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Immigration Policy, Remittances, and Growth in the Migrant-Sending Country

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Abstract:
As evidence accumulates to expose the ineffectiveness of foreign aid, there are increasing calls for rich countries to open up their immigration policies so as to enable migrants' remittances to substitute for foreign aid as a growth-stimulant in poor, migrant-sending countries. In this paper, we use an endogenous growth model to argue that the growth effects of transnational migration and remittances are entirely mediated by the human capital profile of emigrants, as determined by immigration policy at the destination country. Quantitatively, we find that when immigration policy at the destination country provokes a "brain drain", growth is negatively impacted in the sending country despite remittances. The reverse is true when immigration policy targets workers with low levels of human capital.

I. Introduction

Empirical data reveals that globalization of the world's economies has been characterized by rising migration flows from less-developed to developed countries.[4] Up to the 1950s, international migration had its main source in Europe. Since then, however, the pattern of international migration flows has undergone a radical change, with the developing world, including the poorest countries, emerging as its predominant source (Beine, Docquier, and Rapoport, 2008). This phenomenon has be accompanied by a steady surge in transnational remittances from emigrants to relatives and friends worldwide. Money sent home by migrant workers now exceed foreign aid (Kapur and McHale, 2003), representing the second largest financial inflow to many developing countries, behind foreign direct investment (Ratha, 2003).[5] These observations have triggered a growing economic literature interested in the socioeconomic effects migration and remittances may have on the migrant-sending countries.

From a development policy standpoint, growing interest in remittances stems from their perceived potential as catalysts of development. As evidence accumulates to expose the ineffectiveness of foreign aid, there are increasing calls for rich countries to open up their immigration policies so as to enable migrants' remittances to substitute for foreign aid as a growth-stimulant in poor, migrant-sending countries. Indeed, unlike foreign aid, remittance flows put no burden on rich countries taxpayers (Kapur, 2004). Unlike foreign aid which often falls in the hand of elites with extensive economic and political power and little consideration for the wellbeing of the poor majority (Angeles and Neanidis, 2008), remittance flows go directly to the poor households who need it. In that sense, they may represent a viable alternative to foreign aid as a poverty alleviation mechanism. However, remittance flows can be limited by immigration policy in rich countries. With

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[4]United Nations (2002), International Migration Report, New York.

[5]Latest estimates vary between US $401 billion published by the *International Fund for Agricultural Development* (IFAD) and the more conservative figures of US$250 billion published by the World Bank in 2006 . However there is a consensus among these two sources of data that these figures are increasing by almost 30% annually. Remittances sent back to developing countries, for example, rose from $116 billion in 2006 to $240 billion in 2007 (Ratha et al. 2007).

ineffective foreign aid having cost rich countries' taxpayers around $2.3 trillion over the past five decades (Easterly, 2007), many have come to support the view that a more open immigration policy from rich countries can promote development in poor, migrant-sending countries. This paper assesses the merits of this view by exploring the growth effects of transnational remittances by emigrants.

The fundamental premises of our migration and remittance model are the following:

(1). Migrating to a richer economy and remitting to a child dependent left in the migrant sending-country are joint decisions by forward-looking agents. These agents decide on their children level of human capital, while accounting for forgone income from child labor sources.

(2). Migrant remittances are a source of financing for children's consumption needs, enabling them to delay participation in the child labor market, thus extending their school enrolment. In other words, remittances help fight child labor, by promoting school enrolment.[6]

(3). The quality of education in the migrant-sending country is a determinant of the future human capital level of a school-goer.

(4). The human capital profile of migrant workers is influenced by the immigration policy of the destination country.

The first, second and third premises are essentially what distinguishes our analysis from the existing literature on brain drain (e.g. Rapoport, 2002; Stark, 2003; Fan and Stark,

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[6]Indeed a vast literature analyzes the impact of migration or remittances on the accumulation of human capital. Migration is an incentive to increasing human capital (Vidal, 1997). Rapoport and Docquier (2005) show that remittances can impact positively the level of education of children whose households have an emigrant member. Hanson and Woodruff (2002) find that children from households with at least an emigrant member are likely to complete more years of schooling in Mexico. According to Cox Edwards and Ureta (2003), remittances contribute significatively to the reduction of the dropout likelihood of children in Salvadore. When Yang (2003) has analyzed the impact of remittances on Filipino he found that a raise in remittances of 10% of the initial income increases the fraction of children aged 17 to 21 attending school by more than 10% points. And according to Lopez Cordova (2004), if the share of international remittances received rises of 5%, begining at zero, school attendance increases more than 3% in Mexico.

2007; Beine, Docquier and Rapoport, 2008), while the fourth premise provides a basis for exploring the mediation effect of immigration policy in destination countries. We derive necessary and sufficient conditions for transnational migrations and remittance flows to enhance the accumulation of human capital, modeled as the engine of economic growth in the migrant-sending country. Our theory confirms the predictions of existing theories that transnational migrations have (i) a positive effect on parental remittances, and (ii) a negative effect on child labor. However, unlike the existing literature (e.g. Rapoport, 2002; Stark, 2003; Fan and Stark, 2007; Beine, Docquier and Rapoport, 2008), we find that the growth effects of transnational migration and remittance flows are mediated by the human capital profile of emigrants– as determined by the immigration policy at the destination country. Using the no-migration equilibrium as a benchmark, we show that when immigration policy at the destination country provokes a "brain drain", growth is negatively impacted in the sending country. The reverse is true when immigration policy targets less-educated migrants. These contrasting results have an intuitive explanation. To the extent education is the main mechanism of human capital accumulation, the quality of that education is an important determinant of parents' decision to invest in their offspring's human capital. As teachers in the migrant-sending country are hired from the pool of non-emigrant adults, the quality of education provided is impacted by the average human capital of these teachers. When there is an uncompensated brain drain, average human capital of non-emigrants decreases, causing a decline in the quality of education. For altruistic parents, the decline in education quality raises the opportunity cost of school-enrolment for children in an environment where schooling and child labor have competing claims on a child's time. Consequently, parents end up investing less in their children's human capital formation, and growth of the economy-wide average human capital is adversely affected. In contrast, when emigration is a phenomenon of the less educated, hired teachers in the sending country are more-qualified, and the quality of education is higher, causing altruistic parents to remit more, so as to help their offspring accumulate more human capital.

II. Literature Review

Our paper bridges a number of important branches of the economic literature, namely the growth and development literature, the migration and remittances literature, and the child labor literature. Individually, these branches have made significant advances in the understanding of the development process. In the growth and development literature, a seminal work by Schultz (1962) formalizes investment in human capital as an important determinant of an economy's growth performance. Lucas (1988), Barro (1993), and Lee (1993) formalize this same relationship in models of endogenous growth, by emphasizing the dynamics between education, training and growth. Azariadis and Drazen (1990) illustrate the importance of intergenerational transfers of human capital in the development of human resources. Using a growth model with endogenous fertility, Becker, Murphy and Tamura (1990) formalize the existence of under-development traps arising from the arbitrage altruistic parents make between increasing household's size and improving the well-being of each its members. Our paper contributes to this branch of the development literature by exploring the joint effects of emigration and remittances[7] on human capital and growth in the migrant-sending country.

