A New Panel Data Set on Physicians' Emigration Rates (1991-2004)

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Abstract. In this paper, we describe the methodology used to build a new annual panel data set on medical brain drain (MBD) from all countries in the world for the period 1991-2004. The MBD is defined as the proportion of physicians trained in their country and working abroad. The data set relies on primary statistics on foreign doctors collected from 16 OECD countries. Annual data on foreign-trained doctors are available in the most important host countries (representing 75 percent of our sample). We had to interpolate 10-year or 5-year data in the remaining 20 percent of cases. In addition, alternative definitions of what a "migrant" is (based on country pf birth or citizenship) were used for 27 percent of our sample. Our data set data set reveals that small and low-income countries are most affected and experienced a drastic rise in emigration of health professionals. In particular, the MBD is a source of concern in sub-Saharan Africa and South Asia, where the supply of healthcare services is low.

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1. Introduction

The recent trends in international migration of skilled and unskilled labor present many challenges to researchers and policy makers (Ozden and Schiff, 2006). Over the last decade, many studies have focused on the possible impact of brain drain on the countries of origin and on outcomes such as inequality across nations. However, in the absence of reliable comparative data on international migration by skill level, the debate on the consequences of the brain drain for developing countries remains mainly theoretical.

The World Bank-sponsored study by Docquier and Marfouk (2006)[1] provides new estimates of the stock of international migration by country of origin and educational attainment, leading to a series of empirical studies on the economics of brain drain. The construction of the database relies on three steps: i) collection of census data and registration information on the structure of immigration in all OECD countries; ii) summing over source countries for evaluating the stock of immigrants from any given sending country to OECD countries by education level, and iii) comparison of the educational structure of emigration to that of the population remaining at home. The last step gives "emigration rates" by level of educational attainment. Using this method, the DM06 database gives emigration stocks and rates by education level for 195 countries in the year 2000 and for 174 countries in 1990.

In the DM06 data set, brain drain is defined as the emigration of workers with post-secondary education, whatever their field of study. These general brain drain measures may hide important heterogeneity across sectors and occupations since for some occupations, the brain drain may be more severe. For example, the emigration of a large number of nurses from The Philippines may be of concern, while policy makers in India may be concerned by emigration of information technology specialists. If emigration is concentrated in certain fields and the domestic supply of these skills is inadequate, then emigration can induce occupational shortages that may be harmful for economic development.

The above concerns are important for the medical sector. Whilst the number of physicians per 1,000 people is greater than 3 in most industrialized countries, it is lower than 0.05 in many sub-Saharan African countries. Although the emigration of physicians and nurses may generate positive feedback effects for the sending countries[2], medical brain drain

[1] Henceforth labeled as DM06.
[2] Using survey data on foreign doctors in the UK, Commander, Kangasniemi and Winters (2005) evaluate the effects of emigration prospects/stocks on medical training in sending countries and on remittances.

(MBD) is likely to entail a negative impact on the supply of healthcare staff in developing countries, with possible consequences on health, life expectancy and economic growth (see Bhargava et al., 2001, Hagopian et al., 2004, Cooper, 2004, Bhargava and Docquier, 2006).

For an understanding of the consequences of medical brain drain, it is important to have an elaborate knowledge of the patterns of emigration of health professionals. This paper is concerned with the measurement of major components of the MBD, namely the emigration of physicians. There are no official data on emigration of healthcare staff from developing countries. However, following the methodology used in DM06 and in other recent studies, it is possible to gather information on immigration of doctors from the medical associations and statistical institutes in OECD countries. We collected such data and aggregate them to evaluate the stock of foreign doctors working in OECD countries thereby building a unique data set for the emigration of physicians from developing to developed countries on an annual basis for the period 1991-2004. In contrast to other studies[3], our migrants are defined as those trained, rather than born, in their home country. In this paper, we describe the methodology and discuss the main results and compare medical brain drain to the general brain drain (emigration rates of the post-secondary educated). The effects of MBD on life expectancy, adult deaths due to AIDS, and economic growth are analyzed in Bhargava and Docquier (2006).

2. Data sources and methodology

Following Carrington and Detragiache (1998) and Docquier and Marfouk (2006), we evaluate the MBD both in absolute and relative terms. In absolute terms, the stock of physicians from country *i* and working abroad is denoted by $M_{i,t}$.

Relative emigration measures are obtained by comparing the emigration stocks to the total number of doctors originating from the source country (residents plus emigrants). Calculating the medical brain drain as a proportion of the total number of domestically educated doctors provides a better measure of the pressure imposed on the source country. Thus, for example, the emigration of 5,600 Egyptian doctors (less than 4 percent of medical

[3] See DM06 for the general brain drain or Clemens and Pettersson (2006) for the MBD.

labor force) exerts less pressure on the Egyptian economy than the emigration of 56 Liberian doctors (about 40 percent of the medical labor force) exerts on the Liberian economy.

