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IS THE BRAIN DRAIN GOOD FOR AFRICA?

William Easterly
Yaw Nyarko

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ABSTRACT

We build upon recent literature to do several exercises to assess benefits and costs of the brain drain to Africa. Contrary to a lot of the worries expressed in the media and in aid agencies, the brain drain is probably a net benefit to the source countries. We make several arguments: (1) the African brain drain is not large enough to have much effect on Africa's skill gap relative to the rest of the world. Since other regions had a larger brain drain, the skill gap between Africa and the rest would actually be larger in a counterfactual world of NO brain drain with the same amount of skill creation. (2) The gains to the migrants themselves and their families who receive indirect utility and remittances more than offset the losses of the brain drain. According to one of our calculations, the present value of remittances more than covers the cost of educating a brain drainer in the source country. (3) Brain drain has a positive effect on skill accumulation that appears to offset one for one the loss of skills to the brain drain. Hence it is not surprising that we fail to identify any negative growth effect of the brain drain. Although some of our exercises are reliant on special assumptions and shaky data that require further investigation, we conclude based on what we can know in this paper that the brain drain is on balance good for Africa.

INTRODUCTION

Fear of the brain drain seems to dominate many discussions of foreign aid and national policy in developing countries. Should aid donors and government budgets subsidize formation of skills, when skilled workers might then leave for rich countries? Could poor countries possibly obtain a POSITIVE return from the brain drain? We will argue that the answer could be "yes." This would be contrary to most of the received wisdom, and definitely contrary to remarks and comments in the media.

These issues become more salient the poorer the source country, so Africa is the source of some of the most fearful concerns about the brain drain. The Toronto Globe and Mail (November 2, 2005) went so far as to write an article about the African brain drain entitled "The new slave trade: A poor country's best workers" in which it said warned that rich countries could "suck all of the human capital out of the poor countries, leaving them forever destitute."

These fears lead to bold and imaginative proposals for solutions:

> "Countries concerned about a 'brain drain' of their trained physicians to OECD markets might be able to reduce those risks by setting national training requirements slightly lower than the rich countries' standards." (World Bank and IMF, 2007)

> Developing countries and organizations in developing countries should explore possibilities of limiting recruitment from abroad.... The United States and other recruiting countries should end active recruitment of health professionals from developing countries, absent agreement with those countries. (Physicians for Human Rights (PHR), 2004)

The UK has already acted on the latter suggestion, with the Department of Health issuing a list of countries (including most countries in Africa) from which recruitment of nurses is banned. The PHR report has an extensive discussion of how to prevent skilled workers in poor countries from getting around the restrictions (oh no, they might check out job opportunities on the Internet!)

We argue in this paper that these fears are overblown. The brain drain has both costs and benefits for Africans. It is not at all clear that Africans are worse off because of the opportunity for skilled workers to migrate to rich countries. We engage in both theoretical and empirical exercises to evaluate the costs and benefits of the brain drain.

We build upon a rich literature that gives a much more balanced picture of the possibility of "brain gain" in addition to or instead of "brain drain" (Beine et al., 2001, 2003; Clemens, 2007; Docquier & Rapoport, 2004; Faini, 2006; Lucas, 2005, 2006; Manning, 2007; Mountford, 1997; Stark, 2004; Stark et al., 1997, 1998; Stark & Wang, 2002).

We also offer a different perspective on evaluating brain drain than is common in aid agency discussions. Contrary to the mercantilist presumption of development thinking that the main objective should be to maximize development of nation-states, we are concerned with the well-being (and rights) of individuals. Tanzania's development only matters because it affects the well-being of individual Tanzanians. The net benefits and costs of brain drain should be viewed from the perspective of individuals, including those who migrate. There is no reason to ignore the benefits accruing from a given policy to a Tanzanian who is no longer in Tanzania.

We will be frank about some of our priors. We are bothered by the double-standard that exists in much policy discussion of the brain drain. Restrictions on mobility of Africans are discussed casually by people who would never accept limitations on their own mobility. One of the authors of this paper was born in a poor American region (West Virginia) and the other in a poor African country (Ghana). There is no discussion in American policy-making circles of limiting "brain drain" out of West Virginia, even though there has also been a mass exodus of skills there, but the analogous situation in Ghana calls for "action plans" to limit the brain drain. Perhaps the advocates of curbing the brain drain are correct about its costs outweighing its benefits, but then they should also make the same recommendations for brain drain out of poor regions in their own countries. Our prior is that individual freedom of choice as to where to work and live is a good thing in itself, whether within or between countries, and advocates for restrictions on that freedom carry some burden of proof.

Of course, whether the brain drain has a positive or negative effect on specific groups is an empirical issue and, despite our priors, we will keep an open mind on what the evidence shows and theory suggests. To start off, let us give a list of the pluses and minuses of the brain drain for Africans. This list cannot be comprehensive, but it will help get us started. The implied counterfactual is that migration of skilled workers to rich countries does not take place.

Pluses and minuses of the brain drain

Minuses (case for stopping the brain drain)

1. Skills are necessary for long-run development of the source country, therefore skilled workers should stay at home.
2. The human capital of the migrants may have had a positive effect on the income or the growth of income of those left behind if they had stayed.
3. The human capital of the migrants may have had a positive effect on institutions or political leadership of the home society if they had stayed.
4. Family separation due to migration may cause both the migrants and those left behind to suffer in non-monetary ways.

Pluses (case for letting the brain drain happen without restrictions)

1. The migrants themselves are better off, by revealed preference since migration is voluntary
2. Family members left behind may derive indirect utility from the greater well-being of the migrants (and if the migration decision was made by the family as a whole, the family is also better off by revealed preference)
3. The migrants may send remittances back to boost the incomes of those left behind.
4. The home country population may have stronger incentives to invest in human capital if they have opportunity to migrate.
5. The migrants may have a positive effect on politics or institutions from abroad.
6. The threat of migration may serve as a check on the behavior of rulers at home (one specific example: it may change government's behavior in excessively taxing or paying low salaries to professionals)
7. The migrants may return home permanently or temporarily, bringing back technology
8. The migrants may facilitate trading networks that increase source country exports to the destination country (James E. Rauch on the Chinese diaspora)
9. Individual freedom is enhanced by giving individuals opportunities to migrate.

In this paper, we will explore theoretically and empirically some of these pluses and minuses. Before doing that, we will simply put in context the scope of the African brain drain phenomenon, describing why it seems alarming to so many people. Then we will do an exercise to place some bounds on what effect the brain drain might have had according to some simple (and we will argue, unrealistically exaggerating the effect of the brain drain) counterfactuals. Even under these upper bound counterfactuals, we find the quantitative significance of the brain drain to be small for Africa. Next we will present a general theoretical framework for evaluating the brain drain's effect on the individuals concerned, and we will perform some illustrative exercises by calibrating the parameters of the model. We find plenty of reason to believe that the benefits may outweigh the costs once we take into account the gain to the migrants, the indirect utility accruing to their families, and the effect of remittances. Lastly, we will test empirically predictions about the effect of brain drain on skill accumulation and economic growth. We find evidence that the opportunity for brain drain does stimulate skill accumulation and that this effect seems to offset the direct loss of skills from brain drain. We find no evidence for an adverse effect of brain drain on economic growth.

THE AFRICAN BRAIN DRAIN IN CONTEXT

The African brain drain is not so new. There were small numbers of Africans going abroad during the early 1700's for western education. Many who went to be educated went to study religion. McWilliam (1959) tells us of a Ghanaian with the Dutch name of Jacobus Capitein, sent by the Dutch to at Leyden University in the 1700's. His intellectual activities included translating the books of the apostles into the local language Fante and in presenting an argument as to why slavery is consistent with religious doctrines. He was ridiculed by his own people and ignored by the Europeans, and died at 30 years of age. His generation of brain drainers were most probably very influential in translating local languages and spreading the use of the written word.

Kwegyir Aggrey is an exemplar of the brain drain from the early 1900s. He too was a Ghanaian, studying at Columbia University in the 1920s and was connected to the Phelps-Stokes fund and Caroline Phelps-Stokes, a New York philanthropist with a lifelong concern for the educational needs of the underprivileged. This connection resulted ultimately in Ghana's first co-ed, non denominational school, Achimota School, which later on became what is now the University of Ghana, which is Ghana's largest, oldest and most prestigious university.

Many of the independence leaders in Africa were themselves part of a brain drain in the early 20th century. Hastings Banda, Jomo Kenyatta, and many other African independence leaders were all part of an initial brain drain who met and strategized in the UK and USA and then returned to fight for independence. Azikiwe, the Nigerian independence leader studied at Lincoln University in Pennsylvania, and was instrumental in bringing to the US Kwame Nkrumah, Ghana's independence leader, to the same institution where the latter received a bachelor's degree in Economics and Sociology, and subsequently a Master's degree in Philosophy at the University of Pennsylvania. Without that brain drain, independence may have occurred much later, if at all, in many African Countries. (These independence leaders were also in contact with and in some cases contributing to the dialogue within the American civil rights movement.)

Table 1 describes the most recent data on the scope of the brain drain in Africa today, as compared to other regions. This table is only about the stocks of skilled emigrants (where skilled is defined as individuals with tertiary education) relative to other stocks, and contains nothing about flows. The most straightforward statistic on the brain drain is the percent of skilled nationals residing outside of the country. We see that this statistic is worse for Africa than most other major regions of the world, with 13 percent of African skilled workers residing outside of Africa. Only Oceania and the Caribbean are much worse, and these are rather special cases—these are very small populations that appear not to be bound very much by immigration restrictions to nearby rich countries (Australia/New Zealand and the United States, respectively). Mexico/Central America is slightly worse than Africa, but this is also a special case because of the massive flows of all types of migrants from this region to rich countries, as shown in column 2 (the U.S. in this case). Africa stands out for a significant brain drain despite tiny overall emigration stocks. One way to dramatize this is to take the ratio of column (1) to column (2), which can be thought of as the ratio of probabilities of skilled emigration to overall emigration. This ratio is much higher than anywhere else in the world. A related way in which Africa stands out is that skilled migrants make up a large share of total migrants (column 3), despite the local population having a low share of

Table 1: Comparing brain drain by region, year 2000

Name	(1) Skilled emigrants/ (Skilled emigrants + Skilled working age residents)	(2) Emigrants/ (Emigrants+ Residents)	(3) Skilled Emigrants/ All Emigrants	(4) Skilled Residents/All Residents	(5) Ratio of probability of emigration for skilled to overall probability of emigration (1)/(2)	(6) Ratio of probability that an emigrant will be skilled to probability that a resident will be skilled (3)/(4)
Sub-Saharan Africa	13%	1%	43%	3%	13.6	15.4
World	5%	2%	35%	11%	2.9	3.1
North America	1%	1%	58%	51%	1.1	1.1
Caribbean	43%	15%	39%	9%	2.8	4.2
Mexico/Central America	17%	12%	17%	11%	1.4	1.5
South America	5%	2%	41%	12%	3.2	3.3
Eastern Europe	4%	2%	34%	17%	1.9	2.0
Rest of Europe	9%	5%	31%	18%	1.6	1.7
North Africa	7%	3%	19%	9%	2.1	2.2
East Asia	5%	1%	53%	6%	8.4	8.8
West Asia	7%	4%	23%	11%	1.9	2.0
Australia/New Zealand	5%	4%	49%	33%	1.5	1.5
Oceania	49%	8%	35%	3%	6.4	11.5

Source: Docquier and Marfouk (2005)

skilled workers (column 4). Column 7 dramatizes this aspect by taking the ratio of Column (3) to Column (4), and again this ratio is far higher than anywhere else in the world.

Table 2 shows the same statistics as Table 1 for all individual African countries. Cape Verde and the Gambia are the countries with the highest brain drain as percentage of skilled nationals (there is a general empirical regularity that the smallest countries have the highest brain drain).

Table 3 shows instead the absolute size of migration stocks by source country, as well as the shares of different regional destinations. The brain drain from Africa consists of slightly less than 1 million tertiary educated people. The top two countries in absolute size are South Africa and Nigeria, both not surprising given their population size). Smaller countries with a history of violent upheaval also show up towards the top of the list. Kenya and Ghana are more surprising outliers as numbers 3 and 4. English-speaking countries are more likely to rank highly on this list. As far as destinations, the bulk of the African brain drain is almost evenly split between Europe and the Americas, with less than 10 percent going to Asia/Oceania. However, this varies enormously by country, with Ethiopia and Liberia heavily skewed towards the Americas (presumably the U.S.) and Francophone countries toward Europe (presumably France).

We were able to find only two destination countries with easily accessible records on the African-born immigrants (both skilled and unskilled) and their educational characteristics, the United States and the United Kingdom.

Table 4 shows the US statistics by source country and compares Africa to other regions. Nigeria, Ethiopia, Ghana, South Africa, and Kenya again are in the top

Table 2: Africa brain drain in year 2000

Name	(1) Skilled emigrants/ (Skilled emigrants + Skilled working age residents)	(2) Emigrants/ (Emigrants+ Residents)	(3) Skilled Emigrants/ All Emigrants	(4) Skilled Residents/All Residents
Angola	33%	3%	17%	1%
Benin	11%	0%	53%	2%
Botswana	4%	0%	34%	4%
Burkina Faso	3%	0%	30%	2%
Burundi	9%	0%	51%	2%
Cameroon	17%	1%	50%	2%
Cape Verde	67%	25%	15%	2%
Central African Republic	7%	0%	41%	2%
Chad	2%	0%	48%	2%
Comoros	21%	4%	13%	2%
Congo, Dem. Rep. of the	14%	1%	37%	1%
Congo, Rep. of the	22%	3%	40%	4%
Cote d'Ivoire	6%	1%	31%	3%
Djibouti	11%	1%	38%	2%
Equatorial Guinea	13%	4%	12%	4%
Eritrea	34%	2%	41%	2%
Ethiopia	10%	0%	49%	2%
Gabon	15%	1%	53%	3%
Gambia, The	63%	3%	20%	0%
Ghana	47%	2%	44%	1%
Guinea	11%	0%	26%	1%
Guinea-Bissau	24%	2%	14%	1%
Kenya	38%	2%	45%	1%
Lesotho	4%	0%	50%	1%
Liberia	45%	4%	58%	3%
Madagascar	8%	0%	43%	3%
Malawi	19%	0%	43%	1%
Mali	15%	1%	11%	1%
Mauritania	12%	1%	22%	2%
Mauritius	56%	11%	29%	3%
Mozambique	45%	1%	18%	0%
Namibia	3%	0%	51%	4%
Niger	6%	0%	49%	1%
Nigeria	11%	1%	65%	3%
Rwanda	26%	0%	48%	1%
Sao Tome and Principe	22%	6%	18%	4%
Senegal	18%	3%	17%	2%
Seychelles	56%	20%	37%	7%
Sierra Leone	53%	2%	50%	1%
Somalia	33%	3%	28%	2%
South Africa	8%	1%	63%	10%
Sudan	7%	0%	52%	2%
Swaziland	0%	0%	56%	4%
Tanzania	12%	1%	51%	2%
Togo	19%	1%	40%	2%
Uganda	36%	1%	46%	1%
Zambia	17%	1%	48%	2%
Zimbabwe	13%	1%	55%	5%

Source: Docquier and Marfouk (2005)

Table 3: African skilled emigrants by source and destination

		Destination Shares		
Source	Total	America	Europe	Asia/ Oceania
South Africa	168,083	37%	32%	31%
Nigeria	149,494	64%	35%	1%
Kenya	77,516	45%	49%	6%
Ghana	71,309	56%	42%	2%
Ethiopia	51,392	78%	18%	3%
Uganda	34,970	45%	52%	3%
Congo, Dem. Rep. of the	33,085	25%	75%	1%
Zimbabwe	32,676	28%	49%	23%
Tanzania	32,255	62%	34%	4%
Somalia	27,916	43%	53%	4%
Mauritius	23,043	22%	53%	25%
Cameroon	21,822	42%	58%	0%
Liberia	20,842	91%	8%	0%
Angola	20,449	12%	87%	1%
Sudan	18,789	60%	29%	11%
Sierra Leone	18,010	58%	41%	1%
Senegal	15,729	34%	66%	1%
Congo, Rep. of the	14,672	20%	79%	1%
Zambia	13,739	37%	45%	18%
Eritrea	13,144	74%	21%	5%
Cote d'Ivoire	12,088	35%	65%	0%
Madagascar	12,080	18%	81%	1%
Mozambique	10,696	15%	83%	3%
Cape Verde	8,128	53%	47%	0%
Togo	7,874	27%	73%	0%
Malawi	5,474	28%	65%	7%
Benin	4,786	25%	75%	0%
Rwanda	4,528	53%	46%	1%
Mali	3,854	22%	77%	1%
Guinea	3,668	53%	46%	1%
Gambia, The	3,648	32%	67%	1%
Burundi	3,557	56%	43%	1%
Mauritania	2,556	41%	59%	0%
Seychelles	2,426	40%	34%	25%
Gabon	2,170	11%	89%	1%
Burkina Faso	1,926	27%	73%	0%
Central African Republic	1,894	11%	88%	1%
Guinea-Bissau	1,525	1%	98%	1%
Comoros	1,349	11%	88%	0%
Chad	1,320	36%	62%	2%
Swaziland	1,053	69%	20%	11%
Niger	1,042	39%	60%	1%
Namibia	1,026	25%	40%	36%
Equatorial Guinea	1,012	1%	99%	0%
Botswana	940	23%	45%	32%
Djibouti	615	26%	70%	4%
Sao Tome and Principe	571	21%	79%	1%
Lesotho	295	43%	44%	13%
Sub-Saharan Africa	961,037	47%	44%	9%

Source: Docquier and Marfouk (2005)

positions as source countries in this table (which just shows the top 20 source countries). However, African migrants overall are a very small share of the overall foreign-born population and truly tiny as a fraction of the total US population.

One phenomenon highlighted by this table is that "African immigration" to the US has a large proportion of people who are not "black" according to US census definitions for some source countries—South Africa, Kenya, Cape Verde, Sudan, Uganda, Tanzania, Zimbabwe, and Zambia. More surprisingly for some source countries than others, there are a lot of whites, African Asians, and other non-black groups that are part of the brain drain. We are not sure what implications this has for migration policy, if any, but it shows a different picture than the stereotypical image of black African nurses and doctors going to help white patients in the US. As an example as to how this might influence the perspective of the brain drain, those brain drain critics who wanted the skilled migrants to stay at home to be political leaders might have to acknowledge in the counterfactual world it would probably not have been feasible for whites or Asians to be political leaders in the source countries. Racial discrimination in the host countries is also another reason to take race into consideration in evaluating brain drain gains and losses.

Another striking thing from this table is how well educated the African immigrants are, with a percentage with bachelor's degrees more than twice as high as the native population, comparable to Asian immigrants (whose source countries have much higher tertiary enrollments) and higher than all other immigrant groups, including Europe. The same African skill bias we saw in the total emigrant stock data is very evident in the US immigrant data (this may also reflect African migrants getting educated in the States). The income level of African immigrants is about the same as natives (the higher education of the migrants is perhaps offset by adjustment difficulties to the new environment), and obviously vastly higher than incomes in the source countries. Overall, the picture is one of migrants thriving in the destination country.

Of course, there are large differences between countries. We considered the correlation of percentage with bachelor's degrees or higher, log of household income, and home ownership on two characteristics of the immigrant population: size (in logs), and percent black. We failed to find any effect of immigrant population size, which conceivably might have influenced ease of adjustment to the US, on these outcomes. Percent black had a strong negative relationship with all three outcomes (although Cape Verde is a huge outlier), reflecting no doubt the higher attainment of skills in the white and Asian migrants in the source country and possibly the effects of discrimination against blacks in the U.S. Despite the association of percentage with bachelor's degrees with non-black migration, the population-weighted average percentage with bachelor's degrees is only slightly lower (40.7 percent) if we restrict the sample to source countries with blacks accounting for more than 80 percent of the migrants (this reflects the large population of migrants from Nigeria with very high bachelor degree attainment). Hence, it is still true that African immigrants have very high educational attainment if we exclude the "white and Asian" migrant source countries. The main source country exceptions to the "thriving migrants" picture are Cape Verdeans (who are mostly unskilled but whose income is not so bad) and Somalians (both unskilled and low income).

Table 4: Statistics on foreign-born African population in the United States as of 2000 census

Country	Percent of African foreign born	Percent black	%BA or higher	MedHH inc	%Own House
Nigeria	20.9%	93.2%	58.6	45,072	39.1
Ethiopia	10.8%	83.5%	29.5	32,215	24.5
Ghana	10.2%	93.7%	31.6	42,016	27.9
South Africa	9.9%	5.8%	55.8	69,229	55.8
Kenya	6.3%	63.6%	51.4	43,909	35.6
Liberia	6.1%	92.4%	31.1	38,341	33.2
Somalia	5.5%	71.2%	16.6	18,449	5.9
Cape Verde	4.1%	21.7%	7.2	37,443	44.4
Sierra Leone	3.2%	89.0%	31.3	42,554	31.5
Sudan	3.1%	62.2%	40.2	29,437	15.7
Eritrea	2.7%	84.6%	19.9	33,284	29.4
Cameroon	1.8%	94.9%	58.7	42,632	30.0
Uganda	1.8%	53.7%	51.5	51,758	46.6
Tanzania	1.8%	33.1%	50.2	55,185	48.2
Zimbabwe	1.7%	47.8%	50.1	50,388	44.0
Senegal	1.6%	82.2%	33.1	32,547	15.5
Ivory Coast	1.1%	90.5%	34.9	33,236	16.7
Zambia	0.9%	32.9%	52.7	52,403	44.8
Gambia	0.9%	94.2%	22.5	36,522	15.2
Guinea	0.8%	85.6%	24.3	27,755	11.0

	% of foreign born	%BA or higher	MedHH inc	%Own House
Africa	2.8%	42.8	41,196	36.2
Asia	26.4%	43.1	50,554	51.4
Europe	15.8%	29.2	42,763	63.7
Latin America	51.7%	9.6	33,519	42.5
Northern America	2.7%	33.3	46,850	68.7
Oceania	0.5%	28.6	51,425	52.4
Native born population		24.5	42,299	68.3
Memo: African-born population as percent of Native Born Population	0.3%			

Source: US Census

Our data on UK immigrants from the 2001 census confirms the importance of the same source countries as for the US, albeit with Kenya much higher and Ethiopia much lower (Table 5). The table also confirms the significance of white and Asian migration from Africa for some important source countries like South Africa, Kenya, Uganda, Zimbabwe, Tanzania, Zambia, and Malawi. For those who saw whites and Asians as outsiders left over from colonial times and want to see indigenous African development (not a view that we necessarily endorse), this might alter the picture of the "African brain drain."

The UK data also confirm the skill bias in African migration (Table 6 shows it only for black African migrants, so the picture is not altered by white or Asian migrants). More than twice as many black African migrants have college education or above as the native-

Table 5: Source countries for immigrants to UK and racial composition

Country	Share of African-born population	Percent Black African
South Africa	19.0%	3%
Kenya	17.4%	11%
Nigeria	11.9%	87%
Ghana	7.5%	90%
Uganda	7.4%	27%
Zimbabwe	6.6%	37%
Somalia	5.8%	91%
Tanzania	4.4%	13%
Mauritius	3.6%	2%
Zambia	2.9%	24%
Sierra Leone	2.3%	87%
Malawi	1.7%	15%
Sudan	1.4%	55%
Congo (Democratic Republic)	1.1%	84%
Ethiopia	1.0%	85%
Eritrea	0.9%	90%
Angola	0.8%	64%
The Gambia	0.5%	90%
Mozambique	0.4%	9%
Congo (Brazzaville)	0.4%	81%
Cameroon	0.4%	85%
Côte d'Ivoire	0.4%	85%
Rwanda	0.3%	90%
Botswana	0.3%	54%
Burundi	0.3%	86%
Liberia	0.2%	77%
Namibia	0.2%	13%
Swaziland	0.1%	28%
Madagascar	0.1%	17%
Senegal	0.1%	63%
Togo	0.1%	88%
Guinea-Bissau	0.1%	59%
Memo: percent African-born as percent of total UK population	2.0%	

Source: 2001 Census

born UK population, and half as many are unskilled, roughly the same for both males and females.

Skill creation in Africa

Africans spend a high percentage of their government spending on education, relative to the rest of the world—Table 7 shows that this is around 25% for Ghana, 20% for many African countries, such as Algeria (21.1%), Morocco (26.1%), Togo (26.4%), Cameroon (19.6%), Kenya (17%), Gambia (14.6%), Senegal (26.9%) and Niger (18.6%) (Human Development Report, 2004). There is also great political pressure on the governments to increase the

Table 6: Educational qualifications of black African immigrants to UK compared to native born

	Percentage of known total		
	No qualifications	Vocational/ high school	College or above
All UK Born			
All	31%	49%	20%
Males	30%	49%	20%
Females	32%	49%	19%
Black African Born outside the UK			
All	16%	44%	40%
Males	12%	42%	46%
Females	19%	46%	35%

Source: 2001 Census

Table 7: Public spending on education for selected African countries

Country	As % of Total Gov. Expenditure	Tertiary Education as % of Gov. Edu. Exp.
Algeria	21.1%	-
Angola	10.7%	3.7%
Botswana	17%	-
Burundi	16.7%	22%
Cameroon	19.6%	29.5%
Congo	14.4%	-
Ethiopia	9.4%	12.1%
Gambia	14.6%	17.8%
Ghana	24.3%	11%
Kenya	17%	21.6%
Lesotho	12.2%	-
Malawi	11.1%	20.2%
Morocco	26.1%	16.2%
Mozambique	12%	9.9%
Niger	18.6%	-
Senegal	26.9%	24%
Swaziland	19.5%	26%
Tanzania	11.4%	-
Togo	26.4%	29%
Tunisia	13.5%	18.5%
Uganda	11.5%	-
Zambia	8.7%	-

Source: Human Development Report (2004)

number available seats in secondary schools and universities. The proportion of public expenditure on education spent on tertiary level is above 20% in countries like Cameroon (29.5%), Togo (29%), Kenya (21.6%), Senegal (24%) and Malawi (20.2%).

What is the cost of producing brains—i.e., of providing education to Africa's citizens? We will focus on the production of tertiary educated citizens. The book *Higher Education in sub-Saharan Africa* by Keith Hinchliffe (1987) using data for 1979 - 1984, shows unit costs of tertiary education as a multiple of per capita GNP as averaging 8.6 for Africa, with highs of 30 for Tanzania, 13 for Upper Volta and Zimbabwe, 14.2 and 6 for Ghana. The averages for Asia, Latin America and the developed countries are 1.2, 0.9 and 0.5 respec-

Table 8: Unit costs of higher education as a multiple of per capita GNP

Country	1979-1984	2000
Botswana	7.0	1.02
Chad	-	4.21
Congo	-	1.96
Gabon	-	1.59
Ghana	5.7	1.78
Lesotho	14.2	7.50
Malawi	15.9	-
Mali	-	2.32
Niger	5.4	2.91
Rwanda	14	5.69
Swaziland	3.2	2.65
Tanzania	30.9	-
Togo	6.3	2.42
Upper Volta	13.2	-
Zimbawe	12.7	-
Africa	8.6	-
Asia	1.18	-
Latin America	0.88	-
Developed Countries	0.49	-

Source: Own calculations based on Human Development Report (2004), World Development Indicators (online) and UNESCO.

tively. By this measure we see that education in Africa is relatively expensive. This leads of course to concern about the brain drain.

