Grenadines	84.5	United Arab Emirates	67.3
Germany	848 414	Haiti	83.6	Philippines	67.1
China	816 824	Trinidad and Tobago	79.3	Nigeria	65.0
Rep. of Korea	652 894	St. Kitts and Nevis	78.5	Saudi Arabia	64.6
Canada	516 471	Samoa	76.4	Japan	63.8
Vietnam	506 449	Tonga	75.2	Oman	62.7
Poland	449 059	St. Lucia	71.1	South Africa	62.6
United States	431 330	Cape Verde	67.5	Hong Kong (China)	61.9
Italy	408 287	Antigua and Barbuda	66.8	Mongolia	61.1
Cuba	332 673	Belize	65.5	India	60.5
France	312 494	Dominica	64.2	Canada	60.1
Iran	308 754	Barbados	63.5	Venezuela, R. B.	60.1
Jamaica	291 166	Gambia, The	63.3	Uzbekistan	59.5
Hong Kong (China)	290 482	Fiji	62.2	Brunei	59.3
Russia	289 090	Bahamas, The	61.3	Malaysia	59.2
Taiwan (China)	275 251	Malta	57.6	Egypt, Arab Rep. of	58.9
Japan	268 925	Mauritius	56.2	Iran, Islamic Rep. of	58.5
Netherlands	256 762	Seychelles	55.9	Liberia	58.5

TABLE 5.4 Top-30 Skilled Emigration Countries, 2000 (continued)

Ukraine	246 218	Sierra Leone	52.5	Panama	57.7
Colombia	233 536	Suriname	47.9	Israel	57.6
Pakistan	222 372	Ghana	46.9	Singapore	57.1
Ireland	209 156	Mozambique	45.1	Myanmar	56.1
Romania	176 393	Liberia	45.0	Swaziland	56.1
Turkey	174 043	Marshall Islands	39.4	Jordan	55.6
Brazil	168 308	Lebanon	38.6	United States	55.4
South Africa	168 083	Kenya	38.4	China, Macao SAR	55.2
Peru	163 750	Micronesia, Federated States of	37.8	Palestine	55.0
All countries	Lowest selection rates	Countries with population above 5 million	Highest emigration rates, %	Countries with population above 5 million	Lowest emigration rates, %
Serbia and Montenegro	20.7%	Haiti	83.6	Egypt, Arab Rep. of	4.6
Liechtenstein	20.7%	Ghana	46.9	Sweden	4.3
Croatia	20.5%	Mozambique	45.1	Bangladesh	4.3
Gambia, The	20.4%	Kenya	38.4	Spain	4.3
Slovak Republic	20.0%	Lao PDR	37.4	India	4.3
FYR Macedonia	19.6%	Uganda	35.6	Myanmar	4.0
El Salvador	19.1%	Angola	33.0	Paraguay	3.9
Guatemala	19.0%	Somalia	32.7	China	3.8
Albania	18.4%	El Salvador	31.0	Ukraine	3.5
São Tomé and Príncipe	18.4%	Sri Lanka	29.7	France	3.4

Suriname	18.4%	Nicaragua	29.6	Venezuela, R. B.	3.4
Mozambique	17.7%	Hong Kong (China)	28.8	Belarus	3.2
Italy	17.3%	Cuba	28.7	Australia	2.7
Bosnia and Herzegovina	17.0%	Papua New Guinea	28.5	Burkina Faso	2.6
Angola	16.9%	Vietnam	27.1	Argentina	2.5
Senegal	16.7%	Rwanda	26.0	Chad	2.4
Bulgaria	16.4%	Honduras	24.4	Thailand	2.4
San Marino	16.0%	Guatemala	24.2	Libya	2.4
Cape Verde	15.2%	Afghanistan	23.3	Brazil	2.2
Tunisia	14.9%	Dominican Republic	21.6	Indonesia	2.1
Mexico	14.4%	Portugal	19.5	Azerbaijan	2.0
Guinea-Bissau	14.2%	Malawi	18.7	Georgia	1.6
Algeria	14.1%	Cambodia	18.3	Russian Federation	1.5
Tuvalu	13.8%	Senegal	17.7	Japan	1.2
Comoros	13.4%	Cameroon	17.2	Kazakhstan	1.2
Morocco	12.9%	Morocco	17.0	Saudi Arabia	0.9
Equatorial Guinea	12.4%	Zambia	16.8	Uzbekistan	0.7
Portugal	12.0%	Slovakia	16.7	Swaziland	0.5
Mali	10.9%	United Kingdom	16.7	United States	0.5
Turkey	8.8%	Mexico	15.3	Tajikistan	0.4

Source: Various statistical sources and agencies.

TABLE 5.5.A Net Brain Gain in OECD Countries in 1990

	Working-age immigrants (total)	Working-age natives (total)	Proportion of immigrants among residents	Working-age immigrants (primary)	Working-age immigrants (secondary)	Working-age immigrants (tertiary)
Australia	3,284,279	10,453,000	23.9%	1,266,265	908,267	1,109,747
Austria	324,201	5,209,000	5.9%	188,518	108,421	27,262
Belgium	748,543	6,767,000	10.0%	138,461	134,603	94,044
Canada	3,709,285	17,907,000	17.2%	1,392,305	437,485	1,879,495
Czech Republic (**)	—	—	—	—	—	—
Denmark	93,934	3,500,000	2.6%	17,392	20,688	11,375
Finland	34,305	3,373,000	1.0%	22,028	8,248	4,029
France	3,480,664	36,731,000	8.7%	2,910,066	208,570	300,122
Germany	3,262,057	55,795,000	5.5%	1,558,529	481,882	555,735
Greece	112,805	6,663,000	1.7%	38,806	45,427	28,572
Hungary	211,715	6,789,000	3.0%	125,550	31,155	32,317
Iceland	10,565	149,000	6.6%	2,776	3,963	2,239
Ireland	130,940	1,953,000	6.3%	21,905	67,050	34,750
Italy	533,312	38,897,000	1.4%	316,260	78,479	81,407
Japan	1,075,317	82,019,000	1.3%	421,394	279,169	330,355
Korea, Rep of (*)	49,500	33,328,000	0.1%	19,398	12,851	15,207
Luxembourg	83,398	260,000	24.3%	54,739	5,547	10,659
Mexico	363,626	32,797,000	1.1%	180,163	60,163	123,300
Netherlands	961,662	9,883,000	8.9%	570,278	141,513	146,792
New Zealand	456,792	2,016,000	18.5%	121,641	113,169	194,937
Norway	136,241	2,784,000	4.7%	3,108	61,303	33,464