In the migration and remittances literature, empirical evidence on the development effects of transnational remittance flows is mixed. While a number of studies find confirmation for the hypothesis that remittance flows have a positive effect on economic development, others are less optimistic. Proponents of the positive effect contend that remittance flows decrease inequality in the recipient countries (Docquier, Rapoport, and Shen, 2007), enable household to relieve budget constraints, and stimulate demand of goods and services, which, in turn, stimulate production and employment (Stark, Taylor and Yitzenaki, 1986, 1988; Taylor, 1992; Taylor and Wyatt, 1996; Lowell and de la Garza, 2000). Moreover, Quibria (1997), Taylor (1999), and Ratha (2003) argue that remittance flows provide the much needed currency for importing essential inputs that are unavailable domestically,

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[7]Transnational remittances are individual transferts of money from immigrants to beneficiaries (friends, and family members, etc.) living in their native countries.

as well as additional savings for financing economic development. Pessimism about the positive effect of remittance flows has two main sources. Firstly, remittance flows may generate a level of domestic demand that exceeds the economy's production capacity, and thus may represent a source of inflation (Adams, 1991), or unemployment, if cheaper imports are brought in to expunge the remittance-induced excess demand.[8] Secondly, given the income effect of remittance flows, recipients could afford to work less. The resulting decrease in labor supply, in turn, may lead to a negative effect of on economic growth (Chami *et al.*, 2003). We complement this branch of the development literature by exploring the growth effects of remittance flows in a broader perspective of endogenous migration and remittance theory. As determinants of growth, both migration and remittances have been extensively studied by economists. But most existing works, both empirical and theoretical, either treat them separately (Fiess and Verner, 2003; Rapoport and Katz, 2005; Stark and Fan, 2007; Rapoport and Docquier, 2007; Beine, Docquier, and Rapoport, 2008), or when treated jointly (e.g., McCormick and Wahba, 2000; Docquier, Rapoport, and Shen, 2007), their growth implications are not discussed. We offer a unified treatment of migration, remittance flows and growth in the migrant-sending country, highlighting the role played by immigration policy at the destination country in mediating the growth effects of migration and remittance flows.

Our research also contributes to the development literature on parental investment in child's human capital. Most contributions in this branch highlights the trade-off between the current benefits of child labor to poor households, and its future costs in terms of low levels of human capital for children, when they become adults. Basu and Van (1998), Baland and Robinson (2000), Dessy and Pallage (2001), Doepke and Zilibotti (2005), and Dessy and Knowles (2008) are some of the important theoretical contributions to this child labor literature. We build around this literature by emphasizing transnational migration and remittance flows as a strategy for combatting child labor.

The rest of this paper is organized as follows. Section 3 describes the setup, and char-

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[8]The price for agricultural land rose between 1980 and 1986 by 600% due to remittances (Adams, 1991)

acterizes the intertemporal equilibrium. Section 4 solves a numerical example. Concluding remarks are presented in Section 5. Finally, proofs of some results are provided in the Appendix section.

III. Setup

Consider two economies, North (N) and South (S). Both produce a tradable good. North is a rich economy, while South is a poorer one. Therefore, North may become the destination of economic migrants from South. South is initially populated by a continuum one of agents, each endowed with a level of human capital, h, drawn from a distribution characterized by a CDF function:

$$\Psi(h) = \frac{1}{\Delta_h}\left(h - \underline{\eta}\right), \tag{III.1}$$

where $\Delta_h = \bar{\eta} - \underline{\eta}$ and $\Psi(h)$ denotes the measure of parents with a human capital level no greater than $h \in [\underline{\eta}, \bar{\eta}]$, with $0 < \underline{\eta} < \bar{\eta} < \infty$.[9] In this environment, an agent is an adult with one period left to live. Each adult is parent to a two-period-lived, unique, child. Each child is endowed with one unit of time. A child's time endowment is allocated between schooling and work. Henceforth we refer to all adult agents as parents.

Parents who emigrate to North leave their children behind. These children become recipient of parental remittances. Parents make all the decisions in this environment. They each decide whether or not to emigrate to North (N); depending on their location, how much to remit to their child dependent, and how much labor time their child is to supply to the market. Parental remittances are a source of financing for the child's consumption. A child may supplement parental remittances with income from child labor so as to finance his consumption.

Let m be a binary variable representing the migration decision of a parent: $m = N$ if

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[9]Even though we do not believe that human capital is necessarily uniformly distributed in any or all developing countries, we make this assumption for two simple reasons. First, our analysis is not specifically concerned with the measurement of inequality per se. Second, it will gives a convenient device for computing the measure of parents who migrate to North, as well as the measure of those who remain in South.

he decides to emigrate to North and $m = S$, if otherwise. A non-emigrant parent earns a level of income, $\omega_S h$, which is proportional to his/her level of human capital, where ω_m denotes the wage rate in country $m \in \{N, S\}$. By contrast, migration entails a cost to the migrant in the destination country. This cost may reflect the forgone income from restrictions placed by the destination country on migrants' participation in the domestic labor market. These restrictions affect the level of the migrant's total earnings in the host economy.

Let $i \in \{1, 2\}$ denotes immigration policy in North. When $i = 1$, immigration policy is biased in favor of more educated migrants. When $i = 2$, it is biased toward the less educated instead.[10] A parent who elects to migrate to North earns an income, $[h - \varphi^i(h, E_i)]\omega_N$, where $\varphi^i(h, E_i)\omega_N$ denotes the forgone income from restrictions imposed by the recipient country on migrants' participation in the labor market, and $E_i \in [0, 1]$, the number of migrants when immigration policy at destination is $i \in \{1, 2\}$. We model emigration costs as follows:

$$\varphi^i(h, E_i) = \begin{cases} \alpha_1 E_1 + \kappa_1 & i = 1 \\ \alpha_2 E_2 h + \kappa_2 h^2 & i = 2 \end{cases} \tag{III.2}$$

where h denotes the human capital level of the emigrant, and $\alpha_i > 0$ and $\kappa_i > 0$ are exogenously given parameters.

A. Preferences and Budget Constraints

Conditional upon his place of employment, m, a parent makes joint-decisions about own-consumption (c_m), the amount of money, θ_m, to remit to his/her unique child, and the fraction of time, e_m, this child is to spend receiving an education. Education quality in

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[10]Empirical evidence on the pattern of immigration bias is quite mixed. On one hand, there is evidence that emigration in Eastern-European and South-American countries exhibits relatively low brain drain levels even though out-migration rates are very high (Docquier and Marfouk, 2006). Moreover, in Mexico, Cameroon, Zambia and Slovakia skilled migrants represent only around 15% of total migrants. On the other hand, there is also evidence that skilled migrants account for 83,6% of total migrants in Haiti, 52% in Sierra Leone, and 47% in Ghana.

