CHAPTER 2

Absent Human Capital: What Do We Know?

The data on international migration are so poor that it is difficult to estimate simple migrant stocks and flows, let alone their human capital content.[1] By contrast, considerable effort has been put into amassing, refining, and updating data on international financial flows. Several international agencies have taken charge of maintaining these data, most notably the World Bank, International Monetary Fund, Bureau of International Statistics, and the Organization for Economic Cooperation and Development (OECD). To date, no comparable interest has been shown in human capital outflows, perhaps because their consequences are less visible and take longer to reveal themselves than the impacts of financial crises. A good analogy is the response to crises resulting from severe drought versus endemic malnutrition due to poverty: the international community tends to tolerate the latter condition to a much greater degree, even though in the long term its human costs may greatly exceed those due to occasional droughts.

Unfortunately, developing countries, which have the most to gain from compiling and maintaining data on human capital flows, lack the capabilities to do so. In some cases, they are not interested because those leaving are part of the governing elites. The disaggregated and individual nature of these outflows compounds the problem. Nonetheless,

1. For example, some countries report the sizes of their foreign-born populations, while others report the size of their noncitizen populations.

these movements are no more complex than financial outflows, and some means already exist to collect data on them. Censuses, population surveys where they exist, consular offices of embassies, visa applications, in some cases tax authorities—all can provide pertinent information on flows from developing to industrial countries. The first hurdle, of course, is that databases are not geared to compiling this information, and no international standards exist on census or visa information that would match the infrastructure for collecting data on financial flows. In addition, heightened national security concerns have reduced the possibility of open access to data from many of these sources, although developing countries could do more to make their collective interest in this regard known to international organizations.

Another impediment, perhaps the most difficult to overcome, is that the principal measures of human capital flows used to date—years of schooling or level of education—say little about quality. Hence the most that is known concerns the stock of foreign-born tertiary-educated people from some developed countries.[2] This says nothing about the quality of the group, particularly whether it is from the tail end of the distribution, which may be affected by the more varying quality of educational institutions in developing countries. Furthermore, the number of years of education says little about areas of study and how serious the loss of skilled personnel may be in important areas such as science and technology, or what political and economic effects are induced by factors such as emigrants' religion, ethnicity, and region of origin. Notwithstanding these limitations, we draw on a number of sources in this chapter to provide a rough statistical portrait of the relevant human capital stocks and flows.

UN Estimates of Migrant Stocks and Flows

The United Nations estimates that in 2000, 175 million people were living outside their country of birth. This figure is just less than 3 percent of the world's population and considerably more than the 120 million estimated in 1990. About 104 million of these people were living in what the United Nations considers "more developed regions" than their home countries; this group represented close to 9 percent of the home population. Among countries with migrant stocks of more than 1 million people (table 2-1), the United States, with close to 35 million immigrants,

2. See Adams (2003).

Table 2-1. Migrant Stocks of More than One Million in 2000[a]

Country	*Thousands*	*Percent of total population*
United States	34,988	12.4
Russia	13,259	9.1
Germany	7,349	9.0
Ukraine	6,947	14.0
France	6,277	10.6
India	6,271	0.6
Canada	5,826	18.9
Saudi Arabia	5,255	25.8
Australia	4,705	24.6
Pakistan	4,243	3.0
United Kingdom	4,029	6.8
Kazakhstan	3,028	18.7
China, Hong Kong	2,701	39.4
Côte d'Ivoire	2,336	14.6
Iran	2,321	3.3
Israel	2,256	37.5
Moldova	2,088	5.4
Jordan	1,945	39.6
United Arab Emirates	1,922	73.8
Switzerland	1,801	25.1
Italy	1,634	2.8
Japan	1,620	1.3
Netherlands	1,576	9.9
Turkey	1,503	2.3
Argentina	1,419	3.8
Malaysia	1,392	6.3
Singapore	1,352	33.6
South Africa	1,303	3.0
Belarus	1,284	12.6
Burkina Faso	1,124	9.7
Kuwait	1,108	57.9
Venezuela	1,006	4.2

Source: United Nations Population Division (UNPD) (2002).

a. For most countries, the migrant stock number is a midyear estimate of the number of foreign-born. Estimates of the number of noncitizens are used where data on nativity are not available (Japan, Iran, Jordan, Kuwait, and Germany).

has by far the largest foreign-born population.[3] (Recently released estimates from the 2000 census put the figure somewhat lower, at just over 31 million.) The large stocks of foreign-born residents in second-ranked Russia and fourth-ranked Ukraine are largely driven by mobility—restricted even as it was—within the former Soviet Union. Among developed countries, Germany, France, Canada, Australia, and the United Kingdom also have large foreign-born populations. Indeed, when measured as a share of the domestic population, the foreign-born populations of Canada (18.9 percent) and Australia (24.6 percent) are substantially larger than that in the United States (12.4 percent).[4] Another striking feature of foreign-born populations is their large presence (both in terms of absolute numbers and especially as a share of the population) in the oil-exporting Arab countries, in Israel (due to the immigration of the Jewish diaspora), and in poor African countries such as Côte d'Ivoire and Burkina Faso (with neighbor countries with severe civil unrest).

In the second half of the 1990s, the annual net outflow in a number of countries averaged more than 2 people per 1,000 (table 2-2). Not surprisingly, departure figures were highest for countries experiencing civil or regional wars. In war-tornTimor, the rate was 41 per 1,000, and in Burundi, 13 per 1,000. Elsewhere, economic factors presumably played the predominant role in pushing people out, as was the case in Estonia (8 per 1,000), Bulgaria (5 per 1,000), the Philippines (3 per 1,000), and Jamaica (3 per 1,000).

Estimated Emigration Rates by Education Level

The raw numbers do not indicate *who* is leaving. Development impacts—both positive and negative—are highly contingent on this aspect of emigration, on whether it is poor laborers with less than a primary education or the educated elite who are leaving. Depending on the questions asked, census data for developed countries may shed some light on the human capital characteristics of the foreign-born populations by country of origin. Until recently, the only cross-country comparison of human capital loss from developing countries has been done for U.S. census data. Two directly comparative studies have been completed

3. Where estimates of the size of the foreign-born population are not available, the table records estimates of the noncitizen or foreign population (see note to table 2-1 for the countries with noncitizen population estimates).

4. Recent census estimates put the foreign-born shares slightly lower: 21.9 percent in Australia, 18.4 percent in Canada, and 11.1 percent in the United States.

