The Economic Consequences of "Brain Drain" of the Best and Brightest:

Microeconomic Evidence from Five Countries[*]

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Abstract

Brain drain has long been a common concern for migrant-sending countries, particularly for small countries where high-skilled emigration rates are highest. However, while economic theory suggests a number of possible benefits, in addition to costs, from skilled emigration, the evidence base on many of these is very limited. Moreover, the lessons from case studies of benefits to China and India from skilled emigration may not be relevant to much smaller countries. This paper presents the results of innovative surveys which tracked academic high-achievers from five countries to wherever they moved in the world in order to directly measure at the micro level the channels through which high-skilled emigration affects the sending country. The results show that there are very high levels of emigration and of return migration among the very highly skilled; the income gains to the best and brightest from migrating are very large, and an order of magnitude or more greater than any other effect; there are large benefits from migration in terms of postgraduate education; most high-skilled migrants from poorer countries send remittances; but that involvement in trade and foreign direct investment is a rare occurrence. There is considerable knowledge flow from both current and return migrants about job and study opportunities abroad, but little net knowledge sharing from current migrants to home country governments or businesses. Finally, the fiscal costs vary considerably across countries, and depend on the extent to which governments rely on progressive income taxation.

Keywords: Brain drain; Brain Gain; Highly Skilled Migration

JEL codes: O15, F22, J61

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1. Introduction

Two narratives drive discussions of the development impact of high-skilled migration. The first is the idea of a brain drain, whereby the departure of doctors, teachers, engineers, scientists, and other highly skilled workers decimates the human capital and fiscal revenues of sending countries (Bhagwati and Hamada, 1974). Such fears lead to calls for policies to restrict the flow of highly skilled workers, such as demands that developed countries stop recruiting doctors from developing nations, and efforts by developing nations to restrict the ease of their highly skilled individuals migrating.[1] However, contrasting with this is the view of a highly educated diaspora as a potent force for developing the local economy through remittances, trade, foreign direct investment (FDI), and knowledge transfers, with the experience of India and China in setting up technology firms as a result of diaspora working in Silicon Valley a prominent example. (Saxeenian, 2002). Economists have also emphasized that the possibility of migrating may spur human capital accumulation, potentially leading to a net increase in the education levels of those in the home country.[2]

However, what is sorely lacking in such discussions is empirical evidence as to what the experience has been in practice for countries facing high rates of high-skilled emigration. Recent large-scale data efforts have provided a much-improved evidence base with which to talk about the scale of high-skilled emigration (e.g. Docquier and Marfouk, 2004; Beine et al. 2007), and in Gibson and McKenzie (2010) we have used data from New Zealand, Papua New Guinea and Tonga to investigate the determinants of migration and return migration decisions by the highly skilled. Yet quantitative evidence as to the extent to which the many theoretical channels operate in practice in determining the consequences of high-skilled emigration is almost non-existent. In particular, it is unclear whether it is common for highly-skilled emigrants from high migration countries to actually be engaging in knowledge transfers, trade, and FDI, or whether the experience of Chinese and Indian IT companies is so famous because it is the exception, not the rule. We also do not have empirical evidence as to what the size of the fiscal effect is, and how the magnitudes of these different channels compare to the size of the gains experienced by the migrants themselves. The purpose of this paper is to provide the first systematic empirical evidence on these issues.

To do this we chose five countries which represent a range of the types of countries experiencing very high rates of high-skilled emigration. Tonga, and the Federated States of Micronesia (hereafter Micronesia), are small island states, which Beine et al. (2008) show to

[1] For example, in 2009 the Algerian Government said it would restrict study abroad scholarships granted to high achievers in baccalaureate examinations in an effort to stem a worsening brain drain, and Uganda began requiring doctors who wish to pursue further studies abroad to make a written commitment to return to Uganda. On the receiving side, the World Federation of Public Health Associations adopted a resolution in 2005 supporting ethical restrictions on international recruitment of health professionals from developing countries.

[2] See Mountford (1997), Vidal (1998), Stark et al. (1997) and Schiff (2006) for this theoretical debate, Beine et al. (2008) for cross-country empirical evidence, and Chand and Clemens (2008) for a case study in Fiji. Kapur and McHale (2005) provide a nice recent review of the literature.

have the highest "brain drain" rates in the world.[3] Papua New Guinea is a larger developing country in the Pacific with much lower overall levels of migration, but also a high brain drain rate. Ghana was chosen as one of the best-known examples of a sub-Saharan African country grappling with high brain drain, and New Zealand as the OECD country with the highest brain drain rate. If we care about brain drain, it is precisely the experiences of countries like these, which have the highest rates, which should be informative, rather than the experiences of India and China, for which fewer than 5 percent of the tertiary educated population are living abroad.

In each of these countries we pursue an innovative survey methodology, which consists of identifying a well-defined target sample frame of interest – individuals who were the top academic performers in the country at the time of their high school graduation – and then tracking down these individuals wherever they currently live in the world and surveying them. Altogether this involved collecting data on individuals living in 45 different countries, and asking them detailed questions about their migration and educational histories, and the channels through which they interact with their home countries while abroad. We then form counterfactuals for what these individuals would be doing at home through also surveying academically similar non-migrants and return migrants, and through direct elicitation.

Through this approach we are able to measure and quantify a number of the key economic effects of high-skilled emigration. We estimate that the best and the brightest stand to gain \$40,000-75,000[4] per year from emigrating from these five countries. This gain to the migrants swamps by an order of magnitude any of the other measured impacts: annual remittances of \$2,000-7,000, trade and foreign direct investment effects which are infrequent and at most of similar net effect to remittances, and fiscal impacts which are at most \$1,000 for Tonga and Micronesia, \$6,000 for Ghana, \$10,000 for New Zealand and \$17,000 for Papua New Guinea. We also find migration to lead to large increases in human capital of the migrants; little evidence of net knowledge transfers to home governments or business, but significant provision of knowledge about study and work opportunities abroad by highly skilled emigrants. Our assessment of the likely size of possible negative externalities from the absence of these individuals suggest that such externalities are small relative to the magnitude of the benefits from emigration.

The remainder of the paper is structured as follows: Section 2 discusses our unique survey and the incidence of high-skilled emigration seen among the best and brightest, Section 3 estimates the impact of migration on the incomes and human capital of the highly-skilled, and Section 4 attempts to measure the value of impacts on trade, foreign direct investment, and fiscal balance, as well as to provide evidence on the extent of various knowledge transfers. Section 5 concludes.

[3] These brain drain rates measure the share of adults with tertiary education born in a particular country who are living abroad.

[4] All values are expressed in current United States dollars as of January 2010.

2. Surveying the Best and Brightest

The small existing microeconomic empirical literature on the brain drain has generally focused on individuals from a selected profession. For example, Hunter et al. (2009) consider Nobel Prize winners and highly-cited scientists, Ben-David (2007) Israeli economists, Clemens and Pettersson (2008) African health professionals, Commander et al. (2004) doctors in the United Kingdom, and Constant and D'Agosto (2008) Italian researchers and scientists abroad. However, there are several concerns with such occupation-specific studies when it comes to looking at the consequences of high-skilled migration. First, the initial decision to become a physician, scientist, economist, or other such occupation may be closely tied to the desire to migrate – with skill-selective criteria for immigration to many countries, high talent individuals who wish to emigrate may select the occupations that offer the best prospects for doing so, while similar individuals who do not wish to emigrate may choose other occupations. Second, training for the occupation may itself only occur through migration. This is particularly the case in small countries, which do not have Ph.D. programs or medical schools. Finally, whether or not individuals remain in an occupation may depend on whether they emigrate or not – low-paid professionals who do not emigrate may move to more remunerative private sector jobs while emigrants may have trouble getting certified to work in their home country professions. For all these reasons it seems unlikely that the right counterfactual for a high-skilled individual abroad is someone in the same occupation in the home country.

2.1 Our methodology

Instead, the methodology we propose is to define a target sample of interest that can be identified *before* migration has occurred, and then to survey these individuals regardless of their subsequent emigration and occupational choices. In our case, we specify the target sample of interest as individuals who were the "best and brightest" in terms of their academic performance at the end of high school in their home countries. This can be objectively measured in terms of top performance in national examinations, or in terms of being named as one of the top academic performers in the school such as a valedictorian or Dux, salutatorian or proxime accesit. Moreover, it can be measured ex post, so that we can set our target sample of interest as the individuals who were top of their high school classes for students graduating between 1976 and 2004 and then survey these individuals today.