South is proxied by the average human capital of non-emigrant parents:

$$\widetilde{h}_i = \frac{H_i}{1 - E_i}$$

where

$$H_i = \int_{D_S^i} h\psi\left(h\right) dh \tag{III.3}$$

denotes the aggregate stock of human capital of non-emigrants, D_S^i the set from which non-emigrants draw their human capital levels, and E_i the total number of parent emigrants, when immigration policy at destination is i.

All parents have identical preferences over own-consumption (c_m), child's consumption (c_m^k), and the child's human capital level when parent (h_m'). Assume a simple additively separable utility specification of these preferences:

$$U_m = \ln\left(c_m\right) + \gamma\left[\ln c_m^k + \beta \ln h_m'\right], \tag{III.4}$$

where c_m denotes the level of consumption of an parent who resides and works in country $m \in \{N, S\}$, $\gamma \in \mathbb{R}_+$ the level of parental altruism, and $\beta \in (0,1)$, a time discounting factor. Schooling is the only mechanism for accumulating human capital. A child who spends a fraction, e, of his time endowment receiving an education ends up accumulating a level of human capital, h_m', given by:

$$h_m' = \lambda e_m \widetilde{h}_i + \varepsilon h \tag{III.5}$$

where $\lambda > 1$ represents an exogenous efficiency parameter, and εh the level of human capital a child inherited from his parent whose level of human capital is h, with $\varepsilon \in (0,1)$.

A parent who makes the migration decision m allocates his/her income to the financing of own consumption, and remittance flows to his offspring. His/Her budget constraint thus is:

$$P_m c_m + \theta_m \leq y_m, \qquad m = N, S \tag{III.6}$$

where

$$y_m = \begin{cases} [h - \varphi^i (h, E_i)] \omega_N & \text{if } m = N \\ \omega_S h & \text{if } m = S \end{cases}, \tag{III.7}$$

P_m, the domestic price of the tradable good. Since in South children do not migrate, a child's consumption satisfies the following budget constraint:

$$P_S c_m^k \leq \theta_m + (1 - e_m) \omega_k, \tag{III.8}$$

where $(1 - e_m) \omega_k$ denotes income from child labor sources, and ω_k, the child labor wage.

B. Production and Trade

Firms are perfectly competitive in both the output and the input markets. In North, the production technology is given by $Y_N = L_N$, where L_N denotes effective labor (which equals human capital times the time spent delivering it to firms). A parent who emigrates to North will earn a wage given by

$$\omega_N = P_N \tag{III.9}$$

In South, production of the tradable is carried out by both formal and informal firms. The representative formal firm uses a quantity L_S of effective labor to produce a level of output, Y_S, given by:

$$Y_S^F = (1 - b) L_S, \tag{III.10}$$

where

$$L_S \leq H_i, \tag{III.11}$$

H_i the aggregate stock of human capital of non-emigrants, when immigration policy in North is given by $i \in \{1, 2\}$, and $b \in (0, 1)$ a measure of the level of institutional barriers to riches prevailing in South. These barriers may reflect, for example, the extent of corruption

or other institutional bottlenecks prevailing in South, and which induce firms to adopt low-productivity technologies.[11] We interpret b as a measure of the degree of poverty in South. Perfectly competitive hiring of effective labor implies that

$$\omega_S = (1 - b) P_S \qquad (\text{III.12})$$

The representative informal firm hires raw child labor, L_k, to produce a level, Y_k, of the tradable given by:

$$Y_k = \phi L_k, \qquad (\text{III.13})$$

where $\phi \in (0, 1)$ denotes labor productivity in the informal sector,

$$L_k \leq \int_{D_S^i} (1 - e_S) \, \psi(h) \, dh + \int_{D_N^i} (1 - e_N) \, \psi(h) \, dh, \qquad (\text{III.14})$$

and D_S^i (respectively, D_N^i) is the set from non-emigrants (respectively, emigrants) draw their human capital levels when immigration policy in North is given by $i \in \{1, 2\}$. Perfectly competitive hiring of child labor implies that

$$\omega_k = P_s \phi. \qquad (\text{III.15})$$

In the absence of migration and trade, it is assumed that North is relatively more endowed in effective labor than South. In the opening of trade and migration, North will export the tradable while South will import it. In equilibrium, flows of migrants' remittances to South and payments of imports by consumers in South will balanced out to close the system, so that $P_S = P_N$. Henceforth, without loss of generality, we set $P_S = P_N = 1$.

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[11] According to the World Bank *Doing Business 2009 Report*, most countries with a higher cost of doing business are located in the developing world.

C. The Timing of Event

Events in this environment occur according to the following timing.

- In the beginning, North announces its permanent immigration policy $i \in \{1, 2\}$.

- Then, at the start of every period, each agent from South makes his migration decision, m.

- Those who chose $m = N$, in total number, E_i, then migrate to North.

- Next, emigrants (in total number, E_i) and non-emigrants (in total number $1 - E_i$) supply human capital to firms in their respective locations.

- Given their respective locations, they then decide on their child's time allocation.

- Production of the tradable good then takes place, wages are paid, and agents (i.e., the parents) remit to their child dependent.

- Immediately after that, the consumption good is imported, and consumption takes place in both North and South.

- Finally, parents exit, children become parents, each with one child, and another cycle of agents decisions starts.

D. Parents' Decision Problems

Parents in South are forward-looking. Their decision problems can thus be solved by applying the backward induction process. This process is explained as follows. First, as parental utility is strictly increasing, in the optimum all budget constraints will be saturated. Therefore, the value function of a parent h who makes the migration decision m is

$$V(m, \theta_m, e_m, h) = \ln(y_m - \theta_m) + \gamma \left(\ln[\theta_m + (1 - e_m)\omega_k] + \beta \ln\left[\lambda e_m \widetilde{h}_i + \varepsilon h \right] \right). \quad \text{(III.16)}$$

His/her decision problem thus is:

$$\max_{\langle m, \theta_m, e_m \rangle} V(m, \theta_m, e_m, h)$$

Second, each parent chooses employment location, m, by anticipating the consequences this choice will have on his/her child's education and the intra-family remittances. Therefore, a forward-looking parent first determine his/her child's education level, e_m, and the intra-family remittance flow, θ_m, given his/her migration decision, m. Then, given (e_m, θ_m), (s)he optimally selects the localization that yields the highest possible value. More formally, each parent's two stages problem is described as follows:

$$\max \left\{ \max_{\theta_N, e_N} V(N, \theta_N, e_N, h); \max_{\theta_S, e_S} V(S, \theta_S, e_S, h) \right\} \tag{III.17}$$

D.1. Remittance Flows and Child's Education Level

In this sub-section, we solve the second stage of the parent's problem (III.17), conditional upon his/her migration decision, m. We determine the optimal child's education level (e_m) and the optimal remittance flow (θ_m). Using (III.16).

