

Migrant Remittances, Human Capital Formation and Job Creation Externalities in Colombia¹

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Abstract

In this paper I model the effect of migrant remittances on job creation and human capital formation, given migration prospects. The simulations based on the model show that remittances can have offsetting effects on equilibrium human capital and labor market outcomes in the country of origin of migrants. First, remittances enhance schooling opportunities for recipient households, and human capital formation can be augmented. Second, an increase in human capital supply by recipient households induces job creation as labor demand increases in the origin country. If a sufficiently large share of remittance recipients do not migrate, then the net effect is brain gain rather than brain drain ensuing remittances. The calibration and simulation analyses suggest that the net effect of remittances depends upon the accessibility of education and the degree and labor market frictions in the origin country as well as the immigration policy in the destination country of migrants.

Resumen

En este documento se modela el efecto de las remesas en la creación de empleo y la formación de capital humano, dada una perspectiva futura de migración. Las simulaciones basadas en el modelo muestran que las remesas pueden tener efectos contrarios en los resultados de acumulación de capital humano y en el mercado de trabajo del país de origen de los emigrantes. Primero, las remesas mejoran las oportunidades de educación para los hogares receptores de remesas, y por ende la formación de capital humano puede ser aumentada. En segundo lugar, un aumento en la oferta de capital humano por parte de los hogares receptores induce la creación de empleo en la medida en que la demanda por trabajo aumenta en el país del origen. Si una parte suficientemente grande de los receptores de remesas no emigra, entonces el efecto neto es la "ganancia de cerebros" en vez de la "fuga de cerebros". El análisis de calibración y simulación sugieren que el efecto neto de las remesas depende del acceso a educación y del grado de fricciones en el mercado laboral en el país del origen, así como de la política de inmigración en el país de destino.

Keywords: Migrant remittances, Education, Brain Gain, Job Creation.

Palabras clave: Remesas, Educación, Fuga de cerebros, Creación de empleos.

JEL Classification: F22, F36, O11, J69

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I. Introduction

The impact of migration on both sending and receiving countries has long been researched. The purpose of this paper is to shed light on the relationship between migrant remittances and human capital formation under imperfections in the job matching process. Thus we will analyze the impact of migration on the labor markets of the sending countries. Different forces can affect the way labor markets perform, especially when migration occurs between countries at different stages of development. On the one hand, migration from a less to a more developed country affects natives in the destination country by introducing more competition in the labor market and by influencing the decision of entrepreneurs to offer new job opportunities.

On the other hand, migration can also affect the labor market in the origin country. First, migration prospects can influence the education decision of both migrants and stayers (Stark *et al.*, 1997, 1998; Beine *et al.*, 2001). Second, when migrants remit part of their earnings back to their households, they can affect the consumption, investment and employment decisions of the recipients. Also, the decision to increase human capital investments by recipient households generates a job creation externality on nonrecipient households. As aggregate employment prospects improve in the country of origin of the migrant, the rise in expected income increases returns to human capital investments generally. Hence, both aggregate employment and human capital can rise ensuing migration. However, there can be two mitigating effects. One due to the brain drain caused. The other is the wealth effect associated with remittances, which, other things equal, makes consumption and leisure more desirable.

Economic analysis of the effects of remittances has become an important issue recently because of the rapid growth of this form of financial flow. Official estimates by the IADB put remittances to Latin America and the Caribbean at around US\$45.8 billion in 2004, compared to 38 billion in 2003, representing an annual growth rate of about 20%. But the total amount of remittances, which includes flows through unofficial channels, is thought to be greater than this. Even the official level of remittances exceeds the amount of other forms of capital inflows received for many countries in the region. Since 1990, the average annual growth rate of remittances for the region has been 12.4%, which the highest amongst other regions in the World. At present, Latin America accounts for one third of global remittance flows.

Remittances are particularly important Colombia where a substantial increase has been observed since 1999. Emigration drastically accelerated since the 1998-1999 downturn and this explains why remittances rose from US\$745 million in 1996 to US\$3.17 billion in 2004, with an average annual growth rate of 25% during this time. Over the first quarter of 2005, remittances were 6% larger than the first quarter of 2004. The ongoing growth of remittances since 1999 has made them one of the most important items in the balance of payments. Remittances represent four times the income from coffee exports and exceed by 10% oil exports. At present, remittance flows are higher than foreign direct investment. The monthly growth of remittances has been 2.1% on average since January of 2002 due to increases in both the number of transactions and the average amount of each transaction. The number of transactions during the first half of 2002 was 498,000 and it was 564,000 during the first half of 2004, a

rise in volume of 13.2%. The average remittance rose from US\$255 during the first half of 2002 to US\$287 during the first half of 2004.

Given the salient and growing macroeconomic influence of remittances as part of international capital flows in Latin America in general, and Colombia in particular, it is of fundamental importance to assess the general equilibrium effects of migrant remittances. In this paper, we analyze the impact of remittances on human capital in a general equilibrium framework. The basic idea of the model is that migrant remittances can have two opposing effects on human capital and employment for both recipient and nonrecipient households. First, for recipient households, remittances from migrants generate funds that enhance schooling opportunities and potentially generate a brain gain. But, educated remittance recipients could eventually migrate and cause a brain drain. Second, for nonrecipient households, the job creation spillover from higher human capital, when there is net brain gain among recipient households, increases the rate of return to schooling. But, the income effect of remittances could increase desired consumption and leisure, thereby reducing human capital investment. Therefore, the net effect of remittances on human capital is far from obvious. In particular, we show that when households are financially constrained, under certain conditions remittances can increase the human capital supply, and thereby reduce the unemployment rate in the home labor market.

I develop a matching model with frictions in the labor market, giving rise to search, and with capital market imperfections, giving rise to credit constraints. This gives us a useful theoretical framework to discriminate between the 'productive' and 'unproductive' uses of remittances. As with

any source of wealth, the allocation of remittances depends on incentives. When education costs are relatively low and schooling enhances labor market prospects, at home or abroad, the net rate of return to human capital formation is high. If the net rate of return to human capital formation is high (low), additional remittances are likely to be allocated on the margin to schooling investments (consumption).

I also consider the effect of remittances on the unemployment rate of the labor exporting country. Remittances have two opposing effects on the labour market. First they augment the pool of funds for recipient households back home. This causes schooling to rise. Since it is likely that many households in labor exporting countries are credit constrained, remittances available for schooling investment will then relax these constraints and increase the level of the human capital stock. The second effect is on the return to human capital investment in the country receiving remittances. The effect of the rise in the human capital supply of households receiving remittances is to induce job creation, and to reduce the unemployment rate as nonrecipient households also increase schooling. As a result of the higher relative return to education, one effect is the substitution away from consumption and leisure towards human capital investment. At the same time, higher expected income has an opposite effect increasing the desirability of consumption and leisure, as they are normal goods. If the 'substitution effect' outweighs the 'income' effect arising from better opportunities, then remittances will increase human capital supply and reduce the unemployment rate.

The paper is organized in the following way. Section 2 provides an overview of the existing

theoretical and empirical literature on the effects of migration on the welfare of stayers. Section 3 introduces the basic model in which we explore the effect of remittances on human capital and labor market outcomes. Section 4 contains simulation and calibration analyses on the impact of remittances on human capital and unemployment in Colombia. Finally, in section 5 we conclude.

II. Related Literature

In this section we survey the literature on migrant remittances determinants and effects in developing countries, with a particular emphasis on the stylized facts that have emerged from empirical studies.

A. Remittances in Colombia

First, we will review a number of recent studies on remittances in Colombia. In considering the effect of remittances, Cardona and Medina (2005) assess how the reception of remittances impacts upon the household composition of expenditures. They consider whether remittances generate changes in expenditure allocation in four categories: Consumption, education, healthcare and financial investment. There is only evidence of changes in the pattern of expenditure in one item, namely education. In fact, remittance recipient households spend on average 11% more on education. Although the net effect on other items is nil, it may well be that there is an insurance element associated with remittances as they cover income lost after the severe 1998-1999 recession.