Let $P_{i,t}$ denotes the number of physicians working in the home country. In relative terms, the rate of MBD from country *i* at time *t* can be written as:

$$m_{i,t} = \frac{M_{i,t}}{P_{i,t} + M_{i,t}}$$

It is worth noticing that the term emigration rate is thus used to refer to relative stock data and not to immigration flows.

The computation of medical emigration rates requires combining many data sources and using certain assumptions.

Domestic physicians ($P_{i,t}$). The number of physicians in the countries for different years can be obtained from the World Development Indicators (World Bank, 2005); these figures are based on the statistics compiled by the World Health Organization (WHO). Annual data on the number of physicians per 1,000 people are available for the majority of countries. For missing observations, we interpolate them on the basis of the regional trends or use the numbers obtained in a neighboring country with similar economic and health records. The total number of physicians $P_{i,t}$ in country *i* in year *t* can be obtained by multiplying the WHO numbers by the population size (in thousands) provided by the UN Population Division.

In 2004, the average number of physicians per 1,000 people is 0.42 in low-income countries. The shortage is particularly severe in South Asia (0.48 per 1,000 people) and in Sub-Saharan Africa (0.16 per 1,000 people). At the country level, the lowest records are observed in sub-Saharan Africa where countries such as Uganda, Mali, Somalia, Burkina Faso, Central African Republic, Gambia, Niger, Eritrea, Ethiopia, Chad, Mozambique, Liberia, Tanzania, Rwanda, and Malawi have less than 0.05 physicians per 1,000 people. Although the number of doctors increased in developing regions such as Latin America and MENA countries, there is not much improvement in the poorest regions i.e. in South Asia and Sub-Saharan Africa.

Physicians abroad ($M_{i,t}$). The number of emigrants is more difficult to assess. Emigration data, when available, are incomplete and imprecise. Hence, the only way to capture medical brain drain on an annual basis is to collect immigration data from the most important O.E.C.D. host countries. The resulting statistics are likely to depend on the number of destination countries considered and the definition of a "medical migrant". Here we opt for the following methodological options:

- We focus on 16 important OECD countries where data on foreign doctors are available. The stock $M_{i,t}$ is then obtained by aggregating bilateral data from country *i* to the 16 receiving countries in time period *t*. In the Docquier-Marfouk data set, these 16 countries account for 93 percent of the number of skilled immigrants in the OECD (and 88 percent of the total number of immigrants).

- We restrict our sample to general practitioners in activity in the 16 host OECD countries.

- When data are available, emigrants are defined according to their country of qualification. Such data can be obtained from the national medical associations and represent about 73 percent of our sample in the year 2004, i.e. for the vast majority of migrants. This is the case for Canada, France, New Zealand, Norway, United Kingdom and the United States. When the country of qualification cannot be determined, we define migrants according to their country of birth. Such data were obtained from national censuses and registers. This is the case for Australia, Austria, Belgium, Denmark, Ireland and Sweden. They represent 18 percent of our sample in the year 2004. Finally, when the country of birth is not available, we define migrants according to their citizenship. This is the case in Italy, Germany, Portugal and Switzerland, i.e. about 9 percent of the sample.

- We develop an annual data set and concentrate on the period 1991 to 2004. Data provided by national medical associations are available on an annual basis. It is worth noticing that we have annual data and do not need any interpolation for the most important countries (USA, Canada, Germany, United Kingdom, New Zealand), i.e. for about 75 percent of medical migrants in the 16 OECD countries. Regarding data extracted from national censuses, we usually have two or three points. Interpolations are thus only used to characterize the path observed for "smaller" countries (representing 25 percent of the total stock of medical migrants). We interpolate the remaining years using a log-linear adjustment:

$$\ln\left[M_{i,t+k}\right] = \frac{n-k}{n}\ln\left[M_{i,t}\right] + \frac{k}{n}\ln\left[M_{i,t+n}\right] \qquad \text{for } k=0 \text{ to } n.$$

As cross section regressions are usually subject to important mispecification bias, we think it is important to exploit the longitudinal nature of the data as we have done, especially since annual data are available for the vast majority of cases.

Table 1 gives the data sources.