Given (h, m), consider the maximization problem:

$$\max_{\theta_m, e_m} V(m, \theta_m, e_m, h), \qquad m \in \{N, S\}$$

The first order necessary and sufficient condition for an interior solution to this problem leads to:

$$\theta_m = \frac{1}{\delta} \left[(1 + \beta) \gamma y_m - \left(1 + \varepsilon \frac{h}{\lambda \widetilde{h}_i} \right) \omega_k \right] \tag{III.18}$$

$$e_m^* = \frac{1}{\delta} \left[\left(1 + \frac{y_m}{\omega_k} \right) \gamma \beta - \varepsilon (1 + \gamma) \frac{h}{\lambda \widetilde{h}_i} \right] \tag{III.19}$$

where $\delta = 1 + (1 + \beta)\gamma$, and

$$y_m = \begin{cases} h - \varphi^i(h, E_i) & \text{if } m = N \\ h & \text{if } m = S \end{cases}. \tag{III.20}$$

Therefore, the following Propositions obtain by inspection of (III.18) and (III.19):

Proposition 1. *If*

$$y_N > y_S, \tag{III.21}$$

then a parent remits more too his/her child dependent when (s)he migrates than when (s)he does not (i.e., $\theta_N > \theta_S$), and, consequently, his/her child attains a higher level of education in the first case than in the second (i.e., $e_N > e_S$).

Condition (III.21) means that a parent earns more when (s)he emigrates than when (s)he does not. Proposition 1 resonates with earlier empirical findings about the positive effects of emigration and remittance flows on children's education attainments in Mexico (Hanson and Woodruff, 2003).

Proposition 2. *The quality of education in South has a positive effect on the levels of both intra-family remittance flows and child's education attainment. In contrast, children's earning capacity as measured by the child labor wage ω_k has a negative effect on the levels of both intra-family remittance flows and child's education attainment.*

These results are standard in the literature of parental investment in child human capital. In particular, a higher quality education tends to raise the return to education. This, in turn, incites an altruistic parent to make the sacrifice needed to ensure a better future for his/her child. In this environment, this means (s)he remits more whatever his/her location. Furthermore, when children have a high earning capacity, the opportunity cost of education rises. Standard human capital theory (Becker, 1964) predicts that a high opportunity cost of education discourages investment in human capital. In that context, even altruistic parents will reduce their remittances, thus shifting child's time use away from schooling and into child labor.

D.2. The Determinants of the Migration Decision

We stated above that a parent migration decision is binary: either (s)he stays and works in South ($m = 0$), or (s)he emigrates to North ($m = 1$). The objective of this subsection is to uncover the determinants of the decision to migrate. Let $\vartheta^i\left(h, \phi, b, \widetilde{h}_i, E_i\right) = V(N, \theta_N^*, e_N^*, h) - V(S, \theta_S^*, e_S^*, h)$ denote the net value gain from migration, for a parent with human capital level h, when immigration policy in North is $i \in \{1, 2\}$. From (III.16), substituting in (III.18) and (III.19), using (III.7), (III.9), (III.12), and (III.15), and rearranging terms yields this net value gain as follows:

$$\vartheta^i\left(h, \phi, b, \widetilde{h}_i, E_i\right) = \delta \ln\left[\frac{[h - \varphi^i(h, E_i)]\lambda\widetilde{h}_i + \left(\lambda\widetilde{h}_i + \varepsilon h\right)\phi}{(1-b)h\lambda\widetilde{h}_i + \left(\lambda\widetilde{h}_i + \varepsilon h\right)\phi}\right]. \tag{III.22}$$

The following Proposition therefore obtains from straightforward differentiation of (III.22).

Proposition 3. *The following statements are all true:*
(i) poverty in South (i.e., a high b) raises the gain from migration;
(ii) a high number of migrants (i.e., a high E_i) reduces the gain from migration;
(iii) If (III.21) holds, then a high education quality in South (i.e., a high $\widetilde{h}_i$) encourages migration, while a high child labor wage (i.e., a high ϕ) discourages it.

Propositions 1, 2, and 3 imply that differential earning prospects in North and South provide parents in South with the incentive to work abroad. As immigration policy at the destination country affects these earning differentials, it has an effect on the volume of remittance flows (Proposition 1), but also, as we show below, on the quality of education in South $\widetilde{h}_i$. Before we turn to the discussion of the growth effects of migration and remittances, we first characterize the human capital profile of migrants, by relating it to the immigration policy at North.

E. Who Gains from Emigration?

In this sub-section, we explore the sources of differential gains from emigration among parents. How does parental human capital affect the gain from emigration?

Using (III.2), we can rewrite (III.22) as follows:

$$\vartheta^1 \left(h; \phi, b, \widetilde{h}_1, E_1\right) = \delta \ln \left[\frac{[h - \alpha_1 E_1 - \kappa_1] \lambda \widetilde{h}_1 + \left(\lambda \widetilde{h}_1 + \varepsilon h\right) \phi}{(1 - b) h \lambda \widetilde{h}_1 + \left(\lambda \widetilde{h}_1 + \varepsilon h\right) \phi} \right], \qquad \text{(III.23)}$$

if immigration policy $i = 1$ occurs in North, and

$$\vartheta^2 \left(h; \phi, b, \widetilde{h}_2, E_2\right) = \delta \ln \left[\frac{(1 - \alpha_2 E_2 - \kappa_2 h) h \lambda \widetilde{h}_2 + \left(\lambda \widetilde{h}_2 + \varepsilon h\right) \phi}{(1 - b) h \lambda \widetilde{h}_2 + \left(\lambda \widetilde{h}_2 + \varepsilon h\right) \phi} \right], \qquad \text{(III.24)}$$

if $i = 2$ occurs instead. The following Lemma is proved in the Appendix section.

Lemma 1. $\partial \vartheta^1 (.)/\partial h > 0$. Furthermore, if

$$\underline{\eta} > \frac{1}{2\kappa_2} \qquad \text{(III.25)}$$

then $\partial \vartheta^2 (.)/\partial h < 0$.

Lemma 1 above states that, when immigration policy in North is $i = 1$, the gain from emigration is increasing in the migrant's level of human capital (i.e., $\partial \vartheta^1/\partial h > 0$). As a result, parents who gain from emigrating (in total number E_1) are those who have levels of human capital above a threshold $\widehat{h}_1$, while those who lose, and thus will choose not to emigrate (in total number $1 - E_1$) have levels of human capital no higher than that threshold, where $\widehat{h}_1$ is solution to

$$\vartheta^1 \left(h; \phi, b, \widetilde{h}_1, E_1\right) = 0. \qquad \text{(III.26)}$$

By contrast, when immigration policy in North is $i = 2$, and condition (III.25) holds, the gain from emigration is decreasing in the migrant's level of human capital (i.e., $\partial \vartheta^2/\partial h <$

0). As a result, parents who gain from emigrating are those with a level of human capital no higher than a threshold $\widehat{h}_2$, where $\widehat{h}_2$ is solution to

$$\vartheta^2\left(h; \phi, b, \widetilde{h}_2, E_2\right) = 0. \tag{III.27}$$

Condition condition (III.25) imposes a lower bound for parental human capital h. This condition is always easily satisfied for any $\kappa_2 \geq 1$.