A possible macroeconomic impact of remittances is pointed out by Cadena and Cardenas (2004) who consider their role as a money laundering device. The massive migration flows, in the wake of the late 1990's downturn, led to workers' re-

mittances increasing substantially in recent years in Colombia. While remittances have improved living standards of recipient households as Cardona and Medina (2005) quantify, the possibility of use as a vehicle for money laundering is a potential risk. Colombia heavily regulates these transfers, which do not seem to be more costly than in other Latin American countries due to competition between intermediaries. However, the transaction costs associated with remittances compared to other alternative money laundering schemes make them unlikely as a major source for this use.

Other studies analyze the determinants of remittances in Colombia. For example, Gaviria and Mejia (2005) study among Colombian emigrants what are the determinants of remittances, the degree of attachment to their homeland, and their desire to return. They use a survey conducted by Radiocadena Nacional de Colombia linking the characteristics of migrants with those of household members staying behind. The average amount of remittances is increasing in the years of schooling of the senders and only decreases very slightly over time. Among receivers, 13% of households report investing remittances in education as their primary use.

Gaviria (2004) points out that remittances are an option for households with access to the resources that need to be invested in human capital and to bear the costs of migration. This points to migration as an option for households, to enhance income generation and risk diversification, which is subject to positive selection on the basis that only those with a minimum human and financial capital can settle abroad. Results consistent with the latter characterization are obtained by Soto and Walker (2002), who analyze the motivations of Colombian migrants

in the US. They find that obtaining higher wages is the primary motivation. In fact, the evidence points to positive self-selection of migrants as their schooling years and wage before migration both exceed the national average.

B. Remittances as Insurance

Now, we turn to studies of remittances in other developing countries. A fruitful way to assess the economic role of remittances is to rely on household surveys and estimate the proportion of households for which remittances are an important source of income. Such surveys tend to show that remittances are often a crucial element of survival and livelihood strategies for many (typically rural) poor households. For example, Rodriguez (1996) reports that 17% of Philippines households receive income transfers from abroad, representing 8% of national income. Similarly, Cox, Eser and Jimenez (1998) found that 25% of Peruvian households receive private transfers (mainly remittances), representing 22% of their incomes. On a more reduced scale, de la Brière et al. (2002) show that approximately 40% of the households in the Dominican Sierra, a poor rural region of the Dominican Republic, have migrant members, 52% of whom are sending remittances.

In the context of Central America, Cox Edwards and Ureta (2003) find for El Salvador that 14% of rural and 15% of urban households received remittances from friends and relatives abroad in 1997. These studies, as well as many others detailed below, show that remittances are instrumental to achieving mutual insurance, consumption smoothing, and alleviation of liquidity constraints. In another study, Funkhouser (1995) compares remittances to the capital cities

of El Salvador and Nicaragua. In this study, Funkhouser noted that while the number of migrants and the general economic conditions prevailing in the two countries during the 1980s were quite similar, twice as many households received remittances from relatives abroad in San Salvador than in Managua; moreover, for those who received remittances, the average transfer received in San Salvador was twice as high as that in Managua. Using micro data on both migrants and receiving households, Funkhouser (1995) found many similarities between the two pools of migrants with respect to age, education, gender, and, to a lesser extent, number of years since emigration. In other words, differences in remitting behavior could not be accounted for by differences in households or migrants observed characteristics, including the timing of migration. By contrast, the estimation of remittance functions revealed substantial differences in remitting behavior between the two samples, allowing to conclude that differences in unobserved characteristics (i.e., how remitters self-select with the pool of migrants) are central to explaining inter-country differences in remittance behavior. Remitters were negatively selected out of the pool of emigrants, but in a more pronounced way for Nicaragua, meaning that the more educated Salvadorans tend to have stronger motives and/or opportunities to remit. Remittances were negatively correlated to years since emigration for both immediate family members and other relative emigrants in Nicaragua but not for Salvadorans, suggesting higher propensities to return among the latter.

C. Remittances and Education

The relationship between remittances and education has been explored in the literature, with

particular attention to the effect on the decisions of members of recipient households. The first possible link between remittances and education is through the repayment of informal loans.³ A natural interpretation is that the prospect of migration makes education a profitable investment for the family. Hence, migration fosters human capital formation provided that not too many educated individuals emigrate out of the country. In this case, remittances are a financial arrangement to make possible the materialization of the brain gain brought about by migration prospects.

An alternative is that the migrant rather than being the borrower as above is, in some sense, the lender. Along the lines suggested in the theoretical model of remittances and liquidity constraints in this paper, a second possible link between remittances and education must be considered as remittances also finance education for the migrants' household members who stayed back home. Given the relatively high income elasticity of education, one would expect remittances to have significant positive effects on the educational attainments of members from households with migrant members. Notwithstanding, as Hanson and Woodruff (2002) point out, such households are also often characterized by the absence of one parent. Since recent research on education indicates that this could be detrimental to the children's schooling achievements, the overall effect on educational attainments is *a priori* unclear.

Few studies have looked for evidence on this potential forward linkage between remittan-

ces and education. In fact, the only works on remittances and investments in human capital we are aware of are the study by Cardona and Medina (2005) reviewed above, two recent studies on Mexico by Lopez-Cordova (2004) and Hanson and Woodruff (2002), and one by Cox Edwards and Ureta (2003) on El Salvador, which contribute towards documenting the potential growth effects of remittances through human capital formation. First, as pointed out above, Cardona and Medina (2005) find that among Colombian households receiving remittances induce increases in education expenditures.

For Mexico, Lopez-Cordova (2004) establishes using municipal data that a higher incidence of remittances is associated with improvements in various indicators of welfare. A one standard deviation increase in the fraction of households receiving remittances within a municipality is associated with a decrease of 5% in child mortality, a rise in school attendance of 4% and a remarkable fall in illiteracy of 40%. This study is of particular interest because it considers the impact of remittances not only on recipient households but also on nonrecipient household within the same municipality. Hanson and Woodruff (2002) used the 2000 Mexican Census to evaluate the effect of remittances on accumulated schooling (number of school grades completed, and not only number of years) by 10-15 year old, a critical age group. Their preliminary results show that children in households with a migrant member complete significantly more years of schooling, with an estimated increase that ranges from 0.7 to 1.6 years of schooling; interestingly, the gain

³ A number of empirical case studies confirm that, in many instances, remittances may be seen as repayment of loans used to finance educational investments.

is the highest for the categories of children traditionally at risk of being dropped from school, i.e., girls and older children (13 to 15 year old). These results are robust with respect to the identification procedure (i.e., when migration is treated as endogenous) and the introduction of dummy variables for Mexican States.

For El Salvador, Cox Edwards and Ureta (2003) assess how remittances impact upon educational outcomes for recipients. In particular, the improvements in retention rates are quantified for pupils who come from households which receive remittances. They estimate survival functions and show that remittances significantly contribute to lower the hazard of leaving school. This effect would seem to be greater in urban areas, but the mere fact of receiving remittances (irrespective of amounts) is shown to have a very strong effect in the rural areas as well.

D. Remittances and Unemployment

The literature has also explored potential effects of remittances on labor market outcomes in the country of origin of migrants. The most obvious effect that migration from developing countries should have on the labor market in the home economy is that, in itself, migration should lower the unemployment rate by reducing the supply of labor. However, the relationship between migration and the labor market in the labor exporting country is far more complex than this.

In particular, given that it is often the most skilled individuals who migrate, a brain drain could negatively affect the labor market of the labor exporting country, although more recent studies argue that the brain drain need not harm developing countries as the net effect of skilled

migration could be brain gain (Stark *et al.*, 1997, 1998 ; Beine *et al.*, 2001).

