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Emigration and Brain Drain: Evidence from the Caribbean

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Abstract

This paper quantifies the magnitude and nature of migration flows from the Caribbean and estimates their costs and benefits. The Caribbean countries have lost 10–40 percent of their labor force due to emigration to OECD member countries. The migration rates are particularly striking for the high-skilled labor force. Many countries have lost more than 70 percent of their labor force with more than 12 years of completed schooling—among the highest emigration rates in the world. The region is also the world's largest recipient of remittances as a percent of GDP. Remittances constituted about 13 percent of the region's GDP in 2002. Simple welfare calculations (under very conservative assumptions of elasticities) suggest that the losses due to high-skill migration (ceteris paribus) outweigh the official remittances to the Caribbean region.

KEYWORDS: Caribbean, emigration

I. INTRODUCTION

While a vast theoretical and empirical literature considers the impact of immigration on destination countries, little work has been done on emigration and its impact on source countries.[1] This is surprising because the shares of the labor force leaving many individual source countries is considerably higher than the proportionate changes in the labor force of many receiving countries due to immigration.

In several source countries, the reduction in the labor force due to emigration to the United States is in the range of 7–27 percent. To cite a few examples, the labor forces in Barbados; Belize; El Salvador, Guyana, and Jamaica have been reduced by 20 percent or more due to emigration to the OECD. The labor force in countries like Turkey and Algeria has been reduced by about 10 percent due to emigration to Western Europe.[2] In comparison, immigrants constitute about 12 percent of the United State labor force (Davis and Weinstein, 2002). Immigration is considered to be a very important issue for the United States, and has attracted a great deal of attention in the literature.

Given the comparable magnitudes of emigration, it is surprising that little empirical research evaluates the impact on source countries. Some recent papers look at the impact of emigration on source countries.[3] This literature focuses mainly on large countries (like Mexico). A very important region that has eluded this literature is the Caribbean. This paper quantifies the magnitude and nature of migration flows from the Caribbean and estimates their costs and benefits.

The Caribbean region is an excellent case to study the effects of emigration as it has the highest emigration rates in the world. Docquier and Marfouk (2005) have documented the shares of the labor force in several source countries that have emigrated to Organization for Economic Co-operation and Development (OECD) member countries.[4] About 12 percent of the labor force in the Caribbean region has migrated to OECD member countries—much higher than Central America which ranks second at 7 percent. In terms of the absolute number of migrants, emigration from India and China, for example, is much

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[1] See Borjas (1994, 1995) and Friedberg and Hunt (1995) for surveys of the empirical literature. The theoretical literature on international movement of factors includes, for example, Bhagwati and Hamada (1974), Rivera-Batiz (1989), and Quibria (1989).

[2] Substantial migration also takes place to the Persian Gulf region from many countries that has not been well documented. Sources: U.S. Census; OECD Migration Statistics; and World Bank, World Development Indicators.

[3] See Mishra (2007), Hanson (2003), Hanson et al. (2002), and Desai et al. (2002).

[4] The OECD member countries include industrial countries and emerging markets like Mexico and Turkey. For the complete list of OECD countries in the dataset, see Docquier and Marfouq (2005), page 13.

greater, but their labor force is so large that the migrants constitute a very small proportion of the labor force.

The aggregate emigration rates, however, understate the loss of the educated population. The literature on immigration to the United States suggests that immigration has increased, by the greatest proportion, the supply of workers with 0–8 years of schooling (Borjas et al., 1997). However, a sharp contrast exists when we look at migration from the perspective of source countries. For most source countries and especially for the Caribbean, the percentage reduction in the labor force is much larger in the higher-schooling categories. A majority of Caribbean countries have lost more than 50 percent of the labor force in the tertiary education segment, and more than 30 percent in the secondary education segment (9–12 years of schooling). For example, the tertiary educated labor force (with more than 12 years of schooling) in Jamaica and Guyana has been reduced by 85 percent and 89 percent respectively, due to emigration to OECD member countries. Haiti has the lowest aggregate emigration rate (about 10 percent) in the region, but the tertiary-educated labor force has been reduced by 84 percent due to emigration to OECD member countries. In fact, almost all the Caribbean nations are among the top 20 countries in the world with the highest tertiary-educated migration rates (Docquier and Marfouk, 2005). The magnitude of these migration rates suggests that potentially emigration can have large impacts on the local labor markets and on the welfare of those who stay behind in the Caribbean countries.

The simple labor demand-supply framework suggests that changes in domestic labor supply and wages due to emigration lead to a net welfare reduction (termed an "emigration loss") for the producers and workers who have stayed behind (Figure 1). The welfare loss occurs due to the movement of inframarginal workers (i.e., those who are paid less than their marginal product). The concept is analogous to the idea of immigration surplus that exists in the migration literature (Borjas, 1995). The concept was first given by MacDougall (1960) in the context of capital flows.

There are several other costs of high-skilled emigration. Highly-skilled workers often confer externalities to those stayed behind by affecting their productivity through transfer of know-how and also through better monitoring and motivation. If high-skilled workers confer a positive externality, then the loss due to their migration will be higher than the simple emigration loss. The *augmented emigration loss*—the emigration loss that takes into account the decline in productivity of those stayed behind due to emigration of the high-skilled labor force—is estimated in the paper. Another important consideration in assessing the costs of migration is the education subsidies that finance the education of the migrants. The public expenditure on education of migrants is a loss to the source

country, due to the opportunity cost to this expenditure in terms of the foregone expenses on public goods or higher tax rates to finance the expenditure.

At the same time, emigration confers many benefits on source countries. One of the most important measurable "benefits" to the source countries are transfers from abroad or remittances. Most Caribbean countries rank among the top 30 countries in the world with the highest remittances as a percent of GDP. The Caribbean is the world's largest recipient of remittances, as a share of GDP. Remittances constituted about 13 percent of the region's GDP in 2002.

The main result in the paper is that the *total losses* due to skilled migration (which includes the "emigration loss," externality effects, and government expenditure on educating the migrants) outweigh the recorded remittances for the Caribbean region on average, and for almost *all* the individual Caribbean countries. The comparison of the welfare losses with remittances in this paper is subject to the caveat that the measurement of remittances is subject to data deficiencies. Most importantly, measured remittances do not include transfers through informal channels such as those carried by hand or by friends or family, or in-kind remittances of jewelry and consumer goods.[5]

The calculations in the paper are not sufficient to conclude one way or the other about the *overall* impact of emigration. Migration has many other costs and benefits, the measurement of which is beyond the scope of the paper. For example, benefits to source countries exist because of the migrant networks. Migrant networks can lead to more trade and investment (Rauch and Trinidade, 2002). Emigration can also induce human capital formation in the source country by raising the expected returns from education (Beine et al., 2003). On the cost side, migration can result in a fiscal loss from the foregone tax revenue that would have accrued if the migrants had stayed behind (Desai et al., 2002). All these issues have been addressed in the literature, albeit separately.

Broadly three strands of literature are related to this paper. The first strand of literature consists of papers on immigration that quantify welfare effects of immigration into the United States, (Borjas (1995), Davis and Weinstein, (2002)). This paper uses techniques similar to Borjas (1995) study of immigration. In addition to the techniques used in the previous literature, this paper also includes the cost of education subsidies to the source countries in calculating the losses. The second strand of literature consists of recent papers that quantify the impact of emigration on source countries. These papers look at the impact on large source countries such as Mexico and India (Chiquiar and Hanson (2005), Desai et al., (2002), Mishra (2007)). One of the important regions that has not been included in these papers is the Caribbean. As argued above, the potential impact of

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[5] For details on issues regarding measurement of remittances, see IMF (2005).

emigration is likely to be large for the Caribbean countries. The third set of papers focus on migration from the Caribbean. The Caribbean countries have historically experienced large-scale migration. Some papers look at the history of Caribbean migration (Carlson (1994)**,** Duany (1994)). Some papers also document the flow of remittances and discuss the potential impact (Wood and McCoy (1985), Samuel (2000), and Connell and Conway (2000)).

This paper is the first to quantify the welfare impact of skilled emigration on any source country, taking into account the external effects and the costs of education subsidies. This paper differs from the existing literature on Caribbean migration by bringing all three strands of the literature together using very detailed datasets. This paper uses a very detailed dataset compiled by Docquier and Marfouk (2005) on emigration rates, which they construct using census data from a number of OECD member countries. Since the United States is a major destination for Caribbean migrants, the emigration rate to the United States is also estimated separately, using data from the U.S. Census and the New Immigrant Survey (NIS, 2003). The New Immigrant Survey, 2003 is a new survey of legal immigrants in the US, which includes the migration and schooling histories of the migrants. Also, none of the existing papers on Caribbean migration have looked at the composition of emigration rates by skill level.

The rest of the paper is organized as follows: Section II presents the theoretical framework for the welfare calculations, Section III discusses the data and the evidence on emigration from the Caribbean, and Section IV presents the results from the welfare calculations. Section V concludes.

II. THEORY

The quantitative estimates of the gains and losses resulting from emigration must rest on prior conceptualization of these gains and losses. Several costs and benefits of migration accrue to both the recipient as well as source countries.

A. Losses Due to Emigration: A Simple Labor-Demand Framework

The simple economic model of labor demand and supply is an important starting point to quantify the welfare implications and has been used in the literature in the context of immigration and capital flows (MacDougall (1960), Borjas (1995)). The aim here is to quantify the welfare loss due to movement of labor, everything else remaining unchanged.[6] Welfare is measured by GDP

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[6] Davis and Weinstein (2002) simulate the welfare impact due to inflow of both labor and capital into the United States.

accruing to those who have stayed behind in the source country. Consider a single numeraire good whose production function is given as:

$$Q = F(K, L),$$ (1)

where K is the fixed factor assumed to be internationally immobile, L is the labor employed in production and Q is the gross domestic product. Figure 1 shows the simple model of labor demand and supply. The initial equilibrium wage is w_0. A large emigration flow of a magnitude M of workers reduces the labor force from $(N+M)$ to N. The wage rate as a result increases from w_0 to w_1. The workers who have stayed behind gain an area equal to $w_0 w_1 ab$ (rectangle region A), owners of the fixed factors in the economy lose an area equal to $w_0 w_1 ac$ (rectangle region $A+$ triangle region B) and the country as a whole loses the triangle abc (region B). The triangle abc (region B) can be termed as the "*emigration loss.*" The emigration loss arises because the cost of employing the inframarginal workers who migrate is less than the value of their marginal product. The surplus on these workers is therefore lost due to emigration, which imposes a cost on those who have stayed behind. [7]

Following Borjas (1995), the estimated welfare loss to the source countries as a percent of GDP can be expressed as:

Emigration *loss* (triangle B in Figure 1) $= (1/2) s_L e m^2$, (2)

Gain to the workers who have stayed behind $= s_L e m (1 - m)$ (3)

Loss to the owners of the other factor $= s_L e m (1 - \frac{1}{2} m)$ (4)

where e is the magnitude of elasticity of factor price of labor (i.e., the percentage change in wage resulting from a 1 percent change in the size of the labor force),

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[7] Another possible loss accrues to those who have stayed behind, which is not captured in the simple competitive framework (I would like to thank an anonymous referee for pointing out this channel). Had the migrants stayed in the home countries, they would have made transfers to their family members out of their earned income. This is an additional channel through which the family members who stay behind lose, which is not included in Figure 1. In the simple framework, it is assumed that the income earned by the migrant accrues only to him/her and not to those who have stayed behind, and hence is not a part of the emigration loss. Of course, it is possible that the lost transfers to the family members can be compensated by remittances sent back by the migrants.

m is the fraction of the labor force that has migrated, s_L is the share of labor in GDP.