Recall that parents are assumed to be uniformly distributed across human capital levels. Using (III.1), it can be shown that the pattern of emigration induced by immigration policy in North can be characterized as follows:

$$E_i = \begin{cases} 1 - \widehat{h}_1/\bar{\eta} & i = 1 \\ \widehat{h}_2/\bar{\eta} & i = 2 \end{cases}. \tag{III.28}$$

These patterns of emigration have the following implications for respectively the quality of education in South and the aggregate stock of human capital of non-emigrants:

Result 1. The quality of education in South–as proxied by the average human capital level of non-emigrants– is given by

$$\widetilde{h}_i = \begin{cases} \left(\widehat{h}_1 + \underline{\eta}\right)/2 & i = 1 \\ \left(\widehat{h}_2 + \bar{\eta}\right)/2 & i = 1 \end{cases}. \tag{III.29}$$

Observe from (III.28) that an increase in the level of the threshold $\widehat{h}_1$ reduces the number of Emigrants (i.e., $\partial E_1/\partial \widehat{h}_1 < 0$). Therefore from (III.29), it follows that the quality of education in South $\widetilde{h}_1$ is negatively impacted by a "brain drain": $\partial \widetilde{h}_1/\partial \widehat{h}_1 > 0$. Likewise since from (III.28), an increase in the level of the threshold $\widehat{h}_2$ raises the number of emigrants (i.e., $\partial E_2/\partial \widehat{h}_2 > 0$), it follows from (III.29) that emigration of workers with low levels of human capital raises the quality of education in South : $\partial \widetilde{h}_2/\partial \widehat{h}_2 > 0$. This surprising result can be explained as follows. Since teachers are hired from the pool of non-emigrant parents, their average human capital rises as agents with low levels of human

capital exit that pool. As a result, the quality of education increases.

Result 2. The aggregate human capital of non-emigrants is given by:

$$
H_i =
\begin{cases}
\left[\left(\widehat{h}_1 \right)^2 - \underline{\eta}^2 \right] / 2\Delta_h & i = 1 \\[2em]
\left[\bar{\eta}^2 - \left(\widehat{h}_2 \right)^2 \right] / 2\Delta_h & i = 2
\end{cases}
. \tag{III.30}
$$

This result implies that emigration always reduces the production capacity of the sending-country, irrespective of the human capital profile of emigrants as determined by immigration policy at destination: $\partial H_1 / \partial \widehat{h}_1 > 0$ if $i = 1$, and $\partial H_2 / \partial \widehat{h}_2 < 0$ if $i = 2$.

IV. Equilibrium Analysis

In this section, we define and characterize the existence of a general equilibrium for the South's economy, distinguishing between each of the two immigration policy scenario outlined above.

Définition *An equilibrium for this overlapping-generations' economy is a threshold human capital endowment $\widehat{h}_i^*$, a law of motion for the economy-wide average human capital, $\bar{h}_i'$, the quality of education in South $\widetilde{h}_i^*$, and a number of emigrants, E_i^*, such that*

(i) given $\left(E_i^*, \widetilde{h}_i^* \right)$, $\widehat{h}_i^*$ solves

$$
\vartheta^i \left(h; \phi, b, \widetilde{h}_i^*, E_i^* \right) = 0, \tag{IV.1}
$$

$i = 1, 2$;

(ii) given $\widehat{h}_i^*$, the number of emigrant E_i^* is given by:

$$
E_i^* =
\begin{cases}
\left(\bar{\eta} - \widehat{h}_1^* \right) / \Delta_h & i = 1 \\
\left(\widehat{h}_2^* - \underline{\eta} \right) / \Delta_h & i = 2
\end{cases}
, \tag{IV.2}
$$

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and the quality of education in South $\widetilde{h}_i^*$ solves (III.29);

(iii) given $\left(\widehat{h}_i^*, E_i^*, \widetilde{h}_i^*\right)$, the law of motion for the average level of human capital of South's parent citizens satisfies:

$$\bar{h}_i' = \lambda \widetilde{h}_i^* \left[\int_{D_S^i} e_S^* \psi(h) dh + \int_{D_N^i} e_N^* \psi(h) dh \right] + \varepsilon \bar{h}, \qquad \text{(IV.3)}$$

where e_m^* is given by (III.19) and

$$\bar{h} = \int_{\underline{\eta}}^{\bar{\eta}} h \psi(h) \, dh$$

denotes the economy-wide average human capital of the current generation of parents in the absence of migrations.[12]

A. Equilibrium Values for Endogenous Variables

On the basis of this definition, it is clear that an equilibrium exists if and only if there exists $\widehat{h}_i^*$ that solves (III.27), for all i. We characterize this equilibrium in what follows. We begin with the computation of equilibrium values for the thresholds $\widehat{h}_1^*$ and $\widehat{h}_2^*$. From (III.27), substituting in (III.23) and (III.24), respectively and solving for $\widehat{h}_i$ yields

$$\widehat{h}_i = \begin{cases} [\alpha_1 E_1^* + \kappa_1] b^{-1} & i = 1 \\ [1 - \alpha_2 E_2^* - (1 - b)] \kappa_2^{-1} & i = 2 \end{cases}. \qquad \text{(IV.4)}$$

Substituting these values in (IV.2), rearranging terms yields

$$E_i^* = \begin{cases} (\bar{\eta} b - \kappa_1) [\alpha_1 + b \Delta_h]^{-1} & i = 1 \\ (b - \underline{\eta} \kappa_2) [\alpha_2 + \kappa_2 \Delta_h]^{-1} & i = 2 \end{cases}. \qquad \text{(IV.5)}$$

Sufficient conditions for E_i^* to be well-defined are as follows:

$$\kappa_1 \leq b \bar{\eta}; \qquad \text{(IV.6)}$$

---

[12] *Note that $\bar{h}_i \neq \widetilde{h}_i^*$.*

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$$\kappa_2 \underline{\eta} \quad \leq \quad b, \tag{IV.7}$$

$$b\underline{\eta} - \kappa_1 \quad \leq \quad \alpha_1 \tag{IV.8}$$

$$b \quad \leq \quad \alpha_2 + \kappa_2 \bar{\eta}. \tag{IV.9}$$

Conditions (IV.6)-(IV.9) ensure that $E_i^* \in [0,1]$ for all $i = 1,2$. As we interpret b as a measure of poverty in South, it follows from (IV.5) that poverty encourages emigration: $\partial E_i^*/\partial b > 0$. Substituting (IV.5) back into (IV.4) yields the respective equilibrium threshold human capital levels as follows:

$$\widehat{h}_i^* = \begin{cases} [\alpha_1 + b\Delta_h]^{-1} (\alpha_1 + \kappa_1) \Delta_h & i = 1 \\ \left(b\Delta_h + \alpha_2 \underline{\eta}\right) [\alpha_2 + \kappa_2 \Delta_h]^{-1} & i = 2 \end{cases} . \tag{IV.10}$$

The thresholds $\widehat{h}_i^*$ are useful for characterizing the quality of education in South under the two alternative immigration policy scenarios in North. We provide the proof of the following Lemma in the Appendix section.

Lemma 2. *Given the immigration policy i practiced by North, the equilibrium quality of education in South is given by*

$$\widetilde{h}_i^* = \begin{cases} \left[(\alpha_1 + \kappa_1) \Delta_h + \underline{\eta} (\alpha_1 + b\Delta_h)\right] [2 (\alpha_1 + b\Delta_h)]^{-1} & i = 1 \\ \left[(b + \kappa_2 \bar{\eta}) \Delta_h + \alpha_2 \left(\bar{\eta} + \underline{\eta}\right)\right] [2 (\alpha_2 + \kappa_2 \Delta_h)]^{-1} & i = 2 \end{cases} . \tag{IV.11}$$

Lemma 2 implies that in the presence of migration, poverty in the migrant-sending country causes a decline in the quality of education children receive, only when immigration policy at the destination country favors a "brain drain": $\partial \widetilde{h}_1^*/\partial b < 0$ if $i = 1$ but $\partial \widetilde{h}_2^*/\partial b > 0$, if $i = 2$. This is because we measure the quality of education in South by the average human capital of non-emigrants, accounting for the fact that teachers are recruiting among these only.

B. Migration and growth

In this sub-section, we analyze, the impact of migration and remittances on economic growth in South. As human capital is the only engine of growth in this environment, we define economic growth as a long-run variation in the average human capital of all South's agents (both emigrants and non-emigrants):

$$g^i = \frac{\bar{h}'_i}{\bar{h}},$$

where

$$\bar{h}'_i = \int_{\underline{\eta}}^{\bar{\eta}} \left[\lambda e \widetilde{h} + \varepsilon h \right] \psi(h) \, dh$$

is as defined in (IV.3), and

$$\bar{h} = \int_{\underline{\eta}}^{\bar{\eta}} h \psi(h) \, dh.$$

Indeed, using (IV.3), we obtain that the growth rate of average human capital in South is given by $g^i = \chi^i(b; \kappa_i, \alpha_i)$ where

$$\chi^i(b; \kappa_i, \alpha_i) = \left[\int_{D_S^i} e_S^* \psi(h) dh + \int_{D_N^i} e_N^* \psi(h) dh \right] \frac{\lambda \widetilde{h}_i^*}{\bar{h}} + \varepsilon \qquad (IV.12)$$

and

$$e_N^* = \begin{cases} (\phi + h - \alpha_1 E_1^* - \kappa_1) \gamma \beta (\delta \phi)^{-1} - \varepsilon (1 + \gamma) \left(\delta \lambda \widetilde{h}_1 \right)^{-1} h & i = 1 \\ (\phi + [1 - \alpha_2 E_2^* - \kappa_2 h] h) \gamma \beta (\delta \phi)^{-1} - \varepsilon (1 + \gamma) \left(\delta \lambda \widetilde{h}_2 \right)^{-1} h & i = 2 \end{cases}$$

$$e_S^* = \begin{cases} [\phi + (1 - b) h] \gamma \beta (\delta \phi)^{-1} - \varepsilon (1 + \gamma) \left(\delta \lambda \widetilde{h}_1 \right)^{-1} h & i = 1 \\ [\phi + (1 - b) h] \gamma \beta (\delta \phi)^{-1} - \varepsilon (1 + \gamma) \left(\delta \lambda \widetilde{h}_2 \right)^{-1} h & i = 2 \end{cases}.$$

Given the complexity of the terms e_N^* and e_S^*, as a function of b– the poverty level in South–, $\chi^i(b; \kappa_i, \alpha_i)$ may exhibit a high degree of non-linearity.

C. Growth with No-Migration

In this sub-section, we characterize the growth rate of the South's economy in the absence of migration and trade. Denote the no-migration growth rate of average human capital in South as

$$g^0 = \frac{\bar{h}^{0\prime}}{\bar{h}}$$

where

$$\bar{h}^{0\prime} = \int_{\underline{\eta}}^{\bar{\eta}} h^{0\prime} \psi(h)\, dh,$$

describes the law of motion for the economy-wide average human capital, $h^{0\prime} = \lambda e_S^* \widetilde{h}_0 + \varepsilon h$ the human capital of a child whose parent has a level of human capital h, $\widetilde{h}_0 = \bar{h}$ the quality of education in South in the absence of migration, and

$$e_S^* = \delta^{-1} \left[\left[\phi + (1-b) h \right] \gamma \beta \phi^{-1} - \varepsilon (1+\gamma) h \left(\lambda \bar{h} \right)^{-1} \right]$$

the time allocated to child's schooling by a parent with human capital level h. By substitution, we have that

$$\bar{h}^{0\prime} = \delta^{-1} \left[\phi + (1-b) \bar{h} \right] \gamma \beta \phi^{-1} \lambda - \delta^{-1} \varepsilon (1+\gamma) \bar{h} + \varepsilon \bar{h}.$$

Therefore we obtain the no-migration growth rate $g^0 = \chi^0(b)$ as follows

$$\chi^0(b) = \delta^{-1} \gamma \beta \phi^{-1} \lambda \left[\phi + (1-b) \bar{h} \right] - \varepsilon (1+\gamma) \delta^{-1} + \varepsilon \qquad \text{(IV.13)}$$

where

$$\bar{h} = \int_{\underline{\eta}}^{\bar{\eta}} h \psi(h)\, dh.$$

We use (IV.13) as a benchmark for contrasting the growth performance of the migrant-sending economy under alternative immigration policies at the destination economy. Since the expression (IV.12) representing the growth rate exhibits a high degree of non-linearity as a function of b, we simulate the model numerically using parameters values set a the

literature standards.

D. Immigration Policy, Remittances and Growth: A Numerical Simulation

How does immigration policy affect the growth effects of migration and remittances? We address this question in this sub-section. Our strategy is to compare the average human capital growth rate of South's citizens (including both emigrants and non-emigrants) with the growth rate that would have obtained in the absence of migration and trade. In other words, we take the no-migration growth rate of average human capital as the benchmark.

We start by assigning numerical values for relevant parameters. According to Le *et al.* (2005)[13] educational measures are the best proxies for human capital. Krueger and Lindahl (2001), Cohen and Soto (2001), De la Fuente and Doménech (2000), Wolff (2000), and Temple (1999) all used years of schooling as the most common proxy for human capital. Barro and Lee (2001) estimate that the average number of years of schooling in 2000, for developing countries is 4.89. Hence we set the maximum value of human capital $\bar{\eta}$ at 9.23, and the minimum value at $\underline{\eta} = 0.55$. The altruism parameter γ is taken from de la Croix and Doepke (2004) and set at $\gamma = 0.169$. As in Caucutt and Kumar (2007) we assume that the model period is 20 years: individuals are born at age 6 and become parents at the age of 26, have a child, and exit the workforce at the age of 45. The inter-generational discount factor thus is set at $\beta = 0.667$, which corresponds to a yearly discount factor of 0.98 compounded over 20 years. We set the share of human capital inheritance (ε) at 0.175. The efficiency of education (λ) is chosen such that the minimum growth rate of the poorest country–understood as the country with the highest level for b– is equal to 1, in the absence of migration. Total factor productivity in the informal sector (ϕ) is chosen such that the demand for education of the richer parent is positive but less than 1 (i.e., $e_S(\bar{\eta}) < 1$). Therefore we set $\phi = 0.15$ and $\lambda = 1.223$. Theory puts no value on α_1, α_2, κ_1 and κ_2. Therefore we adopt the following value assignment rule: the parameters κ_1 and α_1 are chosen such that conditions (IV.6) and (IV.8) are simultaneously satisfied. The parameter

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[13]Trinh Le, John Gibson and Les Oxley,"Measures of Human Capital: A Review of the Literature". New Zealend Treasury, Working Paper 05/10, November 2005.

κ_2 and α_2 are chosen such that (III.25), (IV.7) and (IV.9) are simultaneously satisfied. This implies that the closed interval from which the values for the poverty measure b are chosen satisfies conditions (IV.7) and (IV.9). Therefore $b \in [0.55, 0.75]$. Table 1 below recapitulates the values assigned to the relevant parameters.

Table 1: Parameters of the model

$\bar{\eta}$	$\underline{\eta}$	ε	γ	β	λ	ϕ	κ_1	α_1	κ_2	α_2
9.23	0.55	0.175	0.169	0.667	1.223	0.15	4.34	10	1	0.05

We use these parameters values to compute (IV.12) and (IV.13).

Figure 1 below plots $g^1 = \chi^1(b; \kappa_1, \alpha_1)$ and $g^0 = \chi^0(b)$ against b, where g^1 denotes the growth rate of average human capital in South when immigration policy practices in North are biased towards the more-educated (i.e., Brain drain).
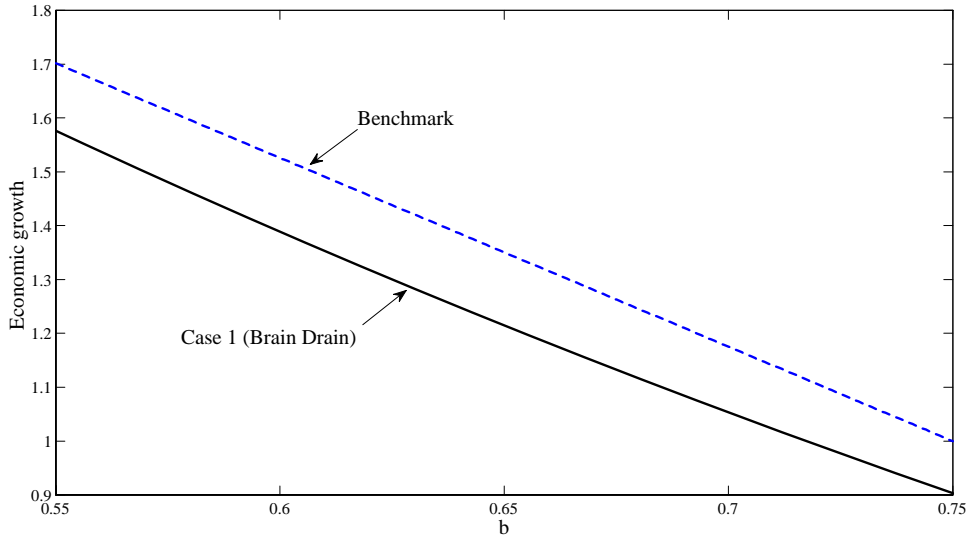

Fig. 1. Growth effect of a "brain drain"

The higher b the poorer the sending country. Figure 1 shows the growth rate in the migrant-sending economy to be consistently lower than the benchmark. It implies that despite emigrants' remittances to their families, a "brain drain" has an adverse effect on the sending country's growth. We explain this result by the fact that a "brain drain" causes

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a decline in the quality of education of the sending country, which in turn discourages investment in human capital.

Figure 2 below plots $g^2 = \chi^2 (b; \kappa_2, \alpha_2)$ against $g^0 = \chi^0 (b)$, where g^2 denotes the growth rate of average human capital in South when immigration policy practices in North are biased towards the less-educated (Case 2).
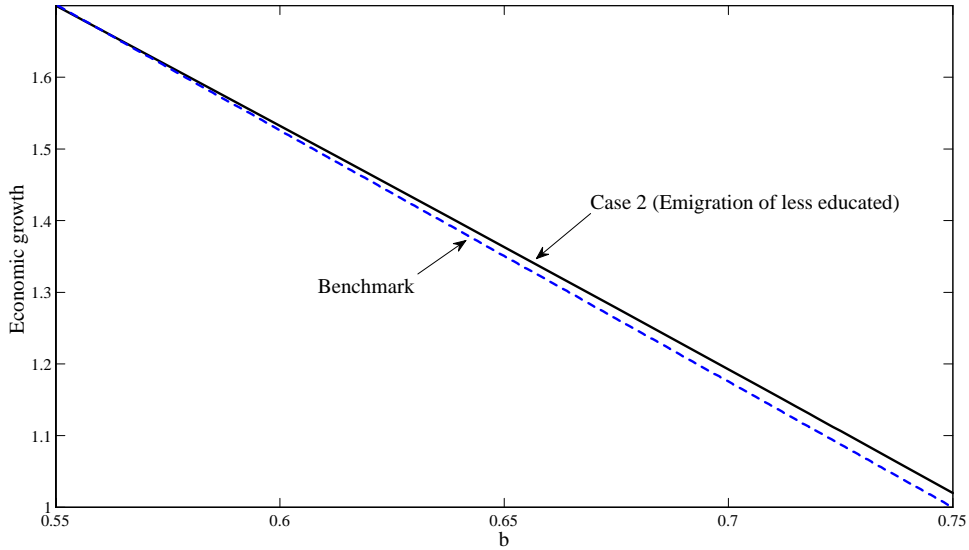

Fig. 2. Growth effects of emigration of low-human capital workers

Figure 2 shows that when immigration policy at the destination country is biased towards the less-educated, growth in the migrant-sending country is no lower than the benchmark, and even exceeds this benchmark when the sending country is sufficiently poor. We explain this result by the fact that, unlike a "brain drain", emigration of the less-educated does not cause a decline in the quality of education of the sending-country. Consequently, remittances have a positive effect on growth compared to the benchmark, when the sending-country is sufficiently poor.

Figures 1 and 2 taken together show that the growth effects of migration and remittances are entirely mediated by the immigration policy at the destination country. An immigration policy that provokes a "brain drain" leaves the sending country worse off in terms of growth performance. In contrast, when immigration policy target less-educated

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migrants, there are beneficial growth effects in the sending country.

V. Conclusion

In this paper, we have established a relationship between migration, remittance flows and economic growth in the migrant-sending country. In our model, parents remit to their children in order to shift child's time use away from child labor, and towards human capital-enhancing education. The quality of education is impacted by the level of the average economy-wide human capital of non-emigrant parents, as teachers are hired among parents agents whose human capital is already formed. Our theory confirms the predictions of existing theories that transnational migration and remittances have a positive effect on school-enrolment. It also predicts that remittances have a negative effect on child labor. However, unlike the existing literature, our theory predicts that the net gain to the sending-country from emigration and remittance flows varies with the education (or human capital) profile of emigrants, as determined by immigration policy at the destination country. A "brain drain" leaves the sending country worse off, despite remittances, while emigration of the less-educated makes it better off. We explain these differential effects of migration and remittance flows by the fact that, unlike the emigration of the less-educated, a "brain drain" causes a decline in the quality of education of the sending country. For altruistic parents, the decline in education quality raises the opportunity cost of school-enrolment for children in an environment where schooling and child labor have competing claims on a child's time. Consequently, parents end up investing less in their children's human capital formation, and growth of the economy-wide average human capital is adversely affected.

Our theory also suggests that an immigration policy biased in favor of less-educated migrants is more effective in combatting child labor in the sending-country than one that encourages a "brain drain". It therefore has important implications for increasing calls for rich countries to use their immigration policy as a development assistance tool (Kapur, 2004). These calls have particularly intensified following the controversy surrounding foreign aid as a development tool, suggesting that remittance flows can substitute for inef-

fective foreign aid as a solution to the long-term prosperity of poor countries. Our theory therefore can be interpreted as sending a warning to rich countries that not all patterns of migration have beneficial effects for migrant-sending countries. In particular, the growing practice among rich countries of selecting highly-educated foreign migrants (Docquier and Marfouk, 2006) may be harmful to poor countries, despite offering better prospects for transnational remittance inflows. A shift of immigration policy toward targeting low-human capital migrants say, on a seasonal basis, may have a more promising effect on poor, migrant-sending countries.

VI. Appendix

In this section we provide the proofs of results stated in the main text.

A. Proof of Lemma 1

The proof of Lemma 1 follows in two steps. First, we establish the first claim: $\partial \vartheta^1 \left(. \right) / \partial h > 0$. Let us re-write (III.23) as follows:

$$\vartheta^1 \left(h; \phi, b, \widetilde{h}_1, E_1 \right) = \delta \ln \Upsilon \left(h \right)$$

where

$$\Upsilon \left(h \right) = \frac{\left[h - \alpha E_1 - \kappa_1 \right] + \chi \left(h \right)}{\left(1 - b \right) h + \chi \left(h \right)}$$

$$\chi \left(h \right) = \left(\lambda \widetilde{h}_1 + \varepsilon h \right) \left(\lambda \widetilde{h}_1 \right)^{-1} \phi.$$

Therefore we know that

$$\frac{\partial \vartheta^1}{\partial h} = \delta \frac{\Upsilon' \left(h \right)}{\Upsilon \left(h \right)}$$

where

$$\Upsilon' \left(h \right) = \frac{N_1 \left(h \right)}{\left[\left(1 - b \right) h + \chi \left(h \right) \right]^2}$$

and

$$N_1 (h) = [\chi' (h) + 1] (1 - b) h + \left[\lambda \widetilde{h}_1 + (\alpha_1 E_1 + \kappa_1) \varepsilon \right] \phi \left(\lambda \widetilde{h}_1 \right)^{-1} > 0.$$

Since $\Upsilon (h) > 0$, this establishes the claim.

Next, we establish the second claim: $\partial \vartheta^2 (.) / \partial h < 0$ if condition (III.25) holds. As in the first claim, we can re-write (III.24) as follows:

$$\vartheta^2 \left(h; \phi, b, \widetilde{h}_2, E_2 \right) = \delta \ln \Gamma (h)$$

where

$$\Gamma (h) = \left[\frac{(1 - \alpha_2 E_2 - \kappa_2) + \phi h^{-1} + f \left(\widetilde{h}_2 \right)}{(1 - b) + \phi h^{-1} + f \left(\widetilde{h}_2 \right)} \right],$$

$$f \left(\widetilde{h}_2 \right) = \frac{\varepsilon \phi}{\lambda \widetilde{h}_2}.$$

Therefore, we know that

$$\frac{\partial \vartheta^2}{\partial h} = \frac{\delta N_2 (h)}{\left[(1 - b) + \phi h^{-1} + f \left(\widetilde{h}_2 \right) \right]^2 \Gamma (h)},$$

where

$$N_2 (h) = - \left[\phi h^{-2} + \kappa_2 \right] (1 - b) - \kappa_2 \left[f \left(\widetilde{h}_2 \right) + \phi h^{-1} \right] + (1 - \alpha_2 E_2 - \kappa_2 h) \phi h^{-2}.$$

To show that $\partial \vartheta^2 / \partial h < 0$, it then suffices to show that $N_2 (h) < 0$. Indeed $N_2 (h)$ can be re-written as follows:

$$N_2 (h) = - \left[\phi h^{-2} + \kappa_2 \right] (1 - b) - \kappa_2 f \left(\widetilde{h}_2 \right) - \phi h^{-2} \left[2 \kappa_2 h - 1 + \alpha_2 E_2 \right],$$

which is clearly negative, whenever condition (III.25) holds. This completes the proof.

B. Proof of Lemma 2

Observe that by definition, the average level of human capital of non-emigrants in South is given by:

$$\widetilde{h}_i^* = \frac{1}{1 - E_i^*} H_i^*$$

where

$$H_i^* = \int_{D_S^{i*}} h\psi\left(h\right) dh$$

denotes the aggregate stock of human capital of non-emigrants, and

$$D_S^{i*} = \begin{cases} \left[\widehat{h}_1^*, \bar{\eta}\right] & i = 1 \\ \left[\underline{\eta}, \widehat{h}_2^*\right] & i = 2 \end{cases}$$

is the set from which non-emigrants draw their human capital levels when immigration policy at destination is $i = 1, 2$. Therefore, using the definition of $\psi\left(h\right)$, we obtain H_i^* as follows

$$H_i^* = \begin{cases} \left(\widehat{h}_1^* + \underline{\eta}\right)\left(1 - E_1^*\right)/2 & i = 1 \\ \left(\widehat{h}_2^* + \bar{\eta}\right)\left(1 - E_2^*\right)/2 & i = 2 \end{cases}.$$

Substituting (IV.5) and (IV.10) yields the result.

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