Table 2-2. Countries with Estimated Net Emigration of More than Two per 1,000 of Population, Annual Average, 1995–2000

Country	*Net emigration per 1,000*	*Net emigration (thousands)*
Timor Leste, Democratic Republic of	40.6	32
Samoa	22.8	4
Burundi	12.9	80
Kazakhstan	12.2	200
Guyana	10.6	8
Tajikistan	10.3	61
Suriname	10.3	4
Fiji	8.8	7
Estonia	8.0	12
Sierra Leone	7.8	33
Haiti	7.4	19
Congo, Democratic Republic of	7.1	340
Saint Lucia	7.0	1
Mongolia	6.5	16
Guinea	6.2	48
Georgia	5.7	30
Burkina Faso	5.5	60
Bulgaria	4.9	40
Mali	4.7	50
Lesotho	3.4	7
Mexico	3.3	310
Benin	3.2	19
Trinidad and Tobago	3.1	4
Guatemala	2.8	30
Sudan	2.6	77
Philippines	2.6	190
Jamaica	2.6	1
Cape Verde	2.5	1
Armenia	2.5	9
Nicaragua	2.5	12
Belize	2.3	1
Guadeloupe	2.2	1
Mauritius	2.0	2
Latvia	2.0	5

Source: UNPD (2002).

using data from the 1990 census and subsequently the 2000 census.[5] In a recent massive data-gathering exercise, Frédéric Docquier and Abdeslam Marfouk extended this line of inquiry to almost the entire OECD, using national census and survey data.[6]

The methodology used in these earlier studies consists of two key steps. First, residents in the United States aged 25 and older who emigrated from specified developing countries were assigned to one of three educational categories: primary or less (0 to 8 years of education), secondary (9 to 12 years of education), and tertiary (more than 12 years of education). Second, the stock of individuals at each level of education was compared with domestic stocks.[7]

While revealing, this methodology has a number of obvious drawbacks. First, the educational categories are broad and imprecise. For instance, a graduate from one of India's elite institutes of technology would be placed in the same category as a graduate from a low-quality private college. Second, it is not clear whether individuals received their educations in their home country or abroad. Concern about human capital loss obviously differs for a person educated in the home country at the expense of home-country taxpayers as opposed to people who studied in their adopted country at their own or their adopted country's expense. Third, no mention is made of the age at which people left their home country. The difference between individuals who left with their parents as infants and those who left immediately after graduation from university to take a high-paying job abroad is self-evident.

Table 2-3 records some salient characteristics of certain developing-country populations residing in the United States in 2000. By far the largest number of emigrants, more than 9 million, were from Mexico. Roughly half of this group (52 percent) came before 1990, and roughly half (48 percent) came afterward. Of the more than 6 million Mexicans aged 25 or older living in the United States, nearly half possess a primary education or less, and only 14 percent have some form of tertiary education. The educational composition is very different for the next two largest groups of nationals, from the Philippines and India. A relatively high share of Filipinos (65 percent) came before 1990, but the share with some tertiary education is much higher than for Mexicans, standing at 73 percent. By contrast, Indians are newcomers, with

5. Carrington and Detragiache (1998); Adams (2003).
6. Docquier and Marfouk (2004).
7. Estimates of domestic stocks are from Barro and Lee (1993, 2000).

Table 2-3. Foreign-Born Population in the United States in 2000: Entry Year and Education Level, Selected Developing Countries

		Entry year (percent)					
	Total	1990–	Pre-	Total	Education 25 or older (percent)[a]		
Country of birth	2000	2000	1990	25 or older	Primary	Secondary	Tertiary
Mexico	9,177,485	48	52	6,374,825	48	38	14
Philippines	1,369,070	35	65	1,163,555	8	20	73
India	1,022,550	55	45	836,780	5	15	80
China	988,785	49	51	846,780	20	26	54
El Salvador	817,340	40	60	619,185	41	42	17
Dominican Republic	687,680	43	57	527,520	30	43	29
Jamaica	553,825	31	69	449,795	8	47	45
Colombia	509,875	45	55	402,935	13	41	46
Guatemala	480,665	49	51	341,590	43	37	20
Peru	278,185	47	53	220,815	8	39	53
Pakistan	223,475	57	43	165,425	7	26	67
Brazil	212,430	66	34	154,250	9	36	55
Nigeria	134,940	53	47	109,160	2	15	83
Egypt	113,400	41	59	96,660	4	19	78
Bangladesh	95,295	70	30	69,180	9	29	62
Turkey	78,380	47	53	64,780	14	28	58
Indonesia	72,550	50	50	53,170	3	23	75
Armenia	65,280	57	43	44,380	9	41	51
Croatia	40,910	33	67	35,455	19	40	41
Albania	38,660	83	17	25,785	14	48	38
Morocco	34,685	53	47	29,670	5	30	65
Sri Lanka	25,265	50	50	21,820	2	26	72
Sudan	19,790	76	24	12,730	8	29	63
Tunisia	9,110	32	68	5,555	7	29	64

Source: U.S. Census 2000; Adams (2003), based on special tabulations from U.S. Census 2000.

a. Primary corresponds to 0–8 years of schooling, secondary to 9–12 years, and tertiary to more than 12 years.

55 percent coming after 1990; however, the share with tertiary education is 80 percent, which is even higher than for Filipinos. Among the other groups on the list, only those from El Salvador and Guatemala exhibit the same low levels of education as do Mexican emigrants.

As a crude measure of the significance of absent human capital, we look at the number of tertiary-educated individuals (aged 25 and older) residing in the United States as a percentage of the total tertiary-educated population (domestically resident and emigrant) of that country (table 2-4). Following William Carrington and Enrica Detragiache,

Table 2-4. Absent Human Capital: Emigration Rates by Education Level, Population 25 or Older, 1990 and 2000[a]

Percent

a. Rates to the United States[b]

	U.S. resident population (≥ 25)				*1990*				*2000*			
Country of birth	*1990*	*2000*	*Change*	*Percent change*	*Total*	*Pri-mary*	*Second-ary*	*Terti-ary*	*Total*	*Pri-mary*	*Second-ary*	*Terti-ary*
Mexico	2,743,638	6,374,825	3,631,187	132	7.1	1.7	20.9	10.3	11.7	9.7	14.7	14.2
Philippines	728,454	1,163,555	435,101	60	2.2	0.1	4.4	6.6	3.5	0.6	2.2	10.5
India	304,030	836,780	532,750	175	0.1	0.1	0.1	1.1	0.2	0.1	0.2	2.7
China	404,579	846,780	442,201	109	0.1	0.1	0.1	1.4	0.1	0.1	0.2	2.2
El Salvador	263,625	619,185	355,560	135	10.2	1.6	66.6	26.1	19.5	11.0	53.4	28.3
Dominican Republic	187,871	527,520	339,649	181	5.9	0.6	29.7	14.2	11.4	5.0	29.8	19.9
Jamaica	159,913	449,795	289,882	181	11.8	0.4	23.4	67.5	25.0	4.5	29.0	78.6
Colombia	162,739	402,935	240,196	148	1.1	0.1	3.7	5.6	2.1	0.4	3.8	9.0
Guatemala	127,346	341,590	214,244	168	3.3	0.4	29.1	13.5	7.1	3.7	23.0	20.5
Peru	86,323	220,815	134,492	156	0.9	0.1	2.3	3.0	1.8	0.3	2.4	4.0
Pakistan	52,717	165,425	112,708	214	0.1	0.1	0.2	2.4	0.3	0.1	0.5	6.0
Brazil	53,904	154,250	100,346	186	0.1	0.1	0.7	0.6	0.2	0.1	0.5	1.1
Egypt	53,261	96,660	43,399	81	0.3	0.1	0.4	2.5	0.3	0.1	0.2	2.2
Bangladesh	12,385	69,180	56,795	459	0.1	0.1	0.1	0.6	0.1	0.1	0.3	2.2
Turkey	43,605	64,780	21,175	49	0.2	0.1	0.7	1.5	0.2	0.1	0.4	1.3
Indonesia	32,172	53,170	20,998	65	0.1	0.1	0.1	1.4	0.1	0.1	0.1	0.7
Sri Lanka	8,715	21,820	13,105	150	0.1	0.1	0.1	3.8	0.2	0.1	0.1	5.3
Sudan	2,496	12,730	10,234	410	0.1	0.1	0.1	1.8	0.1	0.1	0.3	3.3
Tunisia	2,816	5,555	2,739	97	0.1	0.1	0.3	1.6	0.1	0.1	0.2	1.3
b. Rates to all OECD countries[c]												
Mexico					7.4	6.5	8.9	10.4	11.5	9.5	14.3	14.3
Philippines					4.1	1.1	3.1	12.8	5.2	1.4	3.1	14.8
India					0.2	0.1	0.2	2.6	0.3	0.1	0.3	4.2
China					0.2	0.1	0.1	3.1	0.2	0.1	0.2	4.2
El Salvador					14.4	8.2	38.5	32.9	20.2	11.2	53.6	31.5
Dominican Republic					7.9	3.8	23.6	17.9	12.5	5.8	30.9	21.7
Jamaica					25.6	11.0	28.9	84.1	29.0	8.3	30.0	82.5
Colombia					1.8	0.5	3.9	9.2	2.7	0.8	4.6	11.0
Guatemala					4.3	2.1	18.9	18.2	6.9	3.5	22.8	21.5
Peru					1.6	0.3	2.6	5.6	2.8	0.7	3.6	6.3
Pakistan					0.4	0.2	0.6	6.1	0.7	0.3	1.1	9.2
Brazil					0.3	0.1	0.9	1.7	0.6	0.1	1.5	3.3
Egypt					0.7	0.2	1.0	5.3	0.8	0.2	0.7	4.2
Bangladesh					0.1	0.1	0.2	2.3	0.3	0.1	0.7	4.7
Turkey					4.9	4.2	9.3	6.3	5.0	4.6	7.5	4.6
Indonesia					0.3	0.1	0.4	6.2	0.2	0.1	0.3	2.0
Sri Lanka					1.6	0.8	1.5	24.8	2.8	1.9	1.8	27.5
Sudan					0.1	0.0	0.4	5.0	0.2	0.1	0.7	5.6
Tunisia					4.7	4.6	3.4	12.3	4.3	4.2	3.0	9.6

c. Tertiary rates to OECD countries, by region[d]

Region	*1990*	*2000*	*Difference*	*2000/1990*
Caribbean	41.4	40.9	–0.5	0.99
Western Africa	20.7	26.7	6.0	1.29
Eastern Africa	15.5	18.4	2.9	1.19
Central America	12.9	16.1	3.2	1.25
Central Africa	9.8	13.3	3.5	1.36
Southeastern Asia	10.3	9.8	–0.5	0.95
Northern Africa	6.8	6.2	–0.6	0.91
Western Asia	6.9	5.8	–1.1	0.84
South America	4.7	5.7	1.0	1.21
Southern Africa	6.9	5.3	–1.6	0.77
South-Central Asia	4.0	5.1	1.1	1.28
Eastern Europe	2.3	4.5	2.2	1.96
Eastern Asia	4.1	4.3	0.2	1.05

a. For each education category, the emigration rate equals the number of emigrants divided by the domestically resident population plus the number of emigrants.

b. Sources: For 1990, Carrington and Detragiache (1998); for 2000, Adams (2003). Both sources combine U.S. Census data with data on human capital stock from Barro and Lee (1993, 2000).

c. Sources: Docquier and Marfouk (2004) and authors' calculations.

d. Source: Docquier and Marfouk (2004).

we call this measure the *emigration rate*.[8] To the extent that emigrants are included in the measure of the domestically resident population arrived at by Robert Barro and Jong-Wha Lee, this calculation will underestimate the true emigration rate, and so it can reasonably be viewed as a lower bound.[9]

Rates at which the tertiary-educated immigrate to the United States vary greatly across countries. In 2000 the figures ranged from 2.7 percent for tertiary-educated Indians (notwithstanding the fact that 80 percent of U.S. resident Indians have a tertiary education) to 78.6 percent for Jamaicans. Here, whatever the relative quality, the raw numbers suggest a staggering absence of scarce human capital from the home country. Although only 14 percent of the Mexican-born population in the United States has a tertiary education, that population is so large that the tertiary emigration rate is still 14.2 percent—which is far higher than the Indian rate, which, however, may be hiding a large amount of absent Indian human capital given the high human capital intensity of Indian emigrant graduates.