Table 1. Data source

Country	Source	Definition	Available data	Foreign doctors in 2004	In % of the total
Australia	Australian Bureau of Census	Country of birth	1991, 1996, 2001	14805	7,0%
Austria	Statistik Austria	Country of birth	1991, 2001	3940	1,9%
Belgium	Institut National de Statistiques	Country of birth	1991, 2001	10618	5,0%
Canada	Canadian Medical Association	Country of qualification	From 1994 to 2004	15331	7,2%
Denmark	Statistics Denmark	Country of birth	2004, 2005	350	0,2%
France	French Medical Association	Country of qualification	From 1991 to 2004	1585	0,7%
Germany	German Medical Association	Country of citizenship	From 1991 to 2004	11318	5,3%
Ireland	Central Statistical Office	Country of birth	1991, 2002	2016	0,9%
Italy	Istituto nazionale di statistica	Country of citizenship	1991	4910	2,3%
New Zealand	New Zealand Medical Association	Country of qualification	1991, 2004	3994	1,9%
Norway	Norway Medical Association	Country of qualification	2004	3752	1,8%
Portugal	Ordem dos medicos – Lisboa	Country of citizenship	2002, 2003	1989	0,9%
Sweden	Statistics Sweden	Country of birth	1991, 2003	6134	2,9%
Switzerland	Office Fédéral de la Statistique	Country of citizenship	1991, 2000	2206	1,0%
United Kingdom	General Medical Council	Country of qualification	From 1991 to 2004	68365	32,1%
United States	American Medical Association	Country of qualification	From 1991 to 2004	61396	28,9%

3. Description of the data

Data by country group. Table 2 gives the medical brain drain rates and the number of domestic physicians by country group in 1991 and 2004. The average medical brain drain rates appear to decrease with country size. The rates observed in small countries in 2004 (on average, 15.1 percent) are about 6 times as large as the corresponding rates in large countries (on average, 2.5 percent); this ratio was about 4 in 1991. Similar differences were found with emigration rates of the post-secondary educated workers: Docquier and Marfouk (2006) obtained a ratio around 5 in 2000. Between 1991 and 2004, small countries experienced a remarkable rise in MBD (from 7.9 to 15.1 percent); although other reasons can be invoked, this partly explains why the number of physicians per 1,000 people decreased from 1.24 to 1.19.

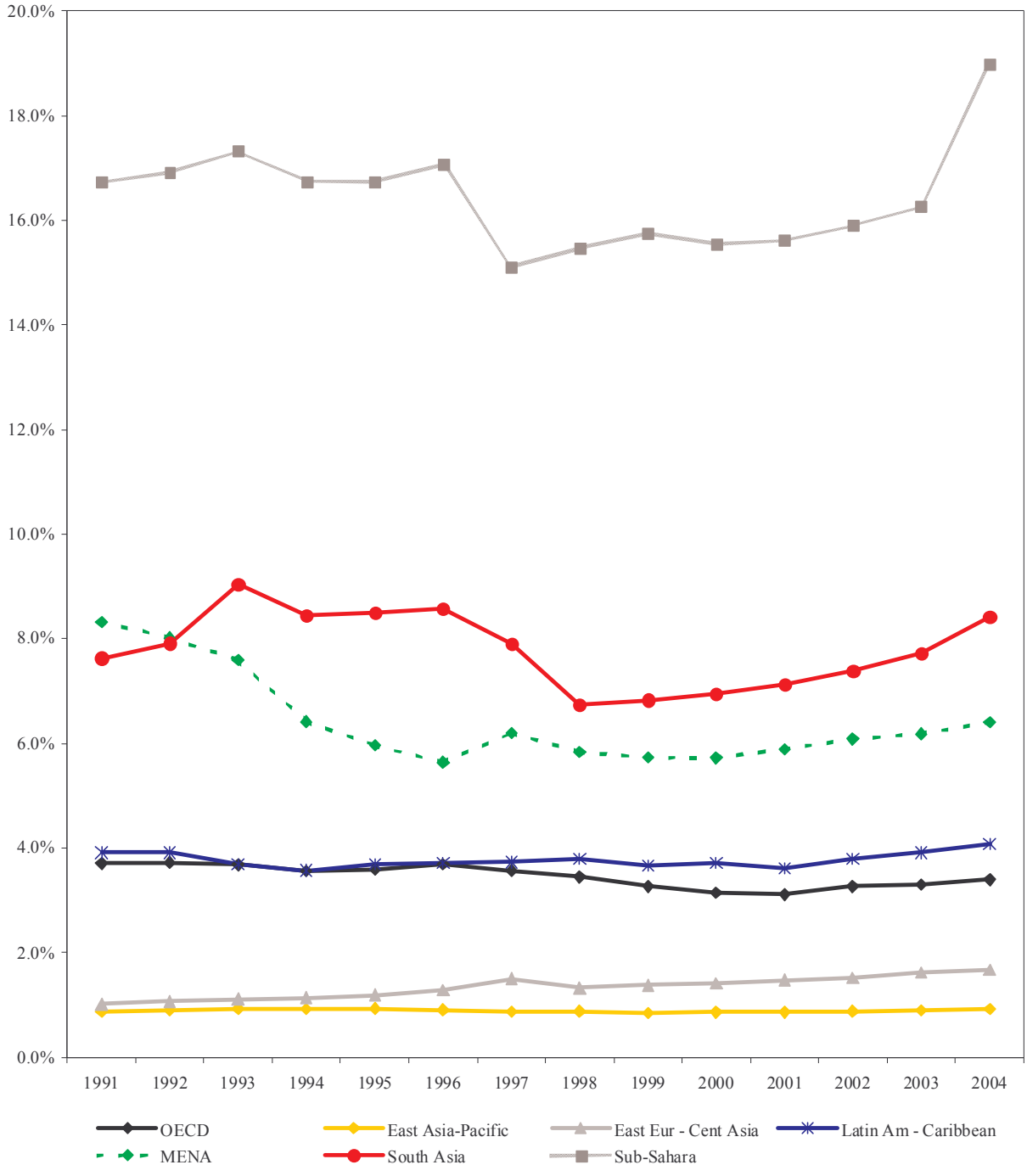
Disaggregating by income groups, low-income countries are more affected than middle and high-income countries; the average number of physicians per 1,000 people in low-income countries stagnated around 0.4. It is also worth noting that the average medical emigration rate rose from 6.1 to 7.2 percent in low-income countries. This contrasts with the trends for the general brain drain of post-secondary educated workers. For example, the DM06 data set showed that the average brain drain rate of developing countries decreased from 7.7 to 7.4 percent between 1990 and 2000 in part reflecting the general rise in education attainment. This confirms that medical brain drain is more severe and specific compared to other occupations and hence the emigration of doctors may be putting strains on the healthcare infrastructure in low-income countries.