The empirical literature has explored how labor market participation among recipient households is related to remittances. Funkhauser (1992) notes that migration and remittances can have two effects on participation decisions on the home country's labor market. The loss of the migrant worker may mean that other household members, in particular females, enter the labor market. However, the receipt of remittances could reduce participation rates because of the income effect. He further suggests that high levels of remittance flows into local labor markets may increase aggregate demand and hence the demand for labor. Using data from El Salvador, he finds that remittances have a negative and significant influence on the labor force participation of both males and females. However, he finds that migrants do not have a significant effect on local labor markets. For females the positive but small effect of the local labor market is enough to outweigh the negative remittance effect, but for males, the negative income effect from remittances dominates all other effects.

Further evidence that remittances act in a similar way to welfare payments is provided by Zachariah *et al.* (2001). They report that the worker-population ratio was 55% amongst non-migrant households in Kerala but only 31.6% in households with an emigrant. They suggest that this finding may be caused by employment seekers from emigrant households being more selective with regards to their job match. Furthermore, they report unemployment rates of 20.8% and 8.1% for emigrant and non-emigrant households respectively. They conclude their section on the effect of migration on employment

and unemployment with the comment "because unemployed persons belonging to emigrant households enjoy the financial support of the emigrant members, they are not in any hurry to get employed" (p. 55).

The idea that unemployment insurance can improve productivity is theoretically explained in Marimon and Zilibotti (1999). They develop an equilibrium search matching model with two-sided and ex-ante heterogeneity to obtain a distribution of match productivity. An increase in unemployment benefits acts as a safety net and the unemployed wait longer for better matches. They find that in an economy with higher unemployment benefits there will be a higher unemployment rate but also a better allocation of skills to jobs. In our context, workers may not only devote more time to employment search, as result of receiving remittances, but also may invest in skill upgrading to enhance job market prospects. Productivity may increase due to both better skill matching and higher average human capital.

E. Remittances and Investment

It is also important to explore exactly how remittances are used in the home country. The central issue here is whether there is a dual use of such resource transfers. On the one hand, studies have suggested that migration, through remittances, have a positive impact on consumption in the source country. Furthermore, if the majority of the money that is sent back is spent on goods and services, then remittances could cause inflation which could lead to excessive wage claims. On the other hand, remittances can be equality enhancing and have a positive impact on the development of poor areas, especially if they are invested in productive activities.

Several papers characterize the composition of spending of household receiving remittances. Most studies have found that remittances are generally spent on consumer goods such as food and clothes as well as housing, although there is a debate over the extent to which they are used for productive purposes. Durand *et al.* (1996) report that 10% of their sample of Mexican migrants to the US who reported that they sent remittances or brought savings back with them spent at least some of the saved/remitted money (i.e. migradollars) productively, 14% reported that they spent some of their migradollars on housing and the remaining 76% reported that they spent the migradollars only on consumption.

Glytsos (1993) estimates that only 4% of the estimated 14 billion drachmas sent migrant remittances to Greece in 1971 was invested in machinery and another 4% was invested in small shops, compared with 63% on consumption, 22% on housing and 7% on land. Using input-output analysis, he estimates that the multiplier effect associated with migrant remittances is 1.7 and this is found to vary between industries. Multiplier effects are estimated to be highest in the apparel and footwear, leather and electrical machinery industries and lowest in services. The author also estimates the potential employment and capital effects of remittances amounted to around 74,000 new non-agricultural and non-public sector jobs and 8% of installed manufacturing capacity.

Adams (1998) also finds that external remittances have an important impact on the accumulation of rural assets using Pakistani data and argues that the marginal propensity to invest transitory income is higher than it is for labor income. Rozelle *et al.* (1999) find that remittances

help to loosen the constraints on crop production in rural China and also stimulate productivity. Furthermore, given that many developing countries are likely to face capital and liquidity constraints, these constraints can be eased as a result of the savings that are deposited by migrants or their families. Therefore, despite the fact that only a small proportion of remittances may be invested directly by migrants or their families, remittances can be channeled into productive uses by the banking system.

Kule *et al.* (2002), summarize the results of two surveys carried out in Albania in 1998. The first of these was completed by around 1500 individuals about their migration experience (of whom just under a half had migrated), whilst the second contained questions which were directed towards firms. Both of these surveys contained information on remittances. The information provided in the first of the surveys suggested that over 50% of the remittance sent to Albania were used for consumption, and 30% were invested. The survey of firms indicates that around 17% of the capital required to establish a business came from remittances, which help to overcome credit-constraints.

Finally, Leon-Ledesma and Piracha (2001) also adopt a positive view of the relationship between migration and development by modelling the effects of short term migration on labor productivity. Remittances can be channeled into investments and increase productivity in the home economy. The authors study the impact of migration and remittances on the employment performance of Central and Eastern European Countries and claim that the main sources of the migrant's savings from overseas are used productively in the home country.

F. Remittances, Human Capital and Job Creation

To the best of my knowledge, the literature on matching theory has been silent until now on the role of migration opportunities on the labor market performance of the home country. In the absence of credit market imperfections, producers choose the optimal level of investment and the introduction of new savings in the economy does not have any effect on the output produced by each firm. The introduction of credit constraints generates new effects and creates a link between the literature on matching theory and the one that investigates the effects of remittances on labor exporting countries.

We provide a framework to explore how international remittances impinge on human capital formation and the labor market. The presumption is that human capital is the engine of growth, and that liquidity constraints affect on human capital formation. The most commonly cited motivation to remit is simply that migrants care of those left behind: spouses, children, parents, and members of larger kinship and social circles. Alongside altruism, and notwithstanding self-rewarding emotions associated with remitting behavior, the very fact that donors and beneficiaries of remittances are spatially differentiated creates room for additional motives.

First of all, remittances may just buy a wide range of services such as taking care of the migrants' assets, with the likelihood and size of remittances depending on whether and when the migrant intends to return. Secondly, it is clear that migration is primarily (but not only) driven by wage differentials, implying that people are ready to incur substantial moving costs in order

to access to international migration. Such migration costs, however, are beyond the possibilities of many prospective migrants and, given capital markets imperfections, must be financed through informal family loans repaid later (with interest) in the form of remittances.

Even when wage differentials are not significant enough to compensate for migration costs, it may still be optimal for some families to have migrant members. This is the case, in particular, for rural households whose agricultural income is highly volatile due to changing climatic conditions and other idiosyncratic risks. When the market does not allow for a trade-off between a lower mean and a reduced variance, migration by some members may become a straightforward way to achieve mutual insurance; for this to occur, wages at destination need not be higher providing that incomes at home and destination are not positively correlated.

In the model, I assume that the driving motivation for remittances is altruism. I focus on the macroeconomic effects of remittances as they impinge on households decision in terms of labour supply, investment, education, and migration with potentially important aggregate effects. The series of works highlighted above focused on the impact of remittances, but they mainly emphasize a particular aspect of the international transfers and are mostly confined to effects on recipient households. Our model considers the effects of remittances on both labor market prospects and human capital formation for all households.

III. Model

Migration is characterized as a family choice and we show that repatriated savings have an important role in the development process of the labor exporting country. Migration decision is taken for the interest of the family. Positive selection is assumed in that relatively more skilled workers have a higher propensity to migrate. This assumption is coherent with the empirical evidence on migration and human capital which shows that individuals with a higher educational level are more likely to migrate (e.g., Chiquiar and Hanson, 2004; Gaviria, 2004).⁴

There is an ongoing debate on the impact of remittances on economic performance. We look at the impact of intra-household transfers from migrants to stayers on the decision making of stayers. In particular, we model the macroeconomic impact in which schooling and labor supply prospects change in the presence of remittances.

A. Building Blocks

The theoretical framework is related to Drinkwater et al. (2003), but allowing for human capital formation. The possibility of emigration in the short-run contracts the supply of human capital as there is brain drain. However in the long-run there can be three sources brain gain. First, migration opportunities raise the rate of return to human capital investments by stayers. Second, remittances relax liquidity constraints for recipients and reduce the costs of schooling.