Figure 1: Labor Demand-Supply Model: Welfare Impact of Emigration
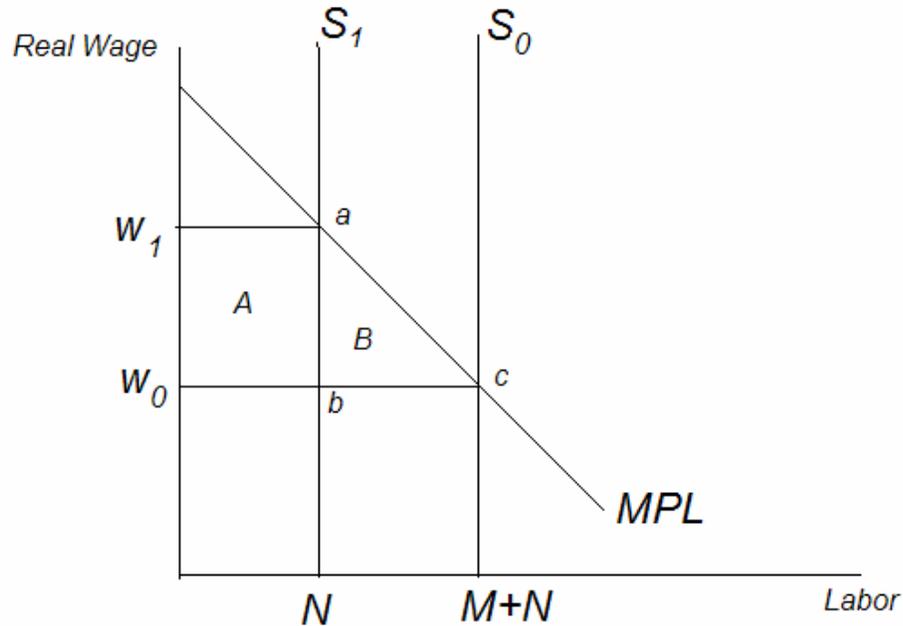
B. Measurement of External Effects

Even if the triangle emigration losses are of second order, the overall emigration loss can be substantial if emigration leads to a decline in the productivity of those who have stayed behind. Qualified doctors, engineers, researchers are not only more productive themselves but are also expected to make other workers in the economy more productive. External effects have been considered important in the immigration literature. Borjas (1995) calculates the "immigration surplus" in the presence of external effects. Borjas finds that immigration surplus increases substantially in the presence of external effects. However, unlike Borjas (1995) which looks at overall immigration rate, this paper focuses on external effects due to high-skilled emigration.

If skilled labor is complementary to the other factors, then the production function can be expressed as:

$$q = f(l_S, l_u) L_S^{\gamma} \tag{5}$$

where q is the representative firm's output, l_S and l_u are the skilled and unskilled labor employed by the representative firm, L_S is the aggregate stock of skilled labor employed in the economy, and γ is the percentage change in marginal product of skilled and unskilled labor due to a 1 percent change in the aggregate stock of skilled labor. As skilled migrants leave the economy, the marginal product of both skilled and unskilled labor decreases i.e. the emigrants confer a negative externality on those who stay behind. With this production function that accounts for external effects, emigration not only reduces the supply of labor but also shifts the marginal product of labor curve inwards. The emigration loss is larger than that without incorporating external effects.

Figure 2 shows the emigration loss in the presence of external effects. The welfare impact of emigration of skilled labor is analyzed, assuming that only skilled labor moves. Emigration of skilled labor reduces its supply from S to S'. The marginal product of skilled labor also shifts from MPL_S to $MPL_{S'}$. The "emigration loss" is given by area ABCD plus triangle DEF. The area ABCD has been added to the emigration loss due to the external effects of labor employment. Emigration of skilled labor would also lead to a decline in productivity of unskilled labor (which is not shown in the figure).

Figure 2. Labor Demand-Supply Model: Welfare Impact of Emigration with External Effects
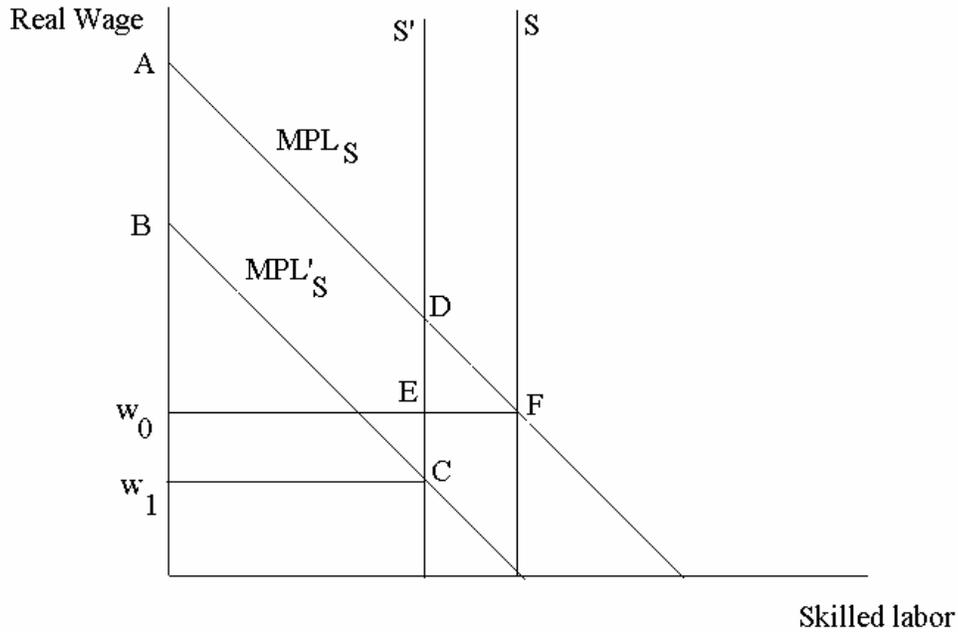
First, the loss due to emigration of skilled labor is calculated without incorporating external effects, and then augmented to include external effects. The magnitude of the loss (as a fraction of GDP) without incorporating external effects can be expressed as

$$\text{Emigration loss (triangle DEF in Figure 2)} = \frac{1}{2} s_S e_S m_S{}^2 \qquad (6)$$

The magnitude of the loss (as a fraction of GDP) including external effects is given as:

Emigration loss with external effects =

$$\frac{1}{2} s_S e_S m_S{}^2 + \frac{\gamma s_S m_S}{1-\gamma}(1 - s_S m_S) + \frac{\gamma s_u m_S}{1-\gamma}(1 - s_u m_S) \qquad (7)$$

where s_S and s_u are, respectively, the skilled and unskilled labor shares of national income, e_S is the magnitude of elasticity of factor price of skilled labor

i.e., percentage change in wage of skilled labor resulting from a 1 percent change in the size of the labor force, and m_S is the fraction of skilled labor force that emigrates. The second and third terms denote the external effects on skilled and unskilled labor, respectively. The expression in (7) is similar to Borjas (1995) study of immigration.

Even if the triangle emigration losses are of second order, the overall emigration loss can be substantial if the external effects are large. The magnitude of the external effects in turn depends on the assumption about the elasticities. In order to calculate the emigration loss in the presence of external effects, we require data on elasticity of factor price of skilled labor and elasticity of marginal product of labor. Both these elasticities are difficult to estimate. The calculations in the paper have been made under varying assumptions on the elasticities.

C. Education Cost of the Skilled Migrants

An important cost that emigration imposes on source countries (and estimates of which have largely been ignored in the literature) is the public expenditure on the education of migrants. This cost is particularly high for the tertiary-educated migrants in developing countries like Barbados, Jamaica, and Trinidad and Tobago (UNESCO, 2004).

In this paper, education subsidy is treated as a sunk cost to the government, which is financed by taxing the non-emigrants. The subsidy is allocated ex-ante in every year's budget and the cost is incurred irrespective of whether or not some students emigrate after getting the education. The public expenditure on education of high-skilled migrants is treated as a loss to the non-emigrant individuals ex-post due to the opportunity cost of this expenditure in terms of expenditure foregone on (or lower provision of) public goods or higher than necessary tax rates on the non-emigrants. Had the migrants stayed behind, they would have contributed to the tax revenue.[8]

As discussed above, the measure of welfare used in the paper is welfare of those stayed behind (excluding the welfare of the migrants). The total loss to the non-emigrant individuals or those stayed behind due to emigration of high skilled is defined to be composed of two components: (i) emigration loss due to the impact on wages and the decline in productivity of those stayed behind given by (7) and (ii) government expenditure or subsidy on education of the high-skilled migrants, which is an additional loss to the non-migrants when considered in terms of the lower provision of public goods or higher tax rates.

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[8] For example, Desai et. al, 2002 quantify the fiscal loss in the case of India, from the foregone tax revenue that would have accrued if the migrants had stayed behind.

In order to place the estimated losses due to emigration in perspective, the next section discusses the different benefits from emigration to source countries and compares the calculated losses to a quantifiable benefit from migration—that is, remittances.

D. Benefits of Emigration

The most immediate benefit from emigration is the flow of remittances or transfers by migrants to the country of origin. Latin America and the Caribbean region is the largest recipient of remittances and also has the fastest growth in its receipts. In 2003, remittance flows exceeded combined flows of foreign direct investment (FDI) and official development assistance (ODA) to the region (Terry, 2004).