For the different geographical regions as well as for OECD countries, the average medical brain drain is particularly severe in Sub-Saharan Africa, South Asia and Latin America. Recall that the numbers of physicians per 1,000 people is very low in all these regions. Figure 1 gives the evolution of the medical brain drain by region between 1991 and 2004. The situation in MENA countries has slightly improved between 1991 and 2004. In contrast, there is no sign of improvement in South Asia and Sub-Saharan Africa. Medical shortages seem particularly severe in the latter two regions.

Table 2. Healthcare staff and medical brain drain by country group

	Situation in 1991					Situation in 2004				
Country group	Total population (x 1,000)	Number of Physicians (x 1,000)	Physicians per 1000 people	Number of emigrants (x 1,000)	Medical brain drain (in %)	Total population (x 1,000)	Number of Physicians (x 1,000)	Physicians per 1000 people	Number of emigrants (x 1,000)	Medical brain drain (in %)
By country size (in 2004)										
Large (>25 million)	4496980	5848	1.27	127	2.1%	5349211	7377	1.38	189	2.5%
Upper-Middle (from 10 to 25)	417829	489	1.14	36	6.8%	526207	614	1.17	43	6.5%
Lower-Middle (from 2.5 to 10)	280760	474	1.69	36	7.1%	335534	591	1.76	43	6.8%
Small (<2.5 million)	33374	43	1.24	4	7.9%	39448	47	1.19	8	15.1%
By Income Group (in 2004)										
High-income	898438	2176	2.34	87	3.8%	993867	2735	2.75	98	3.5%
Upper-Middle	507084	1154	2.24	32	2.7%	571079	1334	2.34	51	3.7%
Lower-Middle	2075489	2829	1.34	39	1.4%	2409020	3608	1.50	61	1.6%
Low-Income	1747933	694	0.39	45	6.1%	2276434	951	0.42	74	7.2%
By region (WB classification)										
OECD	1043610	2407	2.22	93	3.7%	1151477	3023	2.63	106	3.4%
East Asia and Pacific	1577185	1877	1.17	17	0.9%	1832039	2353	1.28	22	0.9%
Eastern Europe and Central Asia	464334	1480	3.17	15	1.0%	470183	1424	3.03	24	1.7%
Latin America and Caribbean	286945	405	1.38	16	3.9%	356148	604	1.70	26	4.1%
Middle East and North Africa	221329	144	0.57	13	8.3%	289085	347	1.20	24	6.4%
South Asia	1120423	496	0.43	41	7.6%	1425891	691	0.48	64	8.4%
Sub-Saharan Africa	480190	63	0.13	13	16.7%	662624	103	0.16	24	19.0%