⁴ For example in the AMCO survey, the majority of remittance recipients do not have schooling beyond secondary education. This is consistent with the presumption that migrants have at least as much schooling as stayers. Given the substantial costs of migration from Colombia, positive selection is likely as there is a positive correlation between household financial and human capital assets.

Third, higher human capital supply by recipient households generates a job creation externality that may increase the returns to schooling for nonrecipient households as well.

1. Preferences

The set up is a search model in which remittances affect the human capital and labor supply in the source economy. I assume that the relatively skilled members of the family are the potential migrants while the other members face frictions in the home labor market. Each household has an utility function for the family of the form:

$$U(y, x, e) = ey + (1 - e)x \quad (1)$$

where e is the fraction of household members who are migrants, y is their disposable income after transfers (including remittances), and x is the income for the stayers. In the baseline model, I assume risk neutrality but later on examine how to relax this assumption. Households compare the utility of the family with or without migration. I then consider a matching model to describe the frictions in the labor market of the source economy.⁵

2. Technology

Let us assume a Cobb-Douglas production function of the form:

$$y_c = A_c h_c^\alpha \quad (2)$$

where the subscripts refer to the country where production takes place. We assume that the only

factor of production is human capital and that production is subject to diminishing returns, with $0 < \alpha < 1$. Furthermore we assume that for any level of aggregate human capital the productivity parameter is larger in the destination country is higher, with $A_d > A_o$. This provides the rationale for migration as migrants enjoy a wage premium which covers the costs of migration. Additionally, the relative abundance of human capital in the destination country is assumed to have a sufficiently low upper bound. In particular, we need $\frac{h_d}{h_o} < (\frac{A_d}{A_o + \zeta})^{\frac{1}{1-\alpha}}$, where ζ is the cost of migrating.

3. Migration

The investment decision in human capital can be positively affected by migration and remittances. The literature which stresses the possibility of a brain gain from migration, shows that a positive, but sufficiently small, probability of migration to a richer country raises the level of human capital investment in the source country (e.g. Stark and Wang, 2001). We look at the impact of migration and remittances in a framework where households can have individuals with low moving costs (potential migrants) while the other members are characterized by high moving costs. We can assume that migration of the first group of agents is freely determined by market conditions while migration of the second group is regulated by the Government in the destination country. The fraction of households with migrants is m .

The probability of migration for individuals with high moving costs (i.e. stayers) depends on whether there is a migrant in the household. I

⁵ Note that the leisure choice is not included explicitly in the model, for tractability reasons.

assume that the fraction of $1 - m$ households with no first wave migrants have very high migration costs such that their probability to migrate is equal to p_{nm} while for households that receives remittances this probability is equal to p_m where $p_m \geq p_{nm}$. For simplicity, let us normalize $p_{nm} = 0$ and $p_m = p$. Our results do not require this dichotomy but rather rely simply on the observation that households with migrants in the destination country enjoy from network effects which facilitate further migration. Households without migrants generally face higher moving costs.⁶

4. Education

The timing of the economy is the following. The agents with low moving costs migrate or stay. In case of migration they remit a given amount τ . The migration decision of the skilled and the probability p of migration of stayers affect the human capital accumulation of the stayers and the labor market equilibrium in the source economy. Now, we concentrate on the human capital investment of high mobility cost individuals. Contrary to their partners, they face frictions in the labor market. They meet a firm with probability q , which is endogenous and described in greater detail below. Their education choice is affected by domestic labor market conditions, the probability to migrate and the labor market conditions in the destination country.

Stayers take migrant income and remittances as given and allocate resources to schooling. Once abroad migrants remit an amount τ . For

simplicity, we assume that they have the same ability to learn γ and that, if the partner migrates, they invest in education a fraction of remittances equal to s . Since we assume risk neutrality and the utility function is linear, the education decision is taken to maximize consumption income net of schooling investments:

$$\max_{h_i} \{c - \frac{h_i^\Psi}{\Psi (\gamma + s\tau_i)}\} \quad (3)$$

$$s.t. \quad c = p_i \{A_d h_d^\alpha + (1 - s) \tau_i\} + (1 - p_i) \{q[A_o \beta h_o^\alpha + (1 - s_i) \tau_i] + (1 - q) \tau_i (1 - s)\} \quad (4)$$

where β is the labor share in the country of origin. We assume that $\tau_m \geq 0$, $\tau_{nm} = 0$, $p_{nm} = 0$ and $p_m = p$.

By solving the maximization problem we obtain:

$$h_m = \{[\alpha p_i (A_d - \bar{q} A_o \beta) + \bar{q} \alpha A_o \beta] (\gamma + s\tau)\}^{\frac{1}{\Psi - \alpha}} \quad (5)$$

$$h_{nm} = \{\bar{q} \alpha A_o \beta \gamma\}^{\frac{1}{\Psi - \alpha}} \quad (6)$$

Human capital accumulation is a positive function of the probability to migrate p and of remittances. If we assume that part of the remittances are invested, then households with a migrant member invest more in education compared to a non-migrant household. Human capital accumulation is also a positive function of the probability to find a job in the domestic labor market and of the workers' bargaining power. We can easily verified that if $p = 1$ recipient households invest for the foreign market, while for $p = 0$ they invest in human capital for the domestic market.

⁶ This characterization is consistent with the findings of Hanson, Robertson and Spilimbergo (2002). Their evidence is consistent with border enforcement having a minimal impact on illegal immigration, and illegal immigration from Mexico having a minimal impact on wages in U.S. border areas. Hence, for a given human capital investment, the main determinant of the propensity to migrate after the first wave is the cost of migration.

We can then determine the average level of education in the source economy after first wave migration and remittances:

$$E(h) = (1 - p) m h_m + (1 - m) h_{nm} \quad (7)$$

Clearly, the effect of migration and remittances on the average level of human capital of the labor exporting country is ambiguous.

5. Labor Market

We assume there are frictions in the process of finding a job. The matching technology is given by,

$$j = v^\phi L^{1-\phi} \quad (8)$$

where v is the number of vacancies and L is the labor force in the origin country.

Upon finding a job, workers receive a fraction β of the revenue they generate,

$$w_i = \beta(A_0 h_i^\alpha) \quad \text{with } i = nm, m \quad (9)$$

We assume that the firm does not know which type of worker will be matched to a vacancy. When a vacancy is created, the decision is taken with respect to the expected average level of education. Firms create vacancies up to the point where the expected revenue generated by new workers is equal to the cost of hiring them,

$$(1 - \beta) A_0 E(h^\alpha) = \frac{\Lambda}{q(\theta)} \quad (10)$$

where Λ is the cost of creating a vacancy and q is the probability that it will generate a match.