Poland	661,517	23,222,000	2.8%	392,288	97,345	100,977
Portugal	170,390	6,304,000	2.6%	11,897	8,899	14,579
Slovak Republic (**)	196,205	9,703,000	2.0%	116,352	28,872	29,949
Spain	845,977	25,036,000	3.3%	477,484	220,448	148,044
Sweden	617,449	5,852,000	9.5%	189,190	240,585	138,034
Switzerland	1,463,670	4,724,000	23.7%	83,430	1,050,239	197,141
Turkey	596,045	24,830,000	2.3%	429,419	100,100	48,972
United Kingdom	2,778,527	37,978,000	6.8%	1,892,892	315,482	570,153
United States	15,472,972	162,796,000	8.7%	3,957,187	5,312,740	6,203,045
EU-15	14,178	244,201	5.5%	8,408	2,086	2,166
Scandinavian countries	892	15,658	5.4%	234	335	189
OECD (in millions)	41.866	657.718	6.0%	16.920	10.583	12.467

Source: Various statistical sources and agencies.

TABLE 5.5.B Net Brain Gain in OECD Countries in 1990

	Proportion of tertiary immigrants (PI)	Proportion of tertiary residents (PR)	Ratio immigrants / residents (PI/PR)	Working-age expatriates (tertiary)	Net brain gain (immigrants - expatriates)	Net brain gain in % of working-age residents
Australia	33.8%	31.1%	1.087	69,529	1,040,218	10.0%
Austria	8.4%	11.2%	0.748	113,432	-86,170	-1.7%
Belgium	12.6%	20.8%	0.605	67,627	26,417	0.4%
Canada	50.7%	43.8%	1.156	396,162	1,483,333	8.3%
Czech Republic (**)	-	-	-	-	-	-
Denmark	12.1%	19.3%	0.627	51,906	-40,531	-1.2%
Finland	11.7%	20.2%	0.581	53,939	-49,910	-1.5%
France	8.6%	21.9%	0.393	225,415	74,707	0.2%
Germany	17.0%	21.8%	0.781	735,191	-179,456	-0.3%
Greece	25.3%	10.9%	2.330	119,572	-91,000	-1.4%
Hungary	15.3%	10.1%	1.511	115,707	-83,390	-1.2%
Iceland	21.2%	11.0%	1.927	5,435	-3,196	-2.1%
Ireland	26.5%	13.9%	1.905	150,929	-116,179	-5.9%
Italy	15.3%	6.3%	2.423	309,014	-227,607	-0.6%
Japan	30.7%	21.2%	1.447	230,540	99,815	0.1%
Korea, Rep of (*)	30.7%	13.4%	2.293	464,228	-449,020	-1.3%
Luxembourg	12.8%	20.8%	0.616	5,303	5,356	2.1%
Mexico	33.9%	9.2%	3.686	359,933	-236,633	-0.7%
Netherlands	15.3%	15.7%	0.975	207,656	-60,864	-0.6%
New Zealand	42.7%	23.3%	1.832	90,464	104,473	5.2%
Norway	24.6%	15.7%	1.564	34,601	-1,137	0.0%

Poland	15.3%	7.9%	1.932	308,051	-207,074	-0.9%
Portugal	8.6%	6.5%	1.316	78,035	-63,456	-1.0%
Slovak Republic (**)	15.3%	9.9%	1.541	95,253	-65,304	-0.7%
Spain	17.5%	9.5%	1.846	94,122	53,923	0.2%
Sweden	22.4%	20.5%	1.088	49,455	88,579	1.5%
Switzerland	13.5%	17.2%	0.781	67,307	129,834	2.7%
Turkey	8.2%	5.0%	1.643	112,739	-63,767	-0.3%
United Kingdom	20.5%	13.9%	1.473	1,156,056	-585,903	-1.5%
United States	40.1%	39.2%	1.023	326,472	5,876,573	3.6%
EU-15	17.1%	15.5%	1.103	3,418	-1,252	-0.5%
Scandinavian countries	24.9%	19.2%	1.296	195	-6	0.0%
OECD (in millions)	31.2%	21.9%	1.424	6.094	6.373	1.0%

Source: Various statistical sources and agencies.

Note: (*) The number of expatriates includes Democratic People's Republic of Korea; the number of immigrants includes Republic of Korea only.

(**) Results for Ex-Czechoslovakia are provided at the Slovak Republic line.

– not available

TABLE 5.6.A Net Brain Gain in OECD Countries in 2000

	Working-age immigrants (total)	Working-age natives (total)	Proportion of immigrants among residents	Working-age immigrants (primary)	Working-age immigrants (secondary)	Working-age immigrants (tertiary)
Australia	4,075,721	12,521,000	24.6%	1,293,435	1,242,616	1,539,670
Austria	816,001	5,802,000	12.3%	387,425	325,337	103,239
Belgium	867,620	7,233,000	10.7%	485,386	195,983	186,186
Canada	4,661,330	20,805,000	18.3%	1,378,260	540,980	2,742,090
Czech Republic	410,249	7,017,000	5.5%	155,660	191,239	59,631
Denmark	169,664	3,748,000	4.3%	37,734	53,611	31,873
Finland	90,511	3,580,000	2.5%	44,051	24,945	21,515
France	3,755,514	40,418,000	8.5%	2,802,954	337,962	614,598
Germany	4,746,000	60,269,000	7.3%	2,545,000	578,000	996,000
Greece	106,041	7,750,000	1.3%	35,484	43,160	23,810
Hungary	251,715	6,836,000	3.6%	109,307	87,908	54,502
Iceland	16,927	174,000	8.9%	3,851	7,016	4,512
Ireland	281,232	2,309,000	10.9%	23,495	127,146	115,721
Italy	923,788	42,627,000	2.1%	488,538	292,781	142,469
Japan	951,302	92,337,000	1.0%	325,594	275,692	328,870
Korea, Rep of (*)	150,812	42,289,000	0.4%	51,617	43,706	52,137
Luxembourg	114,625	303,000	27.4%	37,780	36,644	29,321
Mexico	417,371	45,226,000	0.9%	139,186	119,414	141,912
Netherlands	1,320,320	11,109,000	10.6%	715,337	351,331	253,651
New Zealand	603,606	2,400,000	20.1%	93,909	182,109	232,296
Norway	204,182	3,051,000	6.3%	5,693	112,202	64,239

Poland	741,517	24,675,000	2.9%	441,529	187,418	103,496
Portugal	207,476	6,889,000	2.9%	122,236	43,137	29,816
Slovak Rep	426,072	3,416,000	11.1%	321,721	17,134	41,989
Spain	1,370,657	28,839,000	4.5%	440,493	700,005	230,159
Sweden	805,143	6,219,000	11.5%	201,319	335,463	220,731
Switzerland	1,704,948	5,200,000	24.7%	119,714	970,084	286,682
Turkey	826,110	33,130,000	2.4%	449,020	232,450	141,034
United Kingdom	3,639,907	40,353,000	8.3%	1,334,821	1,048,194	1,256,892
United States	24,366,085	183,564,000	11.7%	5,608,020	8,403,780	10,354,285
EU-15	19,214	267,448	6.7%	9,702	4,494	4,256
Scandinavian countries	1,286	16,772	7.1%	293	533	343
OECD (in millions)	59.022	750.089	7.3%	20.199	17.107	20.403

Source: Various statistical sources and agencies.

TABLE 5.6.B Net brain gain in OECD countries in 2000

	Proportion of tertiary immigrants (PI)	Proportion of tertiary residents (PR)	Immigrants / residents (PI/PR)	Ratio working-age expatriates (tertiary)	Net brain gain (immigrants - expatriates)	Net brain gain in % of working-age residents
Australia	37.8%	34.0%	1.112	116,723	1,422,947	11.4%
Austria	12.7%	14.4%	0.878	130,487	-27,248	-0.5%
Belgium	21.5%	27.5%	0.782	102,187	83,999	1.2%
Canada	58.8%	51.5%	1.143	516,471	2,225,619	10.7%
Czech Republic	14.5%	10.8%	1.346	88,112	-28,481	0.4%
Denmark	18.8%	21.9%	0.858	68,643	-36,770	-1.0%
Finland	23.8%	26.3%	0.905	76,132	-54,617	-1.5%
France	16.4%	21.9%	0.747	312,494	302,104	0.7%
Germany	21.0%	25.5%	0.823	848,414	147,586	0.2%
Greece	22.5%	15.2%	1.481	159,895	-136,085	-1.8%
Hungary	21.7%	12.0%	1.804	124,426	-69,923	-1.0%
Iceland	26.7%	15.5%	1.720	6,598	-2,086	-1.2%
Ireland	41.1%	21.7%	1.900	209,156	-93,435	-4.0%
Italy	15.4%	8.7%	1.781	408,287	-265,818	-0.6%
Japan	34.6%	24.6%	1.404	268,925	59,946	0.1%
Korea, Rep of (*)	34.6%	25.8%	1.340	652,894	-600,757	-1.4%
Luxembourg	25.6%	27.5%	0.932	7,281	22,040	7.3%
Mexico	34.0%	11.3%	3.009	922,964	-781,052	-1.7%
Netherlands	19.2%	21.9%	0.879	256,762	-3,111	0.0%
New Zealand	38.5%	25.9%	1.489	161,740	70,556	2.9%
Norway	31.5%	21.8%	1.447	46,286	17,953	0.6%

Poland	14.0%	11.1%	1.257	449,059	-345,563	-1.4%
Portugal	14.4%	8.8%	1.630	147,438	-117,622	-1.7%
Slovak Rep	9.9%	11.6%	0.850	79,451	-37,462	-1.1%
Spain	16.8%	12.2%	1.372	159,889	70,271	0.2%
Sweden	27.4%	27.5%	0.997	77,703	143,029	2.3%
Switzerland	16.8%	17.2%	0.975	88,051	198,631	3.8%
Turkey	17.1%	8.5%	2.008	174,043	-33,009	-0.1%
United Kingdom	34.5%	17.8%	1.938	1,441,307	-184,415	-0.5%
United States	42.5%	51.3%	0.828	431,330	9,922,955	5.4%
EU-15	23.1%	18.6%	1.240	4,406	-150	-0.1%
Scandinavian countries	29.3%	24.8%	1.182	275	68	0.4%
OECD (in millions)	35.4%	27.6%	1.279	8.533	11.870	1.6%

Source: Various statistical sources and agencies.

Note: (*) The number of emigrants includes Democratic People's Republic of Korea; the number of immigrants includes Republic of Korea only.

workers is rather low in the Slovak Republic, the Czech Republic, Austria, and Spain. The skill structure of immigrants can be compared with the structure of the native population. On average, columns 2 and 3 of tables 5.5.B and 5.6.B show that OECD immigrants are more skilled than individuals in the OECD who are native born. This is especially true when the education of the native population is low (for example, in Mexico, the Republic of Korea and the Democratic People's Republic of Korea, Greece, Turkey, Italy, and Ireland). This is also true in countries where the immigration policy relies on a "points system" (such as in Australia, Canada, and New Zealand) and in the United Kingdom. In highly educated countries, such as the United States, France, Belgium, and Austria, immigrants are less educated than natives.

Finally, columns 4 through 6 of tables 5.5.B and 5.6.B offer a measure of the net brain gain. The net brain gain is defined as the net immigration of skilled workers, expressed in percentage of the working-age resident population. Of course, such an indicator suffers from serious shortcomings: given the variety of education systems, emigrants' and immigrants' education levels are subject to serious comparability problems. Additionally, immigrants take time to assimilate into the labor market and suffer from discrimination. Nevertheless, our indicator provides new insights about who wins and who loses from skilled migration. Because $M_{t,h}^{i,j}$ denotes the stock of working-age skilled individuals born in country j and living in country i at time t , the net brain gain in country i can be evaluated as follows.

$$NBG_t^i = \frac{\sum_j M_{t,h}^{i,j} - \sum_k M_{t,h}^{k,i}}{\sum_s N_{t,s}^i} \quad (5.3)$$

The first term in the numerator is the number of skilled emigrants from country i (column 4 of tables 5.5.B and 5.6.B). The second term is the number of skilled immigrants (column 6 of tables 5.5.A and 5.6.A). Expressing the difference between these two terms in proportion to the resident labor force (column 2 of tables 5.5.A and 5.6.A), we obtain the net brain gain (column 6 of tables 5.5.B and 5.6.B). Countries exhibiting a positive (respectively, a negative) amount are net gainers (respectively, net losers). On the whole, OECD countries benefit from the international mobility of skilled workers. The net gain amounts to 1.6 percent in 2000, compared with 1.0 percent in 1990. The net brain gain has globally improved in all OECD countries. Hence, the 1990 balanced situation in Scandinavian countries turned into a net brain gain in 2000. The EU-15 deficit turned into a quasi-balanced situation. The main winners of this brain gain are Australia,

Canada, and Luxembourg (the latter country experienced a strong improvement between 1990 and 2000), followed by the United States, Switzerland, and New Zealand. Conversely, Ireland, Greece, and Portugal experienced a brain loss of 2 percent.

Conclusion

Because of the poor quality of international data, assessing the economic impact of international migration is a challenging issue. This chapter provides a new data set for skilled emigration rates describing the loss of skilled workers in both developing and developed countries.

In absolute terms, we show that the largest stocks of educated emigrants are from Europe (specifically the United Kingdom, Germany, and Italy); Southern and Eastern Asia (including the Philippines, India, China, the Republic of Korea and the Democratic People's Republic of Korea, and Vietnam); and, to a lesser extent, Central America and Mexico. These emigrants are concentrated in a few destination countries: about 50 percent of skilled migrants live in the United States; this percentage increases to 70 percent if two other immigration countries (Canada and Australia) are included and to 85 percent if the three largest EU countries (the United Kingdom, Germany, and France) are included.

In proportion to the educated labor force in the origin countries, the highest rates are observed in Central America and Africa (in Middle, Western, and Eastern Africa), as well as in the Caribbean and the Pacific area. The emigration rate exceeds 80 percent in nations such as Guyana, Jamaica, Haiti, and Grenada. High rates are observed in a few islands in Oceania. The emigration rate exceeds 50 percent in five African countries (Cape Verde, The Gambia, Mauritius, the Seychelles, and Sierra Leone). Conversely, the brain drain is rather low in the former Soviet Union; the Gulf States; and large countries such as India, China, Indonesia, Brazil, and most of the OECD countries. Calculations made by area of particular interest shed light on the situation in important developing zones. Islamic and Arab countries are not strongly affected by the brain drain, in contrast with Sub-Saharan African countries and, to a lesser extent, the MENA countries.

Regarding selection (that is, the proportion of skilled emigrants in the total emigration stock), the highest selection rates are observed in the Gulf countries where the rate of brain drain is rather low (such as in Qatar, Oman, the United Arab Emirates, Bahrain, and Kuwait), in some high-income countries (for example, Taiwan (China), Japan, Hong Kong (China), Canada, and Israel), and in a few of African countries (including Nigeria, Swaziland, South Africa, and Zambia). Conversely, selection rates are low in traditional unskilled emigration countries (such as Turkey, Mali, Portugal, Algeria, Morocco, Tunisia, and Mauritania), in

selected OECD countries (including Portugal, Mexico, Italy, the Slovak Republic, and Spain), and in a few countries that are characterized by high emigration rates (for example, Senegal, The Gambia, Samoa, Suriname, and Mozambique).

By increasing the number of observations and improving their degree of reliability, our method provides useful material for the empirical analysis of the causes and consequences of the brain drain. Our data set is obviously evolutionary and could be refined in several ways. Nevertheless, we believe that the current version delivers new information that is rich enough to assess the changes in the international distribution of migration rates, to test for the (push-and-pull) determinants per skill group, and to evaluate the macroeconomic consequences of migration on source and destination countries.

Annex 5.A

This annex provides definitions of the country sets distinguished in the tables, and a comparison with previous works.

Data

We distinguish America (including the United States, Canada, and Mexico), Europe (including the EU-15, Switzerland, the Czech and Slovak Republics, Hungary, Poland, Norway, and Iceland), and the rest of the Organisation for Economic Co-operation and Development (OECD) countries (including Australia, New Zealand, Japan, the Republic of Korea and the Democratic People's Republic of Korea, and Turkey).

Country Groups

By region. AMERICA: North America (Canada, the United States), the Caribbean (Antigua and Barbuda, The Bahamas, Barbados, Cuba, Dominica, the Dominican Republic, Grenada, Haiti, Jamaica, St. Kitts and Nevis, St. Lucia, St. Vincent and the Grenadines, Trinidad and Tobago), Central America (Belize, Costa Rica, El Salvador, Guatemala, Honduras, Mexico, Nicaragua, Panama), South America (Argentina, Bolivia, Brazil, Chile, Colombia, Ecuador, Guyana, Paraguay, Peru, Suriname, Uruguay, República Bolivariana de Venezuela).

EUROPE: Eastern Europe (Belarus, Bulgaria, the Czech Republic, Hungary, Moldova, Poland, Romania, the Russian Federation, the Slovak Republic, Ukraine), Northern Europe (Denmark, Estonia, Finland, Iceland, Ireland, Latvia, Lithuania, Norway, Sweden, the United Kingdom), Southern Europe (Albania,

Andorra, Bosnia and Herzegovina, Croatia, the former Yugoslav Republic of Macedonia, Greece, Holy See (Vatican City), Italy, Malta, Portugal, San Marino, Serbia and Montenegro, Slovenia, Spain), Western Europe (Austria, Belgium, France, Germany, Liechtenstein, Luxembourg, Monaco, the Netherlands, Switzerland).

AFRICA: Eastern Africa (Burundi, the Comoros, Djibouti, Eritrea, Ethiopia, Kenya, Madagascar, Malawi, Mauritius, Mozambique, Rwanda, the Seychelles, Somalia, Tanzania, Uganda, Zambia, Zimbabwe), Middle Africa (Angola, Cameroon, the Central African Republic, Chad, the Democratic Republic of Congo, Equatorial Guinea, Gabon, the Republic of Congo, São Tomé and Príncipe), Northern Africa (Algeria, the Arab Republic of Egypt, Libya, Morocco, Sudan, Tunisia), Southern Africa (Botswana, Lesotho, Namibia, South Africa, Swaziland), Western Africa (Benin, Burkina Faso, Cape Verde, Côte d'Ivoire, The Gambia, Ghana, Guinea, Guinea-Bissau, Liberia, Mali, Mauritania, Niger, Nigeria, Senegal, Sierra Leone, Togo).

ASIA: Eastern Asia (China, Hong Kong (China), Macao SAR, Japan, Mongolia, the Republic of Korea and the Democratic People's Republic of Korea, Taiwan (China)), South-Central Asia (Afghanistan, Bangladesh, Bhutan, India, Islamic Republic of Iran, Kazakhstan, Kyrgyz Republic, Maldives, Nepal, Pakistan, Sri Lanka, Tajikistan, Turkmenistan, Uzbekistan), South-Eastern Asia (Brunei Darussalam, Cambodia, Indonesia, the Lao People's Democratic Republic, Malaysia, Myanmar, the Philippines, Singapore, Timor-Leste, Thailand, Vietnam), Western Asia (Armenia, Azerbaijan, Bahrain, Cyprus, Georgia, Iraq, Israel, Jordan, Kuwait, Lebanon, Occupied Palestinian Territory, Oman, Qatar, Saudi Arabia, the Republic of Yemen, the Syrian Arab Republic, Turkey, the United Arab Emirates).

OCEANIA: Australia and New Zealand (Australia, New Zealand), Melanesia (Fiji, Papua New Guinea, the Solomon Islands, Vanuatu), Micronesia (Kiribati, the Marshall Islands, the Federated States of Micronesia, Nauru, Palau), Polynesia (Samoa, Tonga, Tuvalu).

By income group. **HIGH INCOME:** Andorra, Australia, Austria, The Bahamas, Belgium, Brunei Darussalam, Canada, Cyprus, Denmark, Finland, France, Germany, Greece, Hong Kong (China), Iceland, Ireland, Israel, Italy, Japan, Kuwait, Liechtenstein, Luxembourg, Macao SAR, Malta, Monaco, the Netherlands, New Zealand, Norway, Portugal, Qatar, San Marino, Singapore, Slovenia, Spain, Sweden, Switzerland, Taiwan (China), the United Arab Emirates, the United Kingdom, the United States.

UPPER-MIDDLE INCOME: Antigua and Barbuda, Argentina, Bahrain, Barbados, Brazil, Botswana, Chile, Croatia, the Czech Republic, Estonia, Gabon, Grenada, Hungary, Lebanon, Libya, Malaysia, Mauritius, Mexico, Oman, Palau, Panama, Poland, República Bolivariana de Venezuela, the Republic of Korea and

the Democratic People's Republic of Korea, St. Kitts and Nevis, St. Lucia, Saudi Arabia, the Seychelles, the Slovak Republic, Trinidad and Tobago, Turkey, Uruguay.

LOWER-MIDDLE INCOME: Albania, Algeria, Belarus, Belize, Bolivia, Bosnia and Herzegovina, Bulgaria, Cambodia, Cape Verde, Colombia, Costa Rica, Cuba, Djibouti, Dominica, the Dominican Republic, Ecuador, Egypt, El Salvador, Equatorial Guinea, Fiji, FYR Macedonia, Georgia, Guatemala, Guyana, Iraq, Islamic Republic of Iran, Jamaica, Jordan, Kazakhstan, Kiribati, Latvia, Lithuania, Maldives, the Marshall Islands, the Federated States of Micronesia, Morocco, Namibia, Papua New Guinea, Paraguay, Peru, the Philippines, Romania, Russia, St. Vincent and the Grenadines, Samoa, Serbia and Montenegro, South Africa, Sri Lanka, Suriname, Swaziland, the Syrian Arab Republic, Thailand, Tonga, Tunisia, Ukraine, Uzbekistan, Vanuatu.

LOW INCOME: Afghanistan, Angola, Armenia, Azerbaijan, Bangladesh, Benin, Bhutan, Burkina Faso, Myanmar, Burundi, Cameroon, the Central African Republic, Chad, China, the Comoros, the Democratic Republic of Congo, Côte d'Ivoire, Eritrea, Ethiopia, The Gambia, Ghana, Guinea, Guinea-Bissau, Haiti, Honduras, India, Indonesia, Kenya, Kyrgyzstan, Lao PDR, Lesotho, Liberia, Madagascar, Malawi, Mali, Mauritania, Moldova, Mongolia, Mozambique, Nepal, Nicaragua, Niger, Nigeria, Pakistan, the Republic of Congo, the Republic of Yemen, Rwanda, São Tomé and Príncipe, Senegal, Sierra Leone, the Solomon Islands, Somalia, Sudan, Tajikistan, Tanzania, Togo, Turkmenistan, Uganda, Vietnam, Zambia, Zimbabwe.

By size. LARGE (above 25 million): China, India, the United States, Indonesia, Brazil, Russia, Pakistan, Bangladesh, Japan, Nigeria, Mexico, Germany, Vietnam, the Philippines, the Republic of Korea and the Democratic People's Republic of Korea, Turkey, Egypt, Islamic Republic of Iran, Ethiopia, Thailand, France, the United Kingdom, Italy, Ukraine, the Democratic Republic of Congo, Myanmar, South Africa, Colombia, Spain, Poland, Argentina, Tanzania, Sudan, Canada, Kenya, Algeria, Morocco, Peru.

UPPER MIDDLE (from 10 to 25 million): Uzbekistan, República Bolivariana de Venezuela, Nepal, Uganda, Iraq, Malaysia, Taiwan (China), Romania, Saudi Arabia, Afghanistan, Ghana, Australia, Sri Lanka, the Republic of Yemen, Mozambique, the Syrian Arab Republic, Madagascar, the Netherlands, Côte d'Ivoire, Kazakhstan, Chile, Cameroon, Cambodia, Zimbabwe, Ecuador, Angola, Mali, Burkina Faso, Guatemala, Malawi, Cuba, Greece, Niger, Serbia and Montenegro, Zambia, the Czech Republic, Belgium, Belarus, Portugal, Hungary.

LOWER MIDDLE (from 2.5 to 10 million): Tunisia, Senegal, Sweden, Somalia, the Dominican Republic, Bolivia, Azerbaijan, Guinea, Austria, Bulgaria, Haiti, Chad, Rwanda, Switzerland, Swaziland, Hong Kong (China), Honduras, Burundi,

Benin, El Salvador, Tajikistan, Israel, Paraguay, the Slovak Republic, Papua New Guinea, Denmark, Lao PDR, Georgia, Libya, Finland, Nicaragua, Jordan, Kyrgyz Republic, Turkmenistan, Togo, Norway, Croatia, Sierra Leone, Moldova, Singapore, Bosnia and Herzegovina, Costa Rica, Ireland, New Zealand, the Central African Republic, Eritrea, Lithuania, Lebanon, the Republic of Congo, Uruguay, Palestine, Albania, Armenia, Panama, Liberia, the United Arab Emirates, Mauritania, Oman, Jamaica,

SMALL (lower than 2.5 million): Mongolia, Latvia, Kuwait, Bhutan, FYR Macedonia, Slovenia, Namibia, Lesotho, Botswana, Guinea-Bissau, Estonia, The Gambia, Trinidad and Tobago, Gabon, Mauritius, Fiji, Cyprus, Guyana, the Comoros, Timor-Leste, Bahrain, Djibouti, Qatar, Equatorial Guinea, Macao SAR, Cape Verde, the Solomon Islands, Luxembourg, Suriname, Malta, Brunei Darussalam, The Bahamas, Maldives, Iceland, Barbados, Belize, Vanuatu, Samoa, São Tomé and Príncipe, St. Lucia, St. Vincent, the Federated States of Micronesia, Tonga, Kiribati, Grenada, the Seychelles, Andorra, Dominica, Antigua and Barbuda, the Marshall Islands, St. Kitts and Nevis, Liechtenstein, Monaco, San Marino, Palau, Nauru, Tuvalu, Holy See (Vatican City).

By group of particular interest. MIDDLE EAST AND NORTHERN AFRICA (MENA): Algeria, Bahrain, Cyprus, Djibouti, Egypt, Iraq, Islamic Republic of Iran, Israel, Jordan, Kuwait, Lebanon, Libya, Morocco, Palestine, Oman, Qatar, the Republic of Yemen, Saudi Arabia, the Syrian Arab Republic, Tunisia, the United Arab Emirates.

ECONOMIES IN TRANSITION: Belarus, Bulgaria, the Czech Republic, FYR Macedonia, Hungary, Moldova, Poland, Romania, Russia, the Slovak Republic, Ukraine, Estonia, Latvia, Lithuania, Albania, Bosnia and Herzegovina, Croatia, Serbia and Montenegro, Slovenia, Kazakhstan, Kyrgyz Republic, Tajikistan, Turkmenistan, Uzbekistan, Armenia, Azerbaijan, Georgia.

EU-15: Denmark, Finland, Ireland, Sweden, the United Kingdom, Greece, Italy, Portugal, Spain, Austria, Belgium, France, Germany, Luxembourg, the Netherlands.

SUB-SAHARAN AFRICA: Burundi, the Comoros, Djibouti, Eritrea, Ethiopia, Kenya, Madagascar, Malawi, Mauritius, Mozambique, Rwanda, the Seychelles, Somalia, Tanzania, Uganda, Zambia, Zimbabwe, Angola, Cameroon, the Central African Republic, Chad, the Democratic Republic of Congo, Equatorial Guinea, Gabon, the Republic of Congo, São Tomé and Príncipe, Botswana, Lesotho, Namibia, South Africa, Swaziland, Benin, Burkina Faso, Cape Verde, Côte d'Ivoire, The Gambia, Ghana, Guinea, Guinea-Bissau, Liberia, Mali, Mauritania, Niger, Nigeria, Senegal, Sierra Leone, Togo.

ISLAMIC COUNTRIES: Afghanistan, Albania, Algeria, Azerbaijan, Bahrain, Bangladesh, Benin, Brunei Darussalam, Burkina Faso, Cameroon, Chad, the

Comoros, Côte d'Ivoire, Djibouti, Egypt, Gabon, The Gambia, Guinea, Guinea-Bissau, Guyana, Indonesia, Iraq, Islamic Republic of Iran, Libya, Jordan, Kazakhstan, Kuwait, Kyrgyzstan, Lebanon, Malaysia, Maldives, Mali, Mauritania, Morocco, Mozambique, Niger, Nigeria, Palestine, Oman, Pakistan, Qatar, the Republic of Yemen, Saudi Arabia, Senegal, Sierra Leone, Somalia, Sudan, Suriname, the Syrian Arab Republic, Tajikistan, Togo, Tunisia, Turkey, Turkmenistan, Uganda, the United Arab Emirates, Uzbekistan.

ARAB COUNTRIES: Algeria, Bahrain, the Comoros, Djibouti, Egypt, Iraq, Libya, Jordan, Kuwait, Lebanon, Mauritania, Morocco, Palestine, Oman, Qatar, the Republic of Yemen, Saudi Arabia, Somalia, Sudan, the Syrian Arab Republic, Tunisia, the United Arab Emirates.

UN LEAST DEVELOPED COUNTRIES: Afghanistan, Angola, Bangladesh, Benin, Bhutan, Burkina Faso, Burundi, Cambodia, Cape Verde, the Central African Republic, Chad, the Comoros, the Democratic Republic of Congo, Djibouti, Equatorial Guinea, Eritrea, Ethiopia, The Gambia, Guinea, Guinea-Bissau, Haiti, Kiribati, Lao PDR, Lesotho, Liberia, Madagascar, Malawi, Maldives, Mali, Mauritania, Mozambique, Myanmar, Nepal, Niger, the Republic of Yemen, Rwanda, Samoa, São Tomé and Príncipe, Senegal, Sierra Leone, the Solomon Islands, Somalia, Sudan, Tanzania, Timor-Leste, Togo, Tuvalu, Uganda, Vanuatu, Zambia.

UN LANDLOCKED DEVELOPING COUNTRIES: Afghanistan, Armenia, Azerbaijan, Bhutan, Bolivia, Botswana, Burkina Faso, Burundi, the Central African Republic, Chad, Ethiopia, FYR Macedonia, Kazakhstan, Kyrgyz Republic, Lao PDR, Lesotho, Malawi, Mali, Moldova, Mongolia, Nepal, Niger, Paraguay, Rwanda, Swaziland, Tajikistan, Turkmenistan, Uganda, Uzbekistan, Zambia, Zimbabwe.

UN SMALL ISLANDS DEVELOPING STATES: Antigua and Barbuda, The Bahamas, Barbados, Belize, Cape Verde, the Comoros, Cuba, Dominica, the Dominican Republic, Fiji, Grenada, Guinea-Bissau, Guyana, Haiti, Jamaica, Kiribati, Maldives, the Marshall Islands, Mauritius, the Federated States of Micronesia, Nauru, Palau, Papua New Guinea, St. Kitts and Nevis, St. Lucia, St. Vincent, Samoa, São Tomé and Príncipe, the Seychelles, Singapore, the Solomon Islands, Suriname, Timor-Leste, Tonga, Trinidad and Tobago, Tuvalu, Vanuatu.

Comparison with Previous Studies

Comparison with Carrington and Detragiache (1998)

Carrington and Detragiache's 1998 study clearly initiated new debates on the magnitude and distribution of the brain drain. Our data set refines their method

by incorporating additional statistical sources. By collecting census, register, and survey data from all OECD countries, we eliminate two sources of bias:

- Relying on OECD statistics on immigration brings up several problems. First, in 1990, these data only provided information on the country of origin for the top-10 or top-5 sending countries. Hence, small sending countries are usually not identified, at least in the majority of receiving countries. Second, immigration in EU countries is based on the concept of citizenship rather than on country of birth. Third, immigration data are missing for a few OECD countries (Greece, Iceland, Mexico, Poland, the Slovak Republic, and Turkey). Finally, the OECD provides data on the total immigration stock rather than on the adult immigration stock (which can be compared with the labor force in sending countries). Compared with national censuses, we estimate that relying on OECD statistics implies an average underestimation in skilled workers migration rates by 8.9 percent in 2000. This is the major source of bias, especially for small countries that usually are not identified as important sending countries.
- Imposing the U.S. education structure on other OECD countries induces an average overestimation in skilled workers migration rates by 6.3 percent in 2000. The bias is obviously strong in countries sending a minor part of their emigrants to the United States.

On average, Carrington and Detragiache's method underestimates the emigration rates of skilled workers by 2.6 percent in 2000. This average bias seems rather small but hides a strong heterogeneity. This appears on figure 5.A.1, which gives skilled migration rates evaluated under three measurement methods: (a) a method fully based on census and administrative data (our method); (b) a method based on OECD statistics and U.S. education attainment data (Carrington and Detragiache 1998); and (c) an intermediate method based on census and administrative data and U.S. education attainment data. The observations calculated with our method are ranked in a decreasing order. In comparison with the census method, the second method clearly underestimates the brain drain for a majority of countries. On the contrary, the third method overestimates the brain drain.

The two sources of bias cancel each other in a couple of cases. However, the brain drain is particularly overestimated in countries such as São Tomé and Príncipe, Algeria, Tunisia, Morocco, Turkey, Suriname, and Algeria. By transposing the education structure observed in the United States, Carrington and Detragiache (1998) and Adams (2003) obtain high emigration rates of tertiary 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 majority of these migrants live), we obtain much lower-skilled emigration rates (between 5 and 20 percent). On the contrary, the brain drain is largely underestimated in Sub-Saharan Africa (Kenya, The Gambia, the Seychelles, Mauritius) and in small countries sending a small number of emigrants to the OECD area (Malta, Cyprus, and so on).

Comparison with Release 1.0 (Docquier and Marfouk 2004)

Figure 5.A.2 compares the skilled migration rates evaluated in “Measuring the International Mobility of Skilled Workers—Release 1.0” with those evaluated in Release 1.1. It appears that there were no systematic biases in the previous release: a simple regression gives $\text{Release 1.1} = 0.0081 + 0.9866 \times \text{Release 1.0}$, $R^2 = 0.8701$. Nevertheless, replacing survey data with census data obtained from European countries strongly improves our measure for about 20 sending countries.

Acknowledgments

We are grateful to the statisticians from the Statistics Offices of OECD countries that sent us the data and helped us interpret them. We would particularly like to

FIGURE 5.A.1 Emigration Rates under 3 Measurement Methods, 2000

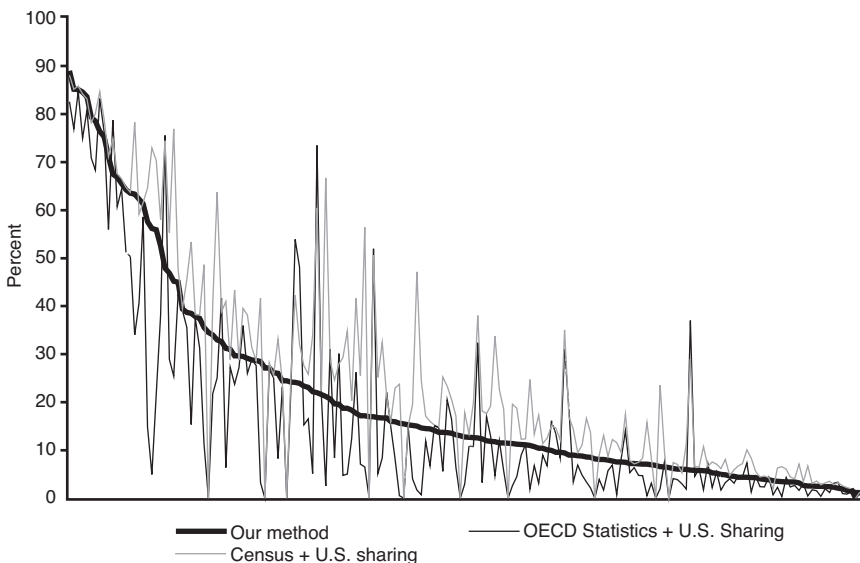
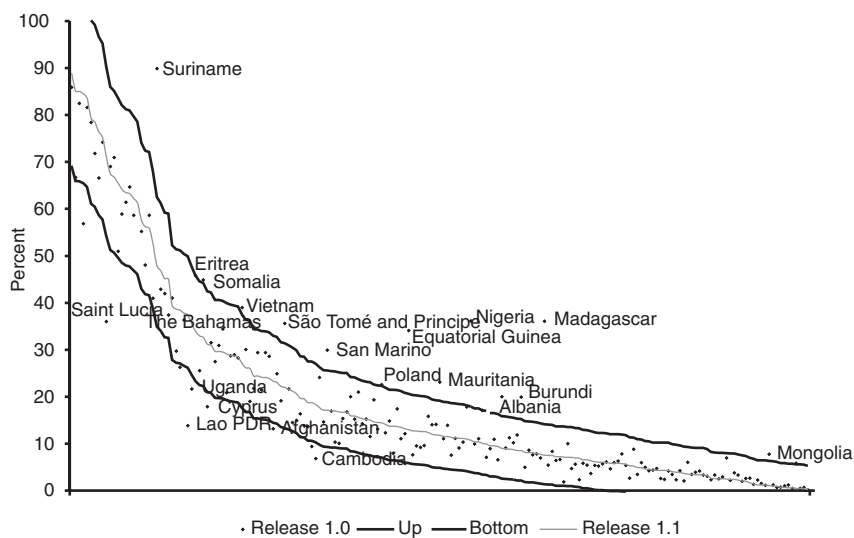


FIGURE 5.A.2 Comparison between Release 1.1 and Release 1.0

thank the members of Statistics Canada, the U.S. Bureau of Census, Statistics New Zealand and the New Zealand Department of Labour, (INSEE)-France (Lille center), Statistik Austria, the Hungarian Central Statistical Office, the Polish Central Statistical Office, the Australian Bureau of Statistics, Statistics Denmark, Statistics Finland, Statistics Norway, Statistics Sweden, the Czech Statistica Office, the Statistical Office of the Slovak Republic, the Spanish Instituto Nacional de Estadística, the U.K. Office for National Statistics, the Turkish State Institute of Statistics, the Central Statistical Office Ireland, Stateg Luxemburg, the Swiss Federal Statistical Office, the Italian Instituto Nazionale di Statistica, and the German Federal Statistical Office.

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Endnotes

1. See the International Organization for Migration on Africa (IOM 2003). The United Nations Development Programme (United Nations 2001) notes that, under the new U.S. legislation, about 100,000 software professionals are expected to leave India each year, over the next three years. The emigration of those professionals costs \$2 billion a year for India.

2. The IOM (2003) reports that “prospects of working abroad have increased the expected return to additional years of education and led many people to invest in more schooling, especially in occupations in high demand overseas.”

3. See IOM (2003) and World Bank (2003) on the perspectives of brain drain in the twenty-first century.

4. This was the position of the United Nations Economic Commission for Africa (UNECA), the IOM, and the International Development Research Centre at the regional conference on Africa, held in Addis Ababa in 2000.

5. OECD statistics suffer from various limitations (see OECD 2002). For example, they only provide information on the country of origin for the main sending countries. Other sending countries are considered as residual in the entry “other countries.” African migration is particularly mismeasured. In addition, OECD data are not available for Greece, Iceland, Mexico, Poland, the Slovak Republic, and Turkey in 2000.

6. A brief comparison is provided in appendix 6.3 of Docquier and Marfouk 2004.

7. Since then, a similar study by Dumont and Lemaître (2004) came out in October 2004. The main differences are as follows: (a) the data sources are somewhat different; (b) the definition of immigrant differs for some countries (for example, French citizens born in Algeria are counted as immigrants (the so-called “Pieds noirs”), while we use data on foreign born (people born abroad with foreign citizenship at birth) published by the French Statistic Institute; (c) we consider the population age 25 and over, while they consider the population age 15 and over; (d) we provide skilled emigration rates for 195 countries in 2000 and 174 countries in 1990, while they provide rates for 102 observations in 2000 (94 in a variant); (5) they aggregate dependent territories and their sovereign state, while we treat dependent territories as separate areas.

8. Note that we report 1990 estimates for a few countries that became independent after January 1, 1990 (for example, Namibia, the Marshall Islands, Micronesia, and Palau).

9. Our working-age concept includes retirees.

10. Bhorat, Meyer, and Mlatsheni (2002) compare South African emigration data with immigration numbers collected in five important receiving countries (Australia, Canada, New Zealand, the United Kingdom, and the United States). They show that the emigration sum was approximately three times larger than South African official statistics.

11. For example, Australian data mix information about the highest degree and the number of years of schooling.

12. Using registration data from Finnish schools and universities, Statistics Finland has problems with degrees obtained abroad. In New Zealand, there was a major change in the classification of postschool qualifications between 1991 and 1996.

13. Hatton and Williamson (2002) estimate that illegal immigrants residing in OECD countries represent 10 to 15 percent of the total stock.

14. See http://uscis.gov/graphics/shared/aboutus/statistics/III_Report_1211.pdf.

15. In some receiving countries, such as Germany, immigrants’ children (that is, the second generation) usually keep their foreign citizenship.

16. Conversely, in other OECD countries with a restricted access to nationality (such as Japan, Korea, and Switzerland), the foreign population is important (about 20 percent in Switzerland).

17. See Malone and others (2003) for more details.

18. Data by foreign background are provided in the Netherlands, France, and Scandinavian countries. See Alders (2001) for the Netherlands or Ostby (2002) for Norway.

19. Note that aggregating appropriated stock data would allow computation of emigration rates for the former Yugoslavia, the former Soviet Union, and the former Czechoslovakia in 2000.

20. Carrington and Detragiache (1998) used data from the Institute of International Education to estimate the number of graduate students completing their schooling in the United States. We consider that some of these students age 25 and over receive grants and can be considered as workers (researchers).

21. Country-specific data by occupation reveal that the occupational structure of those with unknown education is similar to the structure of low-skilled workers (and strongly different from that of high-skilled workers). See Debuissin and others (2004) on Belgium data.

22. For some countries, immigrants often travel back and forth between their new and old countries (for example, Mexico). These immigrants are likely to be counted as still being residents in their home country. For that reason, Carrington and Detragiache (1998) provide an upper bound ($m=M/N$) and a lower bound ($m=M/(N+M)$). Because the upper bound is not interpretable for a large number of countries (higher than one), we only report the lower bound.

23. See <http://esa.un.org/unpp>.

24. See <http://www.cia.gov/cia/publications/factbook>.

25. This partly explains why human capital did not prove to be significant or distort the “good sign” in growth regressions.

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

27. In Cyprus, the 2001 census gives share of population with tertiary education at 22 percent to be compared with 4.6 percent in Cohen and Soto (and 17.1 percent in Barro and Lee).

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