Several other channels through which emigration can benefit source countries have been identified in the literature. Possible network effects exist due to migration. Rauch and Trinidade (2002) have estimated large impacts of the networks in trade and foreign direct investment (FDI) in a cross-section of countries.[9] In the long run, benefits from emigration can occur also from its favorable effect on human capital formation. Emigration, if it is biased towards the high skilled, can raise their relative wages and returns to higher education, and induce human capital formation. A positive probability of emigration to a high-wage country can also raise the expected returns from human capital accumulation and thus induce skill formation (Beine et. al., 2003).

III. DATA AND EVIDENCE

A. Measurement of Emigration Rates

It is difficult to quantify the magnitude of emigration because source countries, in general, do not record information on those who leave. Emigration is measured by obtaining information on the migrants from censuses in recipient countries (see for example, Mishra (2007), Docquier and Marfouk (2005), and Carrington and Detriagache (1998)).

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[9] Davis and Weinstein (2002) look at terms of trade effects of immigration into the United States. If migration from the Caribbean results in relatively higher reduction in factor supplies and output in the export sector, thereby reducing the supply of exports on the world market, then this can result in a terms of trade gain for the region. For the terms of trade gain to be significant in magnitude for individual countries, they should be large in an economic sense i.e., their demand and supplies should affect world prices. To the extent that Caribbean countries lack market power, we can assume this effect to be of a small magnitude for these individual countries.

Three sources of data have been used in the paper—(i) emigration rates to OECD member countries from Docquier and Marfouk (2005), who estimate the aggregate migration rates for a number of source countries in the world; and (ii) emigration rates to the United States using the data on migrants from the U.S. Census (iii) emigration rates to the US adjusted for schooling of the migrants using data from the New Immigrant Survey (NIS, 2003).

Emigrants to most OECD member countries are defined by their country of birth. For example, an emigrant from source country j residing in the United States is defined as a person whom the U.S. Census counts as being born in country j. The migrants include naturalized citizens, temporary and permanent residents, as well as unauthorized migrants. Migrants to the United States also include asylum seekers who sought refuge from political turmoil, oppression and totalitarian governments.[10] The only exceptions are Germany, Greece, Italy, Japan, and Korea, where an emigrant is defined by citizenship.

About 95 percent of the Caribbean migrants enumerated in the 2000 U.S. Census arrived between 1965 and 2000. Detailed information on the year of immigration is not available for migrants to other OECD member countries. However, since the United States is the major destination for migrants from the Caribbean, one can argue that the biggest proportion of migrants to OECD member countries migrated between 1965 and 2000.

The emigration *rate* to OECD member countries is defined as the fraction of labor force having migrated to OECD member countries. It is expressed as

$$m_t^j = \frac{M_t^j}{M_t^j + N_t^j},$$
(8)

where M_t^j is the number of migrants from country j counted in the receiving country's census at time t and N_t^j is the labor force in source country j at time t.

Emigration rate from country j in schooling category S is defined as

$$m_{t,s}^j = \frac{M_{t,s}^j}{M_{t,s}^j + N_{t,s}^j},$$
(9)

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[10] The Caribbean is also one of the largest sources of illegal aliens with the Dominican Republic, Haiti, and Jamaica ranking only behind Mexico (Carlson, 1994).

where $M_{t,s}^{j}$ is the number of migrants from source country j with schooling S who are recorded in the OECD censuses at time t, and $N_{t,s}^{j}$ is the labor force in source country j with schooling S.

B. Magnitude of Emigration from the Caribbean

Migration has been described as "*embedded in the Caribbean psyche*" and is a fact of life in the region (Reyes and Stubbs, 2004). Every year a large number of Caribbean nationals emigrate to other countries for work, education, or for other reasons. About 12 percent of the labor force from the Caribbean region has migrated to OECD member countries over the period 1965–2000. As Figure 3 shows, the Caribbean region has the highest rates of migration into OECD member countries. The second-highest source of emigrants is Central America, which has lost about 7 percent of its labor force due to emigration to OECD member countries.

The figures for the individual Caribbean countries are even more striking. The average of 12 percent for the Caribbean as a whole is largely due to the low migration rates of five countries—Haiti, Dominican Republic, The Bahamas, St. Lucia, and Trinidad and Tobago. As Figure 4 shows, the majority of the other Caribbean countries have lost more than a quarter of their labor force due to emigration to OECD member countries.[11]

The most important destination for migrants from the Caribbean is the United States. Figure 5 shows the fraction of the total number of migrants whose destination is the United States. The fraction ranges from about 60 percent to 90 percent. More than three-fourths of the migrants from The Bahamas, Belize, Dominican Republic, and Haiti reside in the United States. Geographical proximity (i.e., low migration cost), higher wage differentials (relative to other destinations) and immigration laws in the United States, are the most likely reasons for such a bias. The U.S. Immigration and Nationality Act of 1965 changed the basis of entry into the United States from country quotas to family-based reunification. This led to a drastic change in the composition of migrants from developed to developing countries.

The migration rates by schooling are even more striking—70 percent of the tertiary-educated labor force has migrated from the Caribbean to OECD member countries. Table 1 shows the breakdown of emigrants from the Caribbean by their skill (education groups). The figures in the secondary and tertiary schooling categories are striking. Guyana, Grenada, Jamaica, and St. Vincent and the

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[11] Anecdotal evidence exists for a reasonable amount of intra-Caribbean migration, but it has not been systematically documented.

Grenadines have the highest tertiary emigration rates in the region followed by Haiti, Trinidad and Tobago, and St. Kitts and Nevis. In fact, as Figure 6 shows, most Caribbean countries rank in the top 20 in the world in terms of skilled emigration rates (skilled are defined as those with more than 12 years of schooling). Table 2 shows the emigration rates to the United States, by skill categories. About 60 percent of the tertiary educated labor force has migrated from the Caribbean to the United States. The rankings are similar to the emigration rates to OECD member countries in Table 1, with Guyana, Haiti, Jamaica and Grenada having the highest tertiary emigration rates to the United States.

Figure 3. Percent of Labor Force that Has Migrated to OECD Member Countries: Caribbean vs. the Rest of the World, 1965–2000
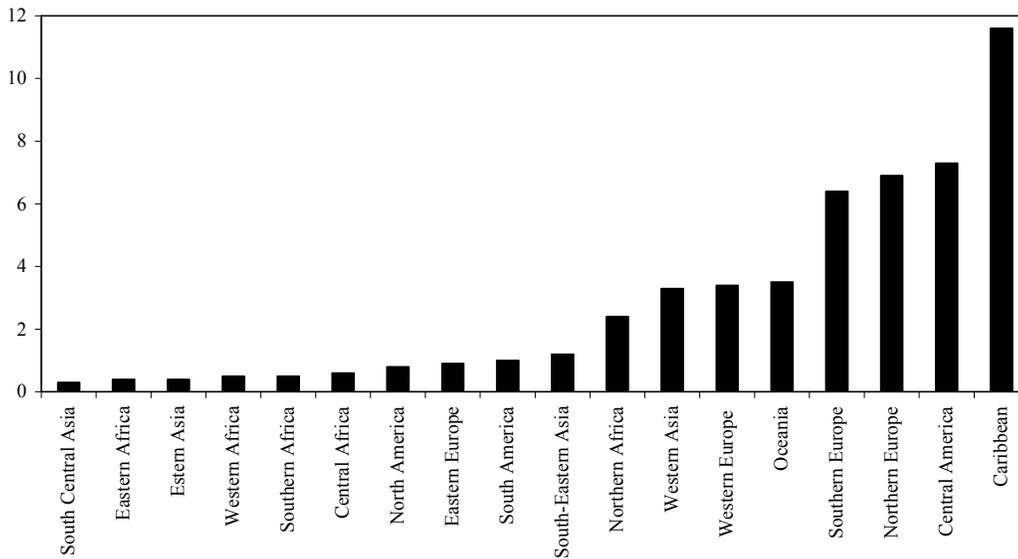
Source: Docquier and Marfouq (2004).

Figure 4. Percent of Labor Force that Has Migrated from the Caribbean Countries
to OECD Member Countries, 1965–2000
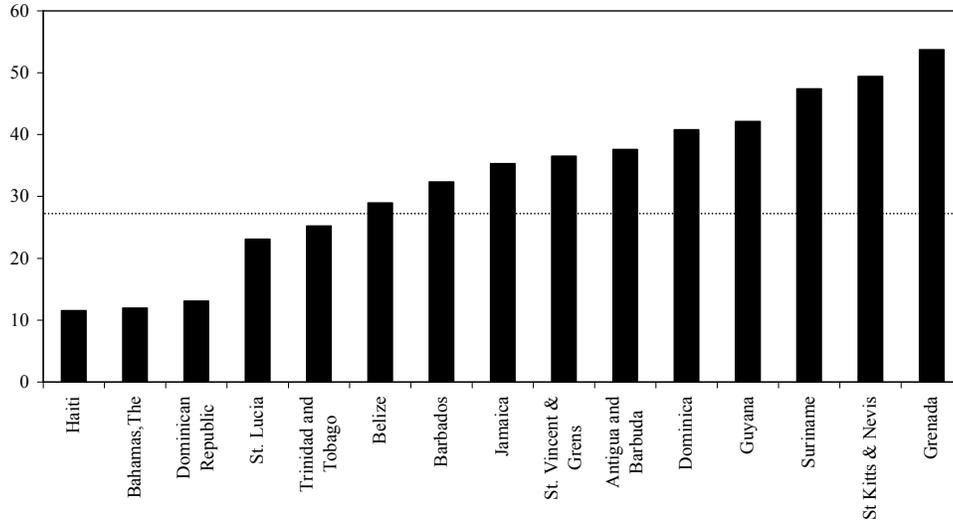
Source: Docquier and Marfouq (2005).