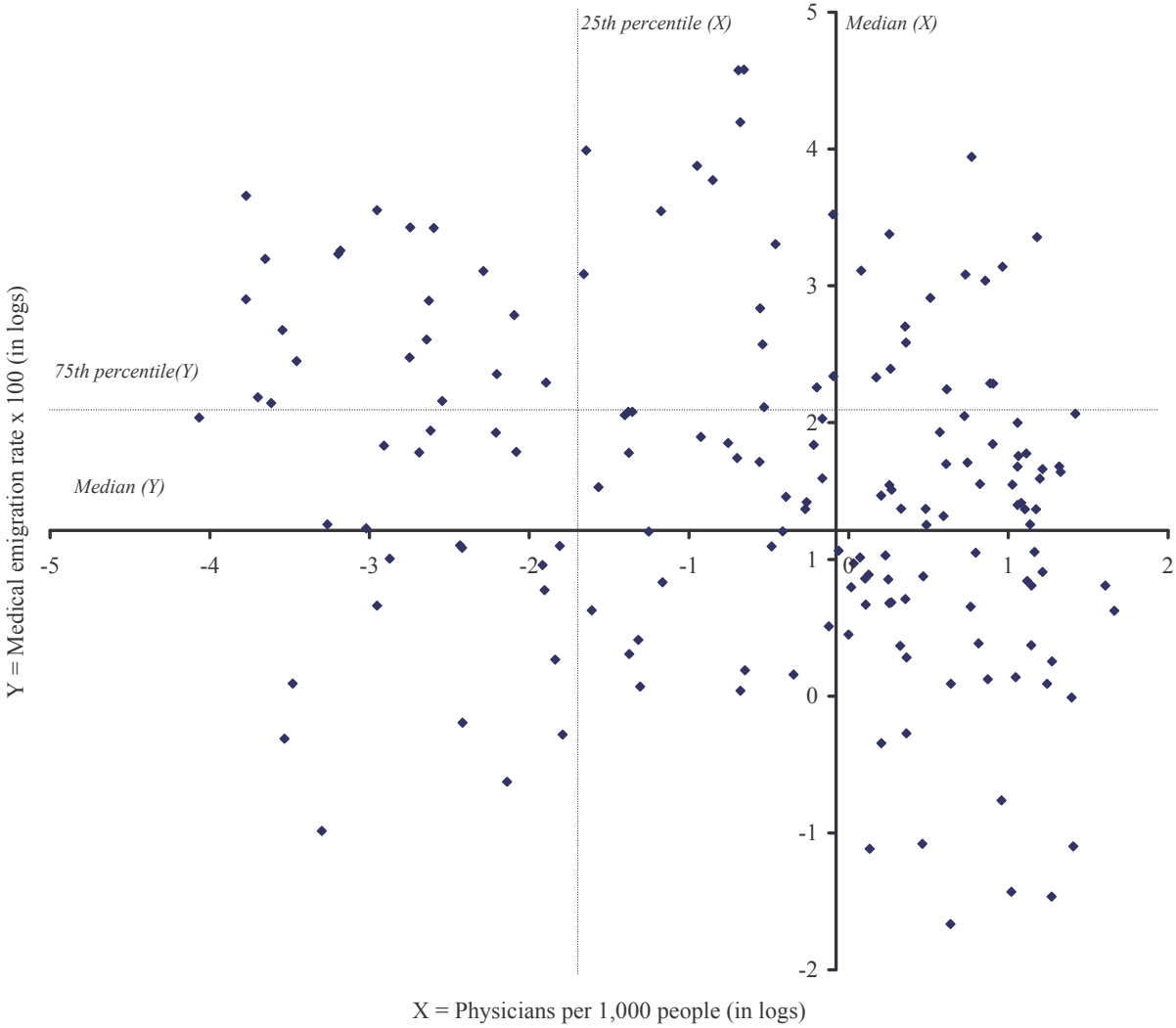
Figure 1. Medical brain drain, data by region



Brain drain and healthcare shortages. Figure 2 plots the medical brain drain and the number of physicians per 1,000 people. We plot the logarithms of average MBD rates in the period 1991-2004. The bold lines cross at the median values of the distribution. The dotted lines represent the 25th percentile for physicians per 1,000 people and the 75th percentile for medical brain drain. Countries where the medical brain drain is a major source of shortage are

in the North-West part of the figure. Nineteen countries belong to that category where the medical brain drain exceeds the 75th percentile and where the number of physicians per 1,000 people is below the 25th percentile of the distribution. These countries are: Afghanistan, Angola, Cameroon, East Timor, Ethiopia, Gambia, Ghana, Guinea, Liberia, Malawi, Papua New Guinea, Rwanda, Somalia, Sudan, Tanzania, Togo, Uganda, Zambia, and Zimbabwe. Out of these 19 countries, 16 are in Sub-Saharan Africa.