We are not claiming that this is by any means the only population of interest for looking at the consequences of brain drain, but claim that it is one important subgroup of interest, the academic high achievers. These individuals go onto work in many of the occupations that countries worry about in terms of brain drain: our sample contains individuals who have become doctors, engineers, computer scientists, academics, scientists, and business leaders. Moreover, it is a subgroup whose composition is likely to be much less affected by desire to emigrate than studies focusing on a specific occupation.

Our focus on the best and brightest is also justified because the literature also stresses that it is likely to be the migration of the most skilled and talented individuals for which these negative effects are greatest. Kapur and McHale (2005, p. 97) write that "clearly people of exceptional talent have a highly nonlinear impact.". However, little empirical evidence is available on the migration of the "best and brightest". The only study which exists is a simple descriptive exercise which examines the emigration rates of graduate students of IIT Mumbai, one of India's most prestigious tertiary institutions, in the 1970s, finding 31 percent settled abroad, compared to an estimated migration rate of 7.3 percent for engineers in the country as a whole (Sukhatme, 1994).

2.2 Country choice

Brain drain rates, as measured by the share of tertiary-educated individuals born in a given country who are living abroad, are highest in small states and a few sub-Saharan African countries (Beine et al. 2007, 2008), and it is in such places that concerns about the possible negative consequences of brain drain are most common. We therefore chose to focus our survey efforts in such countries. We began by choosing three developing countries in the Pacific – the Federated States of Micronesia, Papua New Guinea and Tonga, since the Pacific Islands are the region with the highest brain drain rate in the world (Docquier and Marfouk, 2005). We then also chose Ghana, which has one of the highest brain drain rates in sub-Saharan Africa and which has been one of the countries most involved in discussions about medical brain drain. Finally, we chose New Zealand, which is the OECD country with the highest tertiary brain drain rate. The population, GNI per capita in current US dollars[5], and brain drain rate in the year 2000 for those who entered the destination country after age 18 (Beine et al, 2007) are:

- Ghana: 23.4 million population, $US670 GNI per capita, 44.9% brain drain rate
- Federated States of Micronesia: 107,000 population, $US2,340 GNI per capita, 36.9% brain drain rate.
- New Zealand: 4.3 million population, US$27,940 GNI per capita, 15.8% brain drain rate.
- Papua New Guinea: 6.4 million population, $US1,010 GNI per capita, 19.8% brain drain rate
- Tonga: 110,000 population, $US2,560 GNI per capita, 65.1% brain drain rate.

These countries offer an interesting range of population sizes, levels of development, and also opportunities for migration. Micronesia and New Zealand both have free mobility to an important migrant destination - Micronesia to the United States and New Zealand to Australia – whereas the other countries have more restricted mobility.

[5] Population and GNI per capita are World Bank 2008 estimates.

2.3 The sample frame and survey

In each country we assembled a sample frame of the top academic achievers in the country, for individuals graduating high school between 1976 and 2004, using a mixture of government and school records. A detailed appendix discusses the specifics of sample frame construction for each country. We then attempted to track down these individuals and survey them in their present country of residence. The tracking effort was extensive, and involved visits to the high schools and home communities, online search, the involvement of school alumni networks where they existed, phone book searches by surname, and asking located students for help in identifying others. Individuals were then administered a survey with detailed questions on their migration and educational histories, their current occupation, and the channels through which they interact with their home countries when abroad. These surveys were carried out online, in-person in the five source countries, and, in some cases, by phone. The survey efforts began with the Tongan sample in late 2007, and finished with the Ghanaian sample in late 2009.

Table 1 summarizes the results of this surveying effort. Our total sample frame consisted of 4,131 individuals from the five countries, of which we were able to interview 1,240 (30%). 40% of those interviewed are female. The survey interviewed individuals who are now living in 45 different countries. The survey success rate varied across source countries, ranging from 15 percent in Ghana to 73 percent in Tonga. This reflects both differences in our ability to track individuals from different countries, as well as in differential survey response rates, with fears about identity theft making some high achievers reluctant to participate in an online survey. Even in cases where we could not survey the individual, we endeavored to identify their current location, either directly from them, or from friends and family. Current location is known for the majority of the sample frame from Tonga, Micronesia and New Zealand, and for 47 percent of the full sample.

We view these response rates as incredibly high, given the logistics of tracking individuals over multiple countries based only on a name and the high school they attended. This is particularly the case given the sample of interest are individuals with very high opportunity costs of time, who typically have lower survey response rates. Nevertheless, we are sensitive to the possibility of potential bias caused by incomplete tracking. In particular, we can examine how sensitive the measured migration rates are to survey non-response, using both the known characteristics (age and gender) of the individuals not surveyed, as well as through comparison of the individuals who it took more effort to locate to those located more easily. The results suggest relatively little bias from non-response, at least with regard to migration status.[6] In terms of looking at the consequences of migration, we believe that if there is any bias, it will be towards not being able to locate the less successful individuals. We will keep this in mind in interpretation, but is should mean we are obtaining upper bounds on the extent to which migrants are engaging in certain activities such as trade and investment.

[6] See Gibson and McKenzie (2010) for details of this for New Zealand, Papua New Guinea and Tonga.

2.4 Migration rates

Table 1 demonstrates that the incidence of migration is very high among this highly skilled population. In our sample, 65 percent of the best and brightest aged 22 and over have ever migrated overseas since graduating high school, and 36 percent are current migrants. Comparing these numbers also indicates a high rate of return migration. The highest rates of ever migrating are in Tonga and Micronesia, the two smallest countries. Both countries have very limited tertiary education options at home, and so migration is needed for education. The lowest current migration rate is seen in Papua New Guinea, whose citizens have rather limited options for migration. Educational scholarships which bond individuals to return are one additional factor limiting the extent to which individuals who go abroad to study can stay on and work afterwards in this case. Overall, the sample gives us a good sized sample of migrants with which to examine at the micro-level the consequences of high-skilled emigration, along with individuals of similar ability who are located in the home country and which can be used in forming counterfactuals.

3. Impacts on the migrants themselves

In general, the largest gains from migration accrue to the migrants themselves. Yet measurement of these gains has been relatively neglected in the literature, with the labor literature focusing on the impact of immigration on natives and the development literature focusing on the impact of emigration on individuals remaining in the source country. However, ignoring the impact on the migrants themselves will lead to a very distorted view of the economic benefits and costs of migration for source countries, since the most major effect could be to make natives of these source countries considerably better off. We therefore begin with estimation of the gains in income and education that high-skilled individuals gain through migration.

3.1 The income gains from high-skilled emigration

Panel A of Table 2 presents the mean, standard deviation, and median annual gross income earned by individuals who are currently non-students and employed abroad.[7] We convert all currencies to US dollars at the exchange rates prevailing at the time of the survey. The mean annual income earned by emigrants is $57,000 for Micronesians, $88,000 for Tongans, $93,000 for Papua New Guineans, $102,000 for Ghanaians, and $116,000 for New Zealanders. These are many multiples of per capita income for the developing countries, and considerably higher than the incomes being earned in the home country by return migrants and non-migrants (Table 2, panel B). A simple estimate of the income gain from migration is then just obtained by comparing these two means (A – B mean in Table 2), and shows an annual income gain ranging from $US35,000 for the Micronesians to US$79,000 for the Ghanaians. At a discount rate of 5%

[7] The employment rate is very high among our sample once we exclude students, so we ignore selection into employment.

per year, the gains from spending 30 years working abroad rather than at home would thus range from $532,000 to $US1.27 million.

Typically a simple comparison of migrants and those in the home country would not be very informative about the gains to be had from migration because of concerns about selectivity. In our case, such concerns should be a lot less severe, since we are looking at a group of individuals who are all very similar in terms of ability. To a first-order the non-migrants and return migrants may therefore be a reasonable counterfactual for what the migrants would be earning were they in the home country. Nevertheless, we employ several approaches to examine how robust these estimates are. The first is to control for observable differences through a regression:

$$INCOME_i = \alpha + \beta CURRENTMIGRANT_i + \gamma' X_i + \varepsilon_i \quad (1)$$

We control for age, sex, country of birth (since some of the top students were themselves immigrants), mother's and father's education, and self-assessed family wealth at the end of high school (above average wealth, average wealth, or below average wealth). These variables control for family background characteristics which might plausibly affect both income earned and migration choices. The results are shown as Regression 1 in Table 2. We also consider a second specification, which separates out the return migrants from the non-migrants:

$$INCOME_i = \alpha + \beta CURRENTMIGRANT_i + \delta RETURNMIGRANT_i + \gamma' X_i + \varepsilon_i \quad (2)$$

This specification uses only non-migrants as the comparison group, rather than all individuals working in the home country. We discuss the coefficients on the return migrant dummy in a later section of the paper. Comparing the regression estimates to the simple comparison of means gives broadly similar estimates of the income gains, with the controls having most effect for Papua New Guinea and Tonga.

A second approach is to ask the migrants directly what income they would expect to earn if they were instead working at home. This approach has the advantage of setting the counterfactual as exactly what we would like: the identical individual working at home. These high-skilled individuals seem quite well informed about salary levels in their home countries, and we see, for example, someone who says they would be an academic in the home country reporting they would earn an income similar to those people we actually observe in our data as academics in the home country. Panel C of Table 2 summarizes these answers, while the difference (A - C) is the mean self-assessed income gain from migration. This difference is very similar to the regression estimates for four of the five countries. The exception is Tonga, where the regression estimates of $62,000-69,000 are a little bit lower than the simple difference in means of $76,000-77,000. Nevertheless, the simple difference in means is still well within the confidence intervals for the regression estimates even in this case.

Finally, we attempted to construct instrumental variables for migration. We examined three classes of potential instruments. The first was macroeconomic shocks and political events such as coups; the second was birth-order; and the third was shocks such as parental illness and extreme weather events that occurred when the individual was aged 18 to 22. The latter two categories of variables were only collected for Ghana and Micronesia. We found these types of variables had very low predictive power for predicting current migration, with the only significant first-stage being in Micronesia, where individuals who experienced a typhoon in their home region when aged 18 to 22 were more likely to have migrated (F-statistic of 3.63). The two-stage least squares estimate using this as an instrument gave a similar income gain to that obtained using the other two approaches.

The estimates in Table 2 give the gross income gain from migration at market exchange rates. In Table 3 we examine how these gains change once we allow for cost of living differences and for net, rather than gross, income. The first column repeats the estimate of the gross income gain in U.S. dollars at the market exchange rate, based on regression estimate 2 in Table 2. We do not believe that the International Comparison Program (ICP) PPP rates are the appropriate adjustment for cost-of-living differences among the countries in our study. First, Papua New Guinea, Tonga and Micronesia were not covered by the ICP, and the model used to impute PPP rates for countries not directly surveyed takes no account of population size, remoteness, or ruggedness of terrain, all of which serve to increase prices.[8] Second, the goods and services demanded by these high-earning individuals are likely to differ substantially from the basket of goods used for calculating PPP. For these reasons we consider an alternative cost-of-living adjustment.

The cost-of-living adjustment we use comes from custom tables kindly provided by Xpatulator.com, a commercial service that collects cost of living in 276 global locations, which it uses to assist companies in determining expatriate pay levels and international salary levels in different countries. The overall cost-of-living comparison is based on a comprehensive set of consumption items. Relative to Washington D.C., the cost of living is estimated to be 38.1% cheaper in Tonga, 10.6% cheaper in New Zealand, 4.8% cheaper in Ghana, 14.6% more expensive in Micronesia, and 27.7% more expensive in Papua New Guinea. The higher cost in Papua New Guinea and Micronesia reflects much more expensive communications, recreation, clothing, alcohol and tobacco, and transport costs in these countries.

The second column of Table 3 shows the gross gain using this adjustment. The biggest change is seen for New Zealanders, whose adjusted gain is $25,329 compared to $46,155 without cost-of-living adjustments. This reflects the fact that New Zealand is relatively cheaper to live in than the United States, while Australia and the United Kingdom, the other two main destinations for this group, are more expensive. The adjustments are smaller for the four

[8] International Comparison Program (2008).

developing countries, and in some cases high costs-of-living at home are offset by higher costs-of-living in the main destination countries.

These calculations make no adjustment for the relative quality of living conditions in different locations. Xpatulator also provides a second comparison, which incorporates both cost-of-living differences and the hardship experienced by lower quality living conditions in different locations. We asked them to calculate the amount in local currency that would give the same quality of living as someone living on $US60,000 in Washington D.C. and use this to obtain a second measure of the gross gain. Column 3 gives these estimates, which are similar to those using only the cost-of-living adjustment.

Grogger and Hanson (2008) find that post-tax earnings are a stronger correlate of migration than pre-tax earnings. It is therefore instructive to also examine the size of the net income gains, despite the fact that we are unable to measure the government benefits that might accrue to migrants in different locations from paying different tax rates. Column 4 provides the net income increase at market exchange rates, and Column 5 adjusted for cost-of-living. The net income gains are less than the gross gains in absolute terms, but are still considerable. Even after adjusting for cost-of-living differences and taxes, we still estimate the annual gain in income to be $30,000-$45,000 for the four developing countries, and $21,000 for the New Zealanders. There is thus a large economic benefit to the high-skilled individuals from migrating, and the magnitude of this will provide a point of reference for the impacts through other channels seen in the remainder of the paper.

3.2 Human capital formation

In addition to the gain in income from migrating, another important benefit of migration for the migrants is the additional education they can gain abroad. The income gains from migration already include one measure of the economic benefit to the migrants of this additional education, but it is also of interest to look directly at the extent to which education is accumulated through migration. Panel A of Table 4 summarizes the educational levels of the migrants in our sample, focusing on individuals aged 22 and over, who might be expected to have finished their undergraduate studies. We see that almost all these individuals who were academic high achievers in high school have gone on to receive bachelors degrees, the exception being Micronesia, where 2-year associates degree were the highest educational qualification of many. In Tonga and Micronesia, 100 percent of the migrants had received their bachelors education abroad, reflecting the limited tertiary education options in these countries. It is also common for our sample to have gone onto to achieve a more advanced degree such as a masters degree or Ph.D., medical doctorate, or law degree.[9] These advanced degrees are almost exclusively earned abroad: 100% of the Tongan, Micronesian, and Papua New Guinean migrants in our sample with advanced degrees earned them abroad, as did 86% of the Ghanaians and 75% of the New

[9] We classify a law degree as an advanced degree as in some countries it requires an undergraduate degree first, whilst in others it is a longer length undergraduate program than arts or sciences bachelors degrees.

Zealanders. This is despite Ghana, Papua New Guinea, and New Zealand having domestic education systems which offer the possibility of these degrees.[10]

Panel B summarizes the corresponding educational achievements of the individuals currently resident in the five source countries. The proportion with a bachelors degree is similar to that of the migrant group, but lower proportions in each country have an advanced degree. In Tonga and Micronesia the bachelor degrees were mostly earned abroad, whereas in the other three countries they are mostly earned domestically. With the advanced degrees, 28 percent of those in Ghana and 49 percent of those in Papua New Guinea had earned them abroad.

Panel C of Table 4 then reports marginal effects from probit estimation of equation (2), using having a bachelors degree, and having an advanced degree as the outcomes of interest. The coefficients on the return migrant term will be discussed in the next section. We confirm the association between current migration and higher levels of undergraduate degrees among Tongans and Micronesians, although the relationship for Micronesians is not quite significant. There is also a strong and significant positive association between being a current migrant and having an advanced degree for each of the five countries. While part of this might reflect selection, the more limited set of educational choices in the home countries suggests that if many of the individuals had not migrated, they would not have obtained the education that they now have. This is confirmed by directly asking the migrants who are currently studying what they would be doing now in their home country if they hadn't migrated: 0% of the Papua New Guineans, only 12% of the Ghanaians, 13% of the Tongans, and 18% of the Micronesians aged 22 and older who are abroad and currently studying say they would be studying now if in the home country. In contrast, 37% of the New Zealanders say they would still be studying even if they hadn't migrated. This leads us to believe that most of the measured difference in education rates in Table 3, panel C is indeed the true impact of migration on human capital attainment for the individuals from developing countries.

Finally, the recent literature on brain gain (e.g. Mountford, 1997, Vidal, 1998, Stark et al. 1997) has emphasized that the mere prospect of migration can induce individuals to undertake additional human capital investments, even if they don't end up actually migrating. If individuals are obtaining bachelors or advanced degrees for this purpose, then comparing migrants to non-migrants will understate the gain in education attributable to migration. More generally, there may be other improvements in human capital aside from degrees. Our survey asked whether people had taking any additional classes, or changed the subjects they studied in any way during high school to improve their prospects of being able to work or study overseas. The last column of Table 3 shows some evidence of people undertaking such actions, particularly in Ghana, and to a lesser extent in the other developing countries. The main actions taken were to take private lessons, study a language, and take test preparation classes to help pass tests such as the SAT.

[10] The Micronesians with Masters earned at home had earned masters in theology by remote study.

That is, among our sample, any effect is more in terms of what is studied, rather than how much schooling takes place.

4. Empirical evidence on the channels through which high-skilled emigration affects the sending country

We now turn to measuring the economic impacts of migration on the sending countries, attempting where possible to quantify these impacts and evaluate them relative to a counterfactual of what the individual would have been doing had they not migrated.

4.1 Remittances

Remittances are the most salient and researched contribution of emigrants to their home countries. However, there is debate as to the extent to which highly-skilled emigrants remit. Cross-country studies based on macro data have been used to claim the high-skilled remit less (Faini, 2007) whilst recent microeconomic evidence based on surveys of immigrants in a number of destination countries suggests that more educated individuals remit more, with tertiary-educated migrants from poorer countries being more likely to remit than those from richer developing countries (Bollard et al, 2009).

Panels A and B of Table 5 show the incidence and level of monetary and goods remittances that the non-student migrants in our sample are sending to their home countries. Our survey data does show a high incidence of remitting among the migrants from developing countries, with migrants from New Zealand being much less likely to remit. For the Ghanaian sample we can compare our results to the remitting patterns of all Ghanaian migrants in the OECD (Bollard, McKenzie and Morten, 2009). 86 percent of all Ghanaian current migrants are remitting, which increases to 93 percent if we exclude current students. This can be compared to a remitting rate of 66 percent among all Ghanaian migrants in the OECD. The mean annual amount remitted in monetary remittances conditional on remitting for Ghanaians in our sample is US$4,314, compared to US$3,614 for all Ghanaian migrants in the OECD. Thus the high-skilled migrants in our sample are remitting more frequently and sending more when they do remit than average migrants, even if the amount remitted as a share of income is lower.

The unconditional mean and median amount remitted then include the zero remittances for those not remitting. The appropriate counterfactual here is that these individuals would not be remitting if they had not migrated. So the net effect of migration on remittances is simply the unconditional mean. Adding together the monetary and goods remittances gives a total impact of $5,000 annual remittances for Ghanaians, $2,100 for Micronesians, $625 for New Zealanders (monetary remittances data only), $7,232 for Papua New Guineans, and $4,300 for Tongans. These amounts are significant relative to the per capita incomes of the developing countries, with Ghanaian and Papua New Guinean remittances equivalent to about seven times per capita GDP. Nevertheless, the amounts remitted are only a fraction of what the migrants would have been earning at home (Table 2).

4.2 Involvement in Trade and Foreign Direct Investment

After remittances, the financial channels through which high skilled emigrants are often thought to have most positive economic benefits for their home countries are through their involvement in trade and foreign direct investment. The experience of Indian, Taiwanese, and Chinese information technology firms has been used to suggest that a highly skilled diaspora can use their knowledge of the destination country to lower the costs of transacting across countries (Rauch and Trinidade, 2000; Kugler and Rapoport, 2005, Javorcik et al, 2007), and that emigrants can provide venture capital for starting new firms (Saxeenian, 2001, 2002). However, such studies and anecdotal evidence tends to focus on the cases where these linkages have occurred, and do not provide any information as to how common such experiences are, or to whether the experiences of high skilled IT workers from large economies are translatable to the types of countries where brain drain rates are much higher and domestic markets much smaller.

Our survey directly asked emigrants whether, in the past year, they had helped a home country firm make a trade deal, and if so, the value of this deal, and whether they had themselves directly exported goods from their home country to sell overseas, and the value. Panel C of Table 5 summarizes the results. We see that involvement in trade is very uncommon for this group of the best and brightest, with 3 percent of the Ghanaians, 4 percent of the Micronesians and Tongans, and 6 percent of the New Zealanders being involved in trade – the 10 percent figure for Papua New Guinea represents only 1 out of the 10 non-student migrants from this country who answered this question carrying out such activities. One might argue that a low incidence of involvement may still have large overall impact if the occasions where deals are made involve large transactions. For example, one of the Ghanaian migrants in the sample facilitated a 500,000 cedi ($350,000) trade deal with a Ghanaian company, using his knowledge of Ghana to carry out due diligence on the company and his own company abroad to provide concessionary terms in the deal. A second example is the case of a migrant from Papua New Guinea, who met entrepreneurs in China during his work visits there, and informed them about the possibilities of importing vanilla from Papua New Guinea. He then contacted vanilla exporters in Papua New Guinea he knew, and linked them up, with an initial order of $250,000.

We therefore report the conditional mean and median value of these transactions, although note these are based on only one transaction for Papua New Guinea, 4 transactions in Micronesia, and 6 transactions in Ghana. There are a couple of large transactions, one in Papua New Guinea and one in Ghana, which push the conditional means up for these countries. Nevertheless, when we look at the unconditional means, the low frequency of such transactions occurring reduces these means considerably.

Given how rare such trade transactions are, we do not attempt to formally construct a counterfactual for what trade transactions these individuals would have been doing had they not migrated through regression analysis. Instead, we asked the non-migrants the same questions, and take the mean values among non-migrants as the counterfactual. The last column of Table 5

then presents our estimate of the net impact of being a high-skilled emigrant on trade from the home country. For Tonga and Micronesia this net effect is negative, but close to zero: trade was uncommon among the non-migrants and the migrants, but the mean among non-migrants was slightly higher than that above migrants. For Ghana, the mean effect is $5,346, although we can not reject equality to zero. For Papua New Guinea, the one migrant making a trade deal made a large deal, but again we cannot reject equality to zero. Moreover, the value-added of this trade creation will depend on the profit margin of the trade deals – if this is only 10-25 percent of the transaction value, then the mean effect reduces to $500-1000 in Ghana.

Panel D provides the related answers for whether migrants are providing the capital to start up enterprises at home. Again this is infrequent, with 5 percent or fewer of the emigrants from New Zealand, Micronesia and Tonga doing this, and 8 percent of the Micronesians. It is more common in Ghana, but the amounts invested are relatively small – a conditional mean of $18,000 and median of $2,100 for Ghana, suggesting that most of the businesses being invested in are very small, or that the migrant is not providing the main source of financing. Nevertheless, migrants are more likely to be making such investments in most countries than non-migrants are, and so our net effect in the last column, after taking out the mean for non-migrants is typically positive, although we cannot reject that it is zero.[11] In addition, in answer to a separate question, none of the developing country migrants in our sample report holding shares in home country firms, showing that they are not making large investments in existing formally established companies.

In contrast, high-skilled emigrants are much more likely to be consumers of traded products from their home countries, often through what Orozco et al. (2005) term nostalgic trade. 87 percent of Ghanaian non-student migrants in our sample report having purchased Ghanaian food, drink or goods in their destination country, or having ordered goods directly from a Ghanaian retailer for their personal consumption. However, the mean (unconditional) value of goods ordered directly is only $183 and that of Ghanaian products purchased by migrants abroad is $443. Such nostalgic trade is also common among the New Zealand sample, with 87 percent of emigrants engaging in it,[12] but less common amongst migrants from the small island nations: 47 percent of Micronesians engaged in such trade, with an unconditional mean value of such transactions of $337, and only 13 percent of Tongans did, with an unconditional mean value of $36. Given the small numbers of high-skilled migrants in any particular emigrant destination and the small size of these transactions, these high-skilled emigrants are therefore unlikely to spur trade by serving as a significant export market in of themselves.

4.3 Non-financial flows of knowledge

[11] We formally test for equality to zero by regressing the unconditional amount invested on a dummy for being a current migrant, restricting analysis to the current migrant and non-migrant samples of non-students.
[12] The value of such trade was not asked for the New Zealand sample.

In addition to providing financial support to households and firms in their home countries, high-skilled emigrants are often argued to benefit their home countries through knowledge transfer (e.g. Saxeenian, 2002, Newland, 2004, Kugler and Rapoport, 2005, Kerr, 2008). Although we are unable to place a monetary value on this knowledge transfer, our surveys at least allow us to provide empirical evidence on how common different types of knowledge flows are among the best and brightest, and to ask whether in fact emigrants engage in more of these types of knowledge flows than they would be doing had they not migrated.

Panel A of Table 6 presents the results of questions which asked current migrants whether they had engaged in each of a number of different knowledge transfer activities in the past year. The same questions were asked of non-migrants, and panel B therefore presents the net impact, taking non-migrants of the same age range and gender as the counterfactual for what the migrants would be doing had they not migrated. The first two rows of each panel look at knowledge transfer to the national Government and to home country companies. It is not very common for the best and brightest migrants to be providing this advice: only 4 percent of Ghanaian and New Zealand emigrants, 8 percent of Papua New Guineans, and 13 percent of Micronesians and Tongans had advised their governments. The greater incidence in the smaller countries may reflect the greater likelihood of migrants directly knowing policymakers in these small countries, rather than a greater tendency of these governments to reach out actively to their high-skilled emigrants. In panel B we see the net effect is, significantly negative in Ghana, New Zealand and Papua New Guinea, showing that migrants engage in such interactions with the home government less often than non-migrants. There is no significant effect in Tongan or Papua New Guinea. Knowledge transfer to home companies through migrants advising them is similarly infrequent, and has a negative net effect in three of the five countries, which is significant for New Zealanders.

A much more common form of knowledge transfer involves migrants transferring knowledge about opportunities to study and work abroad. Between 30 and 50 percent of high-skilled emigrants from these countries had advised someone in their home country about such opportunities in the past year, thereby aiding others in their migration decisions. Migrants are significantly more likely to be doing this than similar non-migrants from most countries. A more intensive form of migration facilitation is to act as the sponsor for a home country national wishing to work or study abroad. This is most common among Tongans, with 20 percent acting as a sponsor. It is least common amongst New Zealanders, with only 4 percent doing this. Since this is something that can only be done when abroad, the net effect of sponsoring is the same as the gross effect.

Another frequent form of knowledge transfer involves migrants using their knowledge of their home country to advise people abroad about taking a holiday in their home country. 91 percent of New Zealanders, 75 percent of Papua New Guineans, 66 percent of Ghanaians, 56 percent of Tongans and 44 percent of Micronesians have done this. Although our surveys do not permit quantification of the value of new tourism created by such advice, they do show migrants

engaging in this type of tourism promotion much more frequently than non-migrants (with the exception of Micronesia).

Finally, we can examine whether migrants are transferring knowledge to home country researchers through research collaborations. This is not common for Tonga (4%) and Micronesia (8%), where there is little tertiary infrastructure and thus not a large local research community. However, it is somewhat common in Ghana (14%), New Zealand (16%), and Papua New Guinea (25%), showing that there is some evidence of this knowledge transfer. However, of course it is also possible for domestic researchers to work with researchers abroad, and panel B shows that migrants are not significantly more likely to be engaged in a research collaboration involving researchers in the home country and an abroad country than are non-migrants.

4.4 Return Migration

Developing countries are also believed to benefit from return migration, with individuals returning with physical and human capital earned abroad being more productive (Dustmann and Kirchkamp, 2002 and Mesnard, 2004). Return migration is also hypothesized to have broader payoffs to others in the home country through transfer of skills and knowledge gained abroad (Dos Santos and Postel-Vinay, 2003). Whilst much of this literature has focused on return migration in general, rather than return migration of the highest skilled, Zucker and Darby (2007) show high rates of return migration to Brazil, China and Taiwan (at least for sojourns) of top scientists, and Gundel and Peters (2008) show that high-skilled migrants are more likely to remigrate from Germany than low-skilled migrants, although return migration is less for migrants from non-EU countries.

Table 7 presents our estimates of the impacts of return migration in the five countries studied here. The first column presents the income gain estimated relative to non-migrants through the regression in equation (2). If return migrants are more productive (either as entrepreneurs or in wage jobs) we should expect them to be earning higher incomes. The only country with a marginally significant income gain from return migration relative to not migrating is Papua New Guinea. The point estimates are negative in Ghana and Tonga, and positive, but not significant in Micronesia and New Zealand. They are significantly less than the large income gains to be had remaining abroad (Table 2). The standard errors are generally large relative to the mean, reflecting considerable heterogeneity in the wages earned by these high-skilled individuals in their home countries. Therefore we cannot rule out income gains from return migration, but there is not strong evidence for this.

In contrast, we do see return migrants have accumulated additional human capital relative to non-migrants. Columns 2 and 3 present the marginal effects from probit estimation, as in Table 4 panel C. Increased educational attainment is highest for return migrants in Tonga and Micronesia, who have the most limited educational options at home, and lowest for the New Zealanders. In light of these significantly higher levels of education, it is somewhat surprising

that we do not see more significant positive income gains from return migration. One possible reason for this is pay systems which reward tenure rather than productivity, which were a complaint of a good number of respondents in our surveys.

The fourth column of Table 7 provides the mean level of repatriated savings that individuals say they earned abroad and brought back with them when they returned. We do not have absolute savings levels, so cannot compare to a counterfactual of what they would have saved had they remained in their home countries. In Tonga, Micronesia and Papua New Guinea, the amounts are roughly similar in magnitude to annual remittances, and do not suggest migrants are returning with large accumulated wealth that they can use to make sizeable investments in the home country. The amounts are higher in Ghana and New Zealand.

The last columns look at whether return migrants are more likely to be engaging in trade deals, investing in business start-ups, and sharing knowledge than non-migrants. The point estimates are almost all positive, and are significant in a number of cases, providing some evidence to support the idea that return migration has benefits in these areas. Nevertheless, the monetary values of the trade deals and start-up investments are again generally not that large, particular if we were to consider only the profit or value-added of such transactions. Return migrants are more likely to be advising companies, and to be advising others about work and study opportunities abroad.

4.5 Fiscal Impacts

In one of the first academic studies on the brain drain, Bhagwati and Hamada (1974) drew attention to the possible fiscal cost. They noted that highly-skilled emigrants take their education with them, which was funded by taxes on existing residents, but then do not contribute back into the tax system. We would argue that whether or not education is publicly funded is ex post immaterial, since it is a sunk cost when it comes to the time of making a migration decision – what matters is whether the country loses more in the tax revenue it would collect from these individuals than it would spend on them going forward in terms of public services. This depends on how progressive the income taxation and benefits systems of the countries are. We attempt to provide some indication of the likely range of such costs for the countries in our study.

Table 8 details our attempts to calculate the first-order fiscal impact of emigration of the best and brightest. We begin by calculating the income tax that these individuals would be paying if at home. To do this we take the counterfactual income which migrants tell us they would be earning if at home (which we have seen appears to be reasonably accurate), and then use each countries income taxation schedule to calculate the tax per migrant, after which we present the mean and median tax in the table. The countries differ substantially in both tax rates and in the progressivity of their tax schedules. The lowest taxed and least progressive are Tonga and Micronesia. Tonga has a flat tax rate of 10%, and Micronesia has a tax rate of 6% on the first $11,000 and 10% thereafter. Ghana, Papua New Guinea and New Zealand all have higher tax

rates with more steps and progressivity. Ghana's has five tax rates, with a top tax rate of 25% on income above $6,700. Papua New Guinea has six tax rates, with the first step beginning at 22% and with a top tax rate of 42% on income above $89,000. New Zealand has 4 tax rates, with a top tax rate of 38% on income above $57,000. As a result of these low tax rates and low home country incomes, the loss in income tax revenue is only $1000-1200 for Tonga and Micronesia per high-skilled migrant. It is higher in the other three countries: $5,000 in Ghana, $14,000 in Papua New Guinea where the migrants believe they would be earning relatively high incomes at home and getting charged high tax rates, and $17,000 in New Zealand.

This calculation assumes that there is no tax evasion. To check this assumption we compare the difference between reported gross and reported net incomes in each of our five countries to what we would calculate the tax payment to be based on the national tax tables. The actual tax reported by non-migrants and return migrants in their home countries are very similar to what we calculate as the tax they should be paying according to the tax rates. It therefore seems reasonable to assume that migrants would also pay the amount of tax we estimate if they were working in their home countries.

Next, we calculate the sales tax these migrants would have paid at home if they were consuming these counterfactual incomes in their home country. All five countries have sales taxes or goods and services taxes, with tax rates ranging of 5% in Micronesia, 10% in Papua New Guinea, 12.5% in Ghana and New Zealand and 15% in Tonga. The Tongan government estimates that its goods and services taxes apply to approximately 60 percent of household consumption.[13] We assume the same applies to the other three developing countries and to 90 percent of consumption for New Zealand, and that all income is spent to arrive at the sales tax figures in the next two columns of Table 6.[14] This is highest in New Zealand at $7055 per migrant, reflecting the higher incomes and greater coverage of the sales tax net in this country, and lowest in Micronesia where the low tax rate and lower incomes means the lost sales tax revenue is only $383 per migrant.

Offsetting these fiscal costs of high-skilled emigration are two main fiscal benefits. The first is that if monetary remittances are spent on consumption items and the government has a sales tax, then the government gains a share of these remittances. We assume that 100 percent of monetary remittances are spent, and that again 60 percent of this spending is taxable. Whilst there is debate in the literature as to the extent to which remittances are used for non-consumption purposes, surveys typically find at least 80 percent of remittances are consumed, and even investments in say materials for starting a business may be taxable. Nonetheless, because high-skilled migrants remit back considerably less than they would be earning in the

[13] 'Utoikamanu (2006) "Consumption tax: The Tongan experience" http://archives.pireport.org/archive/2007/July/07-27-rp.htm.

[14] Statistics New Zealand estimates that G.S.T. applies to 91 percent of the CPI.

home country, the effective sales tax revenues on remittances are quite small – ranging from only $56 in New Zealand and $41 in Micronesia, to $130-132 in Tonga and Ghana.

In most cases the larger fiscal benefit from emigration will be that the Government does not have to spend on government services for individuals abroad or the family members accompanying them. Table 8 gives the mean household size for the emigrants, which ranges from 2.5 to 4. We then form an upper bound on the fiscal savings by taking the total per-capita government expenditure – this would be the savings if government expenditure was equally distributed across all households in the home country and all spending was variable costs. A possible lower bound on the fiscal savings in many countries can be obtained by taking the per-capita government health and expenditure expenditure, which might be more variable in costs. This may be a lower bound because it ignores the possibility that children of the highly skilled may be more likely to use expensive higher levels of education, and that it ignores any deductions or exemptions that reduce the tax that the highly educated actually pay.

Comparing these costs and benefits leads to our estimates of the approximate net fiscal cost of high-skilled emigration, given in the last two columns of Table 8. We get quite tight ranges on the likely first-order fiscal effects for the four developing countries. In both Tonga and Micronesia the net fiscal cost is at most $500-1000, and would be negative if we used full government expenditure in the calculations. The fiscal costs are low in these countries because they have low income tax rates that are not very progressive, sales taxes are quite small because of low rates and low incomes, and the government per-capita spending is not much less (Tonga) or greater (Micronesia) than the estimated income tax take from even these highly skilled individuals. This reflects the reliance of Micronesia on grants from the U.S. (tax revenue is only 21% of total government revenue) and of Tonga on indirect taxes and grants.

In Ghana we estimate a net fiscal cost of between $5,450 and $6,300 of high-skilled emigration. These bounds are quite tight, since Ghana's per capita government expenditure is so low – Ghana has a progressive income taxation system which collects far more in income taxes from the highly skilled than it is paying out in benefits. Our bounds are even tighter in Papua New Guinea, ranging from $16,500 to $16,900. Again in this case per capita government expenditure is extremely low, and income tax rates on high incomes are quite high – so the fiscal cost greatly exceeds the fiscal benefits.

Our range of estimates is much wider for New Zealand, ranging from -$6,115 to $12,950, depending on how much of per capita government expenditure actually goes to the highly skilled. Crawford and Johnson (2004) provide a more detailed analysis of the receipt of government benefits by decile in New Zealand for the year 1997/98. Because of New Zealand's highly progressive government spending patterns, households in the top three deciles were estimated to receive only approximately $6,700 per household. Health and expenditure spending approximately doubled between 1998 and 2008, so doubling this figure gives a per household expenditure of approximately $13,400 – which is relatively close to our proxy of $11,302 when

using per capita health and education spending. This gives our best estimate of the fiscal loss to New Zealand of high-skilled migration at $10,000 per high-skilled migrant who leaves.

We acknowledge that there are a number of simplifying assumptions in making these calculations, but we believe they capture the first-order magnitudes. They show how much the fiscal cost depends on the progressivity of the income tax system, the role of sales taxes in allowing migrant-sending countries to receive some fiscal benefit from remittances, and some sense of the fiscal benefits. What is noticeable is how small these fiscal costs are relative to the income gains estimated to the migrants themselves in Table 2.

4.6 Externalities

These findings enable us to come close to being able to estimate the first-order net economic effect of highly-skilled emigration on individuals from developing countries.[15] The one key effect we cannot measure is the uncompensated externalities of high human capital. Such externalities have been at the heart of brain drain debate since the beginning. Grubel and Scott (1966) noted that if labor markets are competitive and individuals paid their marginal product, then if there were no externalities, the departure of highly skilled emigrants would not reduce the welfare of those left behind. Bhagwati and Hamada (1974, p.19) made the case that such externalities could be important with "doctors and exceptionally gifted academics about whose emigration typically the underdeveloped countries seem to worry", although Bhagwati (1998, p.9) subsequently notes that externalities are the "first refuge of the scoundrels" in policy debates, with the evidence as to their existence, let alone magnitudes, rather scant.

How big might these externalities be? Despite costly public subsidies to higher education around the world that are often motivated by a claimed importance of human capital externalities, empirical evidence on these externalities is fragmentary and often contradictory. In a careful, balanced review, Davies (2003) considered the empirical evidence for dynamic externalities, static market externalities and static non-market externalities. In terms of percentage points of rates of return (to add on to Mincerian private rates of return of around 8-10 percentage points), the most credible estimates of dynamic externalities were 1-2 percentage points, the static market externalities were zero and the static non-market externalities around 3-4 percentage points.

The evidence for dynamic externalities, of whether schooling causes growth, has been the most controversial in this literature. Positive human capital externalities should show up as higher macroeconomic returns to education (e.g. from an augmented Solow equation) than microeconomic returns (e.g. from a Mincer equation). Yet using this approach, Pritchett (2001)

[15] There are of course a large number of social impacts from migration, such as changes in access to cultural and travel opportunities, in access to amenities, in opportunities to consume certain products, and in impacts on relationships with family and friends. We do not attempt to value these factors in this paper, but acknowledge their importance in driving migration decisions.

finds that the estimated growth impact of education is consistently less than what would be expected from the individual impacts, suggesting negative externalities. Similarly, Bils and Klenow (2000) find that most of the observed aggregate relationship between schooling and growth runs from expected growth to schooling, rather than the opposite way of schooling causing growth.

In terms of static market externalities, one approach has been to augment Mincer equations with a term for the average education of the neighborhood, city or state the individual lives in. For example, Rauch (1993) found that after controlling for own-education, there was still an additional three percent increase in wages for each additional year of average education in the metropolitan area an individual lived in. However, when Acemoglu and Angrist (2000) instrument for average education, using variation in states minimum school leaving ages, this apparent positive spillover disappears.

Other compelling micro evidence on how proximity to highly skilled peers affects individual productivity comes from the random assignment of college roommates. One widely cited study found significant peer effects only for individuals in the middle of the skills distribution (proxied by SAT scores) whose GPA would be raised by about 2 percent when they have a roommate in the top 15% rather than the bottom 15% of the skills distribution (Zimmerman, 2003). In a less selective setting, which also has majors declared before freshman year, larger roommate effects were estimated for students in engineering, mathematics and natural sciences but not at all for students in humanities and social sciences (Brunello et al, 2010). This possibly reflects the ease of copying homework for questions with "right" answers in the hard sciences, which is an externality unlikely to generalize to the economy-wide level. Similarly credible evidence of productivity spillovers in workplaces is mainly limited to single low-skilled occupations where data on effort and output are reliably measured, such as check-out (Mas and Moretti, 2009) and data entry (Kaur et al, 2010) operators. These studies find productivity spillovers to be very local and to be due to social pressure that leads to increased work effort rather than from greater output per time unit that may reflect learning.

Studies that invoke non-market benefits of education often rely on a compilation of effects on outcomes such as civic participation, crime, fertility, health, longevity and political stability that were first summarized by Haveman and Wolfe (1984). These authors concluded that if these non-market effects were counted, they may double the social rate of return to education. However many of the studies summarized could not adequately control for selectivity, in the form of family unobservables that cause both higher educational attainment and desirable social behavior, and so likely overstate the benefits of education. More compelling approaches, using intra-twin differences to control for unobservables, find negative rather than positive effects of education (Gibson, 2001).

Thus the existing literature suggests that the value of the externalities is likely to be relatively small in terms of productivity spillovers and social benefits. However, the above studies do not

get at the externalities on health of medical professionals, which is the source of some of the strongest concerns about brain drain. Only 5 percent of current migrants from Papua New Guinea, 6.6 percent from Micronesia, 7.7 percent from New Zealand, 14.4 percent from Ghana and 15.5 percent from Tonga are in the health field. We do not know of any credible microeconomic study which identifies the externality of a health professional. At a more aggregate level, Clemens (2007) finds no evidence of a relationship between the rate of health professional emigration and health outcomes in Africa, although Bhargava and Docquier (2008) find an association between emigration and adult deaths from AIDS in high HIV incidence countries. Given the low incidence of health professional migration in our sample, and that the HIV incidence rates in the countries studied are not in the high category, it therefore also seems likely that the health externalities from brain drain of the best and brightest are small.

Combining the different channels we have looked at, we see that the positive effects of remittances, trade creation, and investment in business start-ups are typically of the same or larger magnitudes than the fiscal costs. Therefore in order for externalities to make the overall net impact of high-skilled migration negative for people from the sending countries, we would need the externalities to exceed the $50,000 or more per year that migrants gain from migrating.

This would mean the externalities of high-skilled workers would have to be more than double or triple their private returns in the developing countries studied. Whilst conceivable, this would greatly exceed any measured externality we are aware of in the literature. Even taking the high range of externality estimates, of 5 percent per year of education, and applying them to 16 years of education, still would give an externality equal to 80 percent of the home country average unskilled wage – which is therefore in the order of $800 a year in the developing countries studied, or only 2 percent of the private gains.

5. Conclusions

The number of highly educated emigrants from developing countries living in the OECD doubled between 1990 and 2000 (Docquier and Marfouk, 2005), and has continued to grow over the past decade as developed countries have increasingly made their immigration criteria more skill-selective. As policymakers in high emigration countries watch the departure of many of their most talented citizens, they both worry about the potential costs of this "brain drain" for development in their country as well as wonder about the possibilities offered by having a diaspora of the elite who can send remittances and facilitate trade, investment, and knowledge exchanges. Our goal in this paper has been to provide the first systematic microeconomic empirical evidence as to how common these key channels of interaction between migrants and their home countries are, and what the economic costs and benefits appear to be in practice.

Our results show large positive benefits of high-skilled migration for citizens of high emigration countries. The largest benefits are to the migrants themselves, who benefit through massive gains in income and through greater human capital. High-skilled individuals from

poorer countries do typically remit, but it is rare for them to engage in trade or foreign direct investment. They engage in plenty of knowledge transfer in terms of helping others learn about study and work opportunities abroad, but do not frequently advise their local governments or businesses in their home countries. Return migration is common, and we find return migrants more likely to be engaging in knowledge transfer than non-migrants. The main cost we measure is the fiscal cost of emigration. We show how this varies significantly with the progressivity of the tax system and size of government expenditure, with minimal tax implications in Tonga and Micronesia, and possible fiscal losses from high-skilled emigration of $6,300 per high-skilled migrant per year for Ghana, $10,000 for New Zealand, and $16,900 for Papua New Guinea. These measured benefits greatly exceed the measured costs, suggesting that on net high-skilled migration is improving the living standards of individuals born in countries with high-levels of emigration.

There are two caveats to this conclusion. The first is that we are not able to accurately measure the distributional consequences of this high-skilled migration, since our sample is only of the best and brightest. Nevertheless, the size of the net gains is so large, that these distributional impacts are likely to be of second-order in any welfare calculations. Secondly, our analysis is restricted to a set of relatively small countries which face high levels of emigration. The impacts of high-skilled emigration are likely to be quite different for large countries such as China and India. Ours is the first comprehensive micro-level assessment of the channels through which high-skilled emigration operates, and we see it as a productive area for future research for this approach to be extended to other countries, and potentially to other sample frames of interest other than the top academic achievers.

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Table 1: Sample Sizes, Response Rates, and Migration Rates

Country	# in sample frame	# of survey respondents	Survey Rate	Current Location known: Number	%	% female	# of current migrants	% of 22+ who ever migrated	% of 22+ who are current migrants
Ghana	1851	283	15.3	605	32.7	36.6	106	59.9	37.6
Micronesia	472	157	33.3	319	67.6	59.2	65	84.1	41.4
New Zealand	851	371	43.6	476	55.9	39.9	155	67.8	44.4
Papua New Guinea	691	236	34.2	298	43.1	34.2	22	36.8	9.5
Tonga	266	193	72.6	245	92.1	52.3	98	85.7	48.2
Total	4131	1240	30.0	1943	47.0	39.4	446	64.6	35.8

Notes:

% female, number of current migrants, % of 22+ who ever migrated and who are current migrants pertains to the sample, not the population.

Table 2: Annual Gross Income Gain from Migrating at Market Exchange Rates

	A: Annual income abroad of current migrants (USD)		B: Annual income at home of return and non-migrants (USD)		C: Annual income current migrants expect to earn at home (USD)		Estimate of Annual Income Gain				
	Mean	Median	Mean	Median	Mean	Median	A-B Mean	A-C Mean	Regression Estimate 1	Regression Estimate 2	2SLS Estimate
Country	(S.D.)		(S.D.)		(S.D.)				(Std. Err.)	(Std. Err.)	
Ghana	101696	76986	22565	13712	24627	14064	79131	77069	73883	72878	n.a.
	(87543)		(30468)		(38159)				(12524)	(13820)	
Micronesia	57261	44200	22286	18200	17205	20000	34975	40057	35538	42135	40773
	(43044)		(15631)		(9716)				(7596)	(8920)	(33245)
New Zealand	115505	83707	75139	61077	65614	60753	40365	49890	44788	46155	n.a.
	(89287)		(51249)		(33696)				(9484)	(10943)	
Papua New Guinea	92660	73500	24623	13710	43061	28599	68038	49599	42942	48803	n.a.
	(60187)		(27655)		(36373)				(18647)	(18453)	
Tonga	88156	60991	12593	8772	11325	9640	75563	76832	68991	62436	n.a.
	(96201)		(15986)		(10099)				(22536)	(20275)	

Note:

All estimates are for individuals currently employed and who are non-students

Regressions control for 5-year age groups and sex, country of birth, mother and father's education, and self-assessed family wealth at the end of high school. Estimate 2 also contains a dummy variable for being a return migrant.

Instrumental variable for Micronesia is experiencing a typhoon in their home region when aged 18 to 22, first stage F-statistic is 3.63 (p=0.06).

Table 3: Alternative Measures of Income Gain

	Gross Gain Table 2 Reg. estimate 2	Gross Gain adjusted for cost-of-living	Gross Gain adjusted for cost-of-living and hardship	Net Gain at Market Exchange Rates	Net Gain adjusted for cost-of-living and hardship
Ghana	72878	63128	67141	49952	45619
	(13820)	(14475)	(14240)	(9681)	(9826)
Micronesia	42135	46339	46214	32019	34735
	(8920)	(9677)	(9166)	(6663)	(6718)
New Zealand	46155	25329	32771	33536	21258
	(10943)	(11749)	(11131)	(7126)	(6899)
Papua New Guinea	48803	35700	37646	47559	29590
	(18453)	(7914)	(7082)	(20058)	(5417)
Tonga	62436	65339	59522	47777	41723
	(20275)	(25863)	(23619)	(13258)	(14511)

Notes:

Cost-of-living adjustment and hardship adjustments provided by Xpatulator.com. See text for details on what these measure. Net gains reflect reported income tax paid by survey respondents in each country.

Table 4: Human Capital Formation of individuals aged 22 and older

	Bachelor's Degree		Masters, Law, Medical Doctor, or PhD Degree		Proportion
	Proportion who have this qualification	Proportion of those with this qualification who earned it abroad	Proportion who have this qualification	Proportion of those with this qualification who earned it abroad	who took actions due to prospect of migration
Panel A: Migrants					
Ghana	0.99	0.39	0.73	0.86	0.29
Micronesia	0.50	1.00	0.18	1.00	0.19
New Zealand	1.00	0.13	0.77	0.75	0.07
Papua New Guinea	0.91	0.25	0.64	1.00	0.10
Tonga	0.84	1.00	0.42	1.00	0.14
Panel B: Individuals in Home Country					
Ghana	0.98	0.06	0.49	0.28	0.32
Micronesia	0.40	0.90	0.16	0.83	0.16
New Zealand	0.99	0.01	0.57	0.19	0.08
Papua New Guinea	0.86	0.10	0.30	0.49	0.16
Tonga	0.69	0.95	0.34	1.00	0.20

Panel C: Estimates of the Impact of Being a Current Migrant on Educational Attainment

	Likelihood of having a bachelors degree		Likelihood of having an advanced degree	
	Coefficient	Standard error	Coefficient	Standard error
Ghana	n.a.		0.280***	0.070
Micronesia	0.251	0.157	0.848***	0.057
New Zealand	n.a.		0.259***	0.057
Papua New Guinea	0.092	0.058	0.451***	0.117
Tonga	0.551***	0.129	0.805***	0.049

Notes: Panel C estimates are marginal effects from probit estimation for the sample aged 22 and above, with 5-year age groups, gender, country of birth, parental education, and family wealth while in high school as controls

*, **, and *** indicate significance at the 10%, 5% and 1% levels respectively.

n.a. indicates estimate not available due to almost everyone having a bachelors degree

Table 5: Annual Monetary Flows from Migrants to Home Country

	Proportion who sent flow		Annual Value in USD				Net effect after
	All current migrants	Non-student current migrants	Conditional Mean	Conditional Median	Unconditional Mean	Unconditional Median	subtracting mean for non-migrants (USD)
Panel A: Monetary Remittances (annual)							
Ghana	0.86	0.93	4334	2109.6	3732	1758	3732***
Micronesia	0.69	0.68	2187	1000	1359	500	1359***
New Zealand	0.24	0.26	2476	486	625	0	625***
Papua New Guinea	0.89	0.90	6099	2681	6085	2681	6085***
Tonga	0.63	0.76	4682	2651	3122	1446	3122***
Panel B: Goods and In-kind Remittances (annual)							
Ghana	0.74	0.75	1935	703	1290	352	1290***
Micronesia	0.67	0.68	625	450	577	400	577***
New Zealand	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
Papua New Guinea	0.90	0.91	1355	536	1232	357	1232***
Tonga	0.63	0.61	2506	1446	1319	482	1319***
Panel C: Help a home country firm make a trade deal or exported goods from home country to overseas in last year							
Ghana	0.02	0.03	100734	25666	5596	0	5436
Micronesia	0.07	0.04	2918	325	307	0	-147
New Zealand	0.04	0.06	n.a.	n.a.	n.a.	n.a.	n.a.
Papua New Guinea	0.14	0.10	250244	250244	25024	0	24939
Tonga	0.03	0.04	2555	2555	91	0	91
Panel D: Invested in a business start-up in the home country in last year							
Ghana	0.17	0.22	18002	2110	3750	0	2445
Micronesia	0.04	0.05	30050	30050	1582	0	893
New Zealand	0.02	0.02	n.a.	n.a.	n.a.	n.a.	n.a.
Papua New Guinea	0.14	0.08	537	537	45	0	-5
Tonga	0.05	0.04	4844	4844	404	0	404

Notes: Values are for sample of migrants who are not currently students.
Goods remittances and the value of trade deals and value of business start-ups were not asked of the New Zealand sample.
*, **, and *** indicate net impact is significantly different from zero at the 10, 5 and 1 percent levels respectively.

Table 6: Annual Non-financial flows

Panel A: Proportion of current migrants who are not students engaging in activity in last year

	Ghana	Micronesia	New Zealand	Papua New Guinea	Tonga
Provided advice to national Government	0.04	0.13	0.04	0.08	0.13
Advised a home country company	0.16	0.10	0.06	0.25	0.08
Provided advice about study abroad	0.53	0.54	0.26	0.58	0.36
Provided advice about work abroad	0.42	0.44	0.42	0.83	0.44
Sponsored home country national to work/study abroad	0.08	0.13	0.04	0.08	0.20
Carried out research with people in home country	0.14	0.08	0.16	0.25	0.04
Acted as an official representative an overseas event	0.10	0.08	0.05	0.25	0.16
Advised people overseas about a holiday in home country	0.66	0.44	0.91	0.75	0.56
Member of a diaspora or emigrant organization?	0.23	0.18	0.18	0.09	0.00

Panel B: Net impact relative to non-migrants

	Ghana	Micronesia	New Zealand	Papua New Guinea	Tonga
Provided advice to national Government	-0.16***	0.18	-0.08*	-0.26**	-0.01
Advised a home country company	-0.13	0.08	-0.29***	-0.26	0.02
Provided advice about study abroad	0.18**	-0.03	0.13**	0.36**	0.04
Provided advice about work abroad	0.14	-0.10	0.28***	0.62***	0.09
Carried out research in a home/abroad collaboration	0.04	0.03	0.02	0.13	-0.12
Acted as an official representative an overseas event	0.07	-0.11	0.01	0.10	0.11
Advised people overseas about a holiday in home country	0.29***	-0.03	0.41***	0.51***	0.16

*, **, and *** indicate significance of net impact at the 10, 5 and 1 percent levels respectively. Net impact is coefficient on current migrant in a linear regression of the outcome on migration status, sex, and five year age group.

Table 7: Impacts of Return Migration

	Income Gain (USD)	Having a Bachelors Degree	Having an Advanced Degree	Repatriated Savings Mean (USD)	Trade Deals (USD)	Invested in Business Start-up (USD)	Advise Govt.	Advise Company	Advise on work abroad	Advise on study abroad
Ghana	-2067	n.a.1.	0.210**	24639	574	3641	0.05	0.19**	0.33***	0.28***
	(9618)		(0.078)		(616)	(2306)	(0.07)	(0.09)	(0.10)	(0.10)
Micronesia	8463	0.206	0.686***	3384	27320	364**	0.34***	0.32***	0.21	-0.08
	(5898)	(0.152)	(0.054)		(34237)	(179)	(0.12)	(0.11)	(0.13)	(0.15)
New Zealand	2871	n.a.1.	0.101	53707	n.a.2	n.a.2.	0.08	-0.07	0.34***	0.14*
	(8877)		(0.066)				(0.05)	(0.07)	(0.08)	(0.08)
Papua New Guinea	9089*	0.056	0.333***	4697	9912**	6065	0.28***	0.01	0.35***	0.51***
	(5331)	(0.060)	(0.096)		(4307)	(4766)	(0.07)	(0.10)	(0.09)	(0.09)
Tonga	-8670	0.455***	0.957***	7828	2499	482	0.23	0.29**	0.11	0.43***
	(21788)	(0.097)	(0.025)		(3202)	(410)	(0.14)	(0.12)	(0.16)	(0.16)

Notes:

n.a.1. denotes not available due to almost all having a bachelors degree.

n.a.2. denotes not available due to values not being asked.

Table 8: Annual Fiscal Effects

	Fiscal Costs of Emigration				Fiscal Benefits of Emigration						
	Income Tax Migrants Would pay if at home		Sales tax migrants Would pay if at home		Sales tax if remittances consumed		Mean Household	Per-capita Govt.	Per-capita Govt. health &	Approx. Net Fiscal Cost Using full	Using health
	Mean	Median	Mean	Median	Mean	Median	Size	Expenditure	education expenditure	govt. exp.	& edn. Exp.
Ghana	4999	2430	1655	791	280	132	3.12	290	20	5469	6312
Micronesia	965	600	383	300	41	15	3.08	1378	259	-2939	509
New Zealand	17255	14450	7055	6379	57	0	2.50	12147	4521	-6115	12950
Papua New Guinea	14537	8547	2588	1719	131	58	4.00	134	21	16458	16910
Tonga	1204	964	1083	868	281	130	3.60	784	257	-815	1081