The average level of education in the economy will depend on the human capital education decision of the stayers and on the effect of this education choice on future brain drain. Given

this assumptions, the expected level of human capital in the small developing country will be equal to

$$E(h) = (1 - p) m h_m + (1 - m) h_{nm} \quad (11)$$

The definition $\theta = \frac{v}{u}$ (the 'labour market tightness' parameter) gives the vacancy rate and completes the description of the matching process. In equilibrium,

$$\theta = [(1 - \beta) \frac{A_0 E(h^\alpha)}{\Lambda}]^{-\frac{1}{1-\phi}} \quad (12)$$

The average level of investment in human capital depends on the proportion of households with migrants, the amount of remittances invested in education per recipient $s\tau$, the probability of migration p , and the probability of finding a job q , given by

$$q(\theta) = \theta^{\phi-1} = (1 - \beta) \frac{A_0 E(h^\alpha)}{\Lambda} \quad (13)$$

Similarly, the probability of a vacancy to meet a worker is the product of the vacancies per job searcher times the matches per vacancy:

$$\theta q(\theta) = \theta^\phi = [(1 - \beta) \frac{A_0 E(h^\alpha)}{\Lambda}]^{-\frac{\phi}{1-\phi}} \quad (14)$$

B. Analytical Solution: the Case without Brain Drain

Let us assume a simplified version of the model and look at the limit case of $p = 0$. In this case, workers invest in human capital only for the domestic labor market. The maximization process simplifies in the following way:

$$\max_{h_i} \{c - \frac{h^\psi}{\Psi(\gamma + s\tau_i)}\} \quad (15)$$

$$s.t. \quad c = \{q[A_0 \beta h_i^\alpha + (1 - s_i) \tau_i] + (1 - q) \tau_i (1 - s)\}$$

Optimal human capital investment is,

$$h_i = [\alpha q A_o \beta (\gamma - s\tau_i)]^{\frac{1}{\Psi - \alpha}} \quad (16)$$

and given this, labor matching yields,

$$q^{1-\alpha} = (1 - \beta) \alpha^\alpha \beta^\alpha \frac{A_o^{1+\alpha}}{\Lambda} (m[(\gamma + s\tau)]^{\frac{1}{\Psi - \alpha}} + (1 - m) \gamma^{\frac{1}{\Psi - \alpha}})^\alpha \quad (17)$$

Thus we have two equations and two unknowns. First, the expected level of human capital in the small developing country will be equal to

$$E(h) = m [\Gamma \alpha A_o \beta (\gamma + s\tau)]^{\frac{\alpha}{\Psi - 2\alpha}} + (1 + m) [\Gamma \alpha A_o \beta \gamma]^{\frac{\alpha}{\Psi - 2\alpha}} \quad (18)$$

Then, we obtain:

$$h_i = [\Gamma \alpha A_o \beta (\gamma + s\tau_i)]^{\frac{\alpha}{\Psi - 2\alpha}} \quad (19)$$

with $\Gamma = \frac{(1 - \beta) A_o}{\Lambda}$, and,

$$q = \left[\frac{(1 - \beta) A_o}{\Lambda} \right]^{\frac{\Psi - \alpha}{\Psi - 2\alpha}} [\alpha A_o \beta (\gamma + s\tau)]^{\frac{\alpha}{\Psi - 2\alpha}}$$

These equations show that by inducing job creation, remittances enhance matching prospects. The main conclusion of this exercise is to show that, even if we are assuming away the possibility of brain gain through the migration prospects of recipient households, remittances have a potentially positive impact also on the human capital formation of the nonrecipient households.

This is due to an externality in the labor market. Remittances have a direct positive impact on the human capital investment of recipient households and through this channel increase the average level of human capital in the economy. Since firms open their vacancies as a function of the average expected profits, the rise in average

human capital induces job creation. In this way, remittances increase the probability of employment of nonrecipient workers. The increase in labor demand in the source economy will then influence the human capital investment decision of all workers. In particular, the expected return to schooling is higher to the extent that remittances enhance employment opportunities in the country of origin of migrants.

C. Extensions: Risk Aversion and Borrowing Constraints

We now turn to two extensions of the baseline model. The first is to relax the assumption of risk neutrality. Second, we introduce the possibility of imperfect capital markets. The objective here is to show the robustness of the results, which were obtained above in an environment with risk neutral agents operating in frictionless capital markets.

1. The model with risk-averse workers

Risk-averse workers value remittances more if unemployed and the introduction of these transfers modifies their outside option. Let \bar{z} denote the domestic support for the unemployed and \bar{z} denote income from remittances. Then $z^m = (\bar{z} + \bar{z})$ and $z^{nm} = \bar{z}$ are the unemployment incomes for the worker in a migrant and non-migrant family respectively. Similarly, for the employed incomes are $y^m = (w^m + \bar{z})$ and $y^{nm} = w^{nm}$. The remaining value functions which summarize unemployed and employed workers' asset values are then respectively

$$rU^i = \ln(z^i) + \theta q(\theta) [E^i - U^i] \quad (20)$$

$$rE^i = \ln(y^i) + \lambda [U^i - E^i] \quad (21)$$

for a worker in a family of type $i = m$, nm says that the asset value of unemployed worker of type i depends on the unemployment income and the probability of finding a job, $\theta q(\theta)$ says that the asset value of employed worker of type i depends on the employment income and the exogenous probability of losing a job, λ .

We assume that firms are not able to discriminate *ex ante* between an unemployed migrant and non-migrant since only information concerning the average characteristics of workers is available when the vacancy is opened. This implies that firms will open the same vacancy for the non-recipient and recipient unemployed. In the home economy, households will bargain over two different wages and the wage for workers with migrants in the family will be higher than that of workers in non-migrant families since they have a higher 'threat point'.

In equilibrium all firms enter the market until the asset value from a vacant job, V , is zero. By manipulating the two Bellman equations for the firms and the zero profit assumptions, we can determine the job creation curve jc :

$$A_o[f(h_i) - (r - \delta)h_i] - w_i - \frac{(\lambda + r)p\Lambda}{q(\theta)} = 0; i = nm, m \quad (22)$$

Aggregating over $i = nm, m$, applies to the average wage $w = mw^m + (1 - m)w^{nm}$ as well. During the bargaining stage, the partners agree on a way to share the rents. Wages are determined as the solution to a Nash bargaining problem. We now concentrate on the expected values. Given that the firm surplus is equal to $F^e - V$ and the worker surplus is $E^e - U^e$, the wage is contracted by following the maximization problem:

$$w = \arg \max [E_i^e - U_i^e]^\beta [F^e - V]^{1-\beta}; i = nm, m \quad (23)$$

where $0 \leq \beta \leq 1$ is the bargaining power of workers. By solving the maximization problem, we obtain:

$$\ln \left(\frac{w + \bar{z}}{\bar{z} + \bar{z}} \right) (1 - \beta) (y - w) = \frac{\beta}{w + \bar{z}} \quad (24)$$

If we rearrange the free-entry condition

$$w = \frac{pyq(\theta) - (r + \lambda)\Lambda}{q(\theta)} \quad (25)$$

we can then write the following equation in function of θ :

$$\ln \left(\frac{pyq(\theta) - (r + \lambda)\Lambda + \bar{z}}{q(\theta)} \right) (1 - \beta) \frac{q(\theta)}{\Lambda(r + \lambda)} = \frac{\beta}{\frac{pyq(\theta) - (r + \lambda)\Lambda}{q(\theta)} + \bar{z}} \quad (26)$$

To complete the matching model with capital, the evolution of unemployment is given by

$$\dot{u} = \lambda(1 - u) - q\theta(\theta)u \quad (27)$$

In the steady state $\dot{u} = 0$ and we arrive at the *Beveridge Curve* (BC):

$$u = \frac{\lambda}{\lambda + \theta q(\theta)} \quad (28)$$

We obtain steady-state values for θ , w and u , where w is the average wage in the economy and $\theta = \frac{v}{u}$ (the 'labour market tightness' parameter) gives the vacancy rate.

2. Credit Market Imperfections

Without some constraint on the ability to raise finance for investment, remittances can affect the unemployment income, but they would have no effect on human capital. Firms would

choose the optimal level of human capital at $h = h^*$. However, as discussed in the introduction, the lack of formal channels to obtain credit that characterizes many developing and transitional countries can generate financial constraints for firms. I therefore assume that households face liquidity constraints to finance human capital. With credit constraints $h < h^*$, remittances play a dual role. First, they relax the constraints and enhance human capital accumulation opportunities. To see this 'investment effect' algebraically, we differentiate the equilibrium condition with respect to h to obtain

$$\frac{d\theta}{dh} = \frac{\left\{ \left[\frac{\bar{z} + \bar{z}}{A + \bar{z}} \right] \left[\frac{1}{\bar{z} + \bar{z}} \Lambda p y'(h) \right] - \left(-\frac{\beta y'(h)}{(A + \bar{z})^2} \right) \right\}}{\left\{ \left[\frac{\bar{z} + \bar{z}}{A + \bar{z}} \right] \left[\frac{1}{\bar{z} + \bar{z}} B \right] \Lambda + \ln \left[\frac{A + \bar{z}}{\bar{z} + \bar{z}} \right] \Lambda q'(\theta) - \left(\frac{\beta}{(A + \bar{z})^2} \right) B \right\}} > 0 \quad (29)$$

by noting that the denominator is always negative and the numerator is positive in presence of credit constraints.

