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To cite this article: Stella Capuano & Abdeslam Marfouk (2013) African Brain Drain and Its Impact on Source Countries: What Do We Know and What Do We Need to Know?, Journal of Comparative Policy Analysis: Research and Practice, 15:4, 297-314, DOI: [10.1080/13876988.2013.813122](https://doi.org/10.1080/13876988.2013.813122)

To link to this article: <http://dx.doi.org/10.1080/13876988.2013.813122>



Published online: 01 Aug 2013.



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African Brain Drain and Its Impact on Source Countries: What Do We Know and What Do We Need to Know?

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ABSTRACT *While there appears to be deep and growing concern for the brain drain from Africa, lack of adequate data has so far prevented a comprehensive analysis of its magnitude and its impact on source countries. Using original datasets on international migration, this paper addresses both issues. It shows that many African economies lost a considerable part of their highly skilled labor force due to migration to developed countries. The article also highlights that significant effort is still needed, in terms of data collection and empirical analysis, before drawing clear conclusions on the effects of the brain drain on Africa.*

1. Introduction

According to the latest figures, a high percentage of highly educated Africans migrate overseas. For example, between 1990 and 2000, the stock of high-skilled immigrants from African countries residing in the OECD countries increased by 90 per cent (Table 1). As a consequence, a number of African countries “lost” a significant proportion of their highly educated labor force.

The figures reveal that a considerable “brain drain” from Africa is taking place, a phenomenon that is likely to worsen the already worrying situation of the African continent in terms of human capital, as shown by the most recent indicators on literacy rates and research and development.¹

While there appears to be deep and growing concern for the brain drain from Africa, lack of adequate data has so far prevented a comprehensive analysis of its magnitude and its impact on source countries. Using original datasets on international migration, this paper addresses both issues. After giving an overall picture of the magnitude of the brain drain from Africa, we will concentrate on two related issues that have so far received little attention: female brain drain and the brain drain in the medical profession.

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Table 1. Descriptive statistics by region of origin (1990–2000)

Region of origin	Structure of immigration (in thousands)			Proportion of high-skilled (in %)		Emigration rates (in %)		
	Total	Low-skilled	High-skilled	Among immigrants	In region of origin labor force		Low-skilled	High-skilled
All countries		2000						
Developed countries	58,619	25,280	20,523	35	11.1	1.3	5.5	
Developing countries	19,890	7,047	7,940	40	29.8	3.6	3.9	
	37,890	17,395	12,391	33	6.2	1.0	7.3	
From selected region								
Africa	4,465	2,188	1,407	32	3.9	0.9	10.6	
Asia	15,255	5,468	7,014	46	6.0	0.4	5.8	
Europe	21,364	9,026	6,896	32	17.7	4.4	7.3	
Latin America and Caribbean	13,966	7,319	3,684	26	11.8	4.1	11.1	
		1990						
All countries								
Developed countries	41,996	20,601	12,546	30	9.1	1.3	5.1	
Developing countries	18,206	8,099	5,768	32	23.7	3.9	4.0	
	22,605	11,830	6,513	29	4.7	0.9	6.5	
From selected region								
Africa	2,914	1,760	742	25	2.5	0.9	11.5	
Asia	9,435	3,979	3,786	40	4.7	0.4	5.2	
Europe	19,492	9,906	4,890	25	13.8	5.0	7.0	
Latin America and Caribbean	7,019	3,745	1,926	27	8.9	2.6	10.1	

Note: Migrants are defined as persons aged 25 or older. Low-skilled = persons with less than secondary diploma, high-skilled = persons with tertiary diploma. "Total" corresponds to the sum of low-skilled, medium-skilled and high-skilled migrants. "All countries" refers to the sum of migrants from developed countries, developing countries, dependent territories and migrants who did not report their country of birth. Developing and developed country groups are based on the World Bank income classification.

Source: Authors' computations based on DLM dataset (2009).

Female brain drain may translate into a higher loss than male brain drain, particularly in contexts such as Africa, where female literacy rates are still very low and female human capital constitutes a scarcer resource than male human capital: a vast body of literature has indeed pointed out that women's education is a fundamental element for growth and development (see, for example, World Bank 2007). The second aforementioned issue, i.e. the brain drain within the medical profession, represents a serious problem for the African continent, as it may be linked to a worsening of the health situation of its population and of its health system as a whole.

In our discussion on female and medical brain drain from Africa we will report the results of existing studies and comment on the available data on the topic, but we will also highlight that more effort is still needed in order to reach conclusive results on both phenomena.

The remainder of the paper is organized as follows: in Section 2 we provide an overall picture of the brain drain from Africa, including female brain drain and the case of medical brain drain. In Section 3 we describe existing evidence on the impact of brain drain on source countries. Section 4 discusses a few relevant issues that, in our opinion, deserve the attention of scientific research. Finally, Section 5 concludes.

2. Magnitude of High-Skilled Migration from Africa

The purpose of the present and the following sections is to illustrate how much high-skilled migration from Africa there is. Our analysis is based on the international migration dataset developed by Docquier et al. (2007, 2009) – DLM07² henceforth – which provides detailed information on international migration by sex, educational attainment, countries of origin and destination – in absolute terms and in percentage of the total labor force born in the sending country (emigration rates).

DLM07 relies on harmonized census and register data on the structure of immigration in 30 OECD member states with the highest level of detail on the country of birth for two periods (1990 and 2000). Three levels of schooling are distinguished: primary (low-skilled: including lower-secondary, primary and no school), secondary (medium-skilled: high school leaving certificate or equivalent), and tertiary education (high-skilled: higher than high-school leaving certificate or equivalent). Brain drain is defined as the migration of tertiary educated workers.

DLM07 counts as migrants all working-age (25+) foreign-born individuals living in an OECD country. Considering the population aged 25+ maximizes the comparability of the immigration population with data on educational attainment in the source countries. It also excludes a large number of students who temporarily emigrate to complete their education.

Let $M_{j,s,t}^i$ indicate the stock of adults aged 25+ born in country i and residing in country j with skill level s at time t . Aggregating these numbers over the destination countries j gives the stock of emigrants from source country i living in the OCED area:

$$M_{OECD,s,t}^i = \sum_J M_{j,s,t}^i$$

Skilled emigration rates are obtained by comparing the emigration stocks to the total number of people born in the source country and belonging to the same educational

category. Calculating the brain drain as a proportion of the total educated labor force is more appropriate to evaluate the pressure imposed on the local labor market. For example, one may argue that the pressure exerted on the national economy by 151,451 Egyptian high-skilled emigrants (4.7 per cent of the educated total labor force) is less than the pressure exerted by 7,558 high-skilled emigrants from Cape Verde (82.4 per cent of the national educated labor force).

Let $N_{s,t}^i$ be the total resident population in the country of origin i at time t . The emigration rate from country i to country j at time t is:

$$M_{j,s,t}^i = \frac{M_{j,s,t}^i}{N_{s,t}^i + M_{j,s,t}^i}$$

Table 1 describes the structure of migration to OECD countries by educational attainment and region of origin. It shows that a significant proportion of African immigrants are highly educated. In 2000, approximately one out of every three African migrants (32 per cent) is tertiary educated, compared to 26 per cent for the Latin America and Caribbean region (LAC) and 22 per cent for Europe. The table also reveals that the percentage of the highly skilled among African migrants has increased by 7 percentage points over the period 1990–2000,³ against –1 percentage point for the LAC region, and 4 percentage points for the migrants in developing countries considered as a whole.

Comparing the educational level of migrants with that of the overall population in the home countries reveals that, in general, migrants are better educated than those left behind. This is particularly true in Africa, where, as Table 1 shows, the proportion of the tertiary educated among migrants from Africa (32 per cent in 2000) is eight times higher than their proportion in the continent's labor force (4 per cent). In the last two columns of Table 1 we have computed the high-skilled (brain drain) and low-skilled emigration rates. Looking at the value of the brain drain rate for the African region in 2000, it is remarkable how the propensity to move among highly skilled workers (10.6 per cent)⁴ is approximately 12 times higher than among the low-skilled (0.9 per cent). This clearly indicates that the African continent is losing a considerable part of its human capital endowment.

To further explore this issue, in Table 2 we display the situation of the most affected African countries. The brain drain intensity is different when measured in absolute or relative terms. In absolute terms, unsurprisingly, the largest countries are affected more by the exodus of highly skilled workers. The top eight sending countries in 2000 were South Africa (173,411), Morocco (155,994), Egypt (151,451), Nigeria (148,780), Algeria (87,777), Kenya (80,287), and Ghana (67,105). However, when the brain drain is measured as a proportion of the national highly skilled labor force, small countries suffer from a massive brain drain. This is the highest in Cape Verde (82 per cent), Seychelles (77 per cent), Gambia (68 per cent), and Mauritius (56 per cent).

2.1. *Female Migration: A Hidden Dimension of the African Brain Drain*

Available data show that the female component of both the worldwide and African brain drain is growing over time. In Table 3 we have computed the stock of migrants for 1990 and 2000 by gender, country of origin, and educational level, based on the DLM07. It is

Table 2. Emigration (25 years and over) from African to OECD countries, by country of origin; top 25 ranked in decreasing order, year 2000

Country of origin	High-skilled (in thousands)	Country of origin	High-skilled emigration rate in (%)
South Africa	173,411	Cape Verde	82
Morocco	155,994	Seychelles	77
Egypt	151,451	Gambia	68
Nigeria	148,780	Mauritius	56
Algeria	87,777	Sierra Leone	49
Kenya	80,287	Ghana	45
Ghana	67,105	Liberia	44
Ethiopia	52,538	Kenya	39
Tunisia	40,226	Uganda	36
Congo Dem. Rep.	38,017	Eritrea	35
Uganda	35,921	Somalia	35
Zimbabwe	34,017	Rwanda	32
Tanzania	33,125	Congo Rep.	28
Somalia	26,758	Guinea-Bissau	28
Mauritius	23,185	Sao Tomé and Príncipe	27
Cameroon	22,148	Mozambique	23
Congo Rep	20,426	Comoros	21
Liberia	20,347	Equatorial Guinea	21
Sudan	18,341	Malawi	21
Sierra Leone	16,647	Morocco	19
Senegal	15,844	Cameroon	17
Zambia	14,019	Senegal	17
Cote d'Ivoire	13,674	Togo	17
Eritrea	12,939	Zambia	16
Madagascar	12,506	Congo Dem. Rep.	15

Source: Authors' computations based on DLM dataset (2009).

evident from this table that, on average, 50.9 per cent of international migrants from around the world are women. Moreover, the share of women among highly skilled migrants is also considerable: women comprise 49.3 per cent of the total highly skilled migrants worldwide and 40.6 per cent of highly skilled migrants from Africa.

Between 1990 and 2000, the number of highly skilled female migrants from all over the world increased by 73 per cent, from 5.8 to about 10.1 million (see Table 3). The growth of the low-skilled female migration rate in the same period was much lower (+22 per cent). For Africa, the number of low- and high-skilled female migrants increased by 33 per cent and 113 per cent respectively. In all regions, the growth rate of the stock of highly skilled female migrants was consistently greater than the growth rate of highly skilled male migrants.

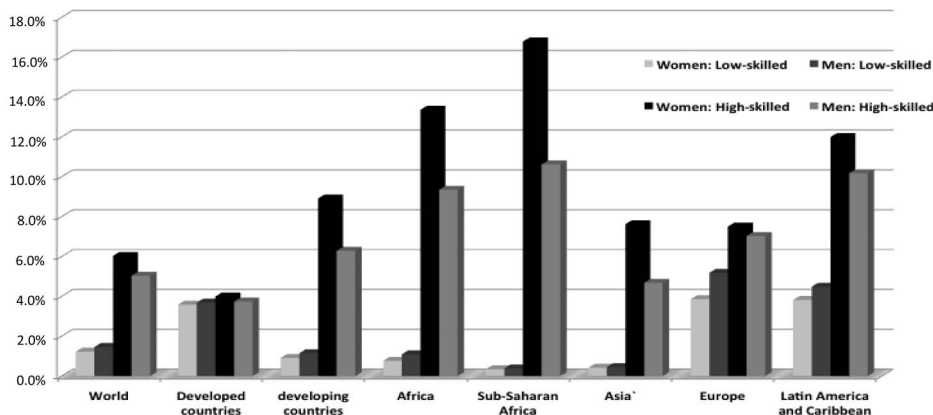
Docquier et al. (2009) point out that this increase in female brain drain is a consequence of the increased female educational attainment on the one hand, and of the higher demand for women's labor in the health care sector and other services on the other hand. Moreover, cultural and social changes in the attitude towards female migration in many source countries may have also played a role. To complete the picture, in Figure 1 we

Table 3. Descriptive statistics by country groups, sex and education level (1990–2000)

Region of origin	Total immigration				Low-skilled				High-skilled							
	Men		Women		Share of women (in %)		Men		Women		Share of women (in %)		Men		Women	
All countries	28,785	29,834	50.9	12,332	12,948	51.2	10,413	10,110	49.3							
Developed countries	9,361	10,529	52.9	3,253	3,795	53.8	3,947	3,993	50.3							
Developing countries	18,808	18,680	49.8	8,675	8,720	50.1	6,363	6,028	48.6							
From selected regions																
Africa	2,494	1,970	44.1	1,195	992	45.4	836	571	40.6							
Asia	7,434	7,821	51.3	2,541	2,926	53.5	3,601	3,413	48.7							
Europe	10,189	11,176	52.3	4,198	4,828	53.5	3,481	3,415	49.5							
Latin America and Caribbean	6,973	6,993	50.1	3,791	3,528	48.2	1,756	1,928	52.3							
				2000												
				1990												
All countries	20,751	21,245	50.6	9,975	10,626	51.6	6,691	5,854	46.7							
Developed countries	8,566	9,640	52.9	3,726	4,373	54.0	2,962	2,807	48.7							
Developing countries	11,594	11,011	48.7	5,920	5,910	50.0	3,589	2,924	44.9							
From selected region																
Africa	1,715	1,199	41.1	1,016	744	42.3	474	268	36.1							
Asia	4,754	4,680	49.6	1,906	2,073	52.1	2,070	1,716	45.3							
Europe	9,357	10,136	52.0	4,616	5,290	53.4	2,591	2,299	47.0							
Latin America and Caribbean	3,456	3,563	50.8	1,873	1,871	50.0	967	958	49.8							

Note: Migrants are defined as persons aged 25 or older. Low-skilled = persons with less than secondary diploma, high-skilled = persons with tertiary diploma. "Total" corresponds to the sum of low-skilled, medium-skilled and high-skilled migrants. "All countries" refers to the sum of migrants from developed countries, developing countries, dependent territories and migrants who did not report their country of birth. Developing and developed country groups are based on the World Bank income classification.

Source: Authors' computations based DLM dataset (2009).

Figure 1. Men's and women's emigration rates by education level and origin, situation in 2000

Source: Authors' computations based on DLM dataset (2009).

compare men and women's emigration rates by educational level and region of origin in 2000. In general, skilled women represent the most mobile component of international migrants. This is the case in Africa, where both the low (0.8 per cent) and high-skilled (13.4 per cent) female emigration rates are respectively lower and higher than the male emigration rates (1.1 and 9.3 per cent).⁵

2.2. Case of African Medical Brain Drain

The brain drain measures that we have just illustrated may not entirely capture the emigration rates in some specific occupations, e.g. IT specialists, teachers, and health professionals. One of the major concerns for Africa is the loss of personnel in the health sector (see WHO, 2006). Thanks to recent data sets (for example, Clemens and Pettersson 2006; OECD 2007)⁶ we are now able to assess how serious the African medical brain drain is. Table 4 uses OECD data to account for the number of physicians and nurses born in the top 25 African sending countries who migrated to the OECD area. Large countries, e.g. Algeria, South Africa, Egypt, Morocco, and Nigeria, are among the top sending countries of medical doctors. Small countries, e.g. Mozambique, Angola, and Sierra Leone, are the most affected in relative terms, i.e. as a proportion of the total number of physicians working in the origin countries. The table also shows that nurses' emigration rates are above 30 per cent for six African countries.

The migration of health professionals represents a plague for African countries as health indicators are poor, the mortality rate is high, and shortages are particularly severe in the medical sector. The World Health Organization's – hereafter WHO – (2009) statistics reveal that in 27 African countries the physicians' density (i.e. the number of physicians per 10,000 inhabitants) does not exceed 2 per cent. According to WHO (2006), due to critical shortages in health workers, 36 out of the 43 Sub-Saharan African countries face serious difficulties in providing their population with essential health services and are unlikely to meet the millennium health development goals.

According to the same source, the correction of this deficit would require a significant increase in the health personnel (+139 per cent). Other studies confirm the critical need for

Table 4. Emigration of health professionals; descriptive statistics by country groups and sex

Country of origin	Physicians			Nurses		
	Absolute values	Country of origin	Emigration rate	Absolute values	Country of origin	Emigration rate
Algeria	10,793	Mozambique	64.5	13,398	Liberia	66.9
South Africa	7,355	Angola	63.2	8,796	Sierra Leone	56.3
Egypt	7,243	Sierra Leone	58.4	6,016	Mauritius	50.4
Morocco	6,221	Tanzania	55.3	5,730	Cap Verde	38.9
Nigeria	4,611	Liberia	54.2	5,230	Sao Tomé & Príncipe	35.0
Tunisia	2,415	Guinea-Bissau	49.2	4,502	Equatorial Guinea	31.0
Kenya	2,385	Sao Tomé & Príncipe	46.7	3,619	Zimbabwe	27.9
Angola	1,512	Senegal	43.0	2,523	Ghana	24.9
Ghana	1,469	Cape Verde	41.7	2,057	Madagascar	24.4
Uganda	1,084	Congo	41.6	1,703	Morocco	20.5
Tanzania	1,018	Benin	40.9	1,421	Seychelles	19.2
Mozambique	935	Togo	40.5	1,338	Eritrea	18.8
Madagascar	889	Malawi	37.9	1,240	Guinea-Bissau	18.0
Zimbabwe	828	Mauritius	35.7	1,210	Mozambique	16.5
Sudan	778	Kenya	34.6	1,157	Somalia	14.4
Mauritius	725	Equatorial Guinea	33.8	1,128	Algeria	12.4
Ethiopia	633	Somalia	33.3	970	Congo	12.3
Libya	592	Uganda	32.9	820	Comoros	11.7
Cameroon	572	Eritrea	32.6	779	Angola	11.5
Zambia	567	Ghana	31.2	548	Nigeria	9.5
Congo	539	Zambia	31.0	452	Ethiopia	9.1
Senegal	449	Zimbabwe	28.4	410	Senegal	8.9
Congo Dem. Rep.	350	Morocco	28.0	404	Central African Rep.	8.4
Côte d'Ivoire	261	Burundi	26.2	337	Uganda	7.4
Sierra Leone	236	Ethiopia	24.6	261	Tanzania	6.8

Source: Authors' computations based on the OECD dataset (2007).

more health workers in Africa. For example, Chen et al. (2004) estimated that one million extra health workers would be required for Sub-Saharan Africa to reach the millennium development goals by 2015. Furthermore, Kurowski et al. (2003) argue that “in the best case scenario for 2015 the supply of health workers would reach only 60% of the estimated need in the United Republic of Tanzania and the need would be 300% greater than the available supply in Chad” (see WHO, 2006, p. 11).

3. Impact of the Brain Drain on Source Countries

One of the major concerns regarding the emigration of the highly educated labor force from Africa is the potential loss of the investment directly associated with training. Nowadays, these fears are widespread, not only among scholars, but also among policy makers and international and regional development agencies. For example, the WHO General Director considered that “countries need their skilled workforce to stay so that their professional expertise can benefit the population. When health workers leave to work elsewhere, there is a loss of hope and a loss of years of investment” (WHO, 2006, p. 8).⁷

No comprehensive data documenting the amount of the training costs of skilled African migrants exist. However, different sources suggest that those costs might be substantial. For example, the UNCTAD has estimated that each African professional migrant represents, on average, a loss of US\$184,000 to Africa (see, among others, Oyowe 1996; Pang et al. 2002; Eastwood et al. 2005; Kirigia et al. 2006; Mugimu 2010). Despite the fact that this estimate is widely cited, we should keep in mind that it has not been updated in more than 15 years. Consequently, it should be considered as an approximation.

A number of case studies quantify the losses for African countries associated with the migration of the highly skilled. For example, the financial cost due to the migration of 600 South African medical graduates to New Zealand was estimated at US\$37 million (Mugimu 2010). The total cost of education from primary to university of a non-specialist medical doctor in Malawi was estimated at US\$56,947 (Muula and Panulo 2007) and 65,997 US dollars for Kenya (Kirigia et al. 2006).⁸ In 2004, Ghana alone lost approximately £35 million spent on training of health professionals who left the country for the UK. In contrast, the recruitment of Ghanaian doctors resulted in approximately £65 million of savings in training costs in the UK between 1998 and 2002 (Mills et al. 2008). From the point of view of the receiving countries, Saraladevi et al. (2009, p. 62) note that in the United Kingdom, “each qualifying doctor costs £200,000–£250,000 and 5–6 years to train, so in economic terms, every doctor arriving in the United Kingdom is appropriating human capital at zero cost for the use of the UK health services and the effect is immediate rather than in 5 years’ time”.

In addition to the waste of resources invested in education, the early literature on the brain drain supports the view that skilled migration has several negative effects on the source countries (see, among others, Bhagwati and Hamada 1974; Kwok and Leland 1982). There are four main messages delivered by the traditional literature: (i) the brain drain deprives developing countries of one of their scarcest resources, i.e. human capital; (ii) skilled migrants are net fiscal contributors and their departure represents a fiscal loss for their home countries; (iii) human capital is a source of economic growth and the brain drain negatively affects the countries’ economic performance and growth prospect; and (iv) the decrease in human capital seriously affects the countries capacity for innovation

and the adoption of modern technologies and increases inequality at the international level, with rich countries becoming richer at the expense of the poor countries.

More recent literature mitigates the above pessimistic view by putting forward several potential compensatory effects of the brain drain. The channels through which these effects may take place are different. For example, return migration can be a beneficial route if returning migrants use the additional knowledge acquired abroad to start up new entrepreneurial activities and contribute to the diffusion of new technology (Stark et al. 1997; Gubert and Nordman 2008; Wahba and Zenou 2009). Other scholars argue that highly skilled migrants promote bilateral trade and foreign direct investment (FDI) between countries of origin and destination through the creation of business networks (see Harris and Schmitt 2003 for a survey and Blanes 2005 for a case study focusing on Spain). Furthermore, Wahba and Zenou (2009) found that Egyptian return migrants are more likely to become entrepreneurs than non-migrants. Gubert and Nordman (2008) reached similar conclusions for return migrants to the Maghreb.

Moreover, remittances can help poverty reduction. Studies conducted focusing on African countries show that remittances can favor the development of the source country (Adams et al. 2009). Other studies have documented a beneficial effect of remittances on education and poverty reduction (see, for example, Sasin 2008; Herrera et al. 2008; Roushdy et al. 2009). However, Faini (2007) argues that as skilled migrants come, in general, from wealthy families,⁹ their propensity to remit is relatively lower. Consequently, the negative impact of the brain drain on source countries might not be mitigated by the favorable effect of remittances.

Another important strand of literature, which Faini (2003) labeled the “revisionist” approach to the analysis of the brain drain, has put forward the concept of brain gain as a potential beneficial effect of highly skilled migration. For example, Mountford (1997); Stark et al. (1997); Vidal (1998); Beine and Docquier (2001) and Beine et al. (2001) argue that if returns to education are higher abroad than at home, the prospects of migration might increase the expected return of human capital, thereby stimulating human capital formation among residents in source countries. As long as only a fraction of the increased highly skilled labor force end up migrating (due to migration uncertainty), the source country’s long-run stock of human capital might be higher than it would have been without migration opportunities. When the incentive effect described above (the brain gain) dominates the observed brain drain effect, we can talk about a net brain gain for the source country. Beine et al. (2008) found that there are countries which benefit from the brain drain, “the winners”, in the authors’ terminology, and countries which experience a net loss of human capital, “the losers”. However, the latter are a larger number than the former and their losses are higher than the gains of the winners. Net gains are obtained in large countries which combine low levels of human capital and low high-skilled emigration rates, while among the losers there are many small African countries characterized by low per capita income (strong financial constraints to education) and high rates of skilled migration.

Other studies focusing on the impact of migration of health personnel found that the medical brain drain has a detrimental effect on public health, measured as the rate of adult death and infant child mortality (for example, Bhargava et al. 2011). The evidence for the possible existence of a medical brain gain is mixed. Chojnicki and Oden-Defoort (2010) found that there might be a brain gain for most African countries, given the positive impact of the medical brain drain on the number of graduates from medical schools. However, Bhargava et al. (2011) argue that the effect is likely to be too small to

compensate for the losses caused by the migration of highly skilled medical professionals. It would then be important, from the policy perspective, that those African countries which are hit the hardest by the medical brain drain phenomenon try and implement policies that mitigate the bad economic conditions for physicians, which represent the main causes of their emigration (see Clemens and Pettersson 2006).

We should keep in mind that the conclusion emerging from these empirical studies should be interpreted with caution, as their results may differ according to the methodology and data use. For example, Beine et al. (2001) found a positive net gain for developing countries as a whole (+2.2 per cent of tertiary graduates), however Docquier et al.'s (2008) conclusion is more pessimistic: the number of "winners" is very limited and, more significantly, the brain drain has a negative effect on the total number of the tertiary educated in developing countries (-2.7 per cent tertiary graduates).

It is worth noticing that the theoretical and applied works on the brain gain may suffer from different shortcomings. First of all, there is a fundamental argumentation flaw: brain gain research tends to refer always to developing countries, highlighting how the brain drain may raise the stock of human capital in the source countries. However, there is surprisingly little support for this idea when it comes to high-skilled emigration from developed countries. On the contrary, the prevailing perspective remains the one of interpreting the emigration of highly skilled people from Europe as a negative phenomenon. The best illustration can be found in the *Third European Report on Science and Technology* in which the European Commission (2003, p. 225) emphasizes:

It is common to present the emigration of European students and researchers as a threat to Europe's competitiveness in scientific fields and applied research. The exodus of highly qualified scientists and engineers, often described as "brain drain", may weaken the field of research in Europe, while strengthening the continent's main competitor, the US.

In same report, the European Commission (2003, p. 222) points out:

The loss of human resources to the US may put a strain on national education systems and place EU employers in a position where there is severe competition with their US counterparts for S&T personnel. A more serious consequence could be that the drain of EU based talent and skills leads to a further relative strengthening and growth of knowledge-intensive industries in the US.

If the brain gain is a general theory, it should lead to the same conclusions regardless the countries of origin to which it applies.

More importantly, we should also take into consideration that the analysis of brain gain may suffer from different shortcomings. First of all, the emigration rate should, ideally, be calculated as a ratio of the emigrant to the origin countries' native population. However, because the datasets the authors use do not contain information on the structure of immigration in the origin country by educational level, the computation of the emigration rate is based on total resident population (natives + immigrants) instead of native population. As a consequence, the magnitude of the brain drain might be underestimated, to a large extent, for countries where immigrants represent a significant proportion of the resident population.¹⁰

An additional key issue concerning the OECD immigration countries is that the empirical literature on brain gain underestimates the magnitude of brain drain for many countries that send a large proportion of their emigrants to non-OECD destinations. According to the United Nations data, the OECD hosts 47 per cent of international migrants and available estimates reveal that South–South migration is almost as large as South–North. Ratha and Shaw (2007) point out that 40 per cent of migrants from developing countries live in the OECD high-income countries, against 47 per cent in other developing countries. Focusing on Africa, this study found that more than two out every three (69 per cent) African international migrants from Sub-Saharan Africa migrate to developing countries.

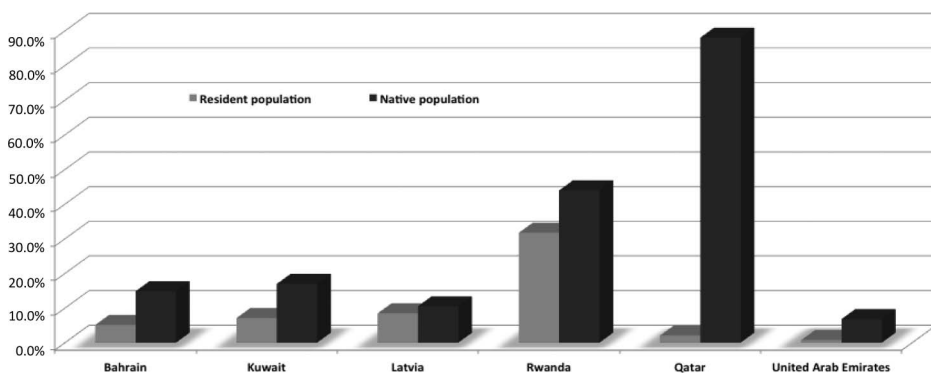
The above considerations suggest that by neglecting migration to non-OECD countries, the empirical work aiming at verifying the brain gain theory underestimates, to a large extent, the magnitude of skilled emigration, especially from developing countries. A new dataset developed by Docquier et al. (2011) – DMOP henceforth – provides information on the structure of immigration to OECD and non-OECD countries by origin, educational level, and gender for 1990 and 2000.¹¹ By adding the migration flows to fifteen African countries,¹² the number of African high-skilled emigrants increases by nearly 131,000 persons (9 per cent) in 2000, and rose to approximately 361,000 or 26 per cent to all the 46 non-OECD countries. Figure 2 uses DMOP and DLM07 in order to compare the emigration rates computed using the resident (DLM07) vs. the native population (DMOP).

As expected, Figure 2 shows that using the resident population instead of the native population will result in the underestimation of high-skilled emigration rates.

In these circumstances it is not surprising that, for these nations, the brain gain could dominate the brain drain effect and thus their inclusion in the group of the “winners”. The real surprise is that none of the ardent defenders of the brain gain theory have addressed this major issue so far.

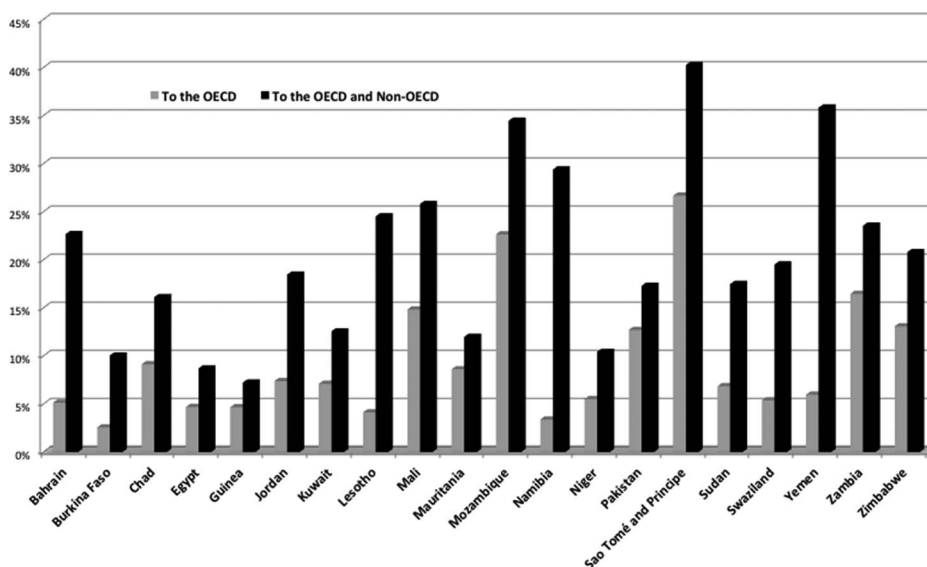
In Figure 3 we use DMOP to compare the highly skilled emigration rates when emigration to non-OECD countries is also taken into account. The figure clearly indicates that the brain drain is largely underestimated in many Sub-Saharan African countries, such as Burkina Faso, Chad, Lesotho, Namibia, Swaziland, Niger, and Mali. For example, for Lesotho, the high-

Figure 2. Comparison of high-skilled emigration rates computed with respect to the resident (DLM07) or the native population (DMOP) to the OECD area for selected origin countries in 2000



Source: Authors' calculations based on DLM (2009) and DMOP (2011) datasets.

Figure 3. Comparison of the emigration rates of high-skilled workers to the OECD and non-OECD versus OECD, for selected origin countries in 2000



Source: Authors' computations based on DLM (2009) and DMOP (2011) datasets.

skilled emigration rate to the OECD and non-OECD countries (23 per cent) is approximately six times higher than the high-skilled emigration rate to the OECD countries (4 per cent). The figure also shows that the magnitude of the brain drain is also underestimated for non-African countries. Our estimates should be considered as a lower-bound measure of high-skilled emigration. In fact, DMOP only considers 76 receiving countries.¹³ Due to the low quality of the data, the information on sending countries is partial. In many cases only a few sending countries can be distinguished.¹⁴ The other countries are aggregated and considered as residual in the entry “other countries” or “unknown”.

These elements reveal that additional work is needed before a definitive conclusion can be drawn on the effect of skilled migration on human capital formation in developing countries in general, and Africa in particular. Indeed, several strands of migration literature put forward different, sometimes opposite, hypothesis on this issue, which suggests that there might be scope for further analysis aimed at shedding some more light on what is still not clear and it is still the object of a lively debate.

4. What Do We Need to Know?

Research on the brain drain from developing countries in general, and from Africa in particular, has a long history; however, significant effort is still needed to shed more light on a few largely unexplored dimensions of skilled migration from Africa. Until now research on the brain gain has been gender blind. Consequently, we have no idea about the impact of skilled female migration on human capital formation. Such an extension would be extremely relevant if applied to African countries. Probably, the lack of adequate data and the relatively limited interest in female migration can be considered responsible for

the low attention that the female brain drain from Africa has received thus far. However, some progress in terms of data collection has recently been made. In fact, a few original datasets (Dumont et al. 2007; Docquier et al. 2007, 2009, 2011; Dumont et al. 2010) have become available which contain detailed information on international migration by gender, educational attainment, countries of origin, and destination. We have documented and used some of the above datasets in order to show the magnitude of female brain drain, and we hope that these new data will stimulate further research on female migration. For example, the latest year to which the above dataset refers is 2000. Widening the time frame of migration data by gender would represent a considerable improvement and open up several opportunities for the analysis of migration dynamics.

A second topic of crucial relevance is the analysis of the brain drain from different key sectors in Africa. Many scholars underlined that scarce and inadequate data on this topic poses major obstacles in studying the dynamics of migration from developing countries (see, for example, Sako, 2002). More recently, the European University Association (2010, p. 14) stated that “both in Africa and Europe there still seems to be a lack of awareness of the extent of brain drain and its impact at all levels, from academic to societal and economic”. So far, the magnitude of international migration of different highly skilled professionals, e.g. academic professionals,¹⁵ engineers, entrepreneurs, teachers, and IT specialists is still unknown. This means that an important piece of information on international mobility of skilled Africans is still missing. Hence, effort in terms of data collection would help policy makers to control and monitor their losses of highly skilled workers. Furthermore, the migration of highly skilled workers represents a loss of human capital not only for the origin countries themselves, but it may result in a double loss of human capital, if, due to job mismatch in the destination country labor market, those highly skilled migrants end up in jobs that require a lower level of education.¹⁶ The existence of this kind of brain waste has been documented in different studies (e.g. Chiswick and Miller 2011; Mattoo et al. 2008; Özden 2006), and it makes it an even more compelling case for a greater data collection effort on international migration from the developing world by sectors of occupations.

Nowadays, a number of immigration countries in the OECD area are thinking about reforms of their immigration policies. Besides controlling its overall volume, a common point of contemporary migration policies is their selective nature in terms of the education of migrants. For example, the skill-based points systems in Australia, Canada, and New Zealand target candidates to emigrate according to their prospective contribution to the economy. In the United States emphasis is put on the selection of highly skilled workers through a system of quotas favoring candidates with academic degrees and/or specific professional skills. Recently, a number of European countries (including France, Germany, Ireland, and the UK) have introduced programs aiming at attracting the qualified labor force. In May 2009, the European Council agreed on the proposed European Union (UE) “blue card”, which aims at attracting highly skilled migrants from non-EU countries.

There is no doubt that the shift in immigration policies of the OECD countries towards selective immigration systems may intensify the African brain drain. However, a comprehensive analysis of the main driving forces behind brain drain from Africa in general and the impact of adoption of more selective immigration policies, in particular flows of skilled workers from the continent, is needed. Such an analysis would help an understanding of migration dynamics from Africa and provide valuable insights to policy

makers in countries of origin to better control and monitor their losses of highly skilled workers.

5. Conclusions

Nowadays, emigration from Africa is increasingly a question of mobility of highly skilled persons. During the period 1990–2000, the number of high-skilled African-born workers in the OECD grew by 90 per cent. As a consequence of this large outflow of highly educated individuals, a number of African countries experienced a considerable brain drain. However, while there appears to be deep and growing concern over the exodus of high-skilled Africans, little research, to date, has been done to establish the impact of skilled migration on source countries. This is mainly due to the small quantity and poor quality of international migration data.

Using different datasets that have recently become available, this paper has shown that: (i) a number of African countries experienced a considerable brain drain; (ii) the migration of health professionals represents a plague for African countries and its potential impacts on public health are worrying; and (iii) women represent a major component of skilled migration for Africa, and female migration should, accordingly, receive more attention from economic and policy research. This last point would be especially interesting for African policy makers who aim to involve the national population living abroad in the country of origin's process of development.

We have also documented the possible main effects of the African brain drain on source countries. In addition to the losses of public resources spent on the education of individuals who end up living outside the country, a number of observers consider that by depriving African countries of one of their scarcest resources, i.e. human capital, the brain drain can negatively affect the continent's economic performance and growth prospects. Yet a recent wave of theoretical and empirical studies highlighted how a limited but positive high-skilled emigration rate can be beneficial for the sending countries. The channels through which this is possible are several, ranging from return migration and additional skills acquired abroad, flows of remittances, tourism revenues, technology transfers, creation of business and trade networks, and the stimulation of human capital formation at home. However, understanding and measuring the effect of the brain drain on African countries requires further empirical research and additional efforts in terms of data collection. This would allow clearer conclusions to be drawn on the effect of skilled migration on human capital formation in developing countries in general and Africa in particular.

Notes

1. 38 per cent of the adult population in Africa is illiterate, and the participation rate in tertiary education is only 6 per cent, which is the lowest in the world, in comparison to a global average of 26 per cent (see UNESCO 2010). Moreover, the continent accounts for only 2.2 per cent of the total number of Research and Development (R&D) researchers in the world and 1.5 per cent of the world's physicians (see WHO 2009).
2. DLM07 is an extension of the Data set developed by Docquier and Marfouk (2004, 2006) which provides information on the structure of immigration in the OECD area by origin and destination countries and educational level but without gender breakdown.
3. Looking at specific regions of origin (Table 2), this proportion is particularly high in countries such as Nigeria (65 per cent), South Africa (63 per cent), and Egypt (59 per cent).

4. The African countries' unweighted average of high-skilled emigration rates is much higher (20 per cent).
5. The gender gap in skilled emigration is more important for Sub-Saharan Africa (6.2 percentage points).
6. For further information, see OECD (2007, 2008).
7. World Health Organization (2006).
8. In comparison to gross national income per capita (GNI) these figures represent a huge investment. In 2008, the GNI per capita is estimated at US\$280 for Malawi and US\$730 for Kenya (World Bank 2010).
9. Inequality of educational opportunities in developing countries is well documented. For example, UNESCO (2009, p. 27) maintains that "being born into the poorest 20% of the wealth distribution in sub-Saharan Africa, or in South and West Asia, more than halves the chance of school attendance at grade 9. These income-based disparities are mirrored in differences in average years of education attained by the people aged 17 to 22. In Mozambique, someone in the poorest 20% has on average 1.9 years of education, compared to 5 years for someone from the richest 20%. In Peru, the gap between rich and poor is 4.6 years of schooling, rising to 6.7 years in India".
10. According to the United Nations data, the percentage of the migrant population exceeds 65 per cent of the resident population in Qatar (76 per cent), United Arab Emirates (71 per cent), and Kuwait (67 per cent). In other countries, international migrants represent a significant proportion of the resident population, for example, Jordan (40 per cent), Bahrain (37 per cent), Brunei (31 per cent), Saudi Arabia (25 per cent), Antigua and Barbuda (21 per cent), Gabon (17 per cent), and Lebanon (18 per cent). The data refers to 2000, the same year used in the Beine and al. (2008) empirical analysis.
11. In 2000, 76 receiving countries were considered (30 OECD countries and 46 non-OECD countries). In the Docquier, Lowell and Marfouk (2007, 2009) dataset, Israel, Chile, Estonia, and Slovenia, which became OECD members in 2010, are included. To allow a comparison between high-skilled workers' emigration rates in DLM dataset used in the empirical works on brain gain theory and the extended database, these countries are included in the non-OECD group.
12. Benin, Burkina Faso, Côte d'Ivoire, Gambia, Guinea, Kenya, Mali, Mauritius, Morocco, Rwanda, Senegal, Seychelles, Tanzania, South Africa, and Uganda.
13. Among them there are seven African countries, which represent only a fraction of the total stock of international migrants living in Africa.
14. In many cases only a very limited number of origin countries could be identified, e.g. Uganda (9), Rwanda (8), and Kenya (5).
15. Case studies reveal that academic professionals' brain drain is a source of concern in African countries. For example, Hatungimana (2007) reported that the University of Burundi has lost a significant proportion of its qualified staff during the last few years. In January 2007, only 169 full-time doctorate-holder lecturers of the 319 that the university should normally count were employed.
16. Özden (2006), for example, shows that in the US only a small fraction (25 per cent) of foreign-born males from Morocco who obtained their Bachelor degree from their home countries have a skilled job and this proportion does not exceed 40 per cent for many developing countries: Ethiopia (37 per cent), Egypt (38 per cent), Ghana (40 per cent), Nigeria (40 per cent), while it is much higher for migrants coming from other countries (e.g. 64 per cent Canada, 65 per cent United Kingdom, 67 per cent Australia, and 76 per cent India).

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