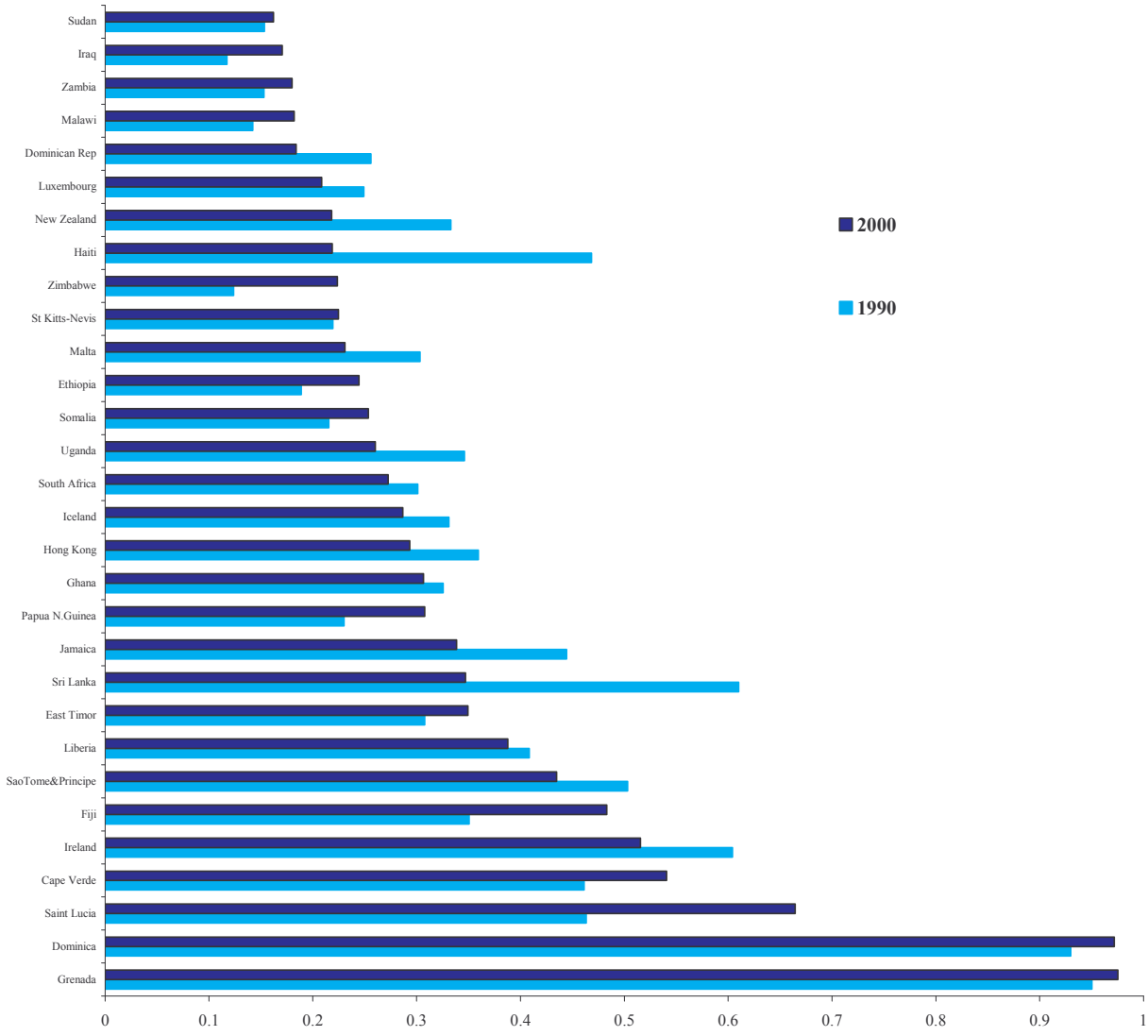
Figure 2. Medical brain drain and physicians per 1,000 people



The most affected countries. Figure 3 gives the MBD rates in the 30 most affected countries. Small countries of the Pacific and Caribbean are strongly affected, as well as two industrialized countries (Ireland and Luxemburg). Among the 30 most affected countries,

there are 12 countries in sub-Saharan Africa (Cape Verde, Sao Tome and Principe, Liberia, Ghana, South Africa, Uganda, Somalia, Ethiopia, Zimbabwe, Malawi, Zambia and Sudan) where the numbers of health professionals are very low. A severe increase over time is observed in Zimbabwe, Malawi, Zambia, and Togo.

Figure 3. Rate of medical brain drain - 30 most affected countries in 1991 and 2004



4. Comparison with a recent data set on emigration of physicians

In a recent study for the Center for Global Development, Clemens and Pettersson (2006) provide estimates of the emigration of physicians for sub-Saharan African countries in 2000. They collected data on foreign physicians from nine destination countries (i.e. UK, US, France, Australia, Canada, Portugal, Belgium, Spain and South Africa). Interestingly, the first eight countries account for more than 90 percent of skilled migrants residing in OECD countries; emigration to South Africa is important for countries such as Botswana, Namibia, Lesotho, Swaziland and Zimbabwe.

It is worth comparing certain features of the data on MBD compiled by Clemens and Pettersson (2006) with our data set. First, the set of receiving countries is larger in our data set (16 rather than 9) though we do not include South Africa. Second, we provide an estimate of the MBD for all the countries in the world between 1991 and 2004 using annual data for 75% of our sample and reasonable interpolations for the remaining 25%. Third and importantly, our definition of a "medical migrant" is different. As in most recent data sets on skilled migration, Clemens and Pettersson (2006) define medical emigrants as those born in their home country. In contrast, when information is available (as for the vast majority of cases), we define migrants as those trained in their home country. Since using the foreign-born definition does not account for whether education has been acquired in the home or in the host country, it is perhaps not surprising that the two definitions yield somewhat different results. For example, the 2000 US census gives 12,813 doctors born in Africa while the US medical association data show 3,997 doctors trained in Africa (only 31 percent of foreign-born doctors). In fact, using the foreign-trained definition, we provide a less pessimistic measures of MBD, since many foreign-born doctors working in the OECD were trained in the host country. Depending on the objective for which the data are going to be used, our definition could appear either too inclusive or too exclusive. Differences are particularly important in countries where higher medical training is not available, such as in Lesotho and Swaziland.

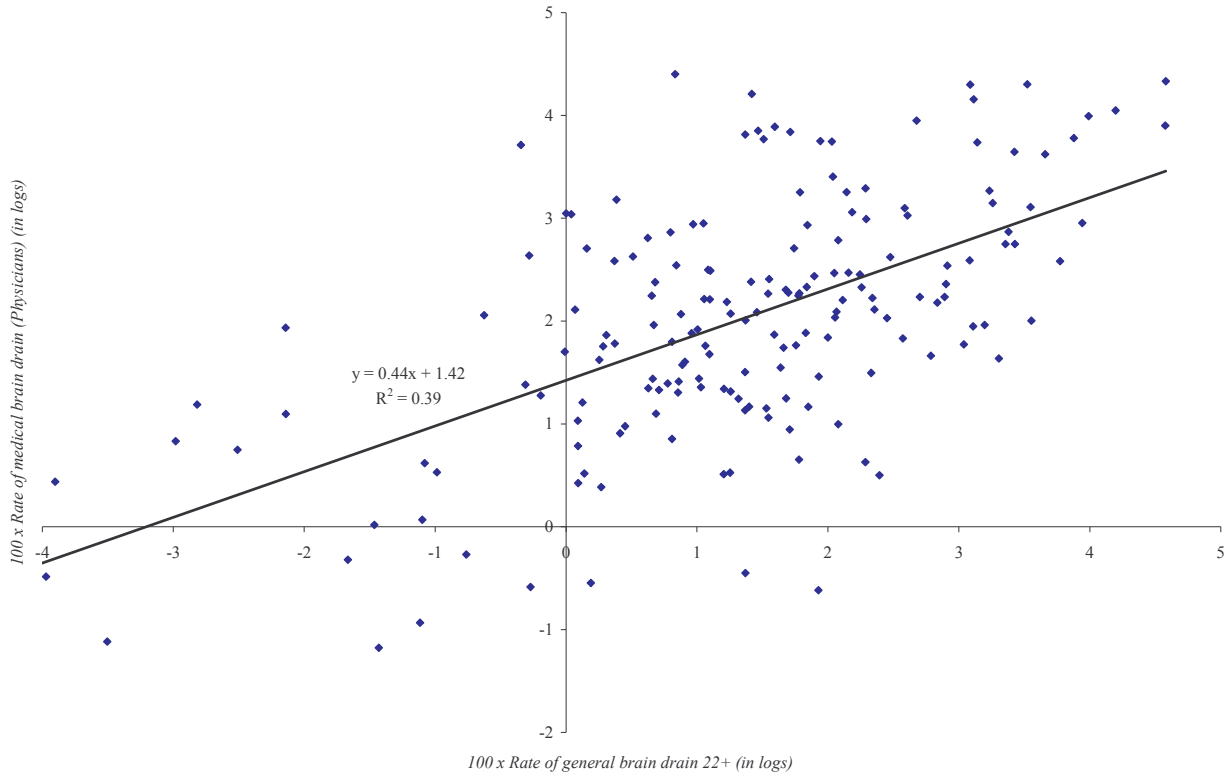
Lastly, comparing the two data sets for sub-Saharan African countries in 2000, the correlation between the estimated number of domestic physicians ($P_{i,t}$) is high (0.991). The correlation between the estimated number of medical migrants ($M_{i,t}$) is relatively high (0.63). However, the total numbers of physicians abroad obtained in our data only represent 41 percent of the total number obtained by Clemens and Pettersson (2006). This is mainly due

to the difference in the definition of migrants, and also partly because of the exclusion of migrants to South Africa; correlation between medical emigration rates is thus low (0.34).

5. Correlation between medical and other brain drain

It is of interest to ascertain how strongly the medical brain drain is correlated with the general brain drain. To investigate this issue, we compare the medical brain drain rates obtained in 2000 to the "corrected" general brain drain rates computed by Beine et al. (2006) for emigrants that arrived after age 22 years (referred to as brain drain 22+). In Figure 4, the correlation is 0.39 and the elasticity of medical brain drain with respect to the general brain drain is 0.44. However, many observations are far from the overall trend, confirming that the general brain drain measures may not reveal important aspects of the occupational heterogeneity.

Figure 4. Medical and general brain drain rates



6. Conclusion

This paper describes a new panel data set on the emigration of physicians. Defining emigrants as those educated, rather than born, in their home country, we collected original statistics on foreign-trained doctors in 16 OECD countries and provide an annual data set on emigration rates for all countries in the period 1991 and 2004. Our data set reveals that:

- Small and low-income countries are among the most affected; as a consequence, the number of physicians per 1,000 people decreased or stagnated in these two groups.

- Contrary to the general trends observed for post-secondary educated workers, the MBD drastically rose in small and low-income countries. This supports the argument that MBD is severe and merits urgent attention from policy makers.

- The most affected regions are the MENA, South Asia and Sub-Saharan Africa. There is no improvement in South Asia and Sub-Saharan Africa. Among the 30 most affected countries, many are in sub-Saharan Africa.

Overall, our data show that MBD should be a major concern in the poorest regions of the world, especially in sub-Saharan Africa. A recent report on brain drain from Africa has underscored the need for African countries to train additional nurses and doctors (Physicians for Human Rights, 2004). This may be difficult in view of the low enrollment rates in secondary and tertiary education. With emigration of healthcare staff, many developing countries should devise strategies for training and retaining healthcare staff. Such issues are investigated in greater detail using our database by Bhargava and Docquier (2006).

7. References

Awases, M., A. Gbary, J. Nyoni, and R. Chatora (2003), "Migration of health professionals in six countries: A synthesis report", World Health Organization, Regional Office for Africa, Congo.

Beine, Docquier and Rapoport (2006), "Measuring International Skilled Migration: New Estimates Controlling for Age of Entry", Policy Research Discussion Paper, forthcoming, World Bank, Washington DC.

Bhargava, A. (2005), "AIDS epidemic and health care infrastructure inadequacies in Africa: A socioeconomic perspective", Journal of AIDS, 40, 241-242.

Bhargava, A., Jamison, D., Lau, L., Murray, C. (2001). Modeling the effects of health on economic growth. *Journal of Health Economics*, 20, 423-440.

Bhargava, A., and Docquier, F. (2006), "HIV pandemic, medical brain drain and economic development in sub-Saharan Africa". Manuscript.

Carrington, W., and Detragiache, E. (1999). How extensive is the brain drain? Finance and Development, June, 46-49.

Clemens, M.A. and G. Pettersson (2006), "A new database on health professional emigration from Africa", Center for Global Development, Working paper n. 95.

Commander, S., M. Kangasniemi, L.A. Winters (2004) "Is the Medical Brain Drain Beneficial? Evidence from Overseas Doctors in the UK", CEP discussion paper 0618, London School of Economics.

Cooper RA. (2004), "Weighing the evidence for expanding physician supply", Annals of Internal Medicine; 141: 705-14.

Docquier, F. and A. Marfouk (2006): Measuring international migration by educational attainment in 1990-2000 - Release 1.1. In C. Ozden and M. Schiff (eds) International migration, remittances, and the brain drain. World Bank, Washington, DC.

Hagopian A, M.J. Thompson, M. Fordyce, K.E. Johnson, G.L. Hart (2004), "The migration of physicians from sub-Saharan Africa to the United States of America: measures of the African brain drain", Human Resources for Health, 2-17.

Ozden, C. and M. Schiff (2006), "International migration, remittances, and the brain drain", World Bank, Washington, DC.

Physicians for Human Rights (2004), "An action plan to prevent brain drain: Building equitable health systems in Africa", Boston, MA: http://www.phrusa.org/campaigns/aids/pdf/braindrain.pdf.