The second effect of remittances is to increase the search. The 'search effect' can move in both directions since:

$$\frac{d\theta}{d\bar{z}} = - \frac{\frac{\bar{z} - A}{(A + \bar{z})(\bar{z} + \bar{z})} \Lambda q(\theta) + \frac{\beta}{(A + \bar{z})^2}}{\frac{\beta}{(A + \bar{z})} \Lambda q(\theta) + \ln \left[\frac{A + \bar{z}}{\bar{z} + \bar{z}} \right] \Lambda q'(\theta) + \frac{\beta}{(A + \bar{z})^2} B} \quad (30)$$

and the numerator can be both positive and negative. In particular, if β is small enough then the search effect is negative with $\frac{d\theta}{d\bar{z}} < 0$ and $\frac{d\theta}{dh} \geq 0$. We totally differentiate equation to see these two effects analytically. I first concentrate on the search effect and a similar analysis applies to the investment effect:

$$\frac{\partial F}{\partial \theta} \frac{d\theta}{d\bar{z}} + \frac{\partial F}{\partial \bar{z}} = 0 \quad (31)$$

Let us,

$$\frac{p y q(\theta) - (r + \lambda) \Lambda}{q(\theta)} = A > 0 \quad (32)$$

and,

$$\frac{q'(\theta) p y q(\theta) - q'(\theta) [q(\theta) p y - p \Lambda (\lambda + r)]}{(q(\theta))^2} = B < 0 \quad (33)$$

$$(1 - \beta) \frac{1}{\Lambda (r + \lambda)} = \Lambda > 0 \quad (34)$$

with

$$q'(\theta) < 0$$

Then:

$$\begin{aligned} \frac{d\theta}{d\bar{z}} \left\{ \frac{\bar{z} + \bar{z}}{A + \bar{z}} \left[\frac{1}{\bar{z} + \bar{z}} B \right] \Lambda q(\theta) + \ln \left[\frac{A + \bar{z}}{\bar{z} + \bar{z}} \right] \Lambda q'(\theta) - \left(-\frac{\beta}{(A + \bar{z})^2} \right) B \right\} \\ + \left\{ \left[\frac{\bar{z} + \bar{z}}{A} \right] \left[\frac{\bar{z} - A}{(\bar{z} + \bar{z})^2} \right] \Lambda q(\theta) + \frac{\beta}{(A + \bar{z})^2} \right\} = 0 \end{aligned} \quad (35)$$

That is:

$$\frac{d\theta}{d\bar{z}} = - \frac{\frac{\bar{z} - A}{(A + \bar{z})(\bar{z} + \bar{z})} \Lambda q(\theta) + \frac{\beta}{(A + \bar{z})^2}}{\frac{B}{(A + \bar{z})} \Lambda q(\theta) + \ln \left[\frac{A + \bar{z}}{\bar{z} + \bar{z}} \right] \Lambda q'(\theta) + \frac{\beta}{(A + \bar{z})^2} B} \quad (36)$$

Suppose that variables θ , h and z refer to a post-migration state with remittances and in the pre-migration state without remittances they take values $\bar{\theta}$, \bar{h} and \bar{z} . Recipient households use remittances to overcome credit constraints.

IV. Parameterization, Calibration and Simulations

In this section we parameterize the three groups of parameters in the model and calibrate for El Salvador and Honduras.

A. Numerical Solution

The baseline model of the source economy is summarized as:

$$q(\theta) = \theta^{1-\phi} = [(1 - \beta) \frac{A_o E(h^\alpha)}{\Lambda}]^{\frac{1-\phi}{\phi}} \quad (37)$$

$$\theta q(\theta) = \theta^\phi = [(1 - \beta) \frac{A_o E(h^\alpha)}{\Lambda}] \quad (38)$$

$$E(h) = (1 - p) m h_m + (1 - m) h_{nm} \quad (39)$$

$$h_m = \{[\alpha p (A_d - \bar{q} A_o \beta) + \bar{q} \alpha A_o \beta] (\gamma + \tau_s)\}^{\frac{1}{\psi - \alpha}} \quad (40)$$

$$h_{nm} = \{\bar{q} \alpha A_o \beta \gamma\}^{\frac{1}{\psi - \alpha}} \quad (41)$$

where \bar{q} is the probability of employment in the source economy. Note that remittance recipients always accumulate more human capital unless $p = 0$, as by assumption $A_d > A_o$, $\beta < 1$, and $\bar{q} < 1$. Hence, in a sense, brain drain facilitates a potential net brain gain from remittances.

B. Parameterizing the Baseline Model

The spirit of the analysis in this section is to value the quantitative impact of migration policies and remittances on the labor market of the labor exporting country. As a first step towards an empirical analysis of our model, we require functional forms for the matching and the production functions. In common with most authors we specify a Cobb-Douglas matching function. So we can write $j = L^{1-\phi} v^\phi$ and hence $q(\theta) = (\theta)^{\phi-1}$, $\theta q(\theta) = \theta^\phi$.

Counting up across the model's equations and the functional forms for the matching and

production functions we need to find values for a series of exogenous parameters. As a reference value we choose $\theta = 1$.

This leaves us with the following aggregate parameters: β (it is usually assumed equal to 0.5 in the matching literature), ϕ , A_o , A_d , α , Ψ and γ . We use data for $y^e = A_o E(h^\alpha)$, $w^e = A_o \beta E(h^\alpha)$, m , p and τ .

The cost of opening a vacancy Λ can be obtained from:

$$\Lambda = \theta^\phi (1 - \beta) A_o E(h^\alpha) \quad (42)$$

We can then estimate α from

$$w_i = \beta A_o h_i^\alpha \quad (43)$$

$$w = \arg \max [E - U]^\beta [F - V]^{1-\beta} \quad (44)$$

$$\beta \ln (E - U) + (1 - \beta) \ln F \quad (45)$$

First order condition:

$$\frac{\beta}{E - U} \left(\frac{1}{w + z} \right) \frac{1}{r - \lambda + \theta q(\theta)} + \frac{1 - \beta}{F} \left(- \frac{1}{r - \lambda} \right) = 0 \quad (46)$$

By noting that

$$F = \frac{y - w}{r + \lambda} \quad (47)$$

and

$$E - U = \frac{\ln (w + z) - \ln (\bar{z} + \bar{z})}{r + \lambda + \theta q(\theta)} \quad (48)$$

we obtain:

$$\ln \left[\frac{w + z}{\bar{z} + \bar{z}} \right] (1 - \beta) (y - w) = \frac{\beta}{w - \bar{z}} \quad (49)$$

and since

$$y - w = \frac{\Lambda}{q(\theta)(r - \lambda)} \quad (50)$$

we can write

$$\ln \left[\frac{w + \bar{z}}{\bar{z} + \bar{z}} \right] (1 - \beta) \frac{\Lambda}{q(\theta)(r - \lambda)} = \frac{\beta}{w - \bar{z}} \quad (51)$$

The next step requires a substitution of the wage derived from the free entry condition:

$$w = \frac{A_\omega y q(\theta) - (r + \lambda) \Lambda}{q(\theta)} \quad (52)$$

We now have a relation which depends only on θ

$$\ln \left(\frac{\frac{A_\omega y q(\theta) - (r + \lambda) \Lambda}{q(\theta)} + \bar{z}}{\bar{z} + \bar{z}} \right) (1 - \beta) \frac{q(\theta)}{\Lambda(r + \lambda)} = \frac{\beta}{\frac{A_\omega y q(\theta) - (r + \lambda) \Lambda}{q(\theta)} + \bar{z}} \quad (53)$$

Our model is given by the following relations in the unknowns θ , u and h :

$$\ln \left(\frac{\frac{A_\omega y q(\theta) - (r + \lambda) \Lambda}{q(\theta)} + \bar{z}}{\bar{z} + \bar{z}} \right) (1 - \beta) \frac{q(\theta)}{\Lambda(r - \lambda)} = \frac{\beta}{\frac{A_\omega y q(\theta) - (r + \lambda) \Lambda}{q(\theta)} + \bar{z}} \quad (54)$$

$$u = \frac{\lambda}{\lambda + \theta q(\theta)} \quad (55)$$

$$f'(h) = r + \delta \quad (56)$$

1. Calibration Framework

The complete model, with remittances is summarized as:

$$BC : u = \frac{\lambda}{\lambda + \theta q(\theta)} \quad (57)$$

$$WC : w = (1 - \beta) z + \beta A_\omega + \Lambda \theta \text{ where} \quad (58)$$

$$z = \rho w + \bar{z} \quad (59)$$

$$JC : A_\omega [f(h) - (r + \delta)h] - w - \frac{(r + \lambda)p\Lambda}{q(\theta)} = 0 \quad (60)$$

$$h^* : f'(h) = r + \delta \quad (61)$$

Thus require functional forms and possibly some parameter values for $q(\theta)$ (from $m(u, v)$) and $f(h)$, and values for the following parameters in the model: $p, \delta, \lambda, \Lambda, \beta, \rho, \xi$ and η .

The functional form for the matching function, $m(u, v)$ is

$$m(u, v) = v [1 - \exp(-\frac{v}{u})] \quad (62)$$

and hence

$$q(\theta) \equiv \frac{m(u, v)}{v} = [1 - \exp(-\theta)] \quad (63)$$

and for $f(h)$ we choose

$$f(h) = A_\theta h^\alpha \quad (64)$$

2. The Calibration of Aggregate Parameters

We calibrate λ to data observations of u, v , (and hence $\theta = \frac{v}{u}$), denoted by \hat{u}, \hat{v} , and $\hat{\theta}$), respectively. Then we have at the calibrated value:

$$\lambda = \frac{\hat{u} \hat{\theta} q(\hat{\theta})}{1 + \hat{v}} \quad (65)$$

To calibrate β and Λ , we use data for the distribution of output between wages and the firm's economic rent. First write,

$$f(h) = w + (r + \lambda) \frac{A_o \Lambda}{q(\theta)} \quad (66)$$

which decomposes output into the wage plus the firm's rent, this last term being $(r + \lambda)J$, where J is the value of an occupied job. Suppose we have data on these components of output as shares of output; i.e., data on $\frac{(r + \lambda)J}{A_o f(h)} = \hat{R}$ and $\frac{w}{A_o f(h)} = \hat{W}$.

Next consider the calibration of Λ . We calibrate the model assuming no credit constraints so that $h = h^*$. From our definition of \hat{R} ,

$$\Lambda = \frac{q(\hat{\theta}) \hat{R} f(h^*)}{\hat{r} + \lambda} \quad (67)$$

Since everything on the right-hand-side is calculated or observed at this point, we therefore have a calibrated value of Λ .

Finally we calibrate β . Put $z = \rho w$ in the pre-migration state and assume we have data ρ for $\hat{\rho}$. Let $y_n(h) = A_o(f(h) - (r + \delta)h)$. Then from the definition of \hat{W} , we obtain the calibrated value of β as

$$\beta = \frac{(1 - \hat{\rho}) \hat{W} A_o f(h^*)}{[y(h^*) + A_o \Lambda \hat{\theta} - \hat{\rho} \hat{W} A_o f(h^*)]} \quad (68)$$

Note that we can choose our units such that in this baseline calibration the productivity parameter $A_o = 1$.

For the calibration of the human capital formation parameters γ and Ψ , we note that

$$E(h) = (1 - p)m \{ [\alpha p(A_d - \bar{q} A_o \beta) + \bar{q} \alpha A_o \beta] (\gamma + \tau s) \}^{\frac{1}{\Psi - \alpha}} + (1 - m) \{ \bar{q} \alpha A_o \beta \gamma \}^{\frac{1}{\Psi - \alpha}} \quad (69)$$

and for a given value of the left hand side we find the values of γ and Ψ that satisfy the equation

given that all other variables are fixed and the parameters are calibrated. We have that γ is a shift parameter indicates for the education cost function while Ψ indicates how fast marginal education costs rise with schooling attainment.

C. Policy Simulations

The household parameters for each country were derived from data from the AMCO survey on migration and remittances. For the parameter m we used for each country the share of households which receive remittances (20.1% of AMCO households receive remittances). For the parameter s , we used the average reported share of remittances spent on education (8.1% of remittances is spent on education). For the parameter e , we used for the average fraction of household members who migrate within households receiving remittances (1.2 migrants per household). For the amount of remittances τ , we used the average monthly amount received (average monthly remittance is U\$293.6).

Among migrants, 87.7% have made only one trip. Among remittance senders, 66.6% emigrated after 1999, 79.8% remit with at least a monthly frequency. Among those sending remittances, 42.7% completed secondary education and 27.8% have tertiary education, and 73.2% of migrants are legal residents of the destination country. For AMCO households, 34% of remittances originate in the US and 54% in Spain.

Only 30.8% of recipients completed secondary education and more than 85% of recipients are relatives, 80.1% close relatives of the sender. Also, 13% of remittance recipients are studying while 5% are searching for a job. For recipients, the unemployment rate is 6.4%, with a 38.9%

labor participation rate. In contrast, 13.5% is the unemployment rate for nonrecipients, with 48.4% participation rate. In Table 1, household parameters are summarized.

For the purposes of the policy simulation exercises the model was solved calibrating the aggregate parameters as described above. The policy parameters are set on the basis of subsidiary evidence. The main policy parameters are related to labor market and education policies in the origin country of migrants and immigration policy in the destination country. These are calibrated in the context of each exercise. For the baseline specifications, we note from the study by Lora (2001) that the labor markets in Colombia compared to the rest of Latin American are very flexible in some dimensions but relatively rigid in others.

In the regional context, Colombia has the lowest expected cost of laying off a worker, which is the termination cost below one monthly salary without any provision for compensation, but has the third highest nonwage labor cost component

with social security contributions at 30% of the wage bill.

Given this, the overall index of labor market reform for Colombia is about 0.7, which is defined relative to best practice in the region set equal to unity. And, from Barro and Lee (1996) and Duryea and Pages (2003) we note that education access and provision is limited even compared to other countries in Latin America, which as a whole is a lagging region in the provision of education.⁷

For the migration propensity parameter p , we note that the U.S. border controls are not necessarily the binding constraint. Both Hanson et al. (2002) and Orrenious (1999) show that migrant networks are more likely to influence this probability via migration costs than patrol policies in the case of the Mexico-U.S. border.⁸

Since 1998 the annual outflow of migrants from Colombia oscillated between 200,000 and 300,000 and the population between 18 and 60 years old in 2003 was 26.643 million. This means that about 1% of the population in that age group have migrated yearly. This would give us a lower bound of the probability of second wave migration (i.e. probability of migration conditional on another household member having migrated). In Table 1 above, we impute $p = \frac{0.2}{3} \approx 0.07$ from the fact that the average number of migrants per household is 1.2 and that there are on average nearly 4 adults per household.

Table 1

HOUSEHOLD PARAMETERS FROM AMCO

m	0.20
s	0.08
e	0.24
p	0.07
τ	\$293

⁷ Only in Sub-Saharan is the regional average of public expenditure in education per student lower than in Latin America.

⁸ Furthermore, as noted by Hanson and Spilimbergo (2001), "whether by accident or design, U.S. borders are porous. One common explanation for why the U.S. Immigration and Naturalization Service (INS), which oversees the Border Patrol, fails to prevent illegal entry is that it operates under conflicting mandates: while groups opposed to immigration demand strict enforcement, industries intensive in manual labor demand that enforcement not undermine their economic viability".

D. Remittance Effects and Education Policy

First, we compare the impact of remittances under varying degrees of education access. The values in the column "Current" were generated by noting that in the year 2000, according to Duryea and Pages (2003), in Colombia among the population older than 25 years in 2000, the average years of completed schooling were 5.01 and the fraction of individuals with secondary schooling was 18.5%.

In this case, γ and Ψ were calibrated to fit country specific parameters using the last equation in the previous section. The values in the column "LA Average" were generated calibrating the parameters γ and Ψ using the Latin American averages for years of schooling attained, which was 5.92 in 2000, and for the percentage with secondary education, which was 21.77.

Table 2 shows the impact of remittances on human capital and employment under different levels of access to education. Given the current level of remittances, to the extent that there are job creation spillovers leading to improvements in schooling for nonrecipient households, such effect would be more pronounced if education were more accessible. If Colombia were able to achieve the average Latin American levels of enrollment and schooling, there would be a proportionally more substantial increase in schooling among nonrecipient households.

This is because households that receive remittances are partially able to overcome education costs. In the meantime, households that do not receive remittances by and large may find schooling investment prohibitive unless educa-

Table 2
EFFECTS OF REMITTANCE FUNDS FOR
SCHOOLING UNDER DIFFERENT DOMESTIC
EDUCATION POLICIES

	Current	LA Average
Current ($s = 0.08$)	$h_m = 14.6573$ $h_{nm} = 3.8735$ $h^e = 5.0763$ $\theta = 0.5749$	$h_m = 16.4921$ $h_{nm} = 6.1840$ $h^e = 7.1628$ $\theta = 0.6522$
Double ($s = 0.16$)	$h_m = 15.4634$ $h_{nm} = 4.1509$ $h^e = 5.6185$ $\theta = 0.7764$	$h_m = 17.9574$ $h_{nm} = 6.5378$ $h^e = 7.8689$ $\theta = 0.8838$

tion policy is targeted to enhance accessibility. Even if the rise in the supply of human capital by remittance recipients increases the rate of return to education, the high cost of schooling can preclude any investment by nonrecipient households.

Without more widespread access to education the potential impact of remittances on aggregate human capital may not materialize. Table 2 shows what would happen if the average fraction of monthly remittances devoted to education doubled. Under the current level of accessibility to education, average human capital would increase about 17% after the rise in remittances devoted to education. By contrast, if the rise in remittances were accompanied by an increase in accessibility to education to the Latin American average, aggregate human capital would rise by more than 56%, with a particularly pronounced improvement among nonrecipient households. Hence, to the extent that schooling is affordable, job creation spillovers materialize.

E. Remittance Effects and Payroll Taxes

We note from the study by Lora (2001) that the labor markets in Colombia compared to the rest of Latin American are very flexible in some dimensions but relatively rigid in others. In the regional context, Colombia has the lowest expected cost of laying off a worker, which is the termination cost below one monthly salary without any provision for compensation. Yet, the payroll tax rate, for social security contributions, is third highest in the region and after the reform of 1993 rose to more than 30%.

We consider how a decline in the payroll tax rate to the Latin American median of 16% affects the macroeconomic impact of remittances. This lowers the expected cost of filling a vacancy, $\frac{\Lambda}{q(\theta)}$, which in equilibrium is the marginal product of employing an additional unit of human capital. Hence, job creation increases resulting in more human capital formation and employment. Now, in the assessment of how a doubling in the share of remittances devoted to education would impact on human capital and employment, the role of payroll taxes is considered.

The aggregate impact of a rise in the share of remittances spent in education under current levels of payroll taxes would be limited to an improvement on aggregate human capital of about 5%. This compares to a rise of about 50% in aggregate human capital if the rise in remittances invested in schooling were accompanied by a slashing in half of the payroll tax rate to the Latin

Table 3

EFFECTS OF REMITTANCE FUNDS FOR SCHOOLING UNDER DIFFERENT DOMESTIC PAYROLL TAX RATES

	Current	LA Average
Current ($s = 0.08$)	$h_m = 14.6573$ $h_{nm} = 3.8735$ $h^e = 5.1763$ $\theta = 0.5149$	$h_m = 16.4830$ $h_{nm} = 5.2126$ $h^e = 7.0831$ $\theta = 0.7950$
Double ($s = 0.16$)	$h_m = 15.1331$ $h_{nm} = 4.0713$ $h^e = 5.4810$ $\theta = 0.5925$	$h_m = 17.0843$ $h_{nm} = 5.9571$ $h^e = 7.9826$ $\theta = 0.8271$

American median. In the model, such a reduction in payroll taxes by itself would generate a rise of 40% in long-run average human capital formation through the virtuous cycle generated by the boost in job creation.

F. Remittance Effects and U.S. Immigration Policy

We consider this a lower bound of the migration propensity. To find the lower bound of the migration probability conditional on another household member having migrated, we used the annual flow of emigrants and divided it by the stock of adult population, both males and females, between 18 and 60 years old. For the baseline calibration we set the probability of migration for households with first wave migrants to $p = 0.07$, as described above the average number of migrants per household is 1.2 and that there are on average nearly 4 adults per household.⁹ Now

⁹ In the case of Mexican migrants, the evidence provided by Orrenious (1999) shows that, on a first trip, access to an additional family member network (a family member who has prior migration experience) increases the annual probability of migrating from 1.9 to 4.8%.

we turn to simulating what would be the effect of two polar cases. First, we consider tightening up border control so that it is not porous at all. In this case of a sealed border, all migrants are legal. From the AMCO survey, we know that roughly 70% of first wave migrants are legal resident of the destination country. Hence, $p_{sealed} = 0.05$. Second, we consider the impact of moving towards an open borders policy which largely reduces migration costs and consider rise in the probability of successful second wave migration to $p_{porous} = 0.1$.

Table 4 shows how the impact of remittances may be affected by U.S. immigration policy. While it is widely documented that border control per se has a marginal effect on migration, relative to say family and village network effects, the polar cases of erradicating all undocumented migration and making all migration legal would plausibly affect flows. Compared to the benchmark in Table 2, with $p = 0.07$ and current combination of education policy and payroll tax rate, limits on emigration appear to enhance the impact of remittances on human capital and employment. The reason is that, with costly education and labor market ri-

gidity, remittances are used to enhance migration prospects given limited opportunities at home. The selection process associated with migration would make remittance recipients more likely to leave and under these conditions opening of the border makes net brain drain more likely.

Brain drain dominates when education access is limited and payroll taxes are high because the effect of remittances on job creation in the local labor market is negligible. This is because while recipient households accumulate more human capital, they do so in a very small scale due to the inaccessibility of education. The impact on nonrecipient households is very limited because job creation externalities are negligible on top of the high costs of education. Given this, to the extent that there is more human capital formation by recipient households it is with the purpose to migrate. The net effect is brain drain.

Yet, there is evidence that, under the present levels of education and job creation costs, a rise in migration prospects tends to enhance the positive impact of remittances on human capital and employment. In fact, when the border is porous there are gains from remittances, as Stark et al. (1997, 1998) and Bine *et. al.* (2001) have pointed out, better emigration prospects can raise the average level of human capital even if some leave the country as the rate of return to human capital is higher.

Brain gain would be more important when education access is more widespread and the labor market more flexible because the effect of remittances on job creation in the local labor market then is important. This is because when recipient households accumulate significantly more human capital, nonrecipient households

Table 4
EