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Eight questions about brain drain

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IZA DP No. 5730

Eight Questions about Brain Drain

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May 2011

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zur Zukunft der Arbeit
Institute for the Study
of Labor

Eight Questions about Brain Drain

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ABSTRACT

Eight Questions about Brain Drain*

High-skilled emigration is an emotive issue that in popular discourse is often referred to as brain drain, conjuring images of extremely negative impacts on developing countries. Recent discussions of brain gain, diaspora effects, and other advantages of migration have been used to argue against this, but much of the discussion has been absent of evidence. This paper builds upon a new wave of empirical research to answer eight key questions underlying much of the brain drain debate: 1) What is brain drain? 2) Why should economists care about it? 3) Is brain drain increasing? 4) Is there a positive relationship between skilled and unskilled migration? 5) What makes brain drain more likely? 6) Does brain gain exist? 7) Do high-skilled workers remit, invest, and share knowledge back home? and 8) What do we know about the fiscal and production externalities of brain drain?

JEL Classification: F22, O15, J61

Keywords: brain drain, brain gain, high-skilled emigration, development

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Brain drain worries many policymakers in migrant-sending countries. Governments complain about decimated medical systems, shortages of teachers and engineers, and poaching of talent their national education systems had paid to train. As one example, Parliament speaker Nabih Berri of Lebanon called brain drain the "biggest problem we face in Lebanon" and called emigration of graduates a "transmitted disease among the youth" (Daily Star, 2010). While such concerns have been present for decades, they have gained increasing prominence as many developed countries have moved to more skill-selective immigration systems and as the spread of HIV/AIDS in sub-Saharan Africa has drawn attention to constraints facing medical systems in those countries. Thus, advocacy groups like Physicians for Human Rights (2009) put out press releases about their petitions with titles like: "US Should Not Deprive Poor Countries of Doctors and Nurses, Say Global Health Advocates."

The term "brain drain" dominates popular discourse on high-skilled migration, and for this reason we use it in this article. However, as Harry Johnson (1965, p. 299) noted, the term brain drain "is obviously a loaded phrase, involving implicit definitions of economic and social welfare, and implicit assertions about facts. This is because the term `drain' conveys a strong implication of serious loss." But it is far from clear such a loss actually occurs in practice; indeed, there is an increasing recognition of the possible benefits that skilled migration can offer both for migrants and for sending countries. Thus, Prime Minister Manhoman Singh of India recently said: "Today we in India are experiencing the benefits of the reverse flow of income, investment and expertise from the global Indian diaspora. The problem of 'brain drain' has been converted happily into the opportunity of "brain gain" (Government of India, 2010).

Brain drain has also been enjoying a renaissance as a subject of study: according to *Econlit* there were 247 articles on brain drain written between 2005 and 2009—about twice as many as over the previous 15 years combined. A notable feature of these recent studies has been a rise in the number of empirical contributions, covering both better descriptive data at the cross-country level as well as detailed study of individual country cases. As a result, for the first time we actually have some data to help answer many of the pressing questions economists and policymakers have about brain drain.

This paper builds upon this wave of research to answer eight key questions underlying much of the brain drain debate: 1) What is brain drain? 2) Why should economists care about it? 3) Is brain drain increasing? 4) Is there a positive relationship between skilled and unskilled

migration? 5) What makes brain drain more likely? 6) Does brain gain exist? 7) Do high-skilled workers remit, invest, and share knowledge back home? 8) What do we know about the fiscal and production externalities of brain drain?

We do not focus on the consequences of high-skilled immigration for receiving countries, in part because there has been less recent literature on this, and in part because the effects are less controversial—typical findings emphasize how high-skilled immigrants become involved in entrepreneurial activities and have positive fiscal consequences for government in receiving countries. We are also deliberately selective in summarizing the recent literature on the consequences of out-migration for development. Readers are directed to excellent recent contributions by Kapur and McHale (2005) and Docquier and Rapoport (2011) for additional discussion, particularly with regard to the recent theoretical literature and macroeconomic evidence.

Question 1: What is Brain Drain?

The term "brain drain" was coined by the British Royal Society to refer to the exodus of scientists and technologists from the United Kingdom to the United States and Canada in the 1950s and 1960s (Cervantes and Guellec, 2002). Now it is more typically used to refer to the emigration of a nation's most highly skilled individuals. Rapoport and Docquier (2006) note in their entry in the *New Palgrave Dictionary* that it is most commonly used to denote the "migration of engineers, physicians, scientists, and other very highly skilled professionals with university training." Typically these movements are from developing to developed countries, but it is also common to see newspaper stories concerned about brain drain from rural areas within the United States, and from selected high-income countries. For example, the 2010 economic crisis in Ireland has resulted in scores of stories lamenting the likely brain drain of university graduates (for example, Fitzgerald, 2010).

Skilled migration constitutes a disproportionately high share of total migration. Docquier and Marfouk (2005) define a country's brain drain rate for a particular educational level as the share of all individuals with that education level aged 25 and over born in that country who live abroad. In the median country in their data we calculate that the brain drain rate for tertiary-educated individuals is 7.3 times that of individuals with only primary education, and 3.5 times

that of individuals with only secondary schooling. As an example, 2.6 percent of Cambodians aged 25 and above with primary education live abroad, compared to 5.9 percent of those with secondary education and 18.3 percent of those with tertiary education.

Table 1 uses data from the 2008 American Community Survey to show the top 10 occupations for tertiary-educated developing country migrants in the United States according to their level of tertiary education.[1] In order to focus only on migrants who received at least their undergraduate tertiary education in their home country, we consider only individuals who migrated at age 25 or older, with the sample size in the table showing the number of developing country migrants in this survey who meet these criteria. The majority of skilled migrants come from a variety of professions, with computer specialists, accountants, managers, and among higher education levels, scientists and academics, the most common.

