Documenting the brain drain of «la crème de la crème»: Three case-studies on international migration at the upper tail of the education distribution

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Documenting the brain drain of « la crème de la crème »: Three case-studies on international migration at the upper tail of the education distribution[1]

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Abstract

Most of the recent literature on the effects of the brain drain on source countries consists of theoretical papers and cross-country empirical studies. In this paper we complement the literature through three case studies on very different regional and professional contexts: the African medical brain drain, the exodus of European researchers to the United States, and the contribution of the Indian diaspora to the rise of the IT sector in India. While the three case studies concern the very upper tail of the skill and education distribution, their effects of source countries are contrasted: clearly negative in the case of the exodus of European researchers, clearly positive in the case of the Indian diaspora's contribution to putting India on the IT global map, and mixed in the case of the medical brain drain out of Africa.

JEL Codes: F22, J24, O15.

Key words: Brain drain, international migration, African medical brain drain, European brain drain, Indian diaspora.

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1. Introduction

Most of the recent literature on the effects of the brain drain on source countries consists of theoretical papers (e.g., Mountford, 1997, Vidal, 1998, Beine et al., 2001) and of cross-country empirical studies on the "brain gain" (Beine et al., 2008) and the diaspora networks channels (Kerr, 2008, Agrawal et al., 2008, Kugler and Rapoport, 2007, Docquier and Lodigiani, 2009). The main novelty of the recent literature is to show that under certain circumstances, the brain drain may ultimately prove beneficial (but of course is not necessarily so) to the source country, and to do so while at the same time accounting for the various fiscal, technological and Lucas-type externalities that were at the heart of the pessimistic models of the 1970s. Another novelty is that it is evidence-based, something which was out of reach until not long ago due to the lack of decent comparative data on international migration by educational attainment.[2]

By nature, theoretical models and cross-country comparisons cannot account for the intricacies and details which are context specific. They have also abstracted (so far) from accounting for the huge heterogeneity among skilled workers, aggregating flows of workers with intermediate skills (e.g., less than 4 years of college education) and high skills (e.g., PhD holders). In this paper we complement the recent literature in that we focus on "the cream of the cream", that is, the upper tail of the skill and education distribution. We first present general data on the international migration of very highly educated individuals, and then investigate in more details three very different regional and professional contexts: the African medical brain drain, the exodus of European researchers (mainly to the United States), and the contribution of the Indian diaspora to the rise of the IT sector in India.

2. Data: the brain drain at the upper tail of the education distribution

2.1. General figures

International migration of highly-skilled professionals (or brain drain) has increased tremendously over the last few decades, at about the same pace as trade, and has recently increased even more rapidly (by 70 percent during the 1990s only).[3] By 2000, there were sixty million highly-skilled (tertiary educated) immigrants in the OECD area, or about one third of

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[2] See Docquier and Rapoport (2009) for a broad survey of this literature.

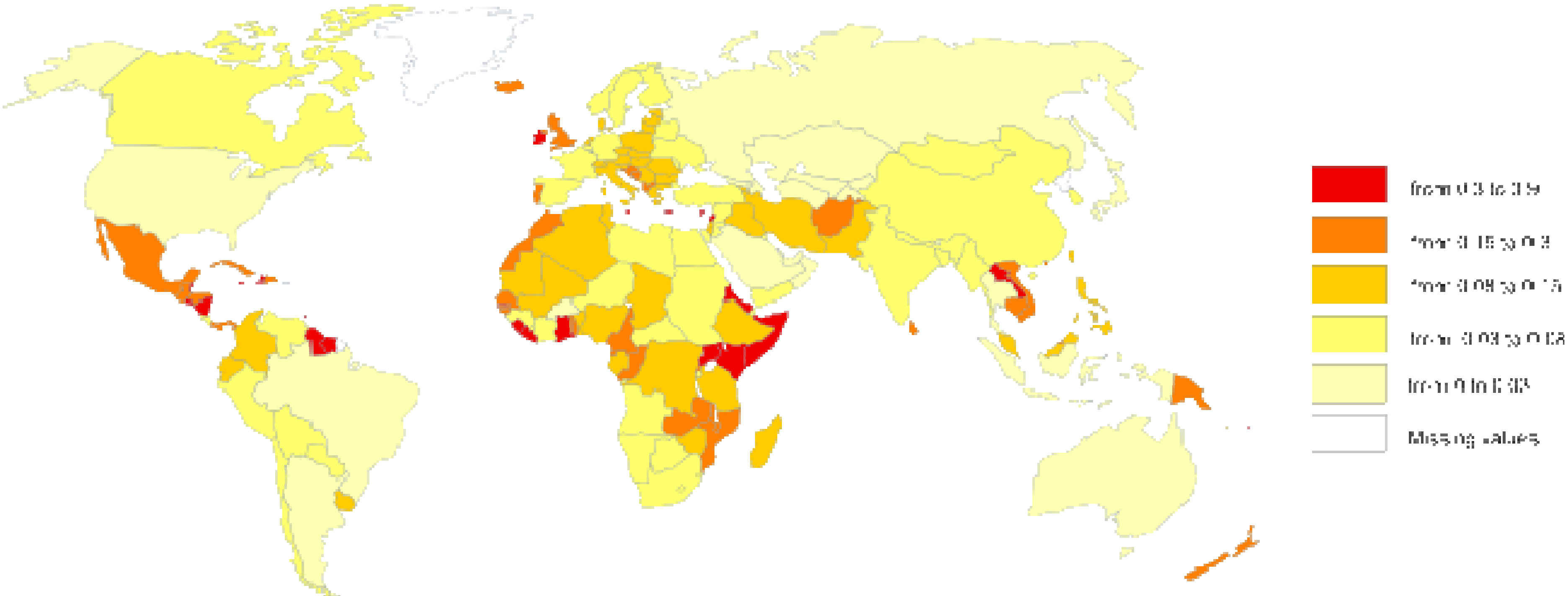
[3] The total number of highly educated immigrants living in the OECD member countries has increased by 70 percent during the 1990s (and has doubled for those originating from developing countries) against just a 30 percent increase for unskilled immigrants.

total immigration. These highly skilled immigrants represent a tiny three percent of the European skilled workforce against more than ten percent of the skilled labor force in countries such as the United States, Canada and Australia. Given that the vast majority of these immigrants come from developing countries where human capital is very scarce, it often represents a significant loss of human capital for source countries. And indeed, some developing countries exhibit brain drain rates frequently higher than fifty percent (which is typically the case for Sub-Saharan African countries) or even eighty percent (in countries such as Jamaica and Guyana) (Docquier, Lowell and Marfouk, 2009).[4]

However, general emigration rates may hide heterogeneity across sectors and occupations. If emigration is concentrated in certain fields and the domestic supply of these skills is inelastic, then emigration can induce occupational shortages that may be particularly harmful for economic development. In this paper, we focus of the upper tail of the skill and education distribution: PhD holders, researchers in Science and Technology, medical doctors, information technology specialists. These professions are crucial for the R&D sector and for technological innovation (in the case of already advanced countries) and adoption (which is more relevant for developing countries), not be mention the fact that health care is a complement to human capital, implying that the quantity and quality of the medical staff strongly conditions the productivity of all other professions (Kremer, 1993). Before turning to our three case studies, we first present more focused data on PhD holders and researchers in science and technology, on the one hand, and on the medical brain drain, on the other hand.

[4] See Figure 1.

Figure 1. Highly-skilled emigration rates (year 2000)



2.2. PhD holders and researchers in Science and Technology

Table 1 focuses on the emigration of PhD graduates. For 82 origin countries, we provide (i) the numbers of PhD graduates working in the US, (ii) the shares of these PhDs among US post-secondary educated immigrants by country of origin, (iii) the ratio of PhD holders living in the US to the estimated number of PhD holders trained in their country (an estimate of the emigration rate to the US of PhD holders by country of origin). To compute (i) and (ii), we use the SESTAT database of the National Science Foundation. To calculate (iii), we use UNESCO data on the flow of PhD graduates trained at origin (average 2002-2004) and assume that the flows of new PhD graduates represent 5 percent of the stock in developing countries and 4 in developed countries. The estimated emigration rate is obtained by dividing the stock living in the US by the estimated stock domestically trained.

The highest numbers of foreign PhD holders are obtained for developed countries and large developing countries such as China, Russia, Iran, Nigeria, Egypt. As a proportion of tertiary graduates living in the US, the proportion of PhD is extremely high in the cases of Slovenia, Cameroon, Georgia and Tunisia. The last columns indicates that the estimated emigration rate of PhD holders is high for Latin American countries and some African countries.

Regarding the capacity to innovate, it is also interesting to focus on researchers employed in S&T. This includes many PhD holders but also many other college graduates employed in this sector. Table 2 compares migration of researchers employed in the US R&D sector (using the SESTAT database) to UNESCO data on researchers nationally employed in S&T. We will provide researchers' emigration numbers and rates to the US for 70 countries, including 39 developing states. The average emigration rates of developing countries (45.6 percent) exceeds that of developed countries (21.4 percent). The rate is particularly high (above 80 percent) in the cases of Cambodia, Cameroon, Colombia, Costa Rica, Ecuador, Panama or Vietnam.

Table 1. Top-30 suppliers PhD's to the US

PhD graduates in the US		Share in graduates in the US		Estimated mig. rate to the US	
China	63153	Slovenia	71,4%	Panama	93,2%
United Kingdom	24482	Cameroon	51,7%	Ethiopia	91,3%
Canada	19122	Georgia	46,1%	Colombia	84,4%
Germany	17840	Tunisia	31,8%	Honduras	78,5%
Russia	12835	Saudi Arabia	26,8%	Iceland	72,9%
South Korea	12172	Iceland	21,5%	Uruguay	71,8%
Iran	8996	China	21,3%	Tanzania	65,8%
France	7277	Estonia	19,6%	Cyprus	49,2%
Poland	6488	Uzbekistan	19,6%	Macao	49,1%
Japan	6478	Azerbaijan	19,6%	Trinidad and Tobago	47,2%
Mexico	5693	Switzerland	18,1%	Argentina	37,0%
Nigeria	4862	Croatia	18,1%	Cuba	30,7%
Egypt	4725	Finland	17,8%	Cameroon	23,7%
Israel	4694	Czech Republic	17,6%	China	22,8%
Argentina	4405	Slovakia	17,6%	Cambodia	22,7%
Romania	4122	Austria	17,4%	Bangladesh	21,7%
Italy	3997	Israel	16,5%	Ghana	16,6%
Brazil	3952	Hungary	16,3%	Ireland	16,0%
Turkey	3798	Ghana	15,9%	Israel	15,9%
Colombia	3787	Romania	15,8%	Canada	15,7%
Cameroon	3714	Turkey	15,4%	Iran	15,1%
Ukraine	3701	Russia	15,2%	Croatia	14,4%
Philippines	3658	Ethiopia	12,5%	Jordan	14,4%
Spain	3435	Spain	12,0%	Mexico	13,4%
Ireland	3294	Argentina	12,0%	Armenia	12,8%
Cuba	3246	Armenia	11,9%	Hungary	12,5%
Greece	2948	France	11,6%	Bulgaria	11,7%
Ghana	2909	Brazil	11,4%	Estonia	11,2%
Hungary	2877	United Kingdom	11,3%	Lebanon	10,7%
Australia	2477	Sweden	11,2%	Philippines	10,2%

Sources: SESTAT-NSF and UNESCO.

Table 2. Researchers employed in Science and Technology in the US in 2003

Developing countries				**High-income countries**			
Birth	***S&T researchers in the US***	***S&T researchers at home***	***Brain drain to US in %***	***Birth***	***S&T researchers in the US***	***S&T researchers at home***	***Brain drain to US in %***
Algeria	1242	5678	17,9	Australia	4889	79919	5,8
Bolivia	2214	1140	66,0	Austria	3815	26563	12,6
Brazil	10980	79600	12,1	Belgium	4767	32229	12,9
Bulgaria	4497	9400	32,4	Canada	72584	122809	37,1
Myanmar	1727	732	70,2	Hong Kong	26602	12410	68,2
Cambodia	3030	239	92,7	Cyprus	591	532	52,6
Cameroon	3643	472	88,5	Czech Republic	2455	17232	12,5
Chile	5496	10120	35,2	Denmark	2561	25035	9,3
China	158524	907743	14,9	Estonia	813	3063	21,0
Colombia	19362	4487	81,2	Finland	791	39897	1,9
Costa Rica	4659	529	89,8	France	16072	195638	7,6
Cote d'Ivoire	288	1292	18,2	Germany	59213	269703	18,0
Croatia	1666	6722	19,9	Greece	6554	16546	28,4
Ecuador	7012	595	92,2	Hungary	4986	15001	24,9
Ethiopia	2549	1649	60,7	Iceland	1002	2034	33,0
Guatemala	1415	398	78,1	Ireland	9270	10741	46,3
Indonesia	5163	45567	10,2	Italy	15022	73181	17,0
Kazakhstan	1108	10339	9,7	Japan	34757	677723	4,9
Latvia	2728	3291	45,3	Kuwait	1118	202	84,7
Lithuania	2285	7105	24,3	Luxembourg	100	2108	4,5
Macedonia	80	1147	6,5	Netherlands	7616	41082	15,6
Madagascar	166	887	15,8	New Zealand	3217	15911	16,8
Malaysia	7955	10419	43,3	Norway	3291	21339	13,4
Malta	452	359	55,7	Portugal	2581	20067	11,4
Mexico	46356	42953	51,9	Singapore	3397	21821	13,5
Nepal	1739	1627	51,7	Slovakia	1227	10008	10,9
Pakistan	14682	12919	53,2	Slovenia	202	4455	4,3
Panama	7498	307	96,1	South Korea	50605	154884	24,6
Paraguay	335	489	40,6	Sweden	3585	50091	6,7
Romania	10900	20761	34,4	Switzerland	3768	25616	12,8
Russia	35588	478090	6,9	United Kingdom	72396	177625	29,0
South Africa	5906	16248	26,7				
Sri Lanka	4652	2703	63,3				
Thailand	7781	18430	29,7				
Tunisia	2003	11805	14,5				
Turkey	8878	31587	21,9				
Uruguay	1625	1244	56,6				
Venezuela	8058	3537	69,5				
Vietnam	44236	9863	81,8				
Average			*45,6*	*Average*			*21,4*

Sources: SESTAT-NSF and UNSECO

2.3. The medical brain drain

In developing countries, the size and quality of the medical sector is a key determinant of human development and economic performances (see Bhargava et al., 2001, Hagopian et al., 2004, Cooper, 2004, Bhargava and Docquier, 2008). While the number of physicians per 1,000 people is greater than 3 in most industrialized countries, it is lower than 0.25 in many developing countries (see Figure 2a). Many observers and analysts have pointed to the medical brain drain as one of the major factors leading to the under-provision of healthcare staff in developing countries (see Bundred and Levitt, 2000, or Beeckam, 2002) and, ultimately, to low health status and shorter life expectancy – hence Michael Clemens's (2007) provocative question: do visas kill?

Two data sets can be used to document the international migration of physicians:

- Clemens and Pettersson (2006) collect data on foreign physicians and nurses from nine important destination countries (UK, US, France, Australia, Canada, Portugal, Belgium, Spain and South Africa) and compute the stock of African-born physicians living abroad by country of birth in 2000. They then evaluate the medical brain drain in relative terms, dividing the number of physicians abroad by the total number of physicians born in each origin country.

- Docquier and Bhargava (2006) use the same methodology but collect data from 17 countries (16 OECD countries and South Africa) and define migrants according to their country of training. Such data can be obtained from national medical associations and are available on an annual basis. They come up with 14 yearly observations per country covering all the countries of the world for the period 1991-2004. Regional comparisons reveal that the medical brain drain is highest in Sub-Saharan Africa (with average rates above 20% against 13% in South-Asia and less than 10% in all the other regions); the figures are relatively stable over the period.

Focusing on the year 2000, the comparison of these two data sets reveals important differences, with a correlation between the two of only .23. The "bilateral" correlations between physician immigrants stocks in the eight common destination countries are much higher (from 55 percent for South Africa to 97 percent for France and the United States). However, the stock based on country of training is usually much lower than the stock based on country of birth (e.g., 10% in France,[5] 45% in South Africa, 77% in the United Kingdom, and 82% in the United States).

Figure 2b shows the geographical distribution of the medical brain drain computed in Docquier and Bhargava (2006). The average medical brain drain is particularly severe in Sub-Saharan Africa, South Asia, East Asia and Latin America. The most affected countries exhibiting emigration rates above 40 percent are Grenada, Dominica, Saint Lucia, Ireland, Liberia, Jamaica and Fiji. Using the same dataset, Figure 2c reveals that the medical brain drain rates have increased dramatically in many African countries but also in Lebanon, Cuba, Cyprus, or the Philippines.

3. Africa's medical brain drain

As explained above, Clemens and Peterson (2006) and Docquier and Bhargava (2006) use different definitions of the medical brain drain, by country of birth (for the former) and by country of training (for the latter). This leads to important differences in their respective estimates of the medical brain drain, as we have seen. Interestingly, the main culprit for such differences is Africa. Indeed, due to absence of local medical schools, eleven African countries have no domestically trained physician emigrants living abroad while they exhibit medical brain drain rates between 5 to 15 percent if one uses the country-of-birth criterion. Figures 3.a and 3.b illustrate the difference between these two definitions of physicians' brain drain in the case of Africa.

3.1. Determinants of the medical brain drain.

As for general migration, it is obvious that the emigration of physicians is not an exogenous process. Individual-level surveys in six African countries indicate that more than half of all physicians would like to emigrate to developed countries, in search of better working conditions and more comfortable lifestyles (Awases et al., 2003). The risks associated with caring for HIV/AIDS patients and the possibility of children of healthcare staff contracting HIV as they enter adolescence may exacerbate the medical brain drain (Awases et al., 2003; Bhargava, 2005).

[5] Licensure requirements for foreign physicians are more stringent in France than in most other host countries.

Figure 2. The medical brain drain

2a. Physicians per 1,000 people, year 2004

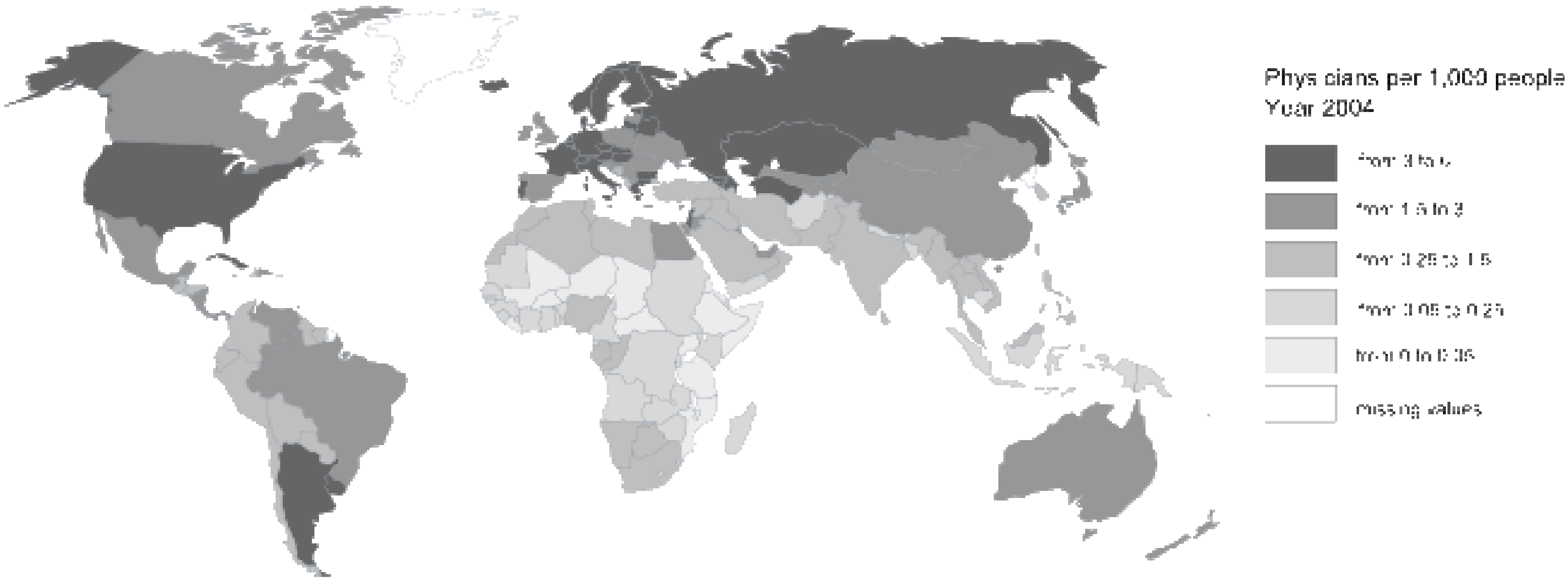


Figure 2. The medical brain drain (cont'd)

2.b. Medical brain drain, year 2004

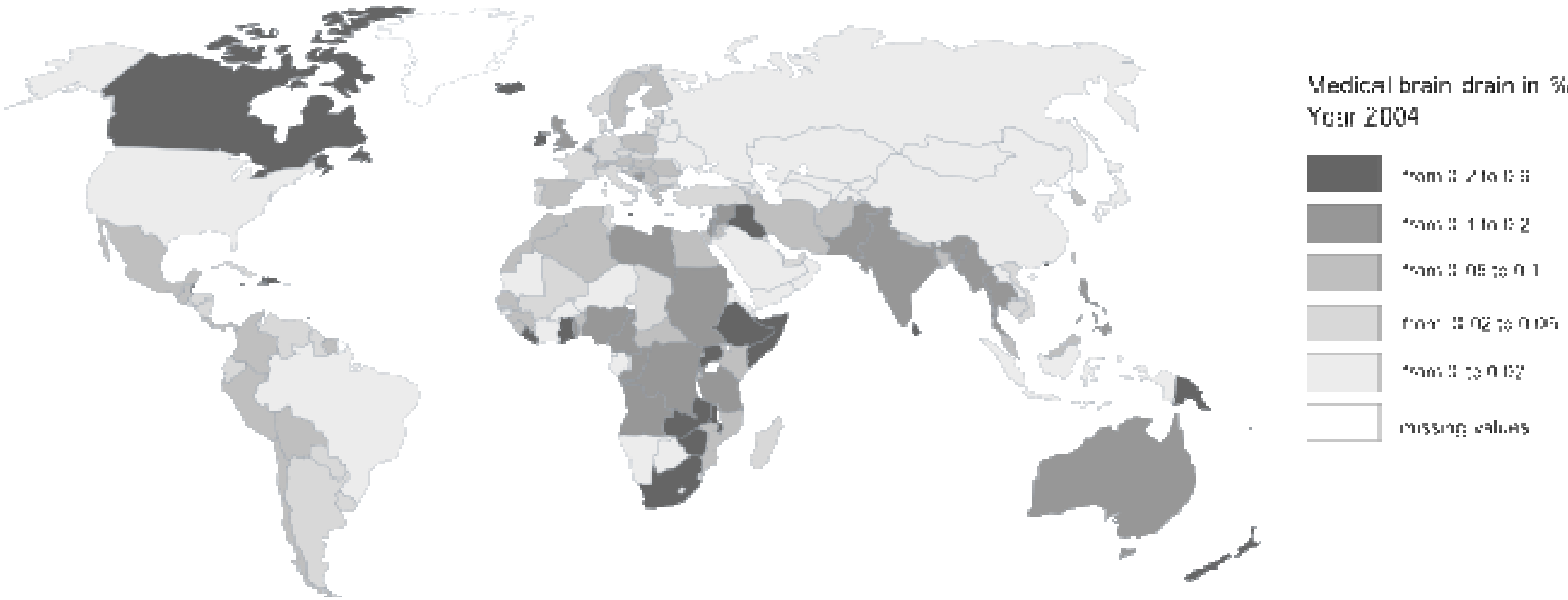
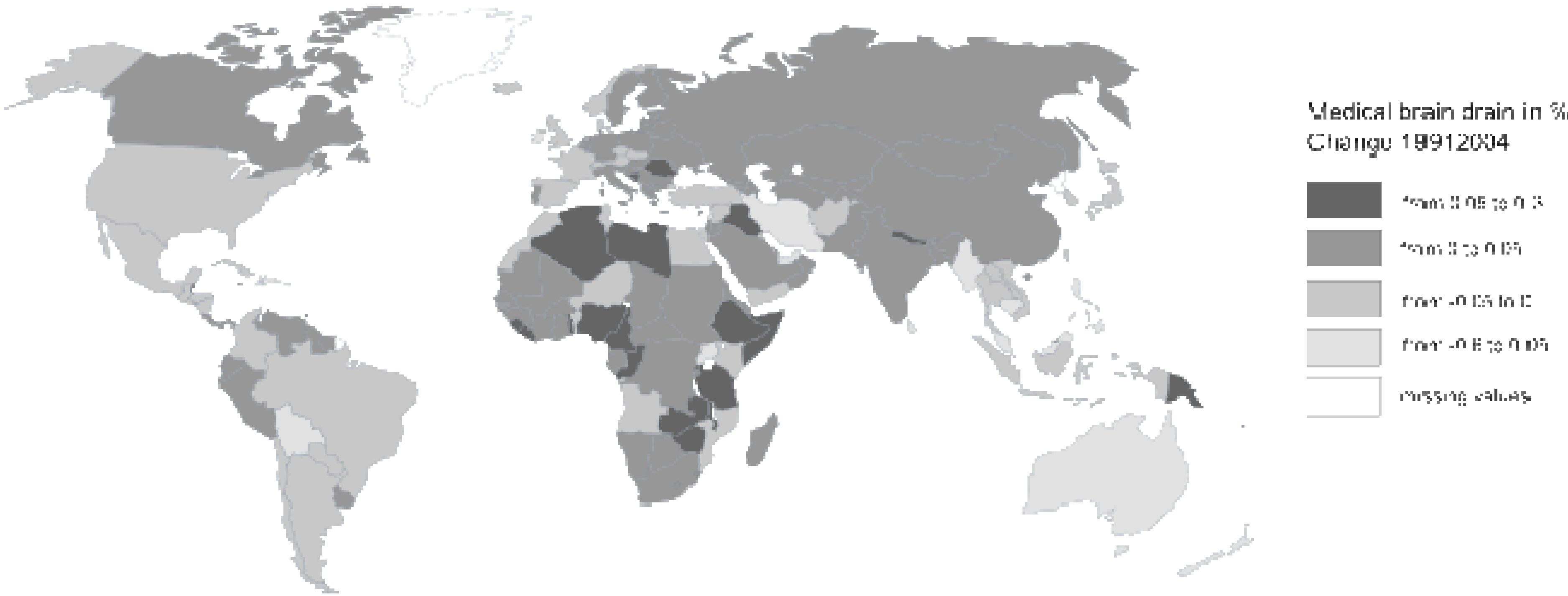


Figure 2. The medical brain drain (cont'd)

Figure 2c. Change in the medical brain drain, 1991-2004



Using their data set by country of training, Bhargava and Docquier (2008) estimated the determinants of the African medical brain drain. Consistently with Awases et al. (2003), countries with higher physician wages have lower emigration rates. Net enrolment in secondary education is also a positive and significant predictor of the medical brain drain, with an estimated short-run elasticity of 0.12. This result is not surprising, as higher enrolments in secondary education entail greater expenditures on education; physicians educated in such environments are likely to have better emigration prospects. More importantly, the HIV prevalence rate is a significant predictor of the medical brain drain, with a short-run elasticity of 0.07 and a long-run elasticity of 0.80; this means that a doubling of the HIV prevalence rate implies an 80 percent increase in the medical brain drain rate in the long run. This is a large effect, with important policy implications.

Using the same data set, Moullan (2008) recently analyzed the effect of bilateral health assistance on the bilateral medical brain drain. The rationale is that, by increasing health capital and infrastructure, health assistance can improve the working conditions of health professionals. His cross-section and panel analyses show that health assistance is an effective tool to retain doctors at home. However, elasticities are relatively low, suggesting that a huge amount of health assistance would be required to reduce the medical brain drain. Interestingly, total bilateral aid (health + non-health) seems to stimulate the medical brain drain under most specifications.

3.2. The case for a medical brain gain

In the spirit of the recent literature on endogenous human capital in a context of migration, we may ask whether there is a chance for a net medical brain gain. Regressing the log of domestic physicians per capita on the log of physician emigrants per capita, Clemens (2007) found a positive correlation of about 70 percent. Clearly, this correlation can be driven by the simultaneous effects of observed variables (GDP per capita, school enrolment conflicts, etc.) or unobserved variables. However, after controlling for observables and instrumenting the number of emigrants, the causal effect of emigration becomes insignificant. This analysis fails to detect any negative effect of health professionals' emigration on the supply of healthcare staff in Africa in a cross-section analysis based on 53 observations. The author attributes this provocative result to the positive effect of emigration prospects on enrolment in medical sciences.

Figure 3. Africa's medical brain drain in percent (year 2000)

3.a. Africa's medical brain drain by country of birth

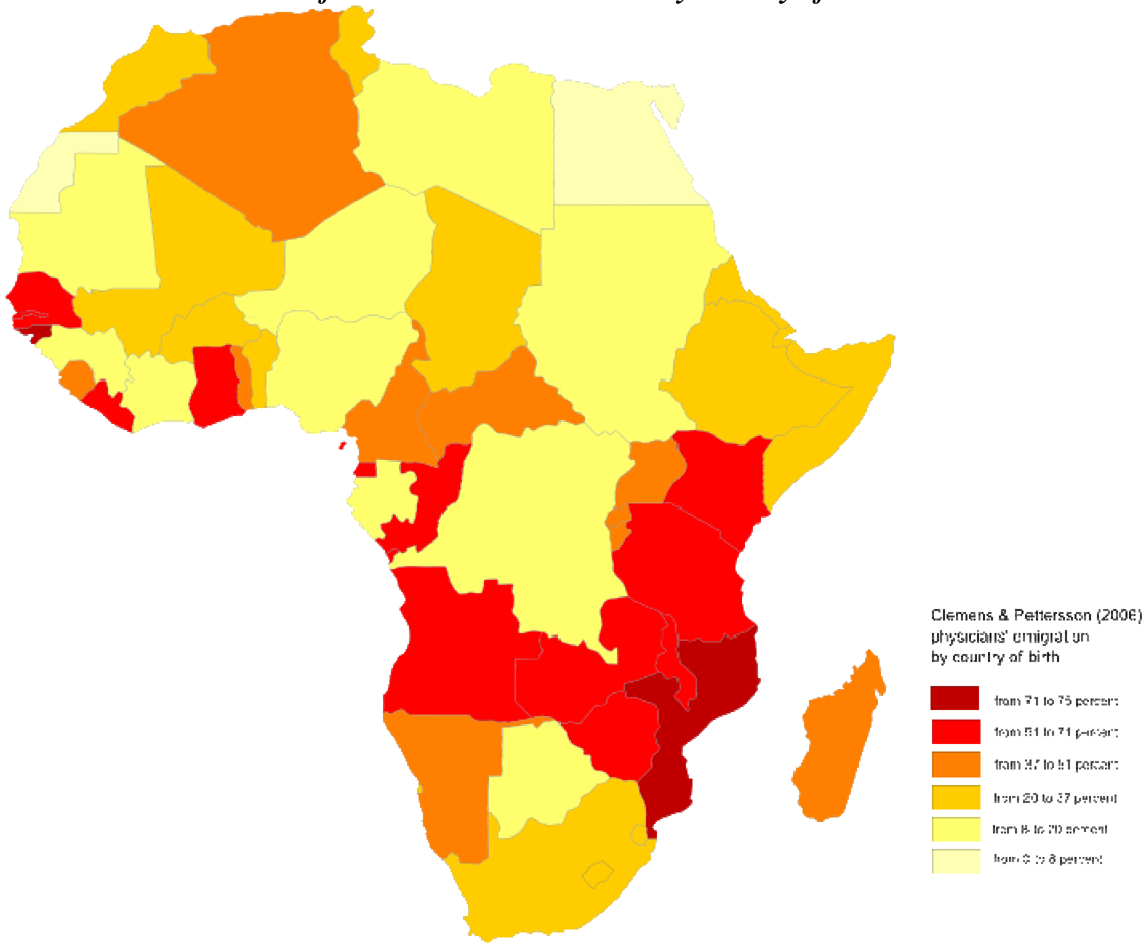
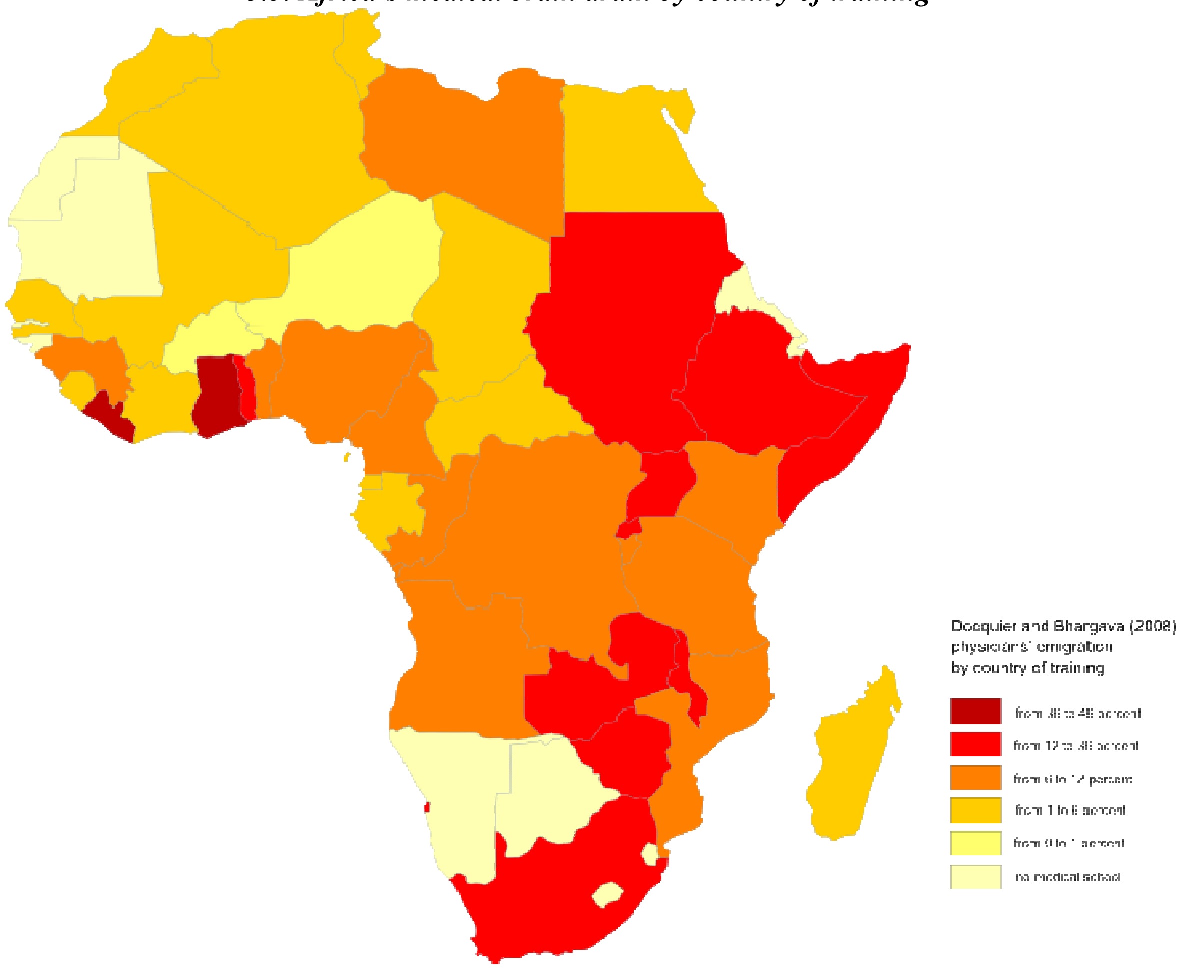


Figure 3. Africa's medical brain drain (cont'd)

3.b. Africa's medical brain drain by country of training



The absence of negative effect of emigration on domestic health worker stocks could also be due to omitted variables such as the size (and quality) of the medical training system. Physician emigration is instrumented with country size and linguistic links. However, data reveal a strong correlation between country size and both the number of medical schools (82 percent) and the annual number of domestically-trained medical graduates (60 percent). In addition, the number of schools and graduates are significantly higher in English-speaking countries or UK former colonies. Hence, it is very likely that country size and linguistic linkages exert a direct impact in the domestic supply of health workers. This causal link obviously needs to be explored in more details in future studies.

Two other studies examine the interactions between education and migration decisions in the medical sector. Although the samples are not restricted to African countries, they deliver interesting results for developing countries in general, and low-income countries in particular.

The first study by Kangasniemi et al. (2007) documents the incentive mechanism in the medical sector, using a survey of overseas doctors working in the United Kingdom. They show that 28 percent of Indian doctors surveyed (the largest group in their sample) acknowledge that the prospect of emigration affected their education decisions. This proportion increases to 37 for doctors originating from low-income countries and 29 percent for those originating from middle-income countries. In addition, the same doctors subjectively estimate that the current proportion of medical students whom effort is affected by the prospect to work abroad amounts to 36 percent for India, 46 percent for low-income countries and 41 percent for middle-income countries. Given these proportions, it is impossible to conclude that the incentive effect is not large enough to increase the skills-supply in origin countries. The key question is: would these doctors or students have opted for medical studies without such emigration prospects? Basically, a necessary condition for a brain gain is that the proportion of students reacting to emigration prospects exceeds the actual emigration rate. The survey suggests that this is likely to be the case for many low-income countries, including most African countries. In addition, doctors remit income to their home countries and many intend to return after completing their training in the UK, so there could be additional benefits via these routes.

In the second study, Defoort (2009) regresses the change in native health professionals on past medical emigration rates. She took advantage of the panel structure of the Docquier-Bhargava's data set and worked with 5 observations per country (one observation every 3 years). Using different methods (fixed effects vs random effects, GLS, IV, GMM), she found evidence of a positive incentive effect in low-income countries. Using simulations, she found an optimal medical brain drain rate of 9 percent. She concludes that only 20 African counties suffer from the medical brain drain while about 30 countries would actually gain (in terms of physicians per capita) from an increase in medical emigration rates.

3.3. Impact on health.

Since 1990, the world's countries and leading development institutions have agreed on a set of "Millennium Development Goals" (MDG). The Millennium Declaration, signed in 2000, established 2015 as the deadline for achieving the MDG. The eight goals include specific health targets: (i) reducing by two thirds the mortality rate among children under five, (ii) reducing by three quarters the maternal mortality ratio and achieving universal access to reproductive health, (iii) combat HIV/AIDS, malaria and other diseases. Much progress has been made in reducing maternal deaths in developing regions, but not in the countries where giving birth is most risky, and many countries are still falling short of meeting the goals.

Is the medical brain drain partly responsible for these bad records? Using the methodology described above, Clemens (2007) found no significant causal impact of the numbers of physicians and nurses abroad on child mortality, infant mortality under age one, vaccination rates or prevalence of acute respiratory infections in children under age five. Chauvet et al. (2008) investigated the determinants of child mortality using a sample of 98 developing countries from 1987 to 2004. In their benchmark full-sample regressions, remittances strongly improve health indicators while health aid per capita and the number of physicians per 1,000 people have no significant impact. However, when interacted with the level of development, health aid commitments become significant and help reducing child mortality in poorer countries, while the number of physicians per 1,000 people has no significant impact. Interestingly, the supply of healthcare staff does not significantly reduce infant and child mortality rates. However, the medical brain drain is shown to significantly deteriorate child health indicators. This suggests that emigrants could positively self-select out of the physicians' population, with only the most talented obtaining a qualification abroad and leaving. In Bhargava and Docquier (2008), the medical brain drain also appears to induce detrimental effects: a doubling of the medical brain drain rate is associated with a 20 percent increase in adult deaths from AIDS. Their study also suggests that a high HIV prevalence can create a vicious circle, by increasing emigration of physicians and nurses, which can in turn increase deaths from AIDS and the numbers of orphaned children. These findings underscore the importance of retaining physicians in Sub-Saharan African countries, especially as antiretroviral treatment becomes more widely available.

4. Europe and the global competition for talent

The new growth literature emphasizes the role of human capital on growth and competitiveness. While imitation of existing technologies requires individuals with strong technical and professional skills developed through secondary or specialized higher education, innovation is research-based and requires the presence of highly-qualified scientists and researchers (Aghion and Cohen, 2004). In the race for innovation and economic leadership, European countries have understood that preventing an exodus of European researchers is crucial. In the words of European Research Commissioner Philippe Busquin, in 2005: “Failing to do so will seriously undermine our chances of creating a genuine European internal market for knowledge and science, and also of meeting our objective of making the EU the most competitive knowledge-based economy in the world”. The EU produces more science graduates per capita (PhDs) than the US but has fewer researchers (5.36 per 1,000 workers against 8.66 in the US and 9.72 in Japan). The Lisbon Council of 1999 and the Barcelona European Council meeting of March 2002 set an official target of raising Europe's investment in research to 3% of GDP by 2010, implying to train and hire 700,000 additional researchers. As the deadline approaches, it seems almost certain Europe will not achieve such targets, and so far the exodus of European researchers has shown no sign of weakening.

4.1. Where does Europe stand?

Let us first compare the situation of Europe to that of other countries in terms of exchange of post-secondary educated migrants. For this purpose, we use the data set of Docquier, Lowell and Marfouk (2009). Table 3 gives a detailed picture of skilled labor exchanges between EU15 countries and the rest of the world in 2000. One can see that by 2000, the EU15 exhibited a net loss of 0.120 million post-secondary educated workers in its exchanges with the rest of the world. This is clearly a lower bound since de DLM data set does not account for EU emigrants to non-OECD countries. This net deficit represented only 0.3 percent of the European skilled labor force, in sharp contrast with the huge gains (12.5 percent of the skilled labor force) in a group of countries comprising the United States, Australia, Canada and New Zealand. In addition, the European deficit of post-secondary educated workers in exchanges with traditional immigration countries was particularly important (2.6 million individuals in 2000); it was more or less compensated numerically by the large entry of skilled workers from developing countries.

In terms of raw numbers, the relative loss of EU15 is rather low. Qualitatively, however, it is likely to be more important. The first reason is that graduates from developing countries are usually less productive than domestic graduates: for example, Dumont and Lemaître (2007) showed that the employment rate gap between natives and immigrants tends to increase with the level of schooling. The authors estimate that one-third of the difference between immigrants and natives is explained by the skill-schooling gap (variation in efficiency for a given level of schooling). This result is comforted by Coulombe and Tremblay (2009) who show that the average skill-schooling in Canada is equivalent to 3.2 years of schooling. The skill-schooling gap is country-specific and decreases with the level of development of the origin country. The second reason is that the European brain drain concerns top-skill workers. Table 4 presents estimates of the brain drain of European researchers employed in Science and Technology (S&T) or European PhD holders. Columns 1 and 2 give the emigration rates of post-secondary educated to the OECD and to the US. Column 3 gives the number of European researchers employed in S&T in the US[6] divided by the sum of researchers employed in the origin country[7] and in the US. Finally, column 4 gives the number of European PhD holders residing in the US[8] divided by the sum of PhD holders residing in the origin country[9] and in the US.

The brain drain of graduates employed in S&T is strongly correlated with the general brain drain to the US and to the OECD computed by Docquier, Lowell and Marfouk (coefficients of correlation of 64 and 70 percent, respectively). However, the brain drain in R&D is on average 5.3 times larger than the general brain drain to the US. In other words, European skilled emigration to the US is biased toward S&T activities. The biggest biases are observed in Belgium, France, the Netherland and the United Kingdom. The brain drain of European PhD holders is less correlated with the general brain drain to the US (coefficients of correlation of 33 and 51 percent, respectively) but is still on average 2.2 times higher than for all post-secondary educated workers.

[6] We use the SESTAT-NSF data set and aggregate the numbers of graduates employed in Research and Development, graduates employed in Computers and Applications, and 50 percent of graduates employed in teaching.
[7] We use the OECD data set on science and technology indicators.
[8] We use the SESTAT data set.
[9] The stock of PhD holders is estimated by multiplying the flow of new PhD graduates by 12 (UNESCO).

Table 3. Exchanges of post-secondary educated workers between EU15 and other OECD countries (1/2)

	EU15 origin country:															**Region of origin:**				
	AUT	**BEL**	**DEN**	**FIN**	**FRA**	**GER**	**GRE**	**IRE**	**ITA**	**LUX**	**NET**	**POR**	**SPA**	**SWE**	**UK**	**EU15**	**TIC**	**OECD**	**Others**	**World**
Emig. to EU15																				
Austria (AUT	0	413	218	362	1549	24629	745	138	3436	154	1107	99	0	680	1854	35384	3131	26614	38110	103239
Belgium (BEL)	605	0	979	923	15193	7743	1471	924	5782	639	17159	1161	23	1356	6741	60699	3955	5932	29211	99797
Denmark (DEN)	193	164	0	763	819	4672	174	229	549	4	931	103	385	2831	2169	13986	2123	7748	15789	39646
Finland (FIN)	58	40	125	0	200	740	52	32	138	2	142	22	33	4170	512	6266	890	1099	13268	21523
France (FRA)	2551	26069	2318	1501	0	32281	3646	2408	23835	1125	10130	21573	2086	3596	33422	166541	23361	56472	362789	609163
Germany (GER-	44000	5511	4917	3730	25843	0	41000	3680	44000	1403	25987	31367	10171	4427	40000	286037	49109	210641	475075	1020861
Greece (GRE-	305	323	165	144	1238	2259	0	119	1163	11	516	35	34	276	2525	9113	3639	2913	49123	64788
Ireland (IRE)	158	434	282	329	3101	3254	149	0	1367	19	1333	154	0	467	62946	73993	12447	2391	26890	115721
Italy (ITA)	1341	1565	531	475	7701	9299	1608	715	0	70	1993	405	957	767	7741	35168	8562	12605	86366	142700
Luxembourg (LUX)	138	4810	623	345	4198	2383	409	125	598	0	866	602	8	447	1268	16820	589	832	3579	21819
Netherland (NET)	3444	24549	1060	668	5456	97718	2105	1196	6983	190	0	2629	1176	916	13397	161488	9041	20254	203206	393989
Portugal (POR)	135	481	132	137	1642	2167	32	156	525	23	887	0	4	198	2291	8810	916	852	16917	27495
Spain (SPA)	920	4520	1280	900	27140	22440	220	860	5680	160	0	2880	20	1540	18060	86620	9500	19900	178020	294040
Sweden (SWE)	1290	400	6680	31330	2100	8850	1780	410	1350	0	1630	430	470	0	5020	61740	7190	31850	95090	195870
United Kingdom (UK)	4966	4926	5232	3075	24454	64573	6609	104112	34353	162	10713	10243	18445	5785	0	297647	163361	58219	714314	1233540
Total EU15	60103	74205	24542	44683	120634	283009	59999	115105	129759	3963	73393	71704	33813	27456	197946	1320312	297815	458321	2307746	4384193
Share in total emigr.	*0.46*	*0.64*	*0.36*	*0.62*	*0.39*	*0.30*	*0.37*	*0.51*	*0.33*	*0.62*	*0.29*	*0.49*	*0.29*	*0.34*	*0.13*	*0.29*	*0.24*	*0.16*	*0.20*	*0.22*

Table 3. Exchanges of post-secondary educated workers between EU15 and other OECD countries (2/2)

	EU15 origin countries:															**Region of origin**				
	AUT	**BEL**	**DEN**	**FIN**	**FRA**	**GER**	**GRE**	**IRE**	**ITA**	**LUX**	**NET**	**POR**	**SPA**	**SWE**	**UK**	**EU15**	**TIC**	**OECD**	**Others**	**World**
Emigration to TIC																				
Australia	6999	2405	3720	2724	9379	38440	18947	22801	28401	64	30259	2642	30913	3517	381348	582559	176295	96507	785418	1640779
Canada	14535	11395	10950	7685	46830	111710	19315	14990	80600	250	65655	31845	32010	4625	365420	817815	162430	225890	1518095	2724230
New-Zeland	495	210	576	165	759	4056	180	2481	375	12	8451	54	2931	366	85236	106347	23739	8091	79782	217959
US	35509	21806	19990	13601	93769	387067	56518	71697	132333	1647	63054	37536	15394	31520	418794	1400236	489072	1917039	6603668	10410014
Total TIC	57538	35816	35236	24175	150737	541273	94960	111969	241709	1973	167419	72077	81248	40028	1250798	2906957	851536	2247527	8986963	14992982
Share in total emigr.	0.44	0.31	0.52	0.33	0.49	0.58	0.59	0.49	0.61	0.31	0.66	0.49	0.69	0.50	0.85	0.65	0.69	0.78	0.77	0.74
Emigration to OECD																				
Total EU15+TIC	117641	110021	59778	68858	271371	824282	154959	227074	371468	5936	240812	143781	115060	67484	1448744	4227268	1149350	2705848	11294709	19377175
Rest of OECD	12507	7027	8114	3738	39383	112241	6712	1070	23765	485	13922	1986	2496	13073	29733	276253	92956	167621	336036	872866
Total OECD	130148	117048	67892	72596	310754	936523	161670	228144	395233	6421	254734	145767	117557	80557	1478477	4503521	1242306	2873469	11630745	20250041
Net emigration																				
EU15	24719	13506	10556	38417	-45907	-3028	50886	41112	94591	-12857	-88095	62894	-52807	-34284	-99701	0	-2609142	182068	2307746	-
TIC	54407	31861	33113	23285	127376	492164	91321	99522	233147	1384	158377	71161	71748	32838	1087437	2609142	0	2154571	8986963	-
Rest of OECD	-14107	1095	366	2639	-17089	-98400	3799	-1321	11160	-346	-6332	1134	-17404	-18777	-28486	-182068	-2154571	0	336036	-
Other countries	-38110	-29211	-15789	-13268	-362789	-475075	-49123	-26890	-86366	-3579	-203206	-16917	-178020	-95090	-714314	-2307746	-8986963	-336036	0	-
Total	26909	17251	28246	51073	-298409	-84339	96882	112423	252532	-15398	-139255	118272	-176483	-115313	244936	119328	-13750676	2000603	11630745	-
% skilled labor force	*3,2*	*0,9*	*3,5*	*5,4*	*-3,4*	*-0,5*	*8,3*	*25,0*	*6,8*	*-18,6*	*-5,7*	*19,0*	*-58,9*	*-6,7*	*3,4*	*0,3*	*-12,5*	*4,5*	*7,6*	-

Legend : TIC = Traditional immigration countries (US, Australia, Canada, New-Zeland)
Source : Docquier, Lowell and Marfouk (2007)

Table 4. Brain drain of European scientists to the US in percent

Country of birth	Graduates DLM (US)	Graduates DLM (OECD)	Researchers in S&T (US)	PhD holders (US)
Austria	3.7	13.5	12.6	4.2
Belgium	1.0	5.5	12.9	2.3
Denmark	2.3	7.8	9.3	4.8
Finland	1.3	7.2	1.9	1.4
France	1.0	3.4	7.6	2.8
Germany	2.4	5.7	18.0	2.7
Greece	4.2	12.1	28.4	8.5
Ireland	10.6	33.7	33.0	16.0
Italy	3.2	9.6	17.0	2.6
Luxembourg	1.8	7.2	4.5	-
Netherlands	2.3	9.5	15.6	3.1
Portugal	4.9	18.9	11.4	0.7
Spain	1.1	4.2	-	1.9
Sweden	1.8	4.5	6.7	1.6
United Kingdom	4.8	17.1	29.0	6.2
Bulgaria	1.3	9.6	-	11.7
Cyprus	4.4	34.2	52.6	49.2
Czech Republic	2.7	8.5	12.5	3.9
Estonia	2.5	9.9	21.0	11.2
Hungary	4.7	12.8	24.9	12.5
Latvia	4.7	8.5	45.3	8.7
Lithuania	3.2	8.3	24.3	5.6
Malta	7.3	58.3	55.7	10.1
Poland	5.7	14.2	-	5.7
Romania	4.1	11.2	34.4	4.8
Slovakia	3.6	14.3	10.9	3.0
Slovenia	1.8	10.9	4.3	2.9
Australia	0.8	2.7	5.8	2.1
Canada	3.9	4.7	37.1	15.7
Japan	0.9	1.2	4.9	1.8
China	2.1	3.8	14.9	22.8

Sources: DLM (2009), SESTAT-NSF, UNESCO, OECD

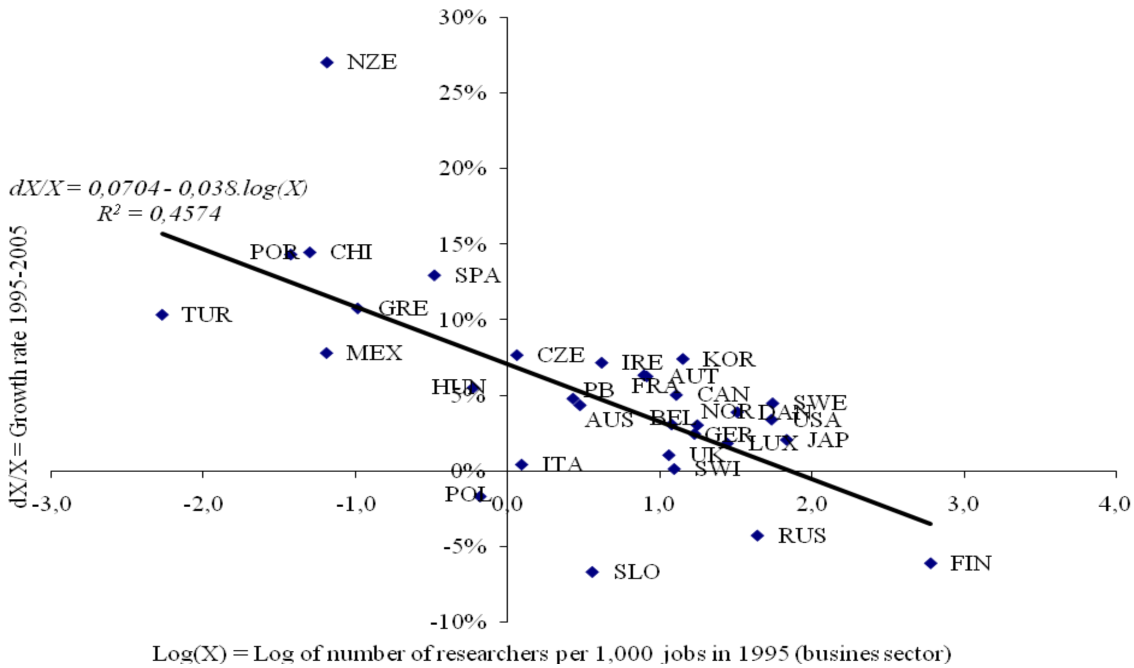
4.2. EU's brain drain and R&D policy.

The figures above clearly reveal that Europe is suffering from a large emigration of scientists and top-skill workers. Comparing US census data for 1980, 1990, 2000 and 2006, Tritah (2008) shows that Europeans emigrants are increasingly drained from the top of the distribution of skills and ladder of occupations that matter the most for the knowledge economy (engineers, researchers and university instructors). Is there any positive feedback effect associated with the European brain drain? Clearly, given the development level of Europe, we should not expect strong incentive effects and huge amount of remittances to be observed. Return migration is more likely to play a role. Nevertheless, Tritah's estimates suggests that returns rate in all large European countries have decreased during the 1990s compared to the 1980s, except for the UK where it has remained stable at below 40%.

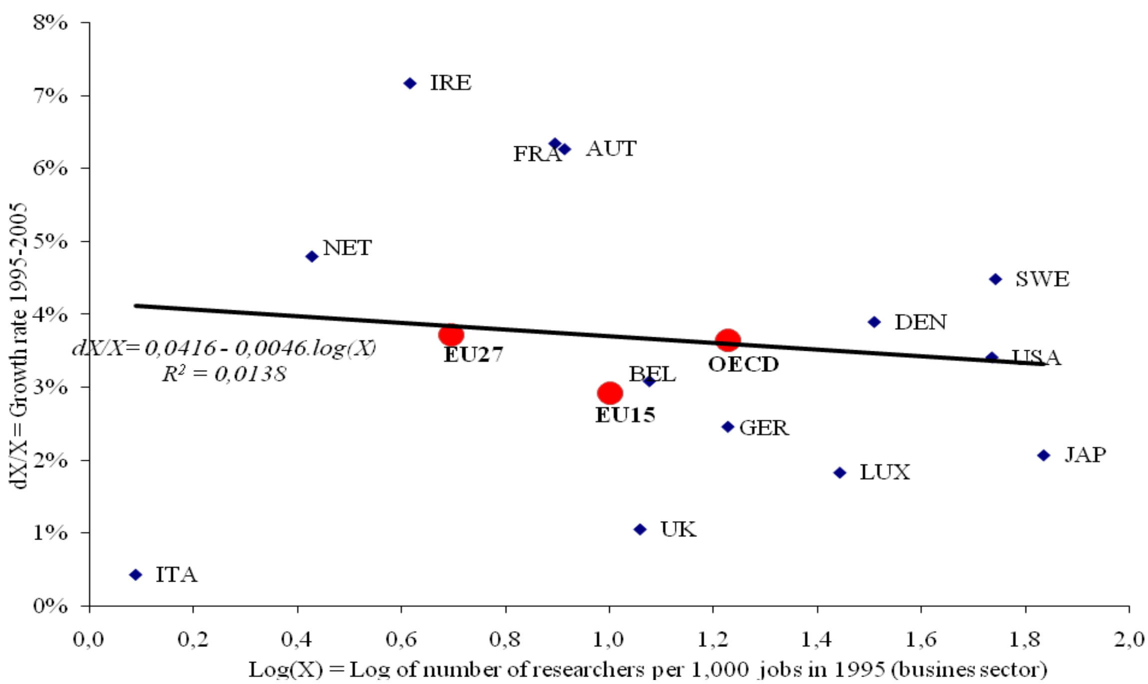
The key question is then: does the emigration of European scientists' threaten R&D performances, or do low R&D investments stimulate the brain drain? The OECD database on Main Science and Technology Indicators reveals that European investments in "knowledge" (sum of R&D expenditures, investments in software, higher-education spending) represents 3.8 percent of GDP, against 5 percent in Japan and 6.6 percent in the United States. In particular, while the 2000 Lisbon Council aimed at increasing European R&D spending from 1.8 percent in the late 1990s to 3 percent of GDP in 2010, this ratio has hardly increased and remains below 2% in 2006 a majority of countries; only Sweden (already at more than 3% in 1995) and Finland meet the objective. Figures 4.a and 4.b compare the number of researchers per 1,000 jobs in 1995 with the growth rate of this variable between 1995 and 2005. The data are taken from the OECD data base on Science and Technology indicators (October 2007). A negative slope of the regression line can be interpreted as a sign of convergence between countries. The strong convergence observed on Figure 4.a is driven by the cases of middle-income and emerging countries. On Figure 4.b, we restrict the sample to advanced countries (EU, Japan, US). The slope becomes insignificant and the R-squared is close to zero. This indicates that the number of researchers per 1,000 jobs remains much lower in Europe than in Japan or the US, which no signs of convergence since the mid-1990s.

Figure 4. Numbers and growth rate of researchers per 1,000 jobs (1995-2005)

4.a. Number of researchers per 1,000 jobs (extended OECD)



4.b. Number of researchers per 1,000 jobs (EU, Japan and US)



Looking at correlations between R&D spending and growth, Tritah (2008) shows that "countries that have increased their R&D spending more in proportion to their GDP are also those whose expatriation of scientists and engineers to the United States has increased the least". Based on an estimated supply and demand framework, he finds the brain-drain to be a symptom of the lack of demand for skilled labor in Europe that has followed the rise in skilled labor supply in the 1990s. His analysis strongly supports the idea that expatriation of scientists and engineers is due, at least to some extent, to the lack of resources dedicated to research in their countries. Other evidence corroborates this result. In particular, low investments in knowledge also translate into low wages for scientists, unstable or unattractive jobs, competition with non PhD graduates, excess load of administrative tasks, etc., which are often cited as major push factors in opinion surveys among European researchers.[10]

4.3. On European Blue cards.

Most European governments have eased restrictions on entry for skilled workers, and many are going much further, not just "letting them in" but rather engaging in what has been termed an international competition to attract talent: "Germany has made it easier for skilled workers to get visas. Britain has offered more work permits for skilled migrants. France has introduced a "scientist visa". Many countries are making it easier for foreign students to stay on after graduating [...]. Ireland's government works hard to recruit overseas talent [...]. Many countries regard universities as ideal talent-catching machines, not only because they select students on the basis of ability but also because those students bring all sorts of other benefits, from spending money to providing cheap research labor. France is aiming to push up its proportion of foreign students from about 7% now to 20% over time. Germany is trying to create a Teutonic Ivy League and wants to "internationalize studies in Germany". The global war for talent is likely to intensify. Most developed countries are already struggling to find enough doctors and teachers, and are wondering how they will manage when the baby-boomer generation retires."[11]

Many practical policy recommendations have been proposed by the European Commission to curb or invert the EU scientists' brain drain. The most recent proposal, officially endorsed by the EU in 2008, is to create by 2010 a European *Blue Card* meant to attract highly-qualified workers. The blue card would grant such workers and their families with rights to work and

[10] See, e.g., Le Monde (Blog), April 27, 2009: "L'exode des chercheurs européens et ses périls".
[11] *The Economist,* "Opening the doors", October 5, 2006.

live in the EU countries for 3 to 5 years. More precisely, the Blue Card would allow an immigrant to work in one EU country. After the first 18 months, the worker could then move to another country, but would still have to apply for a new Blue Card within a month of arrival. This is far from the initial proposal as first proposed by Jakob Von Weizsäcker from the Bruegel Institute in 2006 (Von Weizsäcker, 2006, 2008). In its current format, the Blue Card can help attenuate labor shortages for certain professions, however it is unlikely it can help Europe compensate its deficit in science and technology. Given what we know on the determinants of skilled immigrants destination choices (see our section 2.2 above), the blue card proposal appears too uncertain (with uncertainty regarding mainly chances of renewal and transferability across EU countries) and not generous enough to significantly change the attractiveness of the European labor market for scientists and talented workers.

5. The Indian Diaspora and the rise of India's IT sector

The Indian-born population in the US increased twofold (from one half to one million) over the course of the 1990s, with half of this increase being due to the arrival of skilled (i.e., tertiary educated) workers. The database of Docquier, Lowell and Marfouk (2009) reveals that there were more than one million skilled Indian emigrants worldwide in 2000, placing India second just to the Philippines among developing countries for the number of skilled emigrants living in the OECD area, and almost on par with the Philippines after excluding people arrived before age 22, as shown in Beine et al. (2007). As is well known, Indians also represent the bulk of H1-B visas holders in the US (see Table 5), a visa category aimed at skilled professionals in sectors with occupational shortages (in practice, software engineers and programmers).

Table 5: Number of H1B visas delivered to Indian immigrants, 1998-2008[12]

Year	India as country of Citizenship	India as country of Residence	Total	Percentage of total Citizenship	Percentage of total Residence
2008	154 726	78 913	**409 619**	37,77	19,26
2007	157 613	81 584	**461 730**	34,14	17,67
2006	125 717	67 292	**431 853**	29,11	15,58
2005	102 382	55 873	**407 418**	25,13	13,71
2004	83 536		**387 147**	21,58	
2003	75 964		**360 498**	21,07	
2002	81 091		**370 490**	21,89	
2001	104 543		**384 191**	27,21	
2000	102 453		**355 605**	28,81	
1999	85 012		**302 326**	28,12	
1998	62 544		**240 947**	25,96	

Source: DHS Yearbook of Immigration Statistics for years 1998-2008, http://www.dhs.gov/ximgtn/statistics/publications/yearbook.shtm

Given its high ranking and standing as an exporter of skilled professionals and talented individuals, India has been the subject of a large amount of brain drain oriented research. The presence of highly educated Indians among the business, scientific and academic elites of England, the US, and other Western countries, is impressive and has long been both a matter of national pride and of persistent concern. Echoing this ambivalence, Desai et al. (2009) evaluated the fiscal cost of the brain drain for India at 0.5 percent of Indian GDP or 2.5 percent of total Indian fiscal revenues, a "conservative" estimate in their view. However, their computations are based on the assumption that all Indian engineers abroad would have worked as engineers in India, and would have engaged in engineering studies in the first place, which is disputable. While it is clear that many of them would not have worked as engineers if it was not for the possibility of migration, the no-migration counterfactual is not clear. If one assumes that in alternative occupations their wages would have been lower, then Desai et al. (2009) fiscal loss estimates could instead be seen as an upper bound. In fact, many of them end up in managerial jobs (for example, 52 percent of the graduates of IIT-Bombay of 2005-6 ended up in consulting and finance), which are much higher paying occupations in India than engineering, and accounting for this would indeed push the fiscal loss estimates upwards. Perhaps more importantly, if the loss is not that of engineers per se but a selection

[12] Courtesy of Devesh Kapur.

bias in which entrepreneurial talent is lost,[13] then the tax losses are on corporate and VAT/sales taxes and not income taxes on which Desai et al. (2009) focused on.

In any event, the last years have seen a gradual reversal in media and public attitudes in India, and it is now common to celebrate the contribution of the Indian diaspora to the country's industrial and economic success. India has already been frequently cited in the recent literature to exemplify the potential for a diaspora to foster technology and knowledge diffusion (Kerr, 2008, Agrawal et al., 2008) or the contribution of return migration to the home economy (Agrawal et al., 2008, Saxeenian, 2006). In what follows we will focus on the role of the Indian diaspora, especially that established in the Silicon Valley, in the rise of the Indian IT sector in India. We will base our account mainly on the works of Saxenian (1999, 2002), Arora and Gambardella (2005), Kapur and McHale (2005), Commander et al. (2008), and Kapur (2009, Chapter 4).

The first study to point to the potential role of the Indian diaspora in the rise of the software industry in India is the well known work of Saxenian (1999), who noted the large implication of Indian (and Chinese) entrepreneurs in the Silicon Valley: Indians were shown to run 9 percent of Silicon Valley start-ups from the period 1995 to 1998, with a majority of these start-ups (nearly 70 percent) in the software sector. A more recent survey (Wadhwa et al., 2007) shows the last decade has been even more impressive in terms of Indian-born entrepreneurs' share in the US high-tech sector: it shows that out of an estimated 7,300 U.S. tech start-ups founded by immigrants between 1995 and 2005, 26 percent have Indian founders, CEOs, presidents or head researchers—more people than from the four next biggest sources (United Kingdom, China, Taiwan and Japan) combined. Indian immigrants outpaced their Chinese counterparts as founders of engineering and technology companies in Silicon Valley, with Indians being key founders of 15.5 percent of all Silicon Valley startups, mainly in the fields of software (for 46 percent of them) and innovation/manufacturing-related services (44 percent).

Saxenian (2002) then proceeded to explore not just the potential but the actual business links with India. In her survey of Indian (and Chinese) members of professional associations in the Silicon Valley, she shows that these links are indeed important: for instance, 77 percent of the respondents had one or more friends who returned to India to start a company, 52 percent used to travel to India for business purposes on a regular basis (at least once a year), 27 percent reported regularly exchanging information on jobs/business opportunities with those

[13] As evidenced for example by Saxenian (2006).

back home, 33 percent reported regular exchanges of information on technology. In addition, 46 percent had been a contact for domestic Indian businesses, and 23 percent claimed to have invested their own money into Indian start-ups. Last but not least, when asked about the possibility of return migration, 45 percent reported returning as somewhat or quite likely.

Such results must be taken with caution as they are based on a non-representative sample (due to self-selection into the professional associations surveyed and to the choice to respond to the survey).[14] As Kapur and McHale (2005) note, "these figures contradict what is known about the activities of Indian diaspora from other sources, so that the survey's results need to be treated with some caution. One problem is that the investment data is silent on the magnitude of investments. Foreign direct investment from the Indian diaspora is less than 5 percent of its Chinese counterparts—even though the propensity to invest is comparable for the two diasporas in Saxenian's survey. Similarly, the finding that 45% would consider returning is belied by reality. While aggregate data on return migration is unavailable, segment specific data such as NSF longitudinal data on PhD students suggests a number closer to 5 percent."

Still, Saxenian's results are suggestive of strong connections between the Silicon Valley resident Indians and those in India. And indeed, the role of the Indian diaspora has been singled out as a primary factor of India's emergence on the global IT scene. As Kapur (2002) put it, "One of the puzzles about the explosive growth of India's IT sector is how and why India has emerged as a global leader in a leading edge industry when, despite strenuous (and, in retrospect, misguided) policies, it failed to achieve such leadership in any other technology intensive sector. The issue is even more puzzling if one keeps in mind that conventional indicators of IT penetration, such as personal computers (PCs) per thousand population, internet subscribers, telephone connections, scientists and engineers per million, all make India look decidedly mediocre". To solve this puzzle, Kapur (2002, 2009) first reviewed what he presents as proximate causes of the Indian IT sector success, namely, the lack of State intervention and the flexibility of the labor market in the IT sector, and then turns to what he sees as the root causes. Chief among them is… the brain drain, whose beneficial effects, he argues, have been multifaceted. Paraphrasing Kapur's account and linking his analysis to the general arguments put forward in the recent literature on the effects of emigration on home countries, the following channels may be emphasized:

- A first windfall from India's brain drain is that it has provided prospective investors with information on the quality of the Indian labor force and created virtuous

[14] The overall response rate was 21 percent.

reputational spillovers, sparking demands for Indian IT specialists in countries without previous Indian migration experience (e.g., Germany, Japan) as well as international demand for IT services exported from India.[15] This is very much in line with the general argument about an information and transaction cost channel, especially with the argument that migrant workers, skilled or unskilled, can convey information and reduce transaction costs through their sheer presence in the host countries labor markets. Evidence of such information and transaction cost effects contributing to foster FDI from host to home countries can be found in studies using bileral (Kugler and Rapoport, 2007, Javorcik et al., 2006, Buch et al., 2006) as well as aggregate (Docquier and Lodigiani, 2009) data.

- Second, the overseas Indian presence has helped in the diffusion of knowledge through a variety of mechanisms: substantial skill upgrades for those who worked in the US, with diffusion to India through return migration and brain circulation. This is a a perfect illustration of another channel put forward in the recent brain drain literature, namely, the knowledge and technology diffusion channel, as well as additional evidence of the brain circulation (or return migration with additional skills and human capital). As such, this confirms recent studies using patent citation data to measure the international diffusion of knowledge and innovation through diaspora networks (Kerr, 2008, Agrawal et al., 2008).
- Third, the diaspora has been an effective partner in setting up sectoral institutions and networks who successfully lobbied the Indian government to change the regulatory framework for venture capital in India. While this example is restricted to a particular sector, it is not difficult to imagine that once such lobbying organizations are in place, with their set-up costs already incurred, they can also be activated towards achieving broader political and institutional reforms. This exemplifies the type of institutional reform towards better regulations and more effective economic and political institutions emphasize in the recent brain drain literature in the effects of skilled emigration and foreign students on home countries institutions and governance (Li and McHale, 2006, Docquier et al., 2009, Spilimbergo, 2009).
- And fourth, instead of developing a protectionist attitude by trying to keep engineers and IT specialists at home, the Indian industry has realized the potential gains from foreign experience and supported an increase in the number of H1-B visas for Indian

[15] This echoes Banerjee and Duflo's (2000) evidence that reputation affects the form of contracts that firms outsourcing customized software enter into with Indian software firms.

> professionals in the US. The reason lies in changes in the market structure of the global IT industry, itself a lagged effect of previous brain drain. Ten of the largest twenty-five companies hiring foreign nationals with H-1B visas are IT firms based in India or U.S.-based IT firms run by Indian nationals. This may clearly be interpreted along the lines suggested in our introduction about the endogenous human capital formation in a context of migration, often referred to as the brain drain v. brain gain debate, and further adds to the recent evidence (e.g., Beine et al., 2008) on endogenous human capital formation and return migration as potential mechanisms possibility leading to a beneficial brain drain (or net brain gain).

Kapur's account demonstrates the crucial role played by the Indian diaspora at the onset of the IT revolution which took place in the 1990s as well as in the later phases and goes beyond the general effects on knowledge diffusion and technology diffusion emphasized for example in the papers by Kerr (2008) and Agrawal et al. (2008). This assessment is confirmed by other surveys and analyses. For example, a recent comprehensive survey of India's software industry showed that 30 to 40% of the higher-level employees have relevant work experience in a developed country (Commander et al., 2008). Similarly, Nanda and Khanna (2009) used a survey sent to all the CEOs of Indian software firms to study the role of diaspora links and found that entrepreneurs who live in hubs, where the local networking environment is stronger, rely on local networks and do not necessarily gain significantly from diaspora networks. More specifically, for those entrepreneurs based in smaller cities with weaker networking and financing environments, having a personal experience abroad allows for gaining access to business and financial opportunities through diaspora networks. They conclude that brain circulation is crucial as such networks, it is argued, are successful not just because of the expatriates who live abroad, but because some of the expatriates have returned back home and know how to effectively tap into the diaspora.

6. Conclusion

Most of the recent literature on the effects of the brain drain on source countries consists of theoretical papers and cross-country empirical studies. In this paper we complement the literature through three case studies on very different regional and professional contexts: the African medical brain drain, the exodus of European researchers to the United States, and the contribution of the Indian diaspora to the rise of the IT sector in India. While the three case studies concern the very upper tail of the skill and education distribution, their effects of source countries are contrasted: clearly negative in the case of the exodus of European researchers, clearly positive in the case of the Indian diaspora's contribution to putting India on the IT global map, and mixed in the case of the medical brain drain out of Africa.

These contrasted experiences also illustrate how difficult it is to capture the effect of skilled emigration on source countries using uniform approaches leading to uniform policy recommendations. The recent brain drain literature shows that the brain drain has a potentially strong incidence on between-country inequality. In other words, there are winners and losers, and the brain drain may in some cases contribute to speed up the pace of convergence for some countries while contributing to increased divergence in the case of other countries.[16] The case studies presented in this paper complement and strengthen this view in that they show similar patterns for regions and/or professions. A straightforward implication of the above analysis is that curbing skilled emigration maybe a sound policy objective in the case of Europe (assuming it does so by becoming more "talent friendly") but would clearly be counterproductive in the case of India. Regarding specific professions, the main policy discussions so far have focused on proposals to create blacklists of high-risk occupations and/or origin countries (e.g., physicians and nurses originating from high medical brain drain countries with less than 0.5 healthcare professionals per 1,000 people). Our analysis shows that such proposals, which primarily target the African medical brain drain (see e.g., Beecham, 2002), should also be reevaluated in the light of the complex relationships between the medical brain drain, the endogenous formation of medical human capital, and the health infrastructure and general environment in Africa.

[16] See, e.g., Beine et al. (2008), Mountford and Rapoport (2007), and, for a survey, Docquier and Rapoport (2009).

7. References

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