Figure 5. Percent of Total Number of Migrants from the Caribbean Countries to the United States,
1965–2000
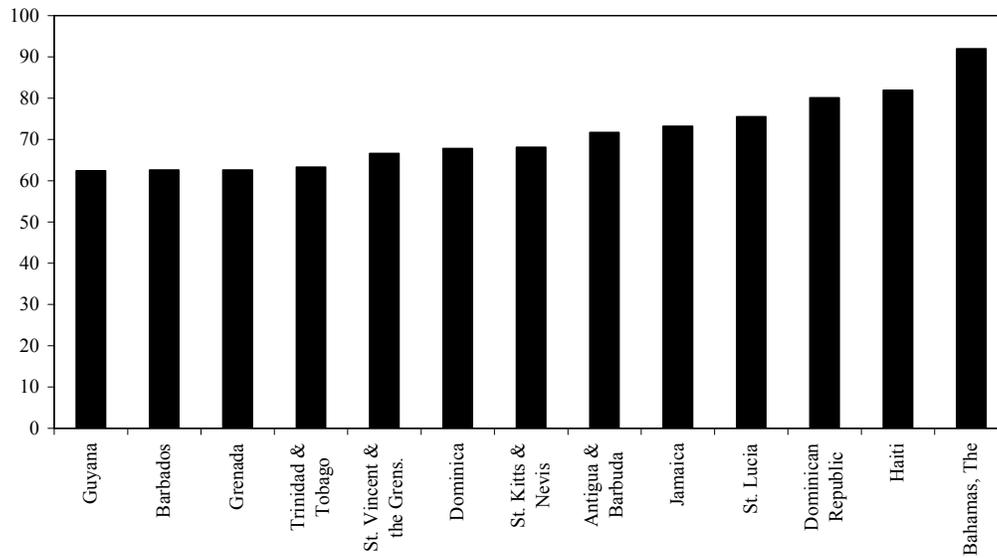
Sources: U.S. Census (2000); and Docquier and Marfouq (2005).

Table 1. Percent of Labor Force That Has Migrated to OECD Member Countries,
1965–2000, (By Level of Schooling)

	Primary	Secondary	Tertiary
Antigua and Barbuda	9	64	67
Bahamas, The	3	10	61
Barbados	18	28	63
Belize	7	58	65
Dominica	19	67	64
Dominican Republic	6	33	22
Grenada	25	71	85
Guyana	18	43	89
Haiti	3	30	84
Jamaica	16	35	85
St. Kitts and Nevis	32	42	78
St. Lucia	12	21	71
St. Vincent and the Grenadines	18	33	85
Suriname	39	74	48
Trinidad and Tobago	8	22	79
Average	15	42	70

Source: Docquier and Marfouq (2005).
Primary: 0-8, secondary: 9-12, tertiary: >12 years of schooling

Figure 6. Top 20 Countries in the World with the Highest Emigration Rates, 1970–2000
(Percent of Educated Labor Force that has Migrated to OECD Member Countries)
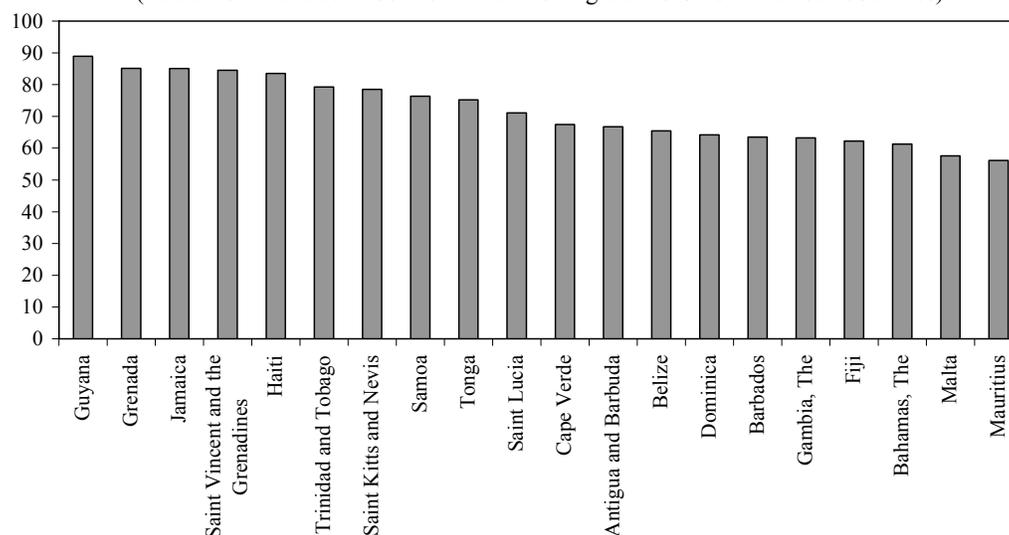
Source: Docquier and Marfouq (2005).
Note: Educated labor force is defined as having more than 12 years of completed schooling.

C. Where Did Migrants Obtain Their Schooling?

The migration rates by schooling in Tables 1 and 2 do not take into account where migrants obtained their schooling. The estimates of emigration rates by schooling are based on the assumption that the migrants recorded in the OECD censuses received their schooling in the Caribbean. Alternatively, for those who received their schooling in the OECD—the counterfactual assumption is that had they stayed behind, they would have received the same level of schooling. For the migrants who received their schooling in the destination countries, it is not clear that their emigration constitutes shocks to which schooling groups in the source countries.

The censuses in the recipient countries do not record information on where the migrants received their schooling. Hence, given the data, it is not possible to conclude the direction of the bias. However, we can try to adjust for this bias in the case of the migrants to the United States. Strong evidence in the case of migrants from developing countries like Mexico suggests that those who migrate in their late teens or later are much less likely to obtain their schooling in the United States (Grogger and Trejo (2002), Gonzalez (2003), Chiquiar and Hanson (2005), Clark and Jaeger (2002)).

Table 2. Percent of Labor Force That Has Migrated to the United States, 1965–2000
(By Level of Schooling)

	Primary	Secondary	Tertiary
Antigua and Barbuda	3	57	56
Bahamas, The	2	10	58
Barbados	4	20	46
Belize	4	54	62
Dominica	6	56	49
Dominican Republic	5	28	18
Grenada	7	61	75
Guyana	7	35	80
Haiti	2	27	79
Jamaica	5	29	78
St. Kitts and Nevis	8	31	65
St. Lucia	2	13	53
St. Vincent and the Grenadines	4	23	71
Trinidad and Tobago	3	17	68
Average	4	33	61

Sources: U.S. Census (2000); and Docquier and Marfouq (2005).

Primary: 0-8, secondary: 9-12, tertiary: >12 years of schooling

The U.S. Census provides information for the foreign-born on the years spent in the United States. Using this information, it is possible to calculate their age at migration. Restricting the sample of migrants from the Caribbean to those who emigrated as adults, it is less likely that these migrants would have acquired their schooling in the United States.

Chiquiar and Hanson (2005), and Mishra (2007) use a similar strategy to adjust for the bias. The adjusted emigration rates (for cut-off ages of 16, 18, 21 and 25) are shown in Annex Table 1. Given that a typical student in the Caribbean enters university at the age of 18 after 13 years of schooling, the age of 18 seems to be a reasonable cut-off to in order to exclude emigrants who are likely to have got less than 13 years of schooling in the Caribbean.

The magnitude of the *adjusted* emigration rates in the tertiary schooling category decreases (as compared to Table 2). In both cases (adjusted and unadjusted), Guyana, Haiti, and Jamaica have the highest tertiary emigration rates in the region. The highly-educated labor force in the region has been reduced by one-third due to emigration to the United States, even after excluding all migrants who emigrated at less than 25 years. On the upper bound, it is reduced by 56 percent, when we exclude all migrants who emigrated at less than 16 years.

Alternative Measure of High-Skilled Emigration using New Immigrant Survey (NIS, 2003) Data

In this section, I use an alternative source of data on immigrants in the US to measure the magnitude of emigration in the tertiary education category. The NIS is a public-use database on new legal immigrants to the US. The data on the first full cohort (NIS-2003), which sampled immigrants in the period May – November 2003 has been made publicly available since March, 2006.

The age at entry into the US used in the section above is based on the question in the US Census which asks "when did you come to live in the United States?" According to Rosenzweig (2005), the question contains a subjective element since it is not clear whether the respondents answer the question when they got a permanent visa (not a student visa), or when they first came at all. Moreover, if a person emigrated at an age of 25 or more years, it is not guaranteed that the person acquired schooling in the home country.

The NIS improves on the US Census in this respect and asks a question directly about the years of completed schooling in the US. However, the NIS data samples immigrants only from three Caribbean countries – Dominican Republic, Haiti and Jamaica. For tertiary educated immigrants born in Dominican Republic, Haiti and Jamaica respectively, 97, 73 and 65 percent did not acquire schooling in the US.

Since the NIS sample is available only for three Caribbean countries, in order to estimate the fraction of immigrants who did not acquire schooling in the US for the other source countries, I calculate a weighted average for each non-NIS country using the data on three NIS countries. The weights are based on the degree to which each of the NIS countries looks like non-NIS countries using a number of education related variables for the emigrants (please see Appendix 1 for details regarding the derivation of weights).

Table 3 shows the adjusted estimates for emigration rates in the tertiary education category. Though the magnitudes of emigration rates are smaller compared to Table 2, nonetheless – even the adjusted rates are extremely high. The tertiary educated labor force in the Caribbean has reduced by more than 40 percent due to emigration to the US. As in Table 2, Guyana, Haiti, Jamaica, and Grenada have the highest tertiary emigration rates followed by St. Vincent and Grenadines, Trinidad and Tobago, and St. Kitts and Nevis.

The adjustment made to the emigration rates using the NIS data, however, need to be taken with caution because of three reasons (i) the NIS covers only new legal permanent immigrants whereas the US Census covers both legal and illegal, temporary and permanent immigrants and (ii) the NIS does not cover most of the Caribbean countries, hence the adjustment of emigration rates for where the migrant acquired schooling is based on the average for all immigrants in the NIS sample, and (iii) the adjusted emigration rates are based on the question in the NIS which asks "years in school in the US". The tertiary educated adult migrants with zero years of schooling in the US are assumed to have acquired schooling in the home country. A small proportion of migrants could have acquired schooling in countries other than the US and the country of birth.

Comparison of the Emigration Rates with Administrative Enrollment Data

In order to ascertain to what extent the number of tertiary educated immigrants counted in the US Census approximates correctly the actual number of tertiary migrants from the Caribbean, I use administrative enrollment data from some key institutions for higher education in the Caribbean. These institutions include the University of West Indies (UWI, which includes three campuses in Barbados, Jamaica and Trinidad and Tobago), University of Technology, Jamaica, and University of Guyana. The data from the UWI includes (i) on-campus student registration at one of the three campuses, and (ii) registration in affiliated institutions and distance education programs. The statistics on the UWI is prepared by the Office of Planning and Institutional Research at the MONA Campus in Jamaica. The data on all these institutions is available from 1991.

Annex Table 2 shows the annual enrollment data. Since the enrollment data is at an annual frequency, for comparison, I look at the number Caribbean migrants counted in the US Census by year of immigration.