8. Carrington and Detragiache (1998).
9. Barro and Lee (1993).

It is also interesting to compare changes in these foreign-born populations (aged 25 and older) over the course of the 1990s. Most striking is the tremendous increase in size. The Indian-born population, for example, increased by almost 534,000, or 175 percent. Emigration rates jumped too, as illustrated by figures for China, which rose from 1.4 percent in 1990 to 2.2 percent in 2000.[10] All these increases reflect large increases in the underlying absent stocks.

What overall conclusions can one draw about U.S.-bound skilled emigration? First, for a number of countries—notably Mexico and countries in Central America and the Caribbean—a substantial fraction of their educated populations are residing in the United States when measured by the crude tertiary emigration rate. Second, excepting those from Mexico and Central America, the foreign-born populations residing in the United States tend to have a fairly high education. And third, when measured as a percentage of total tertiary-educated stocks, the stocks of absent human capital in many countries increased substantially over the 1990s.

Table 2-4 also uses the recently available data from Docquier and Marfouk to calculate country-specific emigration rates to the entire OECD for the same set of countries. For countries in Central and South America and the Caribbean, the emigration rates to the entire OECD are not that much higher than the emigration rates solely to the United States. This obviously reflects the fact that the United States is the destination of choice for most emigrants from these regions. Elsewhere, however, geography and historical ties make other OECD countries attractive destinations. For example, the emigration rate of tertiary-educated individuals from Tunisia to the United States is just 1.3 percent compared with 9.6 percent to the OECD as a whole—most of which is accounted for by nearby European countries. For the two most populous countries in the world, China and India, expanding the focus to the entire OECD also leads to a substantial increase in the estimated tertiary emigration rate. In 2000 the Chinese and Indian emigration rates to the United States were 2.2 and 2.7 percent, respectively, but reached 4.2 percent in the entire OECD.[11] To get a better overall picture, the table also shows emigration rates by broad region for the tertiary-educated. The rates from some regions are shockingly high. In 2000 the tertiary

10. Tertiary-educated stocks residing within many developing countries also increased during the 1990s. China's stock increased from just under 12 million to almost 21 million.

11. Adams (2003).

rate for the Caribbean region was in excess of 40 percent. The figure for Western Africa was 27 percent. Moreover, for a number of very poor regions the rate rose substantially over the 1990s. It climbed almost 30 percent for Western Africa (or 6 percentage points, the highest percentage point increase of all regions), 36 percent for Central Africa, and 96 percent for Eastern Europe.

"Quality" as Reflected in Indian Immigration to the United States

The foregoing analysis raises a key question: to what extent are the "best and brightest" disproportionately emigrating? Put in terms of a concrete example, does the fact that the tertiary-educated Indians in the United States equal just 2.7 percent of tertiary-educated Indians in India mean that India is losing just a small and nonthreatening fraction of its human capital to the United States—or are the Indians that leave of disproportionately high "quality"?

The evidence, particularly from studies of graduates of the six branches of the Indian Institute of Technology (IIT), strongly suggests that those Indians who leave are not drawn randomly from the population of graduates, let alone the population at large. The acceptance rate at these institutes is between 1 and 2 percent from an already highly selective pool. According to an analysis of the "brain drain" from IIT Mumbai in the 1970s, 31 percent of its graduates settled abroad, while the estimated migration rate of engineers for the country as a whole was 7.3 percent.[12] Furthermore, the migration was significantly higher in those branches of engineering in which IIT entrants had the highest scholastic ranking: thus the percentage abroad in electrical engineering (which had higher entrance requirements in those years) was nearly 43 percent, whereas in metallurgical engineering (with lower requirements) it was about 20 percent. Similarly, the top quartile of the graduating class had 43 percent abroad but the rest of the class only 27 percent.

Other disciplines in India have also experienced this type of severe selection bias in emigration. In medicine, the migration rates for doctors in general was about 3 percent during the 1980s, but for graduates of the All India Institute for Medical Sciences, India's most prestigious

12. See Sukhatme (1994). The survey, conducted in 1986, covered students who graduated from IIT Mumbai between 1973 and 1977. Students taking the entrance exam for the IITs are ranked on their performance in a written exam. Students with higher rankings have greater choice of institute and branch of engineering, and once these places are filled, the lower-ranked students choose from the remaining disciplines.

medical training establishment, the rate was 56 percent between 1956 and 1980, and it stood at 49 percent in the 1990s.[13] (The next section examines the outflows from this sector more generally.) A recent analysis of graduates of India's premier management school in February 2000 found that the grades of typical recruits in the international sector are "significantly higher" than those of their counterparts in the domestic sector.[14]

Selection bias is also reflected in the wage and income attainment of the Indian-born population residing in the United States compared with that of Indians born there and non-Indian foreign nationals.[15] Drawing on U.S. census figures for 1990 and Current Population Survey (CPS) data for 1994–2001 (see tables 2-5 and 2-6), we find that the Indian-born population in the United States is indeed very highly skilled. Focusing on the March 2001 CPS results, we see that 78 percent of this population (aged 25 to 64) has a bachelor's degree or better, and almost half of this group has a postgraduate degree: 28 percent has a master's degree, 6 percent a professional degree, and 4 percent a Ph.D. By contrast, only 9 percent of the native-born population has a postgraduate degree. Interestingly, the share with a postgraduate degree in the "other" foreign-born category is also 9 percent. This figure reflects the relatively low educational attainment and high immigrant numbers from Mexico and Central American countries. A striking feature of this last group is that a very high share did not complete high school (32 percent in 2001 compared with 9 percent for the native-born), and also a relatively high share had Ph.D.s (2 percent versus 1 percent).

An even more direct way to gauge the relative skill level of the Indian-born population is to look at their incomes in relation to those of U.S.-born Indians and non-Indian foreign nationals (table 2-6).[16] In March 2001, for example, the median income of the native-born population was $23,925, and 4 percent of this group earned more than $95,700, or more than four times the native-born median. By contrast, 12 percent of the Indian-born population—three times the percentage of the native-born—had incomes greater than this level.

13. For figures between 1956 and 1980, see Khadria (1999). Data on the 1990s are based on submissions by the Comptroller and Auditor General to the Indian Parliament. See Synopses of Debates, Rajya Sabha, Proceedings Other than Questions and Answers, August 22, 2001 (http://parliamentofindia.nic.in/rs/rsdebate/synopsis/193/22082001.html).

14. See Bhattacharjee, Krishna, and Karve (2001).

15. For detailed discussion of this type of selection bias, see Desai, Kapur, and McHale (2003).

16. We restrict our attention to the working-age population (18 to 64).

Table 2-5. Educational Attainment for Native-, Indian-, and Other Foreign-Born, Aged 25–64, 1990 and 1994–2001[a]

Percent

	Population share					*Graduate breakdown*		
Year	*Below high school*	*High school graduate*	*Some college*	*Bachelor's degree*	*Graduate level*	*Master's*	*Profes-sional*	*Ph.D.*
Native-born								
1990	17	32	28	15	8	5	2	1
1994	13	36	27	16	8	6	1	1
1995	12	35	28	17	8	6	2	1
1996	12	35	28	18	8	6	1	1
1997	11	35	28	18	8	6	1	1
1998	11	35	28	18	8	6	1	1
1999	10	34	28	19	9	6	1	1
2000	10	34	29	19	9	7	1	1
2001	9	33	29	19	9	7	1	1
Indian-born								
1990	12	11	14	27	36	21	9	6
1994	8	9	15	35	32	17	11	4
1995	8	10	12	26	44	24	13	7
1996	8	13	12	30	38	27	7	4
1997	7	16	10	34	33	23	6	4
1998	6	14	15	35	31	22	5	3
1999	6	10	10	36	38	25	7	6
2000	6	8	9	35	41	27	6	8
2001	3	9	10	40	38	28	6	4
Other foreign-born								
1990	38	20	20	13	9	5	2	1
1994	34	25	17	16	8	5	2	2
1995	35	25	17	15	8	5	2	2
1996	35	23	18	15	8	5	2	2
1997	34	24	18	16	9	5	2	2
1998	33	25	16	17	9	6	2	2
1999	33	25	17	16	9	6	2	2
2000	32	26	17	16	9	5	2	2
2001	32	25	17	17	9	5	2	2

Source: For 1990, U.S. Census Bureau (1990); for 1994–2001, March Current Population Survey.

a. The five columns under "population share" show the percentage living in the United States who have attained various levels of education for the specified years. The remaining three columns provide a further breakdown by degree type for those who have attained graduate-level education.

Table 2-6. Income Distribution for Native-, Indian-, and Other Foreign-Born, Aged 18–64, 1990 and 1994–2001[a]

Year	Median (2001 U.S. dollars)	Population share (as percent of median)				
		0–50	50–100	100–200	200–400	> 400
Native-born						
1990	20,293	33	17	27	18	4
1994	19,836	31	19	28	18	4
1995	20,100	30	20	28	18	5
1996	20,626	30	20	29	17	4
1997	21,418	30	20	29	17	4
1998	21,580	30	20	29	16	4
1999	22,826	30	20	30	16	4
2000	23,126	30	20	29	16	5
2001	23,925	29	21	30	16	4
Indian-born						
1990	20,670	35	14	21	20	10
1994	21,943	32	14	24	21	9
1995	24,980	28	14	26	22	11
1996	25,145	31	16	25	19	10
1997	24,301	29	18	24	21	8
1998	27,915	29	15	23	24	9
1999	31,715	30	11	24	26	9
2000	29,986	35	9	18	24	14
2001	28,121	34	11	18	25	12
Other foreign-born						
1990	14,483	39	21	23	13	4
1994	13,053	42	23	21	11	3
1995	13,803	41	24	21	11	4
1996	13,562	42	24	22	10	3
1997	13,729	41	24	22	10	3
1998	14,443	40	25	21	10	4
1999	14,816	41	26	21	9	3
2000	15,510	40	26	21	11	3
2001	16,084	37	26	23	10	3

Source: For 1990, U.S. Census Bureau (1990); for 1994–2001, March Current Population Survey.

a. The five columns under "population share" show the percentage living in the United States who lie between various fractions and multiples of the median native-born income for the specified years.

As table 2-6 also shows, the median for the Indian-born group is well above the median for the native-born, which in turn is well above the median for the "other" foreign-born. This again reflects the low average human capital of immigrants from Mexico and Central America (see table 2-3). Even so, the share with very high incomes—again defined as four times the native-born median—is just slightly less in the other foreign-born category than that for the native-born population. Thus although the Indian-born population is undoubtedly an outlier in terms of its human capital intensity (again, see table 2-3), these data are consistent with substantial numbers of very skilled individuals residing in the United States.

The Example of Medical Outflows

Of all the talent lost from developing countries, medical professionals are perhaps of the greatest concern—all the more so in the wake of the AIDS pandemic. To appreciate how scarce medical professionals are in some poorer countries, consider that net importers of health professionals such as Australia and Canada have more than 200 physicians and 800 nurses per 100,000 people, whereas Ghana, a net exporter of health professionals, has only 6.2 physicians and 72 nurses per 100,000—which translates to 16,129 people per physician and 1,389 people per nurse (table 2-7).

Although fragmentary, trends in health professional flows can be pieced together from destination- and source-country data.[17] Driven by domestic nursing shortages, in 2001–02 the United Kingdom for the first time listed more overseas additions to its nurse register than home-country additions: 735 nurses were from the Philippines, 2,114 from South Africa, and 1,342 from Australia. Recruitments from other countries such as India and Zimbabwe were also up sharply over the previous three years. The Code of Practice put in place in 1999 (extended to private recruitment agencies in 2001) prohibited recruiting in South Africa and the West Indies because of the severe shortages in these regions. However, noncompliance by recruitment agencies is reportedly widespread.

According to the U.S. Department of Health and Human Services, the United States suffered a shortage of 111,000 registered nurses in 2000. Foreign recruitment has thus far played a limited role in easing the

17. Here, we draw heavily on an excellent recent survey for the World Health Organization by Buchan and Poz (2002).

Table 2-7. WHO Estimates of Population per Health Professional, Selected Countries and Years

Countries in table 2-4	*Population per physician*	*Year*	*Population per nurse*	*Year*
Mexico	536.5	1990	1,156.1	1995
Philippines	813.0	1996	239.2	1996
India	2,083.3	1992	2,222.2	1992
China	618.4	1998	1,014.2	1998
El Salvador	933.7	1997	2,865.3	1997
Dominican Republic	463.8	1997	3,344.5	1997
Jamaica	713.8	1996	1,550.4	1996
Colombia	862.1	1997	2,070.4	1994
Guatemala	1,071.8	1997	3,703.7	1997
Peru	1,073.0	1997	869.6	1997
Pakistan	1,754.4	1997	2,941.2	1996
Brazil	786.2	1996	2,421.3	1996
Egypt	495.0	1996	429.2	1996
Bangladesh	5,000.0	1997	9,090.9	1997
Turkey	826.4	1998	917.4	1998
Indonesia	6,250.0	1994	2,000.0	1994
Sri Lanka	2,739.7	1999	973.7	1999
Sudan	11,111.1	1996	1,724.1	1996
Tunisia	1,428.6	1997	349.7	1997
Additional countries				
Australia	416.7	1998	120.5	1998
Canada	436.7	1995	111.5	1996
Germany	285.7	1998	104.5	1998
Ghana	16,129.0	1996	1,388.9	1996
Nigeria	5,405.4	1992	1,512.9	1992
Russia	237.5	1998	121.8	1998
South Africa	1,776.2	1996	212.0	1996
United Kingdom	609.8	1993	201.2	1989
United States	358.4	1995	102.9	1996

Source: World Health Organization (2002).

shortages because of restrictions imposed by U.S. immigration laws. Between 1997 and 2000, just 506 foreign nurses applied for licensure, with 32.6 percent of applications coming from the Philippines, 22 percent from Canada, and 7.4 percent from Africa (mainly Nigeria and South Africa). But lobbying by health care employers (and possibly even overburdened employees) is sure to build as shortages increase.

On the sending side, approximately 85 percent of Filipino nurses—some 150,000 individuals—are working overseas. In 2001 some 5,353 were thought to have left to work in the United Kingdom, 5,045 went to Saudi Arabia, 1,529 to Ireland, and 413 to Singapore. Filipinos are also prominent as domestic helpers and on the crews of the world's commercial ships. Overall, an estimated 7 million Filipinos are working abroad, which is equal to more than 20 percent of the domestic labor force.[18]

Given the importance of remittances to the domestic economy—they amount to roughly 10 percent of gross domestic product (GDP) a year—the Philippine government has initiated deliberate policies to encourage nurses to emigrate.[19] For other poor countries, however, the emigration of nurses is an unwanted hemorrhage that is worsening. Despite health care needs due to AIDS, the number of nurses in South Africa applying to work in another country rose from 500 in the early 1990s to more than 3,500 by the end of the decade. Those remaining behind are frustrated and demoralized by the deteriorating quality of care and staff shortages.[20]

Like most other sub-Saharan countries, Ghana is a country coping with an extreme shortage of physicians. Although low per capita income is a major factor behind the scarcity, physician emigration appears to have exacerbated preexisting shortages. Interviews with graduates from Ghana's medical schools suggest that about half of the physician graduates between 1985 and 1994 had left the country within 4.5 years, and three-quarters had left within 9.5 years.[21] The resulting loss has put a tremendous strain on the capacity to provide care, with the vacancy rate for physicians in 1998 standing at almost 50 percent. The clear factor pulling doctors away is the huge salary gap between Ghana and rich countries: in January 1999, a junior doctor (with five years or less of experience) earned an average of $200 a month, while a senior doctor earned just $272.

Elsewhere in Africa the situation is not much better. Since 1996 more than 100 doctors and 1,800 nurses have left Zimbabwe, most moving to English-speaking countries where they can earn a higher salary. Of the 1,200 doctors trained in Zimbabwe during the 1990s, only 360 were still practicing in 2001.[22] In 2001 doctors in Kenya earned the equivalent of

18. Martin and Widgren (2002).
19. Martin and Widgren (2002).
20. Buchan, Parkin, and Sochalski (2003).
21. Dolvo and Nyonator (1999).
22. Physicians for Human Rights (2004).

US$414 a month for working in the public domain. Low salary combined with the disparity in potential earnings has led to an exodus of doctors from Kenya—which the Kenya Medical Association estimates to be 20 doctors a month, an alarming rate given that the country has only 600 doctors in the public sector. The situation is equally serious in Nigeria, which has lost 21,000 doctors to the United States. According to American Medical Association records, however, the number of Nigerian doctors licensed to practice medicine in the United States is much smaller—fewer than 2,000.[23] This suggests that the majority may be working in positions that do not require a license or may have left medicine altogether. Either way, the outflow represents a considerable loss to the Nigerian health system.

Portuguese-speaking African countries have been losing sizable fractions of their health professionals to Portugal.[24] War-ravaged Angola, for example, has sent 820 doctors to Portugal, which is close to the 961 doctors remaining there. Guinea-Bissau has suffered an even more dramatic loss of 358 doctors to Portugal, compared with fewer than 200 remaining. Because a substantial fraction of these emigrant doctors received all or part of their medical training in Portugal, care should be taken in interpreting these numbers as a "brain drain." However, the fact remains that these African doctors are practicing in a relatively rich Western country rather than in Africa.

The shortage of health professionals also shows up in vacancy rates for established posts in the public sector.[25] In Malawi, for example, only 28 percent of established nursing posts were filled in 2003, down from 47 percent in 1998. The situation was worse for specialists in central hospitals, where only 9.3 percent of posts were filled—including just 1 surgeon out of 24 positions. Also in 1993, South Africa's Department of Health estimated that 4,000 doctor positions and 32,000 nursing positions were unfilled in the public sector. These vacancy numbers compare with a public sector workforce of 11,500 doctors and 86,000 nurses.

It is easy to become dulled to this litany of numbers. The human stakes in the medical brain drain and the paradox of poor-to-rich country flows are poignantly captured in a recent *New York Times* article:

23. Physicians for Human Rights (2004).
24. Stillwell and others (2004).
25. Physicians for Human Rights (2004).

> The result of the nursing crisis—the neglect of the sick—is starkly apparent here on the dilapidated wards of Lilongwe Central Hospital [in Malawi], where a single nurse often looks after 50 or more desperately ill people. What is equally visible is the boon to Britain, where Lilongwe Central's former nurses minister to the elderly in the carpeted lounges of nursing homes and to patients in hushed private hospital rooms.
>
> It is the poor subsidizing the rich, since African governments paid to educate many of the health workers who are leaving. At Lilongwe Central, an 830-bed hospital, there are supposed to be 532 nurses. Only 183 are left. That is about half as many as there were just six years ago. And only about 30 of those are registered nurses, the highly skilled cadre that is most sought abroad.[26]

Foreign Populations in Other OECD Countries

Even though the United States has by far the largest population of skilled emigrants, it is certainly not the only important receiving country. OECD estimates for 1990 and 2000 show 4.1 million foreign-born residents in Australia and 5.5 million in Canada (table 2-8). Although these numbers are well below the 31.1 million foreign-born counted in the 2000 U.S. census, as a fraction of the population (21.9 percent in Australia and 18.4 percent in Canada) they both exceed the U.S. fraction of 11.1 percent. Because immigration policies in Canada and Australia focus on skill, the educational attainment is relatively high in both countries.[27]

The OECD countries listed in tables 2-8 and 2-9 show great diversity in both the size and educational attainment of their foreign populations. Germany has the largest foreign-born population in the group: 7.34 million in 2000, or 8.9 percent of the total population. By far the largest contributor is Turkey, which accounted for more than 28 percent of the

26. Celia Dugger, "An Exodus of African Nurses Puts Infants and the Ill in Peril," *New York Times,* July 12, 2004.

27. Across all immigration streams to Canada in 2000, 44 percent of all principal applicants and dependents aged 15 or older had a bachelor's degree or better. Focusing on just the skilled (points-based) stream, 82 percent of principal applicants had a bachelor's or better (27 percent with a master's or doctorate degree). Even for dependents (15 or older), 69 percent had a bachelor's or higher degree. Moreover, the leading source countries for immigrants to Canada are developing countries. In 2000, for example, the top five sending countries were China, India, Pakistan, the Philippines, and Korea.

Table 2-8. Estimates of Foreign-Born Participants, circa 1990 and 2000

	Circa 1990			*Circa 2000*		
Estimate source	*Foreign or foreign-born (millions)*	*Percent of population*	*Year*	*Foreign or foreign-born (millions)*	*Percent of population*	*Year*
Census						
Australia	3.8	22.3	1991	4.1	21.9	2001
Canada	4.3	16.1	1991	5.5	18.4	2001
United States	19.8	7.9	1990	31.1	11.1	2000
OECD						
Austria	0.46	5.9	1990	0.75	9.2	1999
Belgium	0.90	9.1	1990	0.89	8.8	1999
Denmark	0.16	3.1	1990	0.26	4.9	1999
Finland	0.03	0.5	1990	0.09	1.7	1999
France	3.60	6.3	1990	3.26	5.6	1999
Germany	5.34	8.4	1990	7.34	8.9	1999
Ireland	0.08	2.3	1990	0.12	3.1	1999
Italy	0.78	1.4	1990	1.25	2.2	1999
Japan	1.08	0.9	1990	1.56	1.2	1999
Korea	0.05	0.1	1990	0.19	0.4	1999
Luxembourg	0.11	29.4	1990	0.16	36.0	1999
Netherlands	0.69	4.6	1990	0.65	4.1	1999
Norway	0.14	3.4	1990	0.18	4.0	1999
Portugal	0.11	1.1	1990	0.19	1.9	1999
Spain	0.28	0.7	1990	0.80	2.0	1999
Switzerland	1.10	16.3	1990	1.37	19.2	1999
United Kingdom	1.72	3.2	1990	2.21	3.8	1999

Sources: OECD (2002) and various censuses; foreign population data are from population registries or from registries of foreigners except for France (censuses), Portugal, Italy, and Spain (residence permits), and Ireland and the United Kingdom (labor force surveys).

foreign population in Germany in the late 1990s, though inflows from Poland and the Federal Republic of Yugoslavia were larger at the time. Owing to Germany's history of importing largely unskilled guest workers in the 1950s and 1960s, the tertiary educational attainment of its foreign population is 9 percentage points below that of the national population. Neighboring France also has a large foreign population: 3.26 million circa 2000 (or 5.6 percent of the total population). As in Germany, the group's tertiary education attainment lags well behind that of the national population (7.9 percentage points), reflecting large inflows of less skilled individuals from nearby North African countries.

Table 2-9. Shares of Population, Aged 25–64, with Tertiary Education, 1998

Country	*Nationals*	*Foreigners*	*Difference*
Austria	12.5	13.3	–0.8
Belgium	27.6	20.2	7.4
Czech Republic	11.2	23.4	–12.2
Denmark	26.1	27.7	–1.6
Finland	32.0	28.6	3.4
France	21.8	13.9	7.9
Germany	24.2	15.2	9.0
Greece	16.8	19.2	–2.4
Hungary	13.9	28.1	–14.2
Italy	9.5	13.0	–3.5
Luxembourg	16.1	21.7	–5.6
Netherlands	23.9	21.6	2.3
Norway	30.4	36.5	–6.1
Portugal	9.7	14.3	–4.6
Slovak Republic	10.0	15.4	–5.4
Spain	21.0	28.8	–7.8
Switzerland	24.0	23.7	0.3
United Kingdom	27.3	39.3	–12.0

Source: OECD (2002), based on Eurostat data.

In 1998 Morocco accounted for 13.8 percent of the inflows and 16.9 percent of the stock.

In the United Kingdom, the foreign population was estimated at 2.21 million circa 2000, or roughly 3.8 percent of the total population. In contrast to immigrants in Germany and France, this foreign population has relatively high educational attainment, with 39.3 percent possessing a tertiary degree compared with 27.3 percent of the national population. It should be added that such attainment in the foreign population is not unique to the United Kingdom. Eleven of the 18 countries listed in table 2-9 have greater tertiary attainment in their foreign populations than in their national populations. And, as explained in chapter 3, practically all countries have been shifting their immigration policies toward selecting more skilled workers.

Developing-Country Students in OECD Countries

Foreign students at rich-country schools represent a particularly interesting component of foreign-born populations from the perspective of

Table 2-10. Stock of Foreign Students in OECD Countries, 2002

Country	*Total (thousands)*	*Total non-OECD (thousands)*	*Percent non-OECD*
Australia	109.4	89.3	81.6
Austria	28.4	9.8	34.4
Belgium	7.3	2.7	36.8
Canada	32.9	19.0	57.9
Czech Republic	4.1	3.0	72.4
Denmark	11	6.4	58.0
Finland	4.3	2.8	64.1
France	148	108.3	73.2
Germany	171.2	74.8	43.7
Hungary	6.7	4.3	64.2
Iceland	0.2	0.0	18.6
Ireland	6.9	1.9	27.7
Italy	23.2	8.2	35.5
Japan	55.8	34.5	61.8
Luxembourg	0.6	0.1	15.7
New Zealand	5.9	4.6	78.5
Norway	5.8	2.6	45.5
Poland	5.4	4.4	82.3
Spain	29	9.9	34.3
Sweden	12.6	4.6	36.9
Switzerland	24.4	6.7	27.3
Turkey	18.7	17.0	91.1
United Kingdom	209.6	84.3	40.2
United States	430.8	262.8	61.0
Total	1,327.20	736.6	55.5

Source: OECD (2002).

skill supplies that are available to developing countries. If students eventually return to ply their skills at home, then poor countries can obviously benefit from the cutting-edge education acquired in rich countries. The trouble is, many students never return, with nonreturn rates especially high for those from poorer countries.

Of the 1.3 million foreign students residing in OECD countries in 1998, some 55.5 percent were from non-OECD countries (table 2-10). The largest number of foreign students, some 430,000, studied in the United States, and 61 percent of these were from non-OECD countries.

Looking at the 10 largest source countries of the U.S. foreign student body for the academic year 1997–98, one finds that Japan barely edged

out China as the largest sender of students, although China sent far more graduate students (83 percent of its total; see table 2-11). India also shows up as a large sender of graduate students. Also striking is the concentration of foreign graduate students in science and engineering: as much as 74 percent of Chinese graduate students and 73 percent of Indian graduate students are in science-related disciplines.

But will these students return? Although we do not have access to longitudinal data, some information is available on the *return plans* of foreign doctoral degree recipients from U.S. universities in both 1990 and 1999 (table 2-12). The bad news for developing countries is that large majorities plan to stay in the United States following graduation, though it is possible they are planning to return home at some later stage in life. In 1999 roughly 90 percent of both Chinese and Indian doctoral recipients planned to stay in the United States. The percentage in science and engineering planning to stay was similar for nonscience and nonengineering disciplines. Interestingly, although the overall shares planning to stay were similar in 1990 and 1999, the share expecting to stay in science and engineering was notably higher in the later year. For these graduates, there is little doubt that the booming high-tech economy of the 1990s and the easier availability of temporary work visas for skilled professionals contributed to lower return rates. We now turn to the policy developments that made such choices possible.

Table 2-11. Enrollment of Foreign Graduate Students in United States for Top 10 Locations of Origin, 1997–98, 1993–94, and 1987–88

		Foreign students		Percent foreign graduates across discipline					
Rank	Origin	Total	Graduates (percent)	Social sciences	Physical and life sciences	Math and computer sciences	Engineering	Other science and engineering	Non-science and engineering
1997–98									
1	Japan	47,073	19	24	5	4	6	11	51
2	China	46,958	83	5	25	16	26	7	22
3	Korea	42,890	44	10	9	7	18	10	46
4	India	33,818	74	4	9	18	42	4	23
5	Taiwan	30,855	56	7	8	10	20	7	49
6	Canada	22,051	43	14	10	2	7	9	58
7	Thailand	15,090	65	7	5	5	18	8	58
8	Malaysia	14,597	15	8	7	7	24	10	43
9	Indonesia	13,282	26	7	3	4	22	7	57
10	Mexico	9,559	39	13	9	5	20	17	37
	Top 10 total	276,173	50	8	13	11	23	7	38
	Others	205,107	36	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
	All locations	481,280	44	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
1993–94									
1	China	44,381	82	6	32	12	24	6	20
2	Japan	43,770	18	17	6	3	8	9	56
3	Taiwan	37,581	66	5	10	11	27	7	39
4	India	34,796	79	5	10	17	44	4	21
5	Korea	31,076	51	13	15	7	18	7	40
6	Canada	22,655	37	14	9	3	6	8	60
7	Malaysia	13,718	15	13	8	8	22	7	42
8	Indonesia	11,744	29	11	7	5	22	10	46
9	Thailand	9,537	59	6	4	6	13	6	65
10	Mexico	8,021	36	13	12	8	17	14	37
	Top 10 total	257,279	52	8	16	11	25	7	34
	Others	192,470	35	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
	All locations	449,749	45	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
1987–88									
1	Taiwan	26,660	78	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
2	China	25,170	81	9	31	13	21	7	19
3	India	21,010	74	7	14	13	38	5	25
4	Korea	20,520	73	16	15	9	21	7	33
5	Malaysia	19,480	21	12	6	13	12	7	50
6	Japan	18,050	24	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
7	Canada	15,690	38	15	12	3	7	9	55
8	Indonesia	9,010	29	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
9	Thailand	6,430	56	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
10	Mexico	6,170	31	15	15	8	15	14	33
	Top 10 total	168,190	56	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
	Others	187,997	33	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
	All locations	356,187	44	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.

Source: Institute of International Education, Open Doors: Report on International Educational Exchange (annual series), and Profiles (biennial series), 1987–2000, New York, special tabulations, 2001; Science & Engineering Indicators, 2002.

n.a. = not available.

Table 2-12. Foreign Students Who Received Ph.D.s from U.S. Universities and Plan to Stay in the United States, Top 12 Locations of Origin, 1999 and 1990[a]

	1999				*1990*			
	Ph.D. recipients		*Plan to stay (percent)*		*Ph.D. recipients*		*Plan to stay (percent)*	
Origin	*Total*	*Science and engineering*	*Total*	*Science and engineering*	*Total*	*Science and engineering*	*Total*	*Science and engineering*
China	2,400	2,187	90	91	2,615	1,166	89	59
India	1,077	888	89	90	1,285	709	85	66
South Korea	1,017	738	56	63	1,042	971	46	32
Taiwan	981	732	57	62	1,137	1,012	57	45
Canada	473	283	65	72	419	252	46	48
Germany	266	179	67	65	169	123	50	48
Japan	238	156	50	54	208	147	46	41
Turkey	224	186	54	59	185	106	57	62
United Kingdom	215	141	77	79	172	104	69	70
Brazil	205	156	34	31	129	98	17	17
Mexico	191	158	34	32	130	104	36	33
Greece	117	99	76	78	137	125	49	52
Top 12 total	7,404	5,903	72	76	7,628	4,917	69	49
Other locations	3,889	2,645	61	66	2,806	2,623	49	38
Total all locations	11,293	8,548	68	73	10,434	7,540	64	45

Source: National Science Foundation, Division of Science Resources Statistics (NSF/SRS), Survey of Earned Doctorates, unpublished tabulations, 2001; Science & Engineering Indicators, 2002.

a. Data include foreign doctoral recipients with either permanent or temporary visas. Science includes physics, chemistry, astronomy, and earth, atmospheric, ocean, biological, and agricultural sciences, as well as mathematics and computer sciences.