Much of the popular discussion and debate about brain drain concerns the migration of doctors and nurses, but as Table 1 shows, while medical professionals are indeed among the most common occupations, they account for only 12-15 percent of educated immigrants. Health professionals are also the minority of tertiary-educated immigrants in other countries. In the 2001 Canadian Census, health professionals constitute 5.7 percent of working individuals who arrived in Canada at age 25 or older and have bachelor's degrees or higher, 3 percent of those with a masters degree or higher, and 3.9 percent of those with Ph.D.s. In Canada, scientists, teachers and professors are the most common occupations, accounting for 45 percent of those with masters degrees or above, and 65 percent of those with Ph.D.s. Similarly, according to the 2001 United Kingdom Census, health professionals are also only 6.9 percent of the tertiary-educated migrants from developing countries who came to the United Kingdom after age 24, with this number increasing to 10 percent if one also includes non-professional positions in healthcare occupations. In South Africa, the 2001 Census shows health professionals to be 8.2 percent of tertiary-educated immigrants from developing countries who arrived after age 24, and 14.1 percent of those with masters degrees or higher.

[1] We take "developing country" to refer to all countries which are not classified by the World Bank as "high income" -- that is, which have 2009 Gross National Income per capita of $12,195 or lower.

Not only are health professionals not the majority of high-skilled emigrants, but they appear to have lower emigration rates on average than other skilled professionals. We compare the overall brain drain rates for tertiary educated migrants who emigrated at age 22 or higher (Beine et al, 2007) to the medical brain drain rates in Bhargava et al. (2010). Across 161 countries, the median medical brain drain rate is 5.4 percent, compared to a median skilled brain drain rate of 8.4 percent. The skilled brain drain rate exceeds the medical brain drain rate for 69 percent of the countries in this sample.

Mattoo et al. (2010) note that there is often a concern that not all educated migrants end up working in skilled occupations after they have migrated— a phenomenon which they call "brain waste." However, Table 1 shows that the most common occupations for educated migrants are skilled occupations, particularly those in the so-called STEM fields (science, technology, engineering and mathematics). Moreover, using the same 2008 sample we calculate that 79 percent of working migrants from developing countries with a bachelors' degree or more are working in occupations in the United States in which the majority of workers have post-secondary education, as are 90 percent of those with a masters degree or more, and 96 percent of those with a Ph.D. The stereotype of foreign workers with Ph.D.s driving taxis is certainly the exception; only 2 out of 1,936 developing country migrants with Ph.D.s in the American Community Survey sample are taxi drivers. This is in line with Mattoo et al.'s (2010) work using the 2000 census, where they find it is mainly skilled migrants from non-English speaking countries with poor quality education systems who struggle to find skilled work—a finding which might mean that the actual skill level of these migrants is lower than their education would suggest.

Question 2: Why Should Economists Care About Brain Drain?

Recently we heard from editors of two of the professions' top economics journals that work on brain drain is "of great interest to specialists, but insufficiently broad in scope for our general-interest audience," and that one might equally "consider brain drain from the state of Florida to the rest of the US and other countries". It therefore appears worth summarizing some of the reasons economists should care about brain drain, and some ways in which it differs from internal mobility.

First, brain drain has been and continues to be an area of tremendous policy concern in many countries. Over the past decade, Factiva shows an average of 5,000 news articles in English per year about this topic. There are many claims that brain drain decimates healthcare and educational systems in developing countries, and that failure to stop it could lead to "economic and social catastrophe on an unprecedented scale" (Sattaur, 1989). The extent to which such claims are true should matter to economists.

Second, brain drain takes place in the context of what is probably the largest distortion in the international global economic system: barriers on the mobility of labor. Constraints on movement lead to very large gaps between the incomes that can be earned in different destinations – gaps which are orders of magnitude larger than one sees with internal movements. In a recent study of the top academic students from five countries, we document increases in income of $40,000-$60,000 per year when the highly skilled emigrate from developing countries (Gibson and McKenzie, 2010). These barriers also restrict the extent to which less-skilled workers can react to the migration decisions of the higher-skilled. In these ways, international migration is quite different from within-country migration. Unskilled Floridians are free to move to other states if skilled Floridians move, whereas unskilled workers in developing countries have much more limited opportunities to follow skilled compatriot workers who migrate.

Third, the economic literature on brain drain has long been concerned about the existence and extent of production and fiscal externalities. Almost a half century ago, Grubel and Scott (1966) noted that if labor markets are competitive and individuals are paid their marginal product, then if there are no externalities, the departure of highly skilled emigrants would not reduce the welfare of those left behind. In practice, if skilled and unskilled labor are complements in production, and skilled workers do not capture all of the increase in production value that comes from this complementarity, then the departure of skilled workers could lower the pay or employment levels of unskilled workers. When discussing the consequences of possible out-migration from (say) Florida to the other 49 states, it is important to recognize that this would be in a context in which skills within Florida remain reasonably abundant, unskilled workers are also mobile, and a federal taxation system ensures that residents of Florida still benefit fiscally from the earnings of high-skilled individuals who migrate out of the state. Such conditions seem less likely to hold in most developing countries. Bhagwati and Hamada (1974) argued that the fiscal cost was particularly important, with many developing countries

subsidizing education with taxpayer money, and then high-skilled individuals who emigrate not contributing back into the tax system. More recently, much of the concern has been with the supposed externalities health and education professionals have on the well-being of others in their communities. The potential importance of such externalities, complementarities, and fiscal costs in practice strike us as important economic questions.

Finally, it is also worth reiterating that in many developed countries, immigrants constitute important shares of the skilled labor force in many professions. Understanding the determinants of this migration should therefore be of interest even to those whose prime focus is the U.S. economy. To illustrate this, table 2 uses the ACS 2008 to show the share of all tertiary educated workers, and of all workers with Ph.D.s who are foreign-born, and who are born in developing countries for the professions identified in table 1 as being the main occupations for skilled migrants. We see developing country migrants constitute 47 percent of individuals with a Ph.D. working as computer software engineers in the U.S., 36 percent of medical scientists and 35 percent of engineers with Ph.Ds.

Question 3: Is Brain Drain Increasing?

In absolute levels, skilled migration is increasing. However, skill levels in migrant-sending countries are also rising, and for the world as a whole, skilled migration rose at about the same pace as overall education levels in the sending countries in recent decades, so that the brain drain rate remained quite stable for long periods of time and may have even fallen in the past decade.

Between 1960 and 2010, the global migrant stock increased from 74 to 188 million, only slightly faster than world population growth, so that the share of the world's population who are international migrants increased only from 2.7 to 2.8 percent (UNDP, 2009). However, while the global migration rate has been quite flat, the migrant flow has increasingly been from less developed to more developed countries, with a reduction in within-region flows. The number of individuals migrating from the "South" to the "North" increased from 14 million in 1960 to 60 million in 2000 (Özden et al, 2010).[2] At the same time, the percentage of migrants with tertiary education increased dramatically. Defoort (2008) uses data from six main OECD destination

[2] Özden et al (2010) define the "North" as Australia, New Zealand, Japan, Canada, the United States, the EU-15, and other nations of the European Free Trade Association, and the "South" as all other countries. It therefore corresponds to countries which were developed or developing in 1960.

countries to estimate that the proportion of adult migrants with tertiary education increased four-fold over 1975-2000. The increasing amount of South-North migration coupled with the increasing skill level of this migrant flow means that brain drain is increasing in absolute terms.

However, educational levels in developing countries have also been rising dramatically over the past decades. As a result, de Foort (2008) finds that the *rate* of high-skilled emigration (relative to the base of all tertiary-educated individuals) has been very stable at the global level over the period 1975-2000, with the educational level of the home workforce increasing at a similar rate to the increase in tertiary educated migrants. However, sub-Saharan Africa is an exception to this pattern – a region in which tertiary education growth remained low and did not offset the rise in skilled migration.

Analysis of migration flows faces severe data constraints, and a full picture of brain drain trends during the 2000s will not emerge until after data are released from the 2010-11 round of global population Censuses. However, brain drain appears likely to have fallen in relative terms during this time. Tertiary enrolment rates have continued to grow dramatically, with gross tertiary enrolment rates for sub-Saharan Africa increasing from 3.9 percent in 1999 to 6.0 percent in 2009, those in South Asia increasing from 8.0 percent in 2000 to 11.4 percent in 2008, and those in Latin America and the Caribbean increasing from 20.9 percent in 1999 to 35.2 percent in 2007 (World Bank WDI and GDF global database [accessed November 22, 2010]). At the same time as stocks of tertiary-educated individuals have been rising in many developing countries, the intake of skilled workers has been quite flat over the first part of the decade in many OECD destination countries, and fallen in 2008-2010. For example, the United States H1-B visa program (the main temporary residence category for admitting skilled workers[3]) issued visas to an average of 130,000 workers a year over the 2000s, reaching a peak in 2007 at 154,000, and dropping in 2009 back to 110,000 (United States Department of State, 2011). It is worth noting how small this magnitude is – less than one skilled worker admitted per 1000 population.

[3] There are a variety of other visa categories that also are directed towards skilled workers, but the number admitted through these are smaller. In particular, the H1-C program for registered nurses issued 128 visas in 2009; the L1 category of intra-company transfer visas issued 64,000 visas, and the O1 category for individuals of extraordinary ability admitted 9,368 (United States State Department, 2011). By way of comparison, 690,000 individuals received permanent residency in the U.S. in 2010 as either the immediate relative of a U.S. citizen or as a family-sponsored migrant.

Question 4: Is There a Positive Association Between Skilled and Unskilled Migration?

Efforts by migrant-sending countries to halt or reduce levels of skilled migration typically assume that high skilled migration is a phenomenon largely unrelated to less-skilled migration – the same countries concerned about outmigration of skilled workers typically welcome the remittances and job opportunities that migration provide for less-skilled workers. Likewise, immigrant-receiving countries may wish to reduce unskilled immigration while increasing skilled immigration. But the empirical evidence suggests that levels of skilled and unskilled migration actually have a strong positive association—and thus that attempts to limit one form of migration are likely to affect the other.

Both skilled and unskilled migrants are likely to determine their migration decisions in part on the basis of the institutional characteristics of their home country, and the presence of common links with potential destination countries. One specific avenue for a positive association between high and low skill migrants is family reunification. In the U.S. New Immigrant Survey, for example, 45.8 percent of spouses who are brought into the country on a family visa by a university-educated migrant do not have a university degree – evidence of a channel through which an increase in the number of high skill migrants may also result in the increase in the number of low skill migrants.

We analyze stocks of migrants to examine how the stocks of both high skill and low skill migrants evolve over time. We use two data sources: the database of Docquier and Marfouk (2005), which provides bilateral stocks of high and low skill migrants aged 25 and over from 198 source countries in 31 destination OECD countries in 1990 and 2000, and the U.S. Integrated Public Use Microdata Series (IPUMS) Census data, which provides similar stocks over the period 1960 to 2000 for the United States (Ruggles et al., 2010).

Figure 1 presents the relationship between the stocks of low skill and high skill migrants, with levels on the left and changes on the right. Each observation is a destination-source country pair in one year: for the OECD panels at the top there are multiple destination countries, whereas for the USA there is only one destination, but more years. The panels on the left plot the log stock of high skill migrants in each source-destination corridor against the log stock of low skill migrants, after removing any year and destination country fixed effects. The panels on the right also remove source country fixed effects, and so illustrate the correlation between the growth

rate of high skill migrants and the growth rate of low skill migrants in each source-destination corridor.

A clear positive relationship is evident both for the cross section and for the growth rates: countries that sent relatively many high skilled migrants to one country also sent relatively many low-skilled migrants to the same country. Similarly, when a country increases the number of high skill migrants it sends to a recipient country, the number of low skilled migrants to the same country also increases. To investigate further, we look for Granger causality in these datasets from low skill migrants to high skill migrants and vice versa. Granger causality measures causality in a statistical sense: variable *x* is said to Granger cause y if the history of *x* predicts the current value of *y*, conditional on the history of *y*. We regress the level of high skill migrants on the lag of high skill migrants and the lag of low skill migrants, all measured in logarithms, along with year and destination country fixed effects. In the OECD data, there is strong evidence of Granger causality from high skilled to low skilled migration (coefficient of 0.118), and strong evidence of Granger causality from low to high skilled (coefficient of 0.129), both significant at the 1 percent level. For the U.S. data, it is also the case that the number of high-skilled migrants in one period helps predict the number of low-skilled migrants 10 years later (coefficient of 0.128), with significance at the 5 percent level.

Therefore it does not appear to be the case that the rise in skilled migration is coming at the expense of less-skilled migrants – instead countries with a high number of skilled migrants also have a high number of less-skilled migrants in both the cross-section and over time.

Question 5: What Makes Brain Drain More Likely?

High-skill individuals often stand to multiply their income by emigrating out of low-income countries. Yet in most developing countries, the majority of skilled individuals do not emigrate. Recent empirical research at both the macro and micro levels offers evidence on what factors make migration of high-skill individuals more likely.

At the macroeconomic level, the rate of brain drain varies widely across countries. The average developing country has 7.3 percent of its tertiary-educated population stock in higher-income countries, with this proportion varying from 5.4 percent or below in developing countries with populations of 40 million or more to 13 percent in sub-Saharan Africa and 45 percent in

small developing island nations. Docquier et al. (2007) report these numbers and examine the patterns of brain drain across countries. The strongest association is with country population size—that is, countries with less population have a higher proportion of brain drain. In addition, brain drain rates are higher in countries with fractionalization and political instability, and with low levels of human capital. Skilled emigrant stocks are similar for males and females globally, which translates into higher brain drain rates for females, given that home-country education rates for women lag those for men in many developing countries (Docquier and Rapoport, 2011).

There is a large related literature which looks at what determines the share of a country's migrants who are highly skilled. Borjas (1987) noted the importance of inequality in the sending country relative to destination countries, predicting negative selection (i.e. migrants are more likely to be low-skilled) when inequality in the home country is higher than that abroad, and positive selection when the opposite holds. However, in practice, emigration levels are almost universally higher among tertiary-educated individuals than among those with less education. Grogger and Hanson (2011) suggest that one explanation is that income gaps are so large that it is the absolute gap in earnings rather than relative returns to skill that drives emigration. In the context of Mexican emigration to the U.S., McKenzie and Rapoport (2010) show that migrants become progressively less educated on average as the networks on which they can draw upon grow larger, showing the importance of migration costs in determining the pattern of selection.

Clemens (2009) compares the rate of brain drain across countries by population size to the rate of brain drain from internal migration across provinces or states of the United States, Brazil, Kenya and the Philippines. He finds that the rate of international brain drain from countries with small populations is similar to the rate of internal brain drain from areas of small population – both point to the desire for skilled workers to agglomerate in highly populated areas.

At the microeconomic level, our recent detailed surveys of the highest-scoring high school graduates from New Zealand, Papua New Guinea and Tonga also underscore the role of factors other than income gaps in determining the decision to migrate, and the decision of whether to stay abroad or return (Gibson and McKenzie, 2011). We find emigration decisions to be driven more by broader career concerns such as the quality of opportunities to conduct research, to work with leaders in the profession, and to learn from the best, as well as lifestyle and family reasons, than by how much more people could earn abroad. Clemens (2009)

summarizes survey evidence from health workers in Africa who similarly indicate professional advancement, better facilities to work in, and safety for their families as prime motives for migrating, in addition to the higher incomes they can earn.

The evidence is consistent with the high-skilled wanting to be in places in which they can live well, without fear of violence or instability, and in which they have sufficient opportunities to advance their careers and work with like-minded people. It is thus not surprising that India, with a large population, rapidly growing economy, and high-tech centers, sees brain drain now as much less of a problem that small, remote or politically unstable countries do.

Question 6: Does Brain Gain Exist?

A series of theoretical papers over the past 15 years, summarized in Docquier and Rapoport (2011), have shown that it is possible that high-skilled emigration can lead to a rise in human capital levels in the home country. The basic idea of such "brain gain" theories is that decisions of individuals to invest in education react to the prospect of future migration, and that not all those who choose to increase their education because of the chance they may migrate actually end up migrating. Providing more opportunities to work in the U.S. for doctors and nurses from poor countries may then not deplete supplies of medical workers at home, but could in principle raise them by increasing the incentives for people in poor countries to train as doctors and nurses.

In the last few years, some case study microeconomic evidence has started to emerge on whether such a mechanism operates in practice. The key challenge for empirical work is identifying a plausible source of exogenous variation in either migration opportunities or returns to skill abroad, which can then be used to examine the responsiveness of human capital acquisitions. Shrestha (2010) uses a change in the educational requirements of British Gurkha Army recruiters in 1993, which increased the returns to education abroad for Gurkha men in Nepal, to show that this led to increases in the probabilities of completing primary and secondary education for males affected by this change. Chand and Clemens (2008) look at the response of Indo-Fijians to a 1987 coup in Fiji, which they argue affected the incentive to acquire education in order to emigrate for Indo-Fijians, but not for ethnic Fijians. They find increases in levels of Form 7 (13^{th} grade) education and in bachelor degrees. Finally, Docquier et al. (2010) show that

after the 1995 Bosman ruling by the European Court of Justice (ECR *I-04921)*, which increased the opportunities for African soccer players to play in Europe, the skill level of African soccer leagues most likely to supply players to Europe increased. [4]

These case studies share two notable features. First, these studies consider populations whose migration is constrained by policy barriers, so that not all who would like to migrate are able to. A brain gain effect can occur even with open borders, if people acquire education to give them the option value of migrating, and then do not all exercise this option (Katz and Rapoport, 2005). However, the brain gain is more likely when policy barriers limit the number who can migrate. Second, these studies consider cases in which the supply of schooling can easily absorb the added demand for more education. These factors are likely to apply to the cases of secondary education and undergraduate tertiary education in many countries, but may not hold when it comes to talking about doctors, scientists, and other high ability professionals.

Infrastructure constraints and government restrictions on private education limit the supply of medical and graduate education in many countries, particularly in sub-Saharan Africa. If the government only allows one medical school with a fixed quota of students, then clearly it is not possible for more students to be induced to become doctors when migration possibilities open up.[5] In contrast, in countries like the Philippines, private providers allow the supply of nursing education to adapt quickly to increases in demand for such training as a result of migration opportunities for nurses abroad. Furthermore, given the skill-selective nature of immigration systems in many key destinations, the likelihood that a well-qualified doctor or scientist is able to migrate if desired will be substantially higher than for someone with just one year of tertiary education. As a result, there are reasons to believe the brain gain channel will not be as powerful for the most highly skilled as it is for the moderately skilled.

Direct evidence as to whether this channel operates among the most highly skilled comes from surveys we have done of the "best and brightest" individuals who were at the very top of their high school classes in their countries (Gibson and McKenzie, 2010). Among those top

[4] The effect need not always be positive. In Mexico, McKenzie and Rapoport (2011) use variations in the likelihood of migrating to the United States induced by historic migration networks to show household migration can actually lower educational attainment of children, which they attribute to the low returns to education for illegal migrants in the United States.

[5] In a study of medical brain drain from 69 countries, using four three-year time intervals between 1991-2004, Bhargava et al. (2011) find that while the lagged physician brain drain rate does predict the growth rate of physicians, the coefficient is too small for the number of physicians remaining in the developing country to rise as the brain drain rate is increased.

students who were not currently migrants, 16 percent in Micronesia and Papua New Guinea, 20 percent in Tonga, and 32 percent in Ghana said they had changed in part what they studied, or studied extra because of the prospect of potentially migrating. The channel for them though is not so much in terms of attainment, as in what they study – more report studying foreign languages and taking test preparation classes to pass entrance tests abroad. In some of these countries we also did surveys of teachers of 10^{th} to 12^{th} grade in the top secondary schools to see whether they taught anything differently as a result of the possibility their students may migrate. In Micronesia, 35 percent of teachers say they teach things they wouldn't otherwise do: examples include U.S. history and culture, foreign languages, tolerance of different perspectives, and botanical procedures for plants grown abroad. In Papua New Guinea, where 27 percent of surveyed teachers say they teach material they wouldn't otherwise, coverage of exchange rates and international trade, and human resources and labor exports are mentioned.

It is notable that most of these responses in terms of new human capital acquisition in our survey data are for knowledge that in large part only has its main payoffs abroad (although there will also be some benefits in the home country for those individuals whose jobs involve considerable contact with the outside world). This critique of brain gain theories is often raised with regard to medical migration, where it is noted that the prospect of migration may induce over-investment in fields like geriatric medicine which have high demand abroad, at the expense of fields like tropical medicine which have the greatest needs at home but little payoff abroad. We are unaware, however, of any research which goes beyond anecdote and description in this regard, so are unsure as to how serious an issue this is in practice. Nonetheless, in addition to the lack of supply elasticity and ease of movement for particular professions, it adds another reason to be cautious of claims that the prospect of migration will lead to beneficial brain gain.

Finally, we should note that international migration can increase human capital levels in the home country even in the absence of an effect on incentives to acquire education. Two important channels for this are through the use of remittances and repatriated savings to alleviate liquidity constraints that otherwise prevent households from paying for schooling, and through return migration of individuals who acquire schooling abroad and return to their home countries. In our view these two channels are likely to be stronger contributors to a brain gain from international migration than incentive effects in most countries. This is particularly the case in small and poor countries in which facilities for further education are limited: for example, in

Gibson and McKenzie (2010) we find that 90 percent of Micronesians and 95 percent of Tongans with bachelor degrees in their sample earned these degrees abroad, as did 28 percent of Ghanaians and 49 percent of Papua New Guineans with advanced degrees such as a masters or doctorate.

Question 7: Do High-Skilled Workers Remit, Invest, and Share Knowledge Back Home?

The benefits that a sending country might receive from high-skilled immigration are usually listed in terms of return flows of income, investment and expertise from migrants back to the sending country. These are the kinds of benefits that underlie the claim by India's prime minister that modern India is benefitting from its high-skilled out-migration and the resulting global Indian diaspora. But how common are such benefits? As we have seen, brain drain rates are highest from countries with small populations and those experiencing political instability and poor prospects for career success. Thus while India's annual remittances have now reached $55 billion (World Bank, 2011) and India's high-skilled migrants have shaped the development of its impressive information technology sector (Saxenian, 2006), the experience of a country with a population of over one billion and a fast-growing economy may have few lessons to offer the small and/or unstable countries for which brain drain is at most an issue. New research offers a more mixed picture of the potential benefits of brain drain.

Consider first remittances, the most visible channel through which migrants contribute to households back home. Global remittance data at the micro-level are not currently publicly available, so we use a database of 33,000 immigrants in 11 OECD countries put together by Bollard et al. (2010). In this sample, skilled migrants remit more than less-skilled migrants, with the average tertiary-educated migrant remitting about $1,000 per year. We take the 6,318 migrants in their sample with tertiary education who come from countries with at least 50 skilled migrants in the database. We then remove survey fixed effects, and then, in Figure 2, plot the proportion of tertiary educated migrants who remit against Gross National Income per capita in the sending country. There are two important results. First, for most sending countries, less than half of tertiary-educated migrants send remittances. Second, there is a strong negative correlation between income levels and the likelihood that skilled migrants remit. In this sample, the likelihood of remitting is significantly higher for countries with higher brain drain rates, but once we control for per capita income, this relationship is no longer significant.

Both the incidence and the amount remitted appear to be even higher among the most highly-skilled migrants from countries with high levels of brain drain. Gibson and McKenzie (2010) report that between 68 and 93 percent of the developing country high-skilled migrants in their sample remit, with an average amount remitted of around $5,000. Clemens (2011) also finds an annual remittance level of about $5,000 in his survey of African physicians in the U.S. and Canada. Existing empirical evidence therefore does support the idea that high-skilled migrants remit, particularly back to lower-income countries, and that the level of these remittances can be sizeable relative to per capita income in their home countries.

Less empirical evidence is available about the extent to which high-skilled emigrants invest or engage in knowledge flow or return investment, especially for the types of countries for which brain drain rates are highest. At the cross-country level, Kugler and Rapoport (2007) and Javorcik et al. (2011) find a positive relationship between the number of skilled migrants a country has in the United States and the level of foreign direct investment from the U.S. economy to that country. However, their dataset contains only two countries with population rates below one million, making it difficult to see whether this relationship holds in the smallest countries for which brain drain rates are highest. At the micro-level, Gibson and McKenzie (2010) find very low incidence rates of high-skilled migrants being involved in trade facilitation or investment in business start-ups in their home countries: they estimate a small country like Tonga or Micronesia might gain at most $500-$2,000 per high-skilled migrant from trade and foreign direct investment. This contribution is a positive one, but unlikely to have large effects on development.

Reductions in the cost of air travel and improvements in information technology make it significantly easier for high-skilled migrants today to continue to stay in contact with people in their home countries. In principle this opens up many opportunities for knowledge flow. However, again the types of knowledge flow that occur back to large and vibrant economies are likely to differ from those to smaller countries where brain drain rates are higher. Gibson and McKenzie (2010) find the main forms of knowledge flow of high-skilled migrants from Ghana, Micronesia, Papua New Guinea, and Tonga are information about educational and work opportunities abroad, with few migrants providing advice to home country companies or governments.

Question 8: What Do We Know About The Fiscal And Production Externalities Of Brain Drain?

Policymakers in developing countries commonly lament that they pay thousands of dollars to train workers, only to see them migrate abroad. The obvious response to this is to say that this is a policy choice governments are making – they could instead charge the full cost of tertiary education in fees, with loans to pay for these that would then be forgiven if people work in their home country for a specified period of time. However many developing countries lack the capacity to recover these loans, and Albrecht and Ziderman (1991) in reviewing a number of student loan programs from the 1980s found that schemes in Brazil, Venezuela and Kenya ended up getting back less than 10 percent of the value of the loans issued. Moreover, even developed countries like New Zealand have faced large default rates on student loan payments (Fisher, 2010).

Estimates of how much the government pays vary widely, and depend on the split between public and private contributions to education in different countries. Easterly and Nyarko (2009) estimate costs per student of tertiary education of only 2-3 times per capita GNP in a number of African countries. However, much higher costs have been found in studies of the costs of training health professionals: for example, Muula et al (2006) claim a cost of $26,000 (in U.S. dollars) to pay for tertiary education of a nurse in Malawi (on top of a further $4,800 to pay for primary and secondary schooling).

Is it worthwhile for governments to pay these education costs? Three elements of the return realized from these costs should be considered. The first factor, often ignored, is the gain in well-being for the trained individual. If our concern is whether this government spending is improving the well-being of the people that government represents, then we should include in the return on investment how much the education funded through this spending raises income levels for the people this money is spent on. Clearly the option to migrate internationally vastly increases the income that can be earned from a given level of education, therefore increasing the return on investment.

Second, the fiscal return from government providing such training depends on the incomes the high-skilled would earn if they had remained at home and the progressivity of the tax system. Two recent empirical studies have put some numbers on the extent of these returns lost through brain drain. Desai et al. (2009) estimate that the total annual fiscal impact in India of

its migrants in the United States is a loss of 0.47 percent of gross national income in 2005. We calculate this equates to approximately $4,120 per migrant aged 25 and above in the United States.[6] Not all these workers are high-skilled, so the annual loss per high-skilled worker will be higher. However, the calculation also assumes that all these emigrants would have become as equally skilled had they not emigrated, which is a heroic assumption likely to bias their estimates upwards. In Gibson and McKenzie (2010) we calculate annual fiscal losses of brain drain of the best and brightest of $500-1000 per migrant in Micronesia and Tonga, which have low and quite flat income tax rates, and $5,500-6,300 in Ghana which has a higher and more progressive rate. Note that these fiscal costs are the same magnitude or less than the amount remitted by high-skilled emigrants – the difference being that remittances don't go to governments.

We know much less about the third possible area of return – that is, how brain drain affects the production and health externalities that may arise through education. Currently, there are no studies with credible estimates that, say, the benefit of 1,000 fewer skilled workers migrating is an increase of X in productivity of other workers, or that the benefit to having 100 doctors not emigrate is a saving of Y lives. We do know that the economic literature in general has struggled to find strong evidence of externalities from education.[7] In Gibson and McKenzie (2010) we review the range of estimates in the literature and show that even taking the high range of externality estimates would still only give a production externality of 80 percent of the home country average unskilled wage, or around $800 per year per high-skilled migrant in the developing countries we study. Yet it is also worth noting that governments in some developed countries seem to think these externalities are important, as evidenced by their attempts to make their immigration policies more skill-selective. On the other hand, the United Kingdom recently acted to reduce the number of skilled migrants from outside the E.U. so it is likely that policy changes in this area run well ahead of the evidence base.

The existing empirical evidence on health externalities from health worker migration is inconclusive. Clemens (2007) finds no evidence of a relationship between the rate of health professional emigration and health outcomes in Africa. On the other side, Bhargava and

[6] This calculation uses a 2005 Gross National Income of 32.252 trillion Rs from the World Development Indicators, an exchange rate of 44 Rs to the dollar, and Desai et al. (2009)'s estimate of 836,000 Indians aged 25+ in the U.S.

[7] We consider three forms of externalities: dynamic externalities, whereby schooling causes growth through an aggregate externality which shows up in the *A* term in a production function; static market externalities, where the income and productivity of a worker depends on the education levels of those around them (such as through production complementarities); and static non-market externalities, whereby education also has positive benefits on political stability, civic participation, and other such outcomes.

Docquier (2008) find an association between emigration and adult deaths from AIDS in African countries with high HIV incidence. When a larger sample covering developing countries from all regions is used, Bhargava et al. (2011) find no significant effect of medical brain drain on either infant and child mortality rates or child vaccination rates. These studies rely on cross-country panel analysis, with the associated limitations in being able to establish causal relationships. Measurement of these health externalities of skilled migration at a more micro-level is an important area for future research.

Conclusions

Economists have been theorizing about brain drain for almost half a century. But until recently, there has been little empirical evidence to support or contradict these theories. The new evidence should counteract some of the myths and assuage some of the most common concerns about brain drain. Brain drain rates are not skyrocketing. Africa is not the most affected region for brain drain; small island states are. Most skilled migrants are not doctors. But neither are they taxi drivers – they enjoy massive increases in living standards as a result of migrating. The rise in skilled migration does not appear to be crowding out migration opportunities for unskilled migrants: instead, skilled and unskilled migration have increased together. Skilled migrants are remitting back about as much as the fiscal cost of their absence. Existing preliminary estimates of the production externalities of brain drain are quite small.

Yet we are still some way from a comprehensive global answer on the effect of brain drain on sending country growth and development outcomes, and further still from knowing the efficacy of policies chosen with high-skilled migration in mind. Data limitations continue to be a huge challenge to work in this area: there is a pressing need for better data which tracks the flows of high-skilled workers back and forward, as well as for specialized surveys to better understand the consequences of these movements (for discussion of these issues, see Commission on International Migration Data for Development Research and Policy, 2009). We have discussed eight key questions about brain drain. Here we pose and leave for further research five more questions for which answers are needed to better understand the overall impacts of high-skilled migration.

First, what is the value of the option to migrate for those who remain in their home countries? This calculation should include both an economic option value, as well as the utility individuals place on freedom of movement (Clemens, 2009).

Second, what is the externality to a country of an additional doctor, taking into account that it is unlikely that the marginal doctor would be efficiently allocated to the most needy patients if that doctor did not migrate? Likewise, what is the externality that a scientist, engineer, or entrepreneur confers on their host society?

Third, what is the effect of high-skilled migration on institutional development at home? Spilimbergo (2009) has shown that migration to study abroad in democratic countries increases democracy in the sending countries, and there are plenty of anecdotes and case studies of important leaders of independence movements who trained abroad. Yet we are certainly far from being able to show such effects apply more broadly, and even farther from putting a dollar or utility value on such effects.

Fourth, how much does migration policy actually matter for determining the level of skilled migration? Jasso and Rozenzweig (2009) argue that much of the difference in the education composition of immigrants in Australia and those in the United States stems not from the more skill-selective policy of Australia, but from differences in geographic neighbors and in returns to skill in the two countries. Much more needs to be known about how much difference individual country policy actually makes in shaping the skill composition of its immigrants.

Finally, if brain drain hinders development, then acting to limit brain drain should encourage development. But what are the actual development impacts of policy actions to reduce high-skilled immigration, such as moratoriums on hiring doctors from poor countries, and the United Kingdom's proposed large reductions in the numbers of foreign students and skilled nationals from outside the European Union that would be allowed into the United Kingdom? If brain drain hinders development, such actions should benefit development in countries which send more migrants to the United Kingdom. However, we are doubtful that empirical studies of policies to limit migration of skilled workers—whether from sending or receiving countries—will show a net benefit.

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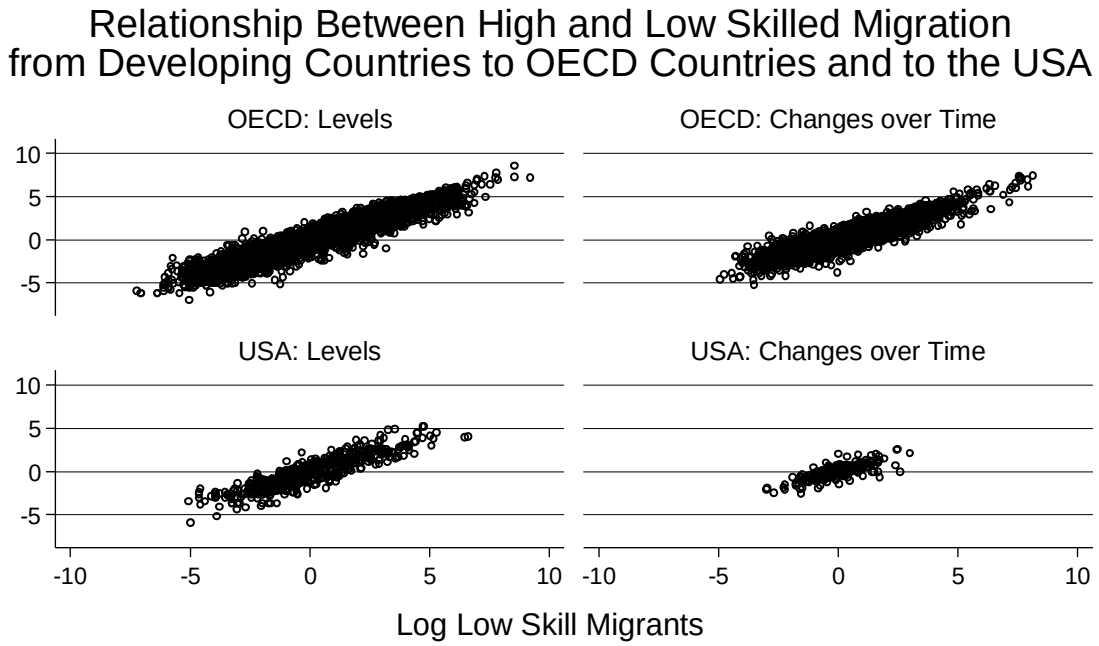
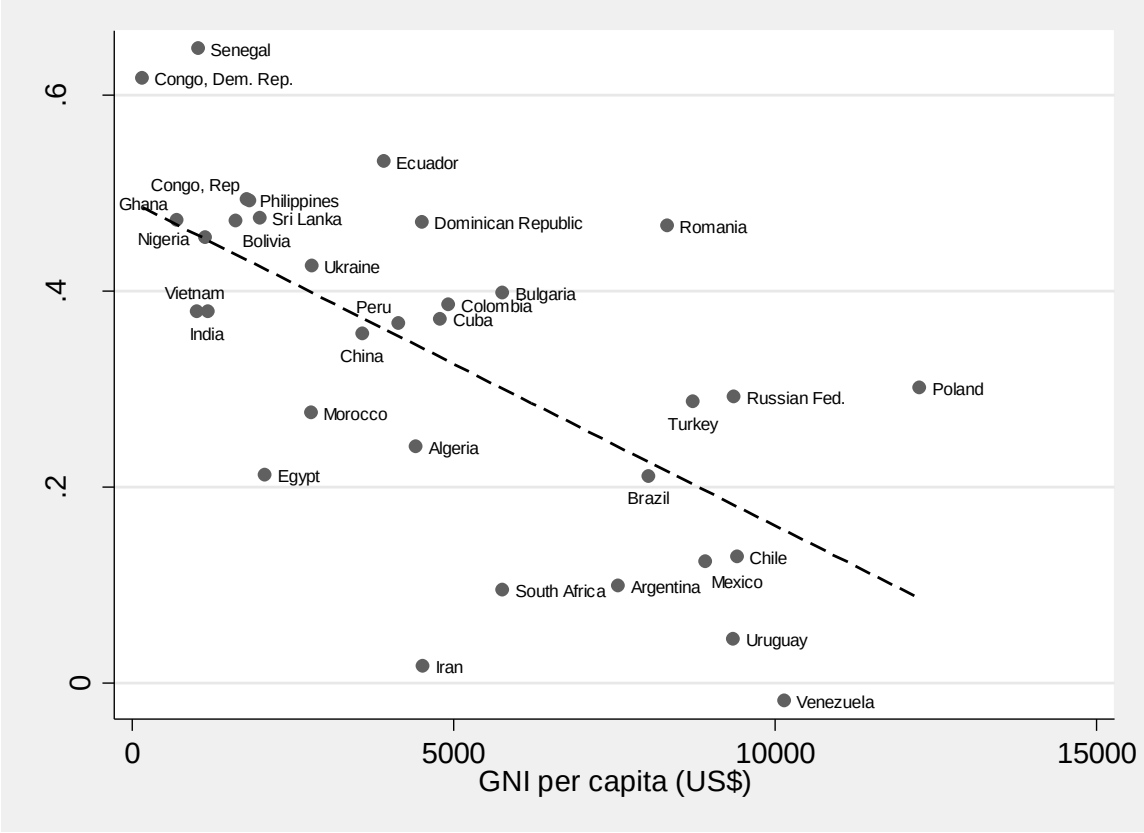
Figure 1



Source: Brain Drain Database (OECD), IPUMS (USA)
Each observation is a year-sending/receiving country pair
The level graph removes constant and time FE, the difference graph removes level, time, and country of birth FE
Receiving country FE removed in both graphs

Figure 2: High-Skilled Migrants from Poor Countries are More Likely to Remit



Source: Bollard et al. (2009) database and World Development Indicators.

Table 1: Top 10 Occupations for Educated Migrants from Developing Countries in the U.S.

Bachelors Degree and Above	%	*Masters Degree and Above*	%	*PhD*	%
Computer Software Engineers	4.9	Physicians and Surgeons	9.2	Postsecondary Teachers	22.6
Registered Nurses	4.8	Postsecondary Teachers	7.4	Physical Scientists, All Other	9.1
Physicians and Surgeons	4.1	Computer Software Engineers	6.7	Medical Scientists	7.6
Accountants and Auditors	3.8	Managers, All Other	3.5	Physicians and Surgeons	7.6
Postsecondary Teachers	3.6	Accountants and Auditors	3.4	Computer Software Engineers	4.3
Managers, All Other	2.7	Elementary and Middle School Teachers	2.6	Managers, All Other	3.8
Elementary and Middle School Teachers	2.4	Medical Scientists	2.4	Engineers, All Other	3.2
Computer Scientists and Systems Analysts	2.0	Computer Scientists and Systems Analysts	2.3	Chemists and Materials Scientists	1.5
First-Line Supervisors/Managers of Retail Sales Workers	1.8	Physical Scientists, All Other	2.2	Computer Scientists and Systems Analysts	1.3
Computer Programmers	1.7	Computer Programmers	2.1	Computer Programmers	1.1
Sample Size	25169		10842		1936
Broader Occupational Categories					
All medical professionals	12.7		15.2		11.8
All computer specialists	10.0		12.5		7.4
All engineers	4.1		5.7		7.5
All teachers and academics	3.6		7.4		22.6
Scientists and Social Scientists	3.8		7.2		22.7
Taxi drivers	0.5		1.1		0.1

Source: American Community Survey 2008 (Steven Ruggles et al, 2010).

Note: % refers to the percentage of all employed immigrants in this educational category

Table is restricted to employed migrants aged 25-65 from countries not classified as High Income, who arrived in the U.S. after age 24.

Table 2: Proportion of Immigrants among all U.S. workers in main occupations for educated migrants

Occupation	All Tertiary Educated		Individuals with PhDs	
	Share who are foreign-born	Share who are born in developing countries	Share who are foreign-born	Share who are born in developing countries
Computer Software Engineers	0.36	0.27	0.62	0.47
Registered Nurses	0.14	0.10	0.22	0.17
Physicians and Surgeons	0.27	0.20	0.32	0.22
Accountants and Auditors	0.17	0.11	0.51	0.35
Postsecondary Teachers	0.21	0.12	0.27	0.14
Managers, All Other	0.12	0.07	0.35	0.17
Elementary and Middle School teachers	0.06	0.04	0.16	0.09
Computer Scientists and Systems Analysts	0.20	0.14	0.41	0.30
First-Line Supervisors/Managers of Retail Sales Workers	0.13	0.09	0.31	0.21
Computer Programmers	0.23	0.16	0.52	0.43
Medical Scientists	0.40	0.27	0.55	0.36
Physical Scientists, All Other	0.38	0.24	0.50	0.30
Engineers, All Other	0.23	0.16	0.57	0.36
Chemists and Materials Scientists	0.25	0.18	0.39	0.27
All Medical Professionals	0.14	0.10	0.24	0.16
All Computer Specialists	0.23	0.16	0.53	0.39
All Engineers	0.18	0.12	0.55	0.35
All Teachers and Academics	0.10	0.06	0.26	0.14
Scientists and Social Scientists	0.21	0.13	0.37	0.22

Source: American community Survey 2008 (Steven Ruggles et al, 2010).
Table is restricted to employed individuals aged 25-65

Table 3: Direct Evidence on the Brain Gain Channel

	Ghana	Micronesia	New Zealand	Papua New Guinea	Tonga
Proportion who took schooling actions due to prospect of migrating abroad	0.32	0.16	0.08	0.16	0.20
Teachers teach different things as a result of expectation some students will go abroad	0.08	0.35	n.a.	0.27	0.06

Source: Gibson and McKenzie (2010) surveys of top students, and surveys of teachers in their schools.
n.a. denotes not available, as teacher survey not undertaken in this country.