On average, close to 11,000 Caribbean migrants leave for the US any given year. Making the NIS adjustment, about 8000 emigrants leave in any given year. In comparison, on average, close to 30,000 students are registered in three primary institutions - the UWI U.Technology, Jamaica and the University of Guyana. The figures suggest that the number of emigrants counted in the US Census emigrating in any particular year is only about a third or lower compared to the total number of students enrolled only in some of the key institutions. Hence, the count of high-skilled emigrants in the US Census who came to the US at least since 1991 does not seem to be necessarily overestimated in comparison with the administrative enrollment data.

Table 3. Percent of Tertiary Educated Labor Force That Has Migrated to the United States
(New Immigrant Survey)

Antigua and Barbuda	41
Bahamas, The	48
Barbados	30
Belize	46
Dominica	41
Dominican Republic	18
Grenada	50
Guyana	53
Haiti	58
Jamaica	51
St. Kitts and Nevis	44
St. Lucia	36
St. Vincent and the Grenadines	48
Trinidad and Tobago	49
Average	44

Sources: U.S. Census (2000); and Docquier and Marfouq (2005), NIS (2003)

Tertiary educated are defined as having more than 12 years of completed schooling.

D. Remittances

Worker remittances are becoming increasingly important as a source of external funding for many developing countries. Worker remittances are defined as the value of monetary transfers sent to the source countries by workers who have

been abroad for more than one year. These are recorded under "current transfers" in the current account of the IMF's Balance of Payments Statistics Yearbook.

During the last two decades, the economic analysis of remittances has received considerable attention in academic and policy circles. One important region that has received little attention in the literature on remittances is the Caribbean. The Caribbean region is the largest recipient of remittances in proportion to its gross domestic product (GDP) (Figure 7). The next biggest recipient is South Asia, followed by the Middle East and Northern Africa.

A broader measure of remittances includes worker remittances, compensation of employees and migrant transfers. This measure has been previously used in the literature (Ratha, 2003, and Kapur, 2004). Compensation of employees is defined as the gross earnings of foreigners residing abroad for less than 12 months, including the value of in-kind benefits such as housing and payroll taxes. Migrant transfers are defined as the net worth of migrants who move from one country to another. For example, the value of IBM stock owned by a migrant who moves from France to Germany gets transferred in international accounting from France to Germany. Compensation of employees are recorded under the "income" subcategory of the current account, and migrant transfers are recorded under "capital transfers" in the capital account of the IMF's Balance of Payments. It is important to note that both the simple worker remittances and the more comprehensive definition of remittances do not include transfers through informal channels such as those carried by hand or by friends or family, or in-kind remittances of jewelry and consumer goods. Also, commercial transfers known as *hawala* are unrecorded in the estimated remittances.[12]

Remittance flows are the largest source of external funding for the region (Figure 8). In 2002, *total* remittances (defined as the sum of worker remittances, compensation of employees, and migrant transfers) constituted about 13 percent of the region's GDP. In comparison, FDI was 6 percent and ODA were only 1 percent of GDP.

Remittance flows have been rising, while both FDI and ODA have declined. Between 1990 and 2002, ODA declined from 4 percent to 1 percent of GDP. Over recent years, FDI has also declined from 9 percent in 1999 to about 6 percent in 2002. In contrast, remittances increased from 3 percent to 13 percent of GDP during the same time period. As shown in Figure 9, many Caribbean nations are among the top 30 nations in the world in terms of remittances received as a proportion of their GDP.

Figure 10 shows the total remittances for the Caribbean countries averaged over 1980–2002. Grenada is the largest recipient in the region, followed by Haiti,

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[12] Hawala is defined as an informal transfer system that operates outside the formal banking or financial channels.

Dominica, and Jamaica. Migrant transfers to Grenada constitute about half of total remittances.

Figure 7. Worker Remittances, 2002
(In percent of GDP)
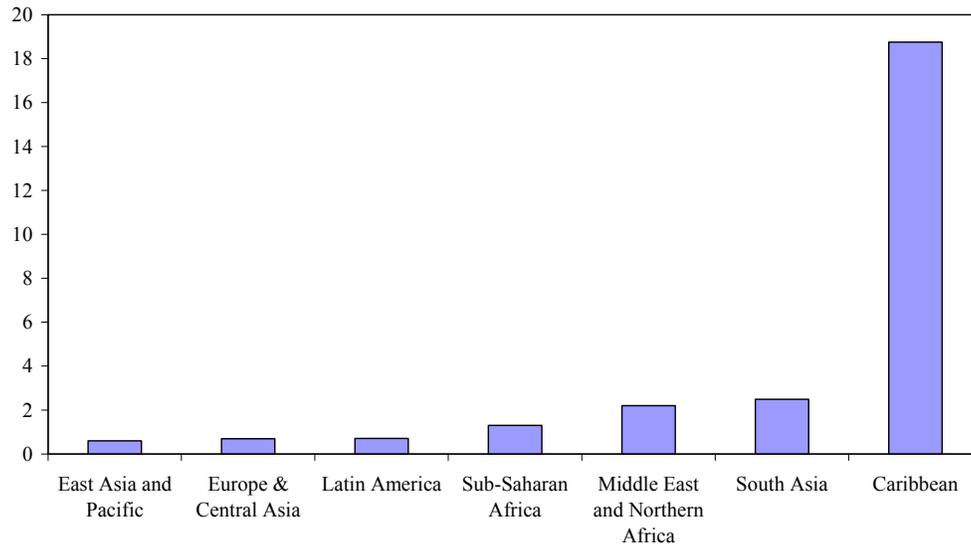
Sources: IMF, Balance of Payments Statistics Yearbook; and country authorities.

Figure 8. Remittances, Foreign Direct Investment (FDI), and Official Development Assistance (ODA) to the Caribbean,
1990–2002, In percent of GDP
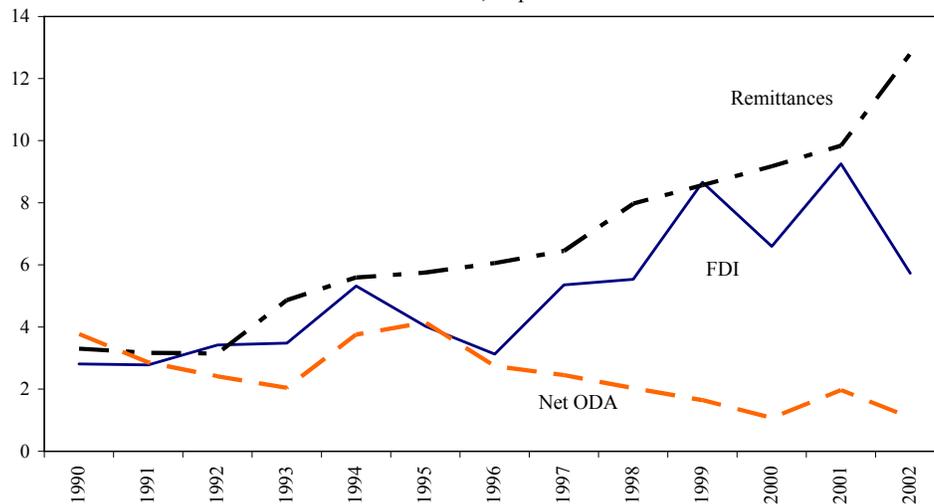
Sources: IMF, Balance of Payments Statistics Yearbook; World Bank, World Development Indicators; OECD; and country authorities.

Figure 9. Total Remittances
(Worker remittances, compensation of employees and migrant transfers,
as a percent of GDP in 2002)
Top 30 countries in the world
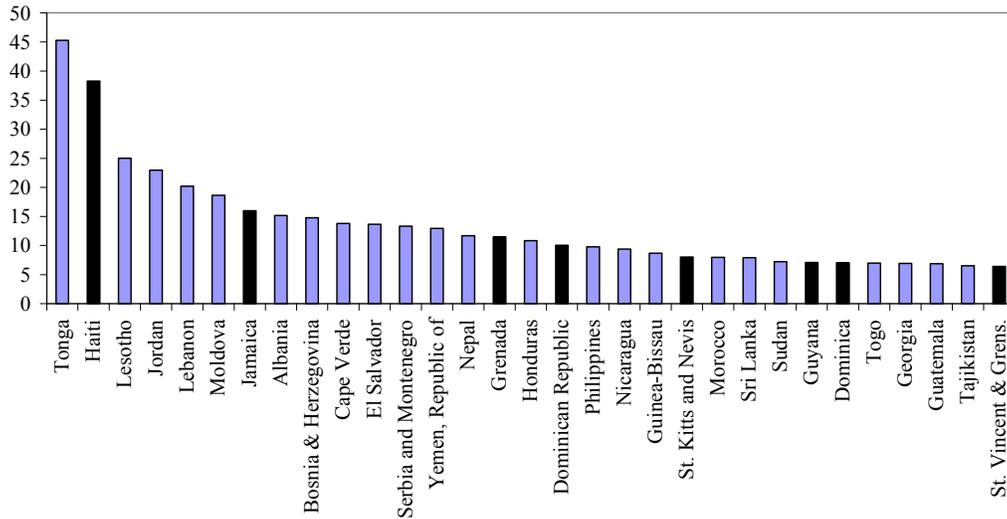
Figure 10. Total Remittances, Average 1980–2002
Worker Remittances, Compensation of Employees, Migrant Transfers
(In percent of GDP)
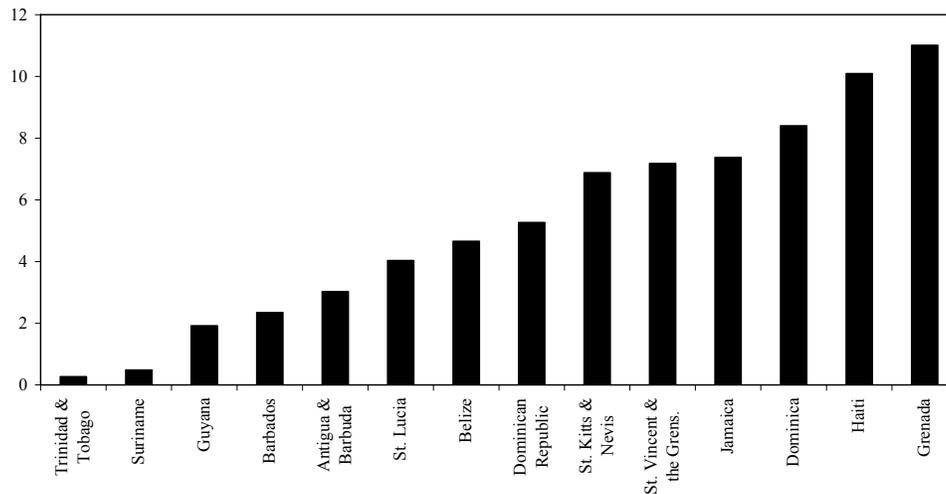
Sources: IMF, Balance of Payments Statistics Yearbook; and country

E. Public Expenditure on Education

Governments in developing countries, including the Caribbean, cover a major portion of the cost of education of their citizens in the form of education subsidies. In the calculation of welfare losses, I also include the government expenditure on education of the highly educated individuals who eventually leave the country. The total government expenditure on highly educated migrants includes the expenditure on the primary, secondary, and tertiary education of these migrants.