The Hinchliffe data is 20 years old. As indicated earlier, there has been a rapid increase in the number of students in teritiary education institutions. This increased number as well as efficiencies in delivery would be expected to reduce the unit cost of educating students. We did our own computations, using more recent data from the UNDP (2004) Human Development Report, World Development Indicators and UNESCO (2005). Our data show smaller costs, as expected. The numbers we obtain are in the range of 2 and 3 times GNP per capita (Table 8).[1]

Despite these high costs, African countries have rapidly increased the number of their citizens receiving education, especially tertiary education. K.Y. Amoako in his lecture published in the Tertiary Education Series (Ghana) has studied the expansion of universities in Sub-Saharan Africa. From six universities in Sub-Saharan Africa in 1960, he records more than 120. Enrollments have jumped, from 1.5 million students in 1980 to 3.8 million in 1995. Francophone West Africa in the colonial era had only one university, the University of Dakar. Now there is at least one for each country. East Africa had only Makerere—now there are more than a dozen. The increase from 1995 to today has been even more spectacular.

However, this expansion was starting from a very small base and so tertiary education still reaches only a small fraction of college-age youth, as table 9 makes clear.

Almost all of the universities are run and paid by the government,[2] with tuition accounting for an infinitesimally small amount of the costs. Combined with the small absolute size of the government budgets relative to the needs of the population, we see why many have worried about the brain drain from Africa.

Table 9: Median tertiary enrollment rates in Africa, 1991-2005

	Overall median	Female median	Male median
1991	2.06	0.70	2.74
1999	2.12	1.30	3.08
2000	2.57	1.64	3.43
2001	2.77	1.23	3.34
2002	2.91	1.88	3.67
2003	2.30	1.54	3.18
2004	2.51	1.81	3.52
2005	2.85	1.85	3.76

Source: UNESCO

It is often these two facts—the high exodus rate of Africa's educated classes in combination with the high government subsidies of higher education which leads to most of the outcry about the African brain drain.

There is no market to discipline the government in setting the seats of different types. Two kinds of pressures emerge. On the one hand, because of relative ease of filling up seats in the humanities, the production of graduates in these areas exceeds the ability of the economy to appropriately absorb them. On the other hand, one often hears statements in the press that there is a stong desire to have more scientists and mathematicians to help bring Africa to the technological frontier. It is interesting to note that, using Ghana as a case study, most of the seats produced in the newly formed private universities are in business and computer science. Note that the public university bias towards humanities is similar to what often happens in the US higher education market. Graduate degrees in the humanities are often heavily advertised and, at least in NYU, full-funding is given in those fields. There is a lot of soul searching in the humanities departments producing these Ph.D. degrees since there are often no jobs in the academy.

DOES THE BRAIN DRAIN EXPLAIN AFRICA'S SKILL GAP WITH THE REST OF THE WORLD?

We now begin to examine whether the brain drain is good or bad for Africa using a variety of methods. First, we consider a counterfactual of no brain drain.

There is one aspect of Africa's brain drain that was already present in Table 1 above, which should caution against any quick jump to brain drain alarmism. Africa's brain drain may be unusually large relative to both total emigration and to the remaining stock of skilled persons resident in Africa, but both of the latter quantities are small. Hence the size of Africa's brain drain relative to Africa's remaining residents is extremely modest (Column 3 in Table 10 below). Even Europe (not including Eastern Europe), for example, has a bigger brain drain than does Africa (see Column 3 again). Suppose we posit a counterfactual in which two conditions held: (1) the brain drainers had never left home, and (2) they still would have become skilled if there had been no brain drain opportunity. We will present evidence in Section IV below against assumption (2), but let us grant it for the moment as a best case scenario for what could happen if the brain drain were stopped.

Column (4) shows the counterfactual if both assumptions held (it is roughly equal to the sum of (2) and (3), except that we need to adjust the denominator to increase the number of residents by the skilled emigrants who are now assumed to have remained residents). Even if all the African skilled emigrants had stayed at home, the share of skilled persons in the working age population would still be very low. The share of tertiary educated people in the population would increase only from 2.8 percent to 3.2 percent. Africa is still the region with the greatest shortage of skills, by a large margin. In fact, compared to other regions, Africa actually falls further behind in this counterfactual world, because the Caribbean and Oceania would have benefited much more from a reversal of the brain drain than Africa. More surprisingly, Europe would have benefited more from this counterfactual of no brain drain but same skills, so the skill gap between Europe and Africa is actually higher in the counterfactual world. The only region with a smaller improvement than Africa in the counterfactual world is East Asia. So if this is the right counterfactual, the skill gap between Africa and ALL other regions except East Asia is SMALLER with a brain drain than with no brain drain. The brain drain, even under the most unrealistic and simplistic assumption that it would be possible to have the same number of brains stay at home as are now outside the country, is not to blame for Africa's shortage of skilled professionals relative to the rest of the world.

The brain drain, even under the assumption that it would be possible to have the same number of brains stay at home as are now outside the country, is not to blame for Africa's shortage of skilled professionals relative to the rest of the world

To be sure, there are some individual African nations where this counterfactual makes a significant difference. However, the number of such cases is small, and the nations so affected themselves are very small (recall that small nations have an unusually high brain drain). Table 10 shows the African nations with the biggest change in skill ratios in the simulation. Two nations—Seychelles and Cape Verde—would see a large change in their skill ratios in the counterfactual world. Mauritius and Liberia are the only other African nations where the change in the skill ratio is above 2 percentage points. After that, the counterfactual change in skill ratios falls off sharply. Countries that

Table 10: Does brain drain explain Africa's skill gap? (data from year 2000)

Name	(1) Skilled emigrants/ (Skilled emigrants + Skilled working age residents)	(2) Skilled Residents/All Residents	(3) Skilled Emigrants/All Residents	(4) Counterfactual skilled/residents ratio if all skilled emigrants still become skilled but remain at home
Sub-Saharan Africa	13%	2.8%	0.4%	3.2%
World	5%	11.3%	0.6%	11.9%
North America	1%	51.3%	0.5%	51.5%
Caribbean	43%	9.3%	6.9%	15.2%
Mexico/Central America	17%	11.1%	2.3%	13.0%
South America	5%	12.3%	0.7%	12.9%
Eastern Europe	4%	17.4%	0.8%	18.0%
Europe (excluding E. Europe)	9%	18.3%	1.7%	19.6%
North Africa	7%	8.6%	0.7%	9.2%
East Asia	5%	6.0%	0.3%	6.3%
West Asia	7%	11.4%	0.8%	12.1%
Australia/New Zealand	5%	32.7%	1.9%	33.9%
Oceania	49%	3.1%	2.9%	5.8%
Top 15 Highest counterfactual alterations in Africa				
Seychelles	56%	7.1%	9.0%	14.8%
Cape Verde	67%	2.5%	5.1%	7.2%
Mauritius	56%	2.7%	3.5%	6.0%
Liberia	45%	2.6%	2.1%	4.6%
Congo, Rep. of the	22%	4.4%	1.3%	5.6%
Sierra Leone	53%	1.0%	1.1%	2.1%
Sao Tome and Principe	22%	3.9%	1.1%	4.9%
Eritrea	34%	2.0%	1.0%	3.0%
Somalia	33%	2.0%	1.0%	3.0%
Ghana	47%	1.1%	1.0%	2.1%
South Africa	8%	10.4%	0.8%	11.1%
Zimbabwe	13%	5.3%	0.8%	6.0%
Kenya	38%	1.2%	0.7%	1.9%
Gambia, The	63%	0.4%	0.7%	1.1%
Equatorial Guinea	13%	3.9%	0.6%	4.5%

Source: Own calculations

have received a lot of attention as hot spots of brain drain, like Ghana, South Africa, Zimbabwe, and Kenya, would see skill ratios increase by 1 percentage point or less. Even if we grant the implied counterfactual world of those who are alarmed by the brain drain, the numerical consequences for the source country skill ratios are surprisingly small.

AN OVERALL FRAMEWORK FOR PLUSES AND MINUSES OF THE AFRICAN BRAIN DRAIN FOR INDIVIDUALS

One aspect of the brain drain that is often not mentioned is the fact that those who successfully migrate abroad often enjoy markedly improved standards of living (as demonstrated in the tables above). Parents who care about their offspring also enjoy increased utility with successful brain drain of their offspring. They may choose optimally to have taxes imposed on them to improve the school system with the sole purpose of increasing the chances that their own offspring will be able to migrate one day. These desires by parents are no different from parents in rural or small towns in the US who fund their school systems knowing full well that there will be next to complete brain drain of the educated from those school systems to big cities in the US. Those parents understand fully that perhaps the only benefit of those tax payments is see their own offspring better educated and therefore better able to drain to other regions.

It is, of course possible, that holding fixed the given the migration outcome of their offspring they would prefer other parents' kids not to drain away. This of course would lead to better public and private goods for themselves—better hospitals, better government administration, shorter waits for doctors, etc. Ex ante, however, it may in each parent's interest to vote to allow a brain drain even if her own offspring has a less than probability one chance of being able to drain away. This section will illustrate this with some back of the envelope calculations. In subsequent sections we shall provide calculations which indicate that the same may be true of the society as a whole—in particular, taking into account all the externalities a country may decide it is in its best interests to allow and encourage a brain drain.

Below we provide a simple framework for performing precisely the calculation mentioned above. We do this in a very simple stripped down model, to get the key ideas across. We then provide some back of the envelope computations using numbers from a variety of data sources. The message is clear: given a vote, many may decide to vote to continue the brain drain or even increase it. Later on, we will discuss ways in which our numbers could be disputed, in our robustness section.

Our calculations underestimate the positive aspects of the brain drain for the many reasons outlined in the earlier section. Here we look only at utilities, remittances and some proxy for the public goods created by educated people who stay in their home countries rather than being drained away.

First we sketch a simple model. Think of there being two types or ages of people in the economy, the young and the old. Suppose that there is a unit of the population that is young. Let us perform a simple static or one period exercise. In particular, suppose that the government has resources of G which it spends on two different activities: roads and education. Let e denote the resources spent on education and H that on roads. The government therefore has the budget constraint

$$H + e = G. \tag{1}$$

Let $\psi=\Psi(e)$ denote the fraction of the young who will be educated when education spending is e. The function Ψ will of course be increasing in e, so that higher e results in a higher percentage of the young being educated. Of the educated a fraction d will be drained off to foreign countries, with the residual fraction 1-d

remaining in the home country. There will therefore be three types of young: the fraction ψd who are educated and drain; the fraction $\psi(1-d)$ who are educated and remain in their home countries; and the fraction $(1-\psi)$ who receive no education. We now specify the utility levels of each of these three groups of young.

The educated young who do not drain, and therefore remain in their home countries, produce public goods for all in the society to consume. The precise amount y of the public good produced depends upon spending on infrastructure, H, as well as the total number of educated young available, $\psi(1-d)$, via the production function f:

$$y = f(G - e, (1- d)\ \psi). \qquad (2)$$

We will think of y as being the doctors and nurses, teachers and professors, engineers, etc, in the country who could have migrated but did not. We will not think of this similar to our thoughts of independence leaders, since it is unclear that by merely increasing the number of educated you significantly increase the chance of such once in a generation leaders.

Since increasing either the infrastructure or the educated young available in the economy would be presumed to increase the output of the public good, we suppose that f is increasing in both arguments. Notice that we suppose that only the educated produce public goods. In particular, we ignore the role of the uneducated in producing the public good. There are a number of reasons for this modeling. (a) We use this simplification to highlight the effect of the brain drain. Note that as the drain fraction d goes up, the production of the public good goes down. It is this important effect that we want to study. Adding the uneducated into the production function would not change our principal conclusions. (b) Further, when looking at tertiary education, which is what we are doing here, in many African countries the educated are a very small proportion of the uneducated. Introducing the unskilled into the production function f will add few interesting insights not already captured by the first two arguments of f.

Now we describe the payoffs of the three different types of the young. The fraction $\psi(1-d)$ of the young who are educated and stay within the economy receive the payoff $u^E(y)$, which depends upon the quantity y of the public good produced. Let us set $u^E(y)=cy$, where c denotes a form of "skill premium." The fraction $(1-\psi)$ of the young who do not receive an education will be modeled as having the utility or payoff of y. The fraction ψd of the young who are educated and drain each receives an income of w^D in the countries in which they work. They also send the amount R back as remittances to their family back home. The net income of the drainers is therefore $u^D \equiv w^D-R$. We use these very crude and simplified assumptions on the payoffs of the different types of young to enable us to focus on the brain drain aspects of interest to us.

Now think of a typical young person, "behind the veil," not knowing which of the three types of young they will end up being in. The expected income, u^Y, of that young person is of course the weighted average of the three payoffs, weighted by the probability of being in each class:

$$u^Y = \psi d\ (W - R) + \psi(1 - d)\ cy + (1 - \psi)y \qquad (3)$$

Of course, one could argue that for the very rich say, they could be sure that their offspring will be educated and may even drain. In particular, it may be better to model the three probabilities as being a function of wealth. We will argue later that we could indeed include this feature without doing much harm to our basic results.

As regards the old, they receive an income equal to y plus whatever they receive as remittances from their offspring who successfully get an education and drain, which in expected value terms is given by:

$$u^O = y + \psi dR \quad (4)$$

All types of the young care also about their parents utility, U^O. This enters the utility function discounted by the factor δ^Y—in particular, the total ex ante payoff of young is as below:

$$U^Y = u^Y + \delta^Y U^O. \quad (5)$$

Similarly, the old also care about the utility of their offspring—this enters their utility function additively but discounted by δ^O—in particular, the ex ante utility level of the old is as below:

$$U^O = u^O + \delta^O U^Y. \quad (6)$$

The values of U^Y and U^O will be determined in an equilibrium where both (4) and (5) hold simultaneously. Solving those two equations simultaneously implies that

$$U^Y = \kappa (\delta^Y u^O + u^Y) \quad (7)$$

and

$$U^O = \kappa (\delta^O u^Y + u^O) \quad (8)$$

where

$$\kappa \equiv \frac{1}{1 - \delta^Y \delta^O}. \quad (9)$$

Note that if either δ^Y or δ^O is 0, κ=1.

We now have all the ingredients to make some observations.

Too many educated people? The optimal choices of ψ and e

The function Ψ is that which maps education levels e to the fraction of the young who are educated, ψ. Since Ψ is by assumption strictly increasing, there is a one to one mapping between e and ψ,so when studying optimal choices we can look at either variable. To study the effect of increasing ψ, we first note the following derivative:

$$\frac{\partial u^Y}{\partial \psi} = d(W - R) + (1 - d)cy - y + [\psi(1 - d)c + (1 - \psi)]\frac{\partial y}{\partial \psi}; \quad (10)$$

When W and d are very high relative to y, as would be expected to be the case in many poor countries, we see that $((\partial u^Y)/(\partial \psi))$ is positive. This is not surprising. An increase in the general education levels should be expected to benefit the young more than the old. As regards the old, it is easy to see that

$$\kappa = \delta^O \left(\frac{\partial u^Y}{\partial \psi} + \frac{\partial y}{\partial \psi} dR \right). \quad (11)$$

If the old care about the young, and if $((\partial u^Y)/(\partial \psi))$is large (which we just argued may be the case when W is large), then $((\partial U^O)/(\partial \psi))$would be positive. This is the case even when R=0. Hence we see that if the old are decision makers and they care for their offspring they will set ψ as large as possible. We repeat here that this may be the same motivation behind why parents in many rural but affluent countries pay for school systems knowing full well that their offspring will leave and not help directly their communities.

If both $((\partial u^Y)/(\partial \psi))$ and $((\partial y)/(\partial \psi))$ are positive over their relevant domains, we obtain the conclusion that the old would prefer very high levels of education, almost to the exclusion of monies spent on roads.

To check our modeling we ask under what conditions this would both be true and be violated. Well, if y=f(G-

e,(1-d)ψ) an increase in ψ, and equivalently e, will have a negative effect via the first argument and a positive effect through the second effect. This can be seen by writing

$$\frac{\partial y}{\partial \psi} = (-f_h + (1 - d) f_e) \frac{\partial e}{\partial \psi} . \quad (12)$$

In a poor country each argument of f will most probably be small, so the usual Inada conditions will work on each argument in opposite directions. When the stock of infrastructure is very small relative to the stock of educated people, one would expect the an increase in ψ to reduce y via its effect on decreasing even further the infrastucture level.

This of course begs another question: despite the absurdly low levels of educated people in the country, are there too many of them relative to the size of their country? This is an issue the Yoweri Museveni has spoken about often. High education spending takes away from other infrastructure spending, which may not be optimal for the poor country with small stocks of both educated people and roads and infrastructure. One of the principle reasons for the brain drain is the lack of adequate compensation for skilled workers in their home countries relative to being abroad. The existence of a brain drain suggest that there is a larger stock of human capital than may be optimal for the economy. Perhaps there should be more spending on roads.

As an aside, we note that the above begs a bigger question: Are there too many people in Africa? In particular, are there too many people in the country relative to the "optimal" stock of people given the countries endowments and ability to find jobs for them. This interesting topic will not be pursued here. Interesting work on this has been done by Lant Pritchitt (2004).

Too big a brain drain?

Let us now ask a related question. Suppose that all parameters excluding d are fixed. Does an increase in d help or hurt individuals in the economy? If either the source nation or the receiving nation can increase the rate of brain drain, everything else remaining the same, would this be for the better or for the worse?

First, note that since y=f(G-e,(1-d)e) we have

$$\frac{\partial y}{\partial d} = - f_e . \quad (13)$$

an increase in the rate of the brain drain, d, has the obvious negative effect on the public goods provision. The effect of the increase in d on the utility of the young will be made up of two parts: (a) the first is via the effect of reduced levels of the public good on the utilities of the young who are educated but non drained and the the uneducated; (b) the second is the increased probability of draining, which affects only the educated since only they drain, resulting in an increase in the income from that from being educated and drained versus educated and not drained. These two effects are represented in the two bracketed expressions in the equations below:

$$\frac{\partial u^Y}{\partial d} = - \{f_e [\psi (1 - d)c + (1 - \psi)]\} + \{[\psi(W - R)] - [\psi cy]\}. \quad (14)$$

Clearly, if the wage of those who drain, W, is sufficiently large as we expect it to, and if ψ is sufficiently large, then the first term in square brackets will dominate the other two, so that increasing d will have a net positive effect.

As regards the effect on the old of an increase in the rate of the brain drain d, there are three effects of the model: the effect of d on the utility of the young who they care about; the effect of d on the remittances the old will receive; and the effect of d on the public goods

provision y which is related to the income that the old receive. These three effects are represented by the three terms on the right of the derivative equation:

$$\frac{\partial U^O}{\partial d} = \kappa \left(\delta^O \frac{\partial u^Y}{\partial d} + \psi R + \frac{\partial y}{\partial d} \right).$$

We have already argued that it is plausible to believe that the young would benefit from an increase in the brain drain—in particular that the first term above, $((\partial u^Y)/(\partial d))$ may be positive. Similarly, the effect on remittances of an increase in d is positive and will be a benefit to the old. The one negative term is the last one, the effect of the increase in d on the public good provision. This will be negative because and increase in d implies a reduction in the stock of the educated remaining within the country, which lowers the public good provision. If this is small relative to the other effects, then the net effect of an increase in d will be positive.

Quantifying remittances

An interesting feature of the African brain drain is the desire by many Africans to maintain ties to their home countries. It is impressive to see the large number of Africans who send their savings in the US to slowly build a houses in their home country for when they return. Indeed, we suspect that you can measure a migrants savings by the height to which the building has been completed. Clearly this is a sub-optimal use of the migrants savings since the house is not being used while the migrant is adding to it—a process which may take decades. It is interesting to note that many cities in Mexico have now offered mortgage financing to migrants to enable them to complete their houses and pay off the debts over time.

Further, for the more affluent members of the African diaspora, there are now springing up gated communities in many West African cities, which look and feel like equivalent gated communities in the US. These cater not only to the emerging African middle classes, but also to the large African diaspora living abroad.

As regards numerical values of the size of the remittances, there is a wide range of estimates and potentially serious problems of undercounting. Let us use Ghana as an example. Despite the high brain drain from Ghana documented earlier, official figures show only $99 million in remittances in 2005. Kenya, which has about the same size brain drain, has more than five times that. It is hard to believe that Kenyan emigrants have a propensity to remit that is five times higher, although we have no direct evidence to contradict it. However, there are other reasons to think that the official data underestimate the true size of remittance receipts, a significant share of which are transmitted by travelers or other informal channels. Correcting for these informal channels, some Bank of Ghana studies put the figure as high as $1bn.[3]

Even with these undercounting problems, remittances in official data are still a significant part of foreign exchange earnings in African countries, as shown in Table 11. On average, remittances amount to 81 percent of foreign aid, 13 percent of exports, and 3.2 percent of GDP (the distribution is skewed, so medians are lower).

Regardless of the exact value of the remittances, there may be considerable scope for increasing remittance flows by reducing transactions costs associated with sending remittances. Mexican banks and municipalities seem to be moving in this direction to capture more remittances from Mexican migrants living in the US.

Table 11: Remittances by country in Sub-Saharan Africa

Country Name	Remittances received in million US$, 2005	Remittances as ratio to foreign aid, 2004	Remittances as ratio to exports, 2004	Remittances as percent of GDP, 2005
Benin	63	17%	8%	1.5
Botswana	125	238%	2%	1.2
Burkina Faso	50	8%		1.0
Cameroon	11	1%		0.1
Cape Verde	137	81%	38%	13.9
Comoros	12	49%		3.1
Congo, Rep.	11	13%	0%	0.2
Cote d'Ivoire	160	104%	2%	1.0
Ethiopia	174	7%	8%	1.6
Gabon	6	16%	0%	0.1
Gambia, The	58	99%	34%	12.6
Ghana	99	6%	2%	0.9
Guinea	42	15%	5%	1.3
Guinea-Bissau	28	37%	34%	9.3
Kenya	524	58%	9%	2.8
Lesotho	327	348%	46%	22.5
Madagascar	3	0%	1%	0.1
Malawi	1	0%		0.0
Mali	155	27%	13%	2.9
Mauritania	2	1%		0.1
Mauritius	215	567%	6%	3.4
Mozambique	57	5%	3%	0.9
Namibia	16	9%	1%	0.3
Niger	60	11%	11%	1.8
Nigeria	3329	396%	6%	3.4
Rwanda	21	2%	5%	1.0
Sao Tome and Principe	1	3%		1.4
Senegal	633	60%	29%	7.7
Seychelles	11	68%	1%	1.6
Sierra Leone	2	7%	11%	0.2
South Africa	658	85%	1%	0.3
Sudan	1016	159%	37%	3.7
Swaziland	81	76%	4%	3.0
Tanzania	16	1%	0%	0.1
Togo	148	292%	24%	6.7
Uganda	476	33%	36%	5.5
Sum	8728			
Average		81%	13%	3.2
Median		22%	6%	1.4

Source: World Development Indicators (online)

Would the central planner or government also advocate a brain drain?

The computations above have taken into account the perspective of the representative old person and representative young person. We cast this in terms of someone choosing, from their individual perspectives, whether to advocate a brain drain. When we were analyzing the utilities of these representative individuals, we took into full account the effect of the brain drain on the provision of the public good. If we take the central planner as someone who cares about the utilities of representative old and young people, as described above, then it should be clear that the central planner solution will look a whole lot like the individual optimization exercises for the young and old described above.

We now consider the perspective of a national government. On the one hand, we could think of the government as aspiring to optimize, as does the central planner. After all, this is what the governments should be doing. In that case, by caring about the utilities of the local citenzry, the governments may advocate the brain drain as outlined above.

On the other hand, one could argue that the goal of the government is to optimize the output within the economy. Governments may care only about the output within the economy, and will not care at all about the utility of its citizens who successfully eventually migrate out of country, and it may also not be too concerned about the utility of the parents of such emigrated people.

There are a number of ways of computing the output in the economy. The narrowest definition would be to define the objective of the governments to be that of optimizing the size of the public good y. If that is the case, then it should be fairly clear that such governments will not advocate a brain drain, since, in our model, the public good increases with the number of educated people who remain in the economy. However, a very slightly less narrow view include the remittances of migrants back to the home economy. We perform some back of the envelope computations to show that if we use this definition of the objective of a government, we will conclude that the government itself may want to encourage the brain drain.

One often hears, especially in the African press statements of the kind "the government is wasting its money since it spends on students only to have them leave. Those who benefit from the schooling provided by the government ought to pay back to the government the value of those benefits." Let us do some back of the envelope computations to study this.

In the literature on the rates of return to education, the present value of the cost of university education for the typical person is something like six times the GDP per capita of the economy. Let X denote the annual remittances of the typical person who is drained out of the economy. The net present value of this flow is about 20X at 5% rate of interest. Hence so long as X>6/20=0.3, the remittances exceed the cost of education. Hence so long as the remittances of the typical person exceeds 30% of GDP per capita, the remittances exceed cost. The World Bank estimated Ghana's GDP per capita at $450 in 2005, so 0.3 of this would be $135 per year.

We mentioned earlier that some estimates put the remittances at well above the official estimates. However, let us take the official statistics, at $44 million, for Ghana and assume that these are correct (we believe they are under-estimated by a factor of 10). Let N be our estimate for the number of people in the brain drain. The per capita remittances using

the official remittance figure would then be $44million/N. The above Table 3 suggests N is a little more than 71,000 Ghanaians in the West. This implies a per capita remittance of over $600, which is well above 30 percent of GDP per capita.

In other words, on a straight cash basis, remittances exceed costs of training tertiary educated brain drained citizens, even under exceptionally conservative assumptions.

We could go further. Suppose that the government starts charging tuition fees. The universities are currently exceptionally over crowded, with insufficient seats for those who would like to enter and for those who are in the system, large classrooms, "perchers" in dorm rooms (students staying in dorm rooms of friends unofficially). This would make the net return to government even higher since the cost of educating students would be lower.

Then there is the new phenomenon of private universities in Africa. Although they currently do not hold large numbers of students, they are poised to become much more important in the higher education of African students. Education remains one of the most closed markets, especially in the third world. There is floating around now the idea of opening up education markets for outsiders to compete—after all, the provision of education is a service which perhaps should be subject to the same free trade rules as physical commodity trades.

Robustness section

One could ask what types of considerations could make the analysis above be incorrect. We discuss below some of those that come to mind.

1. *Unequal access to the school system:* One could imagine a situation where only the elite class has access to higher education. The elite class may therefore advocate a brain drain while the rest of the people without access would prefer that the educated not be allowed to drain away.

In many African countries, the education system is perceived to be on the whole meritorious, at least the progression from secondary school to the universities. In that progression, there are usually nationwide examinations administered centrally, and therefore with somewhat small room for abuse.

If it is the rich who have access to the school system, then the modeling assumption which is harmed will be the assumption that the probabilities of being different types of young—educated and drained, educated and non-drained and non-educated—may depend upon wealth. However even in this case, the basic structure above remains the same; what changes are the values of the probabilities. One would have to rework the numbers to see the total effect. At this time, we believe that our basic results continue to hold and in particular that there will continue to be a push toward more brain drain.

Some entry points into the school system are restricted by income—primary schooling for example is difficult for the very poor. On the other hand, being poor often translates to lower voting power. Our result would then say that the voting system would result in encouragement of the brain drain.

2. *Remarks on the Calculations:* In our computations, we suggest that it may be optimal to set d to one, in which case the provision of the public good could be zero, if a positive stock of the educated within the country is required for positive public good pro-

duction. One may object to the implication of zero consumption. We do stress here that since we model utilities as linear (everything is in terms of incomes) it may be appropriate to think of y as a public good, as opposed to thinking of y as a consumption good. Furthermore, one would expect the government to impose restrictions if their populations started leaving in such numbers that the remainder begins to approach zero. The Rawlings administration imposed exit visas during the height of the economic decline at the beginning of his rule of Ghana, and the communist Eastern Bloc countries have had them in place for a long period of their history.

If we do change and move to a concave utility function with utility of zero public good being equal to zero, how would things change? The basic insight would remain the same—there would be pressure to increase the drainage levels. There would also be pressure to make sure that the public good remains at a minimal level. The purpose of our calculation is just to emphasis the positive aspects, which is sometimes lost in the discussions on the African brain drain.

Measuring the intangible benefits of the brain drain

1. Above we mentioned aspects of the early brain drain and how they assisted in the development of writing in the local languages, the establishment of formal educational institutions and the production of the Independence leaders. Given the history of many African countries, slavery then colonialism and poverty, perhaps the optimal strategy for the national planners was to send as many of its people abroad to have a percentage come back with newly acquired skills, human capital, and simply knowledge about how things are done overseas. We believe that was indeed a desire of many of the post independence leaders, who encouraged students and educated people to travel abroad to learn the way foreign economies are run.

2. Brain Circulation: When travelling go to many West African cities it is obvious to many observers that a lot of new economic activity is being generated by people who have lived abroad for a long time and then returned to their home countries. Even more interesting are those who maintain residences both in their home country and in the country they drained to. Finally there are those whose primary residence is abroad but who return to their home countries every year to assist in some way or the other with economic development. Many have used the terminology of brain circulation rather than brain drain to describe the current day movement of educated Africans between their homes and the west.

One other argument that is often made about the brain drain is that it causes the loss of leadership of a vibrant middle class. The argument is that many of those who are drained away are the most vibrant and entrepreneurial members of their respective societies. If only they would stay in their home countries, they would be the engine of growth. Their mere presence would lead to the development of a vibrant middle class, who would insist on western values, transparent government, etc.

First, the exposure to outside ideas is itself an engine of growth. Having a significant portion of the population abroad means that those resident in the home countries are able to benefit via information flows—either through visits, discussions, etc with those who have drained. Many of those who do initially drain, often come back with new ideas to help develop their respective socities. It was mentioned in the introduction the influence of the independence leaders of Africa,

many of them who were initially drained but who returned to their societies later on in life.

As has been stressed by the recent growth literature, it is ideas and knowledge which form a big part of the engine of growth of nations. Our independence leaders, who were initially brain drained, realized this. Ghana had a scheme, started by Kwame Nkrumah, of what was called "chartered flights." These were government subsidies to encourage Ghanaian youth in secondary schools or universities to visit the UK. Kwame Nkrumah said bluntly that he wanted his people to see how things were abroad to get an idea of where he wanted to take his country.

This circulation of brains helps in the diffusion of knowledge which is precisely what is needed in our developing economies. Those who are part of the brain drain may be those who are the most adept at change—they after all are the ones who successfully migrated, perhaps they are better at implementing the change in their home country.

Some of the more exciting things going on in Ghana involve many of the drained/circulating brains. A returning Ghanaian expatriate, who had been educated at Swarthmore and then been in upper management at Microsoft, started a new private high-quality university, Ashesi University. NYU has opened a study-abroad center in Ghana partially based at Ashesi. Another Ghanaian returnee from the brain drain, started DataBank, one of Ghana's first investment banks. These examples are only anecdotal, but they point to the need for more research on some of the intangible benefits of returning and circulating brain drainers.

INCENTIVES TO FORM HUMAN CAPITAL AND THE EFFECT ON GROWTH

Several papers (Oded Stark and coauthors, for example) have pointed out how, via the incentive effect on forming human capital, the possibility of a brain drain and subsequent higher wages can increase investments in human capital so much as to offset the negative effects of any brain drain.

Given the substantial apparent unemployment among graduates of universities in Ghana, it is clear that the potential to drain away is a huge incentive for many African students to work hard in school. African students have to overcome huge hurdles to get their education these day even after they are admitted into the universities. These range from lack of textbooks, large class sizes, often distracted faculty who need to make ends meet with auxiliary activities, poorly maintained residential facilities, labs, etc. What keeps most of the students going is the prospect that they may land an opportunity abroad. If this prospect is closed to tightly, this may have an effect on the effort levels of students in the system, and therefore the quality of the graduates of the school system. What is the value of a Kofi Annan in motivating Ghanaians?

The arguments about the brain drain and the quantity of human capital

The theoretical arguments that the brain drain could have a positive effect on total human capital creation are well known. Most obviously, if the return to skills is increased by the chance at earning skilled wages abroad that are higher than those available at home, then the brain drain will create positive incentives to form human capital at home. This means the brain drain will have offsetting effects on human capital residing in the home country: it will increase the total stock of human capital of home country nationals, while shifting the composition of that stock towards those who reside outside the home country.[4]

In the standard infinite-horizon optimizing neoclassical growth model, with no mobility of human capital, agents invest in human capital until its marginal product is equal to the discount rate. Compared with this benchmark, an (exogenous) drain of human capital out of the country raises the marginal product of the human capital still left at home by making it scarcer. In the model, the higher marginal product of human capital would lead to more investment in human capital at home until its marginal product is once again driven down to equal the discount rate. Hence in this simple benchmark model, the prediction is that brain drain would have zero effect on the stock of human capital left in the country—new human capital creation and brain drain cancel each other out exactly.

Testing the net effect on human capital of brain drain

We explore these predictions in a simple empirical framework. Let HD be skilled labor that stays at home, HF skilled labor that is abroad, and H total skilled labor (=HD+HF) all in stocks, and all originating in the country in question.

Then

$$dHD = dH - dHF \tag{15}$$

where dHD means the change in skilled labor at home from 1990 to 2000. Divide through by H (initial value in 1990), so we have

$$\frac{dHD}{H} = \frac{dH}{H} - \frac{dHF}{H} \tag{16}$$

Table 12: First stage regression for brain drain

	dHf/H
Log of distance from France	0.022
	(0.22)
Log of distance from UK	0.055
	(0.53)
Log of distance from USA	-0.107
	(2.43)*
Log of population in 1990	-0.053
	(4.17)**
Constant	1.331
	(3.80)**
Observations	157
R-squared	0.26
F-statistic	11.74
P-value of F-statistic	0.0000

Robust t statistics in parentheses

** significant at 5%; ** significant at 1%*

Now suppose that the formation of new skilled labor H is a positive function of the population growth rate, but also of the possibility of emigration because that raises the return to becoming skilled. So suppose

$$\frac{dH}{H} = a + bn + c\ \frac{dHF}{H} \qquad (17)$$

where n is the growth rate of the whole population (or labor force), and c is positive if there is a positive incentive effect of brain drain on new human capital creation.

To get to the equation that we will estimate, substitute (17) into (16):

$$\frac{dHD}{H} = a + bn + (c - 1)\ \frac{dHF}{H} \qquad (18)$$

We will instrument for dHF/H to address reverse causality (such as omitted factors that might determine dH/H but also raise dHF/H). The interesting thing will be whether the coefficient on dHF/H is greater than -1 (because c is positive).

We measure dHF/H and dHD/H as the change in the stock of tertiary educated nationals outside and inside the country, respectively, from 1990 to 2000, divided by the total stock of tertiary educated population in 1990. The instruments for dHF/H are variables that we think are likely to influence brain drain to the main destination countries (the US, the UK, and France): a dummy for former colony of Great Britain, a dummy for former colony of France, the log of distance from US, the log of distance from France, the log of distance from UK. We also include the log of population size in 1990 as an instrument for brain drain, since small countries are usually less constrained by restrictions on immigration into the destination country. The first stage regression is shown in Table 12.

Table 13: Second-stage regression for effect of brain drain on domestic brain gain

	dHd/H
dHf/H	0.343
	(0.56)
Population Growth	1.83
	(3.38)**
Constant	0.234
	(1.27)
Observations	157
Hansen J-statistic for overidentification (Chi-squared with 3 df)	7.318
P-value for J-statistic	0.0624
Memo: Coefficient of c	1.343
	(2.19)*

Robust z statistics in parentheses
** significant at 5%; ** significant at 1%*

The most powerful instruments seem to be the distance from the US and the population size. The instruments do a reasonable job explaining the variation in dHF/H with an R-squared of .27, and pass the weak instruments test with an F-statistic of 11.74, so we move to the second stage.

The second-stage regression in 2SLS for equation (18) is shown in Table 13.

The coefficient on dHF/H is actually positive, indicating that brain drain increases the stock of skilled people left at home. The instruments pass the overidentifying restrictions test, although just barely.

The coefficient on brain drain is very imprecisely estimated, so we cannot reject that it is zero. We can reject that the coefficient is -1, which is excluded by the 95% confidence interval for the coefficient. Since the coefficient is equal to c-1, this is equivalent to c being significantly greater than zero, indicating we do have evidence of a positive effect of the brain drain on human capital formation. The actual estimate of c is 1.343, which is imprecisely estimated but is significantly greater than zero. So in summary, the simple theory sketched above predicted a coefficient (c-1) of zero, and the data do nothing to reject that prediction.

These results are only about the quantity of total brains. There are also good reasons to think that brain drain will have a positive effect on the quality of skills attained. True human capital includes both the quantity of educated people and the quality of skills they have gained. Any plausible production function for human capital quality would have student effort as a complementary factor. So if brain drain increases the incentive for students to work hard, then brain drain would raise the quality as well as quantity of skills produced.

Brain drain and growth regressions

A more indirect way to test the effect of brain drain is to assess its effect on economic growth. Standard

Table 14: Top 15 countries with largest hypothetical loss in annual growth from brain drain according to growth accounting

Country	Growth loss per annum for 1990-2000
Guyana	3.4%
Jamaica	2.8%
Haiti	2.8%
Trinidad and Tobago	2.1%
Cape Verde	1.8%
Gambia	1.5%
Bahamas	1.3%
Sierra Leone	1.3%
Mozambique	1.2%
Fiji	1.1%
Barbados	1.0%
Liberia	1.0%
Ghana	0.9%
Angola	0.8%
Suriname	0.6%

growth accounting would yield one component of growth (dY/Y) explained by human capital accumulation. Assuming neutral technical progress (A) and estimating shares from US data of .3 for physical capital (K), .23 for human capital (measured as college educated persons) at home (HD), and .47 for unskilled labor (L), we get the following standard growth accounting equation:

$$\frac{dY}{Y} = \frac{dA}{A} + 0.3\frac{dK}{K} + 0.23\frac{dHD}{HD}\ 0.47\ \frac{dL}{L} \qquad (19)$$

Manipulating the equations above, we get an expression for dHD/HD as a function of a brain drain variable:

$$\frac{dHD}{HD} = \frac{dH}{HD} - \frac{dHF}{HD} \qquad (20)$$

If we assumed that there was zero positive incentive effect on human capital accumulation, then the predicted loss in growth due to brain drain is then:

$$\text{Loss in growth} = -0.23\ \frac{dHF}{HD} \qquad (21)$$

The predicted loss of growth based on the growth accounting calculation is quite large in some countries.

We can enter the brain drain term (dHF/HD) on the right hand side of (21) into a growth regression for all countries with available data and see whether it has the predicted growth effect.

The results of the growth regression may also capture more indirect ways by which brain drain could have a positive or negative effect. Brain drain could affect any of the other components of growth accounting like physical capital accumulation or technical change, and hence we could possibly get a coefficient that is more negative than -.23. This approach is also more robust if there is mis-measurement of total human capital H, or if the skills that are draining have a differential contribution to growth than those that stay at home (due to selective migration, as would be predicted by many theories). And of course, the effect on growth is really the bottom line for whether brain drain has a negative effect on countries' economies.

Table 15: Growth regressions on brain drain and other controls (OLS)

	growth90_03	growth90_03	growth90_03
brain drain	0.0002442		-0.004
	(0.22)		(-1.28)
log income per capita 1990		-0.009	-0.009
		(2.02)*	(2.00)*
primary enrollment, 1990		0.0001391	0.0001354
		(1.10)	(1.08)
secondary enrollment, 1990		0.0003832	0.0004129
		(2.96)**	(3.06)**
tertiary enrollment, 1990		-0.0002724	-0.0003343
		(1.86)	(1.99)*
openness variable, 1990		0.013	0.014
		(3.35)**	(3.25)**
Constant	0.011	0.05	0.053
	(2.83)**	(1.92)	(1.94)
Observations	152	87	86
R-squared	0.000	0.190	0.200

Robust t statistics in parentheses
** significant at 5%; ** significant at 1%*

For all of these reasons, we supplement the exercise above with growth regressions.

When we do so, we find no negative effect of brain drain on growth. First, we do ordinary least squares. Under the ridiculously heroic assumption that all other factors that influence growth are orthogonal to brain drain, we can check the simple correlation—and we find there is none (Table 15). We then add a bunch of standard controls to the growth regression, including initial schooling. The results are fairly conventional, with "good policy" (specifically openness) and some measure of initial schooling (secondary schooling in this case) having a positive effect. Again, the brain drain shows no significant negative effect. In both regressions, we can reject the predicted coefficient on brain drain of -0.23.

Interestingly, we failed to find any effect of tertiary enrollment on growth. Our measure may be very noisy or otherwise flawed, but it is not so easy to establish the link between skills and growth. Hence, it is even less surprising than the brain drain is still insignificant in this regression.

We also explore possible reverse causality by doing two-stage least squares, using the same instruments as above. Again the simple bivariate association fails to establish any effect of brain drain on growth, and the regression passes the tests for weak instruments and for overidentifying restrictions (Table 16). Brain drain is still insignificant in the IV regressions with the full set of controls (with a much smaller sample). We again reject the predicted coefficient on brain drain of -0.23. Unfortunately, instrument problems bedevil this second regression, with the regression performing poorly on both weak instruments and overidentifying restrictions tests. However, coefficients did not shift much from the OLS regression and we are not sure that IV is even required to address reverse causality

Table 16: 2SLS growth regression instrumenting for brain drain

	growth90_03	growth90_03
brain drain	0.000397	-0.005
	(0.09)	(-0.98)
log income per capita 1990		-0.009
		(2.08)*
openness variable, 1990		0.015
		(3.41)**
primary enrollment, 1990		0.000134
		-1.13
secondary enrollment, 1990		0.000447
		(3.19)**
tertiary enrollment, 1990		-0.00041
		(-1.95)
Constant	0.011	0.056
	(1.94)	(2.00)*
Observations	149	83
Robust z statistics in parentheses		
** significant at 5%; ** significant at 1%*		
Hansen J statistic (overidentification test of all instruments):	1.476	8.819
Chi-sq(3) P-val	0.68777	0.03179
First-stage F-statistic	5.97	1.98
P-value of first stage	0.0002	0.1068

Instruments: log of distances to US, UK, France, log of population in 1990.

problems from growth to brain drain. If poor growth caused brain drain, we would have expected the relationship to be much more negative in OLS than in IV. As it was, we found no significant negative effect in OLS in the first place.

The bottom line, with the caveats noted above, is that we fail to find any evidence for a negative effect of brain drain either on the stock of human capital remaining in the country, or on the country's growth rate.

CONCLUDING REMARKS

We have provided some remarks on the question of the brain drain with particular reference to Africa, and using Ghana as a case study of effects on individuals. Of course much more work needs to be done in firming up many of the conjectures made.

However, we think we can make some evaluation of the brain drain based on our results. We fail to find any negative effect of brain drain on the stock of skills remaining in the source country, suggesting skill creation incentives offset the loss of skills one for one. We fail to find any negative effect on growth. In contrast to the zero results for the usual predicted negative effects of brain drain, we find many reasons to think that individuals are better off because of brain drain, including both the migrants and their families back in the source countries. Our back of the envelope calculation for Ghana suggests that the present value of remittances more than covers the cost of educating a brain drainer. We also suggest some positive intangible effects, although these are admittedly much more speculative. On balance, therefore, theory and empirics suggest that the ability of some people in the country to go abroad and form part of the brain drain (and circulation) has had a net positive effect on individuals from the source country. In short, based on our results, we think the brain drain is good for Africa.

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ENDNOTES

1. Our computations are available upon request.
2. It has only been in recent years that governments have allowed private universities to be established in Africa. The private tuition-based universities still account for a very small percentage of the overall number of students in the tertiary education system.
3. See page 5 of the Ghana country study by the Centre of Migration, policy and Society (Ref. RO2CS008) by Adam Higazi (Univ. of Oxford).
4. Beine, Docquier and Rapoport (2001, 2003) are important previous works that also consider the positive theoretical effect of migration on human capital creation, and test these effects empirically both in human capital accumulation and growth. We extend and update this work to develop the theoretical predictions more precisely, and to cover many more countries with more up-to-date data.

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