The annual expenditure on education of the high-skilled migrants who eventually leave the country, E^m, can be expressed as:

$$E^m = c_S \times M_S \tag{11}$$

Where M_S is the number of high-skilled migrants and c_S is the cost of educating each high-skilled migrant.

The cost of educating each high-skilled migrant includes government expenditure on his/her primary, secondary and tertiary education. I assume that this cost can approximated by the average current expenditure by government on a student, where the average is calculated across students attending primary, secondary or tertiary schooling. Thus, the cost to the government of educating each high-skilled migrant is approximated by

$$c_S \approx \frac{T}{E} \tag{12}$$

Where T is the total annual expenditure on education by the government (on primary, secondary and tertiary education) and E is the total annual school enrollment.

Ideally one would estimate the average cost separately for primary, secondary and tertiary education, by dividing the expenditure on these education categories by the enrollment in the respective categories i.e. ideally

$$c_S = \frac{T_{pr}}{E_{pr}} + \frac{T_{se}}{E_{se}} + \frac{T_{te}}{E_{te}} \tag{13}$$

Where pr, se and te standard for primary, secondary and tertiary education respectively.

However, data on expenditure by education categories is not available for the Caribbean countries i.e. T_{pr}, T_{se} and T_{te} are not available. Hence, I use the total expenditure on education and divide it by the total number of students. In other words, the denominator is overestimated in (12), or the calculated expenditure per student is underestimated.

I use data on annual education expenditure (T) and enrollment (E) from the World Development Indicators (WDI) of the World Bank and UNESCO (2004). Please see Appendix 2 for details of the data sources and the calculations.

Figure 11 shows the estimated cost of educating the high-skilled migrants for all Caribbean countries (except Haiti and Suriname) in millions of US dollars. The expenditure is the highest for Jamaica, Trinidad and Tobago and Guyana, reflecting primarily the heavy public investment in education as well as the large number of skilled migrants from these countries.

Figure 11. Estimated Government Expenditure on Education of High-Skilled Migrants
(In millions of US dollars)
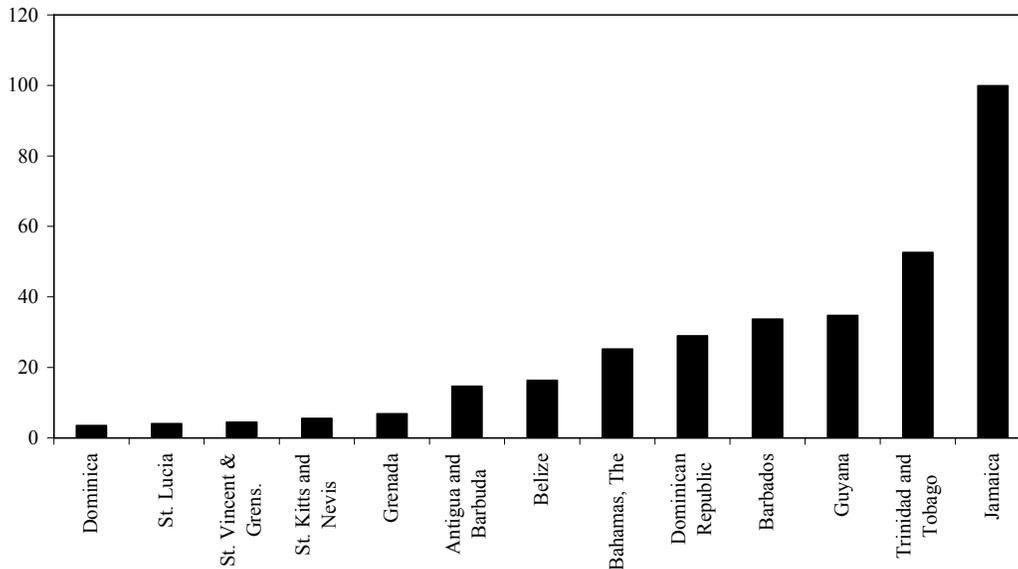
Source: World Development Indicators, UNESCO. High-skilled are defined as having more than 12 years of completed schooling. The number of emigrants are adjusted using the NIS.

IV. RESULTS

A. Emigration Loss

The calculation of the emigration loss as a percent of GDP requires estimates for: (i) elasticity of factor price for labor; (ii) labor's share in national income; and (iii)

the emigration rate. The share of labor in national income is assumed to be 70 percent following Borjas (1995) and Hall and Jones (1999). Mishra (2007) in a study of Mexico estimates the impact of emigration on Mexican wages. The paper finds that a 10 percent reduction in the size of the labor force due to emigration to the U.S. increases Mexican wages by 4 percent. Also, the vast empirical evidence on labor demand, surveyed by Hamermesh (1993), suggests that the elasticity of factor price of labor is of the order of -0.3 (that is, a 10 percent reduction in the size of the labor force increases wages by 3 percent). The two elasticity assumptions of 0.3 and 0.4 used in this paper follow from Hamermesh (1993) and Mishra (2007), respectively.

The emigration loss predicted by the labor demand-supply model is small. Table 4 shows the estimates of emigration loss to individual Caribbean countries as a percent of the GDP. In order to put these numbers into perspective, Column 3 shows the figures for remittances to the Caribbean as a fraction of countries' GDP. Since elasticities and the share of labor in GDP are assumed to be the same for all countries, the differences in emigration losses comes only from differences in the emigration rates across countries. On average, official remittances outweigh the emigration loss for the region. Even under the assumption of high elasticity, except for Guyana, Suriname and Trinidad and Tobago, official remittances outweigh emigration loss in all countries. Also, since the wage differentials between the Caribbean and OECD member countries are large, the emigration loss would be easily outweighed by the gains of the migrants themselves.

Emigration loss is, however, an aggregate measure. It is a net effect of a gain to the workers who stay behind and a loss to the owners of other factors that are assumed to be internationally immobile (capital). In other words, emigration involves a redistribution of the reduced aggregate income in favor of the workers. Annex Table 3 shows that this redistributive impact of emigration is significant in magnitude. On average, the gain to the workers who have stayed behind is 6 percent of GDP and the loss to the owners of the other factors is about 8 percent of GDP. Even for Trinidad and Tobago, where the emigration losses are relatively small (in relation to remittances), a sizable redistribution exists in favor of the workers.[13]

B. Losses Due to High-Skill Migration

The emigration loss due to emigration of skilled labor, *ceteris paribus,* is significant. One of the most significant characteristics of migration from the Caribbean region, apart from the very high rates of migration, is the loss of the

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[13] Bahamas is excluded from Tables 4, 5 and Annex Tables 3 and 4, because the data on remittances is missing.

educated population. The estimates in Table 5 show that the emigration loss as a fraction of GDP due to emigration of high skilled workers (everything else remaining unchanged) is much larger. The aggregate emigration rate combines the emigration rates of the high- as well as the low-skilled. As lower-skill groups

Table 4. Emigration Loss and Remittances
(in percent of GDP)

	Emigration Loss e=0.3	Emigration Loss e=0.4	Remittances Average 1980–2002
Antigua and Barbuda	1.5	2.0	3.0
Barbados	1.1	1.5	2.3
Belize	0.9	1.2	4.7
Dominica	1.7	2.3	8.4
Dominican Republic	0.2	0.2	5.3
Grenada	3.0	4.0	11.0
Guyana	1.9	2.5	1.9
Haiti	0.1	0.2	10.1
Jamaica	1.3	1.7	7.4
St. Kitts and Nevis	2.6	3.4	6.9
St. Lucia	0.6	0.7	4.0
St. Vincent and the Grenadines	1.4	1.9	7.2
Suriname	2.4	3.1	0.5
Trinidad and Tobago	0.7	0.9	0.3
Average	1.4	1.8	5.2

Source: Author's calculations.
Note: e denotes the elasticity of factor price of labor (i.e., percentage change in wages resulting from a 1 percent change in the size of the labor force). Emigration loss is calculated using equation (2).

have smaller emigration rates, their inclusion results in a smaller measure of emigration rate. If instead, only the high-skilled workers are considered, the emigration rates are higher. Consequently the emigration loss is also larger. Still, remittances outweigh or almost equal the emigration loss due to high-skilled migration for the region as a whole and for most of the countries (except Guyana, Suriname, and Trinidad and Tobago).[14]

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[14] In the calculations, the assumed skilled labor share of GDP is 0.3. This follows from the assumption that the highly educated belong to the top 20 percent of the income earners. The average income share of the top 20 percent is about 0.4 as estimated by Dollar and Kraay (2002).

(continued…)

Table 5. Emigration Loss Due to High-Skilled Migration
(in percent of GDP)

	Emigration Loss e=0.3	Emigration Loss e=0.4	Remittances Average 1980–2002
Antigua and Barbuda	2.0	2.7	3.0
Barbados	1.8	2.4	2.3
Belize	1.9	2.6	4.7
Dominica	1.9	2.5	8.4
Dominican Republic	0.2	0.3	5.3
Grenada	3.3	4.3	11.0
Guyana	3.6	4.7	1.9
Haiti	3.1	4.2	10.1
Jamaica	3.3	4.3	7.4
St. Kitts and Nevis	2.8	3.7	6.9
St. Lucia	2.3	3.0	4.0
St. Vincent and the Grenadines	3.2	4.3	7.2
Suriname	1.0	1.4	0.5
Trinidad and Tobago	2.8	3.8	0.3
Average	2.4	3.2	5.2

Source: Author's calculations.

Note: e denotes the elasticity of factor price of labor (i.e., percentage change in wages resulting from a 1 percent change in the size of the labor force). Emigration loss is calculated using equation (6).

The loss due to emigration is amplified if emigrants confer a positive externality on nonemigrants. In that case not only is the surplus on the inframarginal workers lost due to emigration (emigration loss), but the positive externality is lost as well (the external effects). Two values for the elasticity of marginal product with respect to the aggregate stock of skilled labor (gamma) are assumed, 0.05 and 0.1, respectively (Borjas (1995) uses identical values).

Annex Table 4 shows the estimates of emigration loss due to high-skilled migration in the presence of external effects. For high values of the elasticities, in the presence of external effects, emigration loss outweighs remittances for the region as a whole and for many countries. The magnitudes of the emigration losses are much higher than the estimates of immigration surplus in the presence of external effects in Borjas (1995), which range between 0.3–0.7 percent of

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Consequently, the assumed share of skilled labor in GDP is: overall labor share in GDP *0.4 = 0.7*0.4=0.28.

GDP. The reason for the larger effect is that emigration rates from the Caribbean are greater relative to the immigration rate into the United States.

Table 6 shows the total losses due to skilled emigration.[15] The total losses comprise: (i) emigration loss from the simple labor demand supply framework; (ii) external effects i.e., the impact on productivity of those who have stayed behind; and (iii) government expenditure on the education of migrants. The results shown in Table 6 are under the assumption of high elasticities.

The first observation from Table 6 is that the total losses due to high-skill emigration are indeed significant for most countries. The losses range from 2 percent of GDP in the Dominican Republic to 24 percent of GDP in Guyana. Second, on average, the losses outweigh the official recorded remittances for the Caribbean region and for almost all the individual countries (except Dominican Republic). For Dominican Republic, the losses are considerably small due to low emigration rates as well as low government expenditure on education. Even under assumption of low elasticities (not shown in the table), the losses outweigh remittances for the region and for most individual countries.

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[15] Bahamas, Suriname and Haiti are excluded from Table 6 and Annex Table 5 due to missing data on education expenditure and /or remittances.

Table 6. Total Losses Due to High-Skill Emigration vs Remittances
(in percent of GDP)

	Estimated Education Expenditure	Emigration Loss (gamma=0.1, e=0.4)	Emigration Loss + Estimated Education Expenditure	Remittances Avg 1980–2002
Antigua and Barbuda	4.6	6.6	11.2	3.0
Barbados	4.0	6.2	10.3	2.3
Belize	3.1	6.5	9.6	4.7
Dominica	2.9	6.3	9.2	8.4
Dominican Republic	0.2	1.8	2.0	5.3
Grenada	4.7	9.0	13.7	11.0
Guyana	14.4	9.5	23.9	1.9
Jamaica	3.1	8.9	12.1	7.4
St. Kitts and Nevis	4.9	8.1	13.0	6.9
St. Lucia	1.9	7.2	9.1	4.0
St. Vincent and the Grenadines	4.4	8.9	13.3	7.2
Trinidad and Tobago	1.6	8.2	9.8	0.3
Average	4.2	7.3	11.4	5.2

Source: Authors' calculations.
Note: e denotes the elasticity of factor price of labor (i.e., percentage change in wages resulting from
a 1 percent change in the size of the labor force).
Gamma denotes the elasticity of marginal product of labor (the percentage change in marginal
product of skilled labor due to 1 percent change in aggregate stock of skilled labor).
Emigration loss is calculated using equation (7) in the Appendix.

The results from the welfare calculations are similar when we consider only emigration to the United States. Since an overwhelming majority of Caribbean migrants come to the United States, it is instructive to look at the magnitude of emigration loss from migration to the main destination country. Also, the U.S. Census allows the calculation of adjusted emigration rates by restricting the sample to migrants only above a certain age at migration, to filter out those migrants who are likely to have received their education in the source country. Finally, we also use the emigration rates estimated in Section III.E. using data from NIS, 2003.

Annex Table 5 shows the total losses due to emigration to the United States., under assumptions of high elasticities. The results in Annex Table 5 are similar to the cases when the emigration rates to OECD member countries are considered (Table 6). On average, the total losses due to high-skilled emigration outweigh the remittances to the region. Also, total losses outweigh or almost equal remittances for most individual countries (except the Dominican Republic, Dominica and Grenada).

Finally, the welfare effects of emigration to the US, with adjusted emigration rates estimated using the NIS, 2003 is shown in Table 7. The main

result that the losses due to high-skilled emigration from the Caribbean outweigh the gains from remittances still holds, although with a smaller difference between the total gains and losses. The losses are outweighed by remittances for Dominica, Dominican Republic, Grenada, Jamaica, St. Kitts and Nevis and St. Vincent and Grenadines.

Table 7. Total Losses Due to High-Skilled Emigration to the United States vs Remittances
(in percent of GDP)
(Migrants restricted to those who got their schooling in home country, NIS)

	Estimated Education Expenditure	Emigration Loss (gamma=0.1, e=0.4)	Emigration Loss + Estimated Education Expenditure	Remittances Average 1980–2002
Antigua and Barbuda	2.2	3.8	5.9	3.0
Barbados	1.3	2.9	4.2	2.3
Belize	2.0	4.2	6.1	4.7
Dominica	1.3	3.4	4.6	8.4
Dominican Republic	0.1	1.3	1.4	5.3
Grenada	1.7	5.1	6.8	11.0
Guyana	4.9	5.5	10.4	1.9
Jamaica	1.3	5.3	6.6	7.4
St. Kitts and Nevis	1.7	4.3	6.0	6.9
St. Lucia	0.6	3.4	4.0	4.0
St. Vincent & Grenadines	1.3	4.8	6.1	7.2
Trinidad and Tobago	0.6	4.6	5.3	0.3
Average	1.6	4.0	5.6	5.2

Source: Author's calculations.
Note: e denotes the elasticity of factor price of labor (i.e., percentage change in wages resulting from a 1 percent change in the size of the labor force).
Gamma denotes the elasticity of marginal product of labor (the percentage change in marginal product of skilled labor due to 1 percent change in aggregate stock of skilled labor).
Emigration loss is calculated using equation (7);
the skilled emigration rate to the United States, with restricted age at migration, is used for the calculations.

Emigration, return to education and investment in schooling

The welfare calculations above do not take into account the effect of emigration of high-skilled on the returns to education and in turn investment in schooling. Mishra (2007) finds that Mexican emigration to the US increases the relative wages of high-skilled workers, and hence returns to higher education. The greater impact of emigration on wages of high-skilled in Mishra (2007) is driven by the higher emigration rates of high skilled (assuming constant labor demand elasticity across schooling groups).

In order to illustrate the effect of emigration on returns to schooling and human capital formation, let us assume a hypothetical case of a ban on emigration of tertiary educated from the Caribbean, or assume that the Caribbean born tertiary educated individuals, irrespective of where they acquired their schooling come back to their home countries. This would increase the tertiary educated labor force in the Caribbean region by 127 percent.[16] Assuming an elasticity of wages with respect to emigration of 0.4 from Mishra (2007), this would imply about a 50 percent decrease in wages of the tertiary educated. Since the wages of workers in other schooling categories remains unchanged, this would also imply a decrease in their relative wages by 50 percent.

Assuming a supply elasticity also of 0.4 (i.e. a 10 percent increase in relative wages of high-skilled increases their supply by 4 percent), the ban on emigration would reduce the relative supply of tertiary educated workers by 20 percent. Thus, the welfare gain due to the impact of emigration on human capital formation can be substantial, which is not taken into account in the paper and is an interesting subject for future research.

V. CONCLUSIONS

For most countries in the Caribbean, the total losses due to skilled migration (which includes the emigration loss predicted by the labor-demand supply framework, augmented with external effects, and government expenditure on educating the migrants) outweigh remittances. The caveat remains many other costs and benefits of skilled migration are possible, the measurement of which is beyond the scope of this paper.

Countries could take two possible approaches with regard to migration: (i) minimize losses by trying to retain the high skilled; and/or (ii) seek to increase the benefits of emigration by adopting a "Diaspora Approach." The latter uses the diaspora to build networks for trade, tourism, and investment promotion; harness its knowledge, skills, and assets; and attract higher and more efficient forms of remittances.

Even if countries incur a net loss due to emigration, a border tax might not be the most reasonable policy response. Appealing to the pioneering work of Bhagwati in the 1970s and 1980s on policy responses to emigration, an argument could be made for a border tax on migrants (similar to a Tobin tax). The tax was proposed by Bhagwati (1976), with the prior that developing countries lose due to migration. It is in principle also an extension of the idea of progressive income

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[16] This estimate is M/N where M is the total number of tertiary educated Caribbean-born migrants in the OECD and N is the labor force in the Caribbean (obtained using Docquier and Marfouq (2005))

taxation—the improvement of the well being of migrants is taxed for the benefit of those left behind.

The main reasons for the border tax not being reasonable are the problems in implementing such a tax. Taxes can also have distortionary effects. Since the absolute number of migrants from Caribbean countries is not very large, the per capita tax rate will have to be very large to raise a sizeable revenue. In fact, the United States is the only country that taxes individuals on the basis of citizenship rather than place of residence.

Retaining the high skilled without the possibility of taxes would be facilitated by reorienting education. The high rates of emigration from the region are due not only to the "pull factor" i.e., higher wages abroad, but also the limited opportunities for highly, but similarly, educated people in the same small geographical areas (i.e., the "push factor"). One approach to creating the right incentives is to reorient the higher education system towards providing skills in demand within the region, in particular the services sector, which dominates these economies. Such reorientation could include, for example, the establishment of hotel management institutes or specialized banking and finance institutes. It is particularly important for the Caribbean governments to consider the possibilities for reorienting education, as a major portion of the cost of education of their citizens is covered by education subsidies. Governments might reap higher returns by investing in education infrastructure that leads to more retention of the high skilled.

Since the international experience has been that it is difficult to prevent emigration, the real policy challenge is how Caribbean countries can maximize the benefits from their population living and working overseas. Remittances should be the most immediate focus, as they can affect growth through investment, both physical and human. Evidence from micro-level studies suggest that remittances lead to greater human and physical capital investment (Cox and Ureta (2003) study of El Salvador, Hanson and Woodruff (2001) and Woodruff and Zenteno (2001) studies of Mexico, Lucas (1987) study of Africa). Countries need to recognize the importance of remittances and improve recording of the data.

Appendix 1: Calculation of NIS Adjustment for non-NIS Countries

This appendix shows the detailed calculations for deriving the NIS-adjusted emigration rates for Caribbean countries not included in the NIS. The NIS includes migrants from only three Caribbean countries – Dominican Republic, Haiti and Jamaica. For these countries, the NIS provides information on whether the migrants acquired schooling in the US. For tertiary educated immigrants born in Dominican Republic, Haiti and Jamaica, 97, 73 and 65 percent respectively did

not acquire schooling in the US. I apply these figures to the other Caribbean countries using weights based on how similar are the immigrants from the other Caribbean countries to three NIS countries.

The table below shows the immigrant characteristics used to derive these weights. For example, Antigua and Barbuda is closest to Jamaica on three of the four immigrant characteristics –age, years of schooling and average income, and to Dominican Republic on one characteristic – age at migration. Hence the estimated fraction of emigrants who did not complete their schooling in the US is given by 3/4×Jamaica+1/4×Dominican Republic (=3/4×65+1/4×97).

Emigrant characteristics, NIS vs non-NIS countries					
Country of birth	Avg age	Avg age at migration	Avg yrs of schooling	Avg annual income (in US $)	Share did not complete school in US
Antigua and Barbuda	41	22	12	23390	73
Bahamas, The	34	16	12	16378	83
Barbados	45	24	12	22281	65
Belize	41	21	12	18166	75
Dominica	35	22	11	18608	83
Grenada	42	25	12	20836	66
Guyana	40	25	12	20557	66
St. Kitts and Nevis	42	23	12	21061	69
St. Lucia	39	24	12	19979	68
St. Vincent & Grens.	40	24	12	20922	67
Trinidad and Tobago	40	23	11	21075	71
Haiti	39	24	11	16223	73
Dominican Republic	37	22	10	13035	97
Jamaica	41	24	12	20698	65

Source. US Census, 2000

Appendix 2. Calculation of the Average Cost of Educating a Migrant

According to Equation (12) in the main text,

$$e \approx \frac{T}{S}$$

Where T is the total annual expenditure on education by the government (on primary, secondary and tertiary education) and S is the total annual school enrollment.

The data on education expenditure for Antigua and Barbuda, Dominica, Haiti and Grenada and Suriname are not available in the WDI. For Dominica and Grenada, the expenditure on education is obtained from a database maintained by the IMF's Fiscal Affairs Department. The data is based on staff reports from Article IV consultations of the Fund with member countries. The expenditure on Antigua and Barbuda is approximated by the average of expenditure on the other five countries in the Eastern Caribbean Currency Union. Thus, the average cost per student can be calculated for all the countries except Haiti and Suriname.

The data on enrollment in primary and secondary education is obtained primarily from WDI. The data on secondary enrollment is not available in the WDI for Bahamas, Barbados, Belize, St. Kitts and Nevis, and St. Lucia. For these countries, I use the secondary school enrollment data from the UNESCO. The tertiary school enrollment data is from the UNESCO, which includes only the bigger Caribbean countries – Jamaica, Barbados and Trinidad and Tobago. For the other countries, S does not include tertiary enrollment.

Ideally S should include only the enrollment in government-owned institutions, the information on which is available only for primary education. For primary schooling, WDI provides the percentage of pupils in private school which we exclude from the total primary enrollment. However, for secondary and tertiary schooling, S is overestimated, which would bias the calculation of e downwards.

I use the expenditure and enrollment data for 2000 in order to calculate e. Since the migrants came in at different point in time, one would ideally use the annual expenditure on education at different points in time. However, data on public expenditure on education is available only for recent years.

Consider for example, the case of Jamaica. The annual expenditure on education is about 6 percent of GDP or 490 million US dollars. The total of students enrolled in public institutions (primary, secondary or tertiary) in a given year in Jamaica is 575,000. Hence the expenditure per student, per year, on average is equal to 490 million / 575,000, which is approximately 850 US $ per student. After using the NIS adjustment, about 117,000 emigrants have left Jamaica (mainly between 1965 and 2000). Hence the total annual expenditure on all these migrants is approximately equal to (117000 x 850) $US, which is approximately equal to 100 mn US $, which is the figure shown in Figure 11. This is also equal to 1.3 percent of Jamaica's GDP in 2000, as shown in Table 7.

Annex Table 1. Percent of Tertiary Educated Labor Force that Has Migrated
to the United States, 1965-2000

| Country | Age at immigration greater than or equal | | | |
	16 years	18 years	21 years	25 years
Antigua and Barbuda	49	47	47	35
Bahamas, The	51	45	19	13
Barbados	39	36	31	24
Belize	55	51	32	23
Dominica	46	43	35	28
Dominican Republic	15	13	11	8
Grenada	72	70	43	33
Guyana	77	75	66	59
Haiti	75	73	67	59
Jamaica	72	70	63	56
St. Kitts and Nevis	59	57	47	37
St. Lucia	48	46	16	11
St. Vincent & Grenadines	66	63	29	19
Trinidad and Tobago	63	60	54	45
Average	56	54	40	32

Sources: U.S. Census (2000); Docquier and Marfouq (2005); and author's calculations.
Primary: 0-8, secondary: 9-12, tertiary: >12 years of schooling

Annex Table 2. Comparison of the Administrative Enrollment Data
and the Number of Emigrants in the US Census

| Year | Registration | | | | | US Census, | NIS |
	On-campus, UWI	Afiliated Institutions	U Tech, Jamaica	U. Guyana	Total	2000	adjusted
1991	13,375	777	5,236	2,540	21,928	15,460	11,286
1992	13,996	1,895	5,189	2,970	24,050	14,540	10,614
1993	15,231	1,771	5,945	3,607	26,554	13,780	10,059
1994	15,727	1,448	6,386	3,357	26,918	14,580	10,643
1995	16,553	562	6,770	3,494	27,379	13,600	9,928
1996	17,052	2,570	7,102	3,708	30,432	10,680	7,796
1997	18,864	2,771	6,579	3,888	32,102	8,900	6,497
1998	19,345	4,246	6,072	4,656	34,319	8,600	6,278
1999	19,825	3,754	7,550	4,921	36,050	9,540	6,964
2000	19,465	3,982	6,049	4,976	34,472	2,400	1,752
Average	16,943	2,378	6,288	3,812	29,420	11,208	8,182

Age of the migrants counted in the 2000 Census is restricted to 25 or years
Source. Official Statistics, Office of Planning and Institutional Research, UWI MONA Campus, Jamaica

Annex Table 3. Distributional Impact and Remittances
(in percent of GDP)

	Gain to Workers e=0.3	Gain to Workers e=0.4	Loss to Other Factors e=0.3	Loss to Other Factors e=0.4	Remittances Average 1980–2002
Antigua and Barbuda	4.9	6.6	6.4	8.5	3.0
Barbados	4.6	6.1	5.7	7.6	2.3
Belize	4.3	5.8	5.2	6.9	4.7
Dominica	5.1	6.8	6.8	9.1	8.4
Dominican Republic	2.4	3.2	2.6	3.4	5.3
Grenada	5.2	7.0	8.3	11.0	11.0
Guyana	5.1	6.8	7.0	9.3	1.9
Haiti	2.1	2.9	2.3	3.0	10.1
Jamaica	4.8	6.4	6.1	8.1	7.4
St. Kitts and Nevis	5.2	7.0	7.8	10.4	6.9
St. Lucia	3.7	5.0	4.3	5.7	4.0
St. Vincent and the Grenadines	4.9	6.5	6.3	8.4	7.2
Suriname	5.2	7.0	7.6	10.1	0.5
Trinidad and Tobago	4.0	5.3	4.6	6.2	0.3
Average	4.4	5.9	5.8	7.7	5.2

Source: Author's calculations.
Note: e denotes the elasticity of factor price of labor (i.e., percentage change in wages resulting from a 1 percent change in the size of the labor force). The distributional impact is calculated using equations (3) and (4).

Annex Table 4. Emigration Loss with External Effects Due to High-Skilled Migration
(in percent of GDP)

	Low Elasticities Gamma = 0.05, e = 0.3	High Elasticities Gamma=.1, e=0.4	Remittances Avg 1980–2002
Antigua and Barbuda	3.9	6.6	3.0
Barbados	3.6	6.2	2.3
Belize	3.8	6.5	4.7
Dominica	3.7	6.3	8.4
Dominican Republic	0.9	1.8	5.3
Grenada	5.4	9.0	11.0
Guyana	5.8	9.5	1.9
Haiti	5.3	8.7	10.1
Jamaica	5.4	8.9	7.4
St. Kitts and Nevis	4.9	8.1	6.9
St. Lucia	4.2	7.2	4.0
St. Vincent and the Grenadines	5.4	8.9	7.2
Suriname	2.5	4.5	0.5
Trinidad and Tobago	4.9	8.2	0.3
Average	4.3	7.2	5.2

Source: Author's calculations.
Note: e denotes the elasticity of factor price of labor (i.e., percentage change in wages resulting
from a 1 percent change in the size of the labor force).
Gamma denotes the elasticity of marginal product of labor
(the percentage change in marginal product of skilled labor due to 1 percent change in
aggregate stock of skilled labor.
Emigration loss is calculated using equation (7). Skilled emigration rate to the United States, with
restricted age at migration, is used for the calculations.

Annex Table 5.Total Losses Due to High-Skilled Emigration to the United States vs Remittances
(in percent of GDP)

	Estimated Education Expenditure	Emigration Loss (gamma=0.1, e=0.4)	Emigration Loss + Estimated Education Expenditure	Remittances Avg 1980–2002
Antigua and Barbuda	2.9	5.4	8.4	3.0
Barbados	2.0	4.3	6.3	2.3
Belize	2.6	6.0	8.6	4.7
Dominica	1.5	4.6	6.1	8.4
Dominican Republic	0.2	1.5	1.7	5.3
Grenada	2.5	7.7	10.2	11.0
Guyana	7.4	8.3	15.7	1.9
Jamaica	1.9	8.0	9.9	7.4
St. Kitts and Nevis	2.5	6.4	8.8	6.9
St. Lucia	0.9	5.0	5.9	4.0
St. Vincent and the Grenadines	2.0	7.2	9.1	7.2
Trinidad and Tobago	0.9	6.8	7.7	0.3
Average	2.3	5.9	8.2	5.6

Source: Author's calculations.

Note: e denotes the elasticity of factor price of labor (i.e., percentage change in wages resulting from a

1 percent change in the size of the labor force).

Gamma denotes the elasticity of marginal product of labor (the percentage change in marginal product of

skilled labor due to 1 percent change in aggregate stock of skilled labor).

Emigration loss is calculated using equation (7);

the skilled emigration rate to the United States, is used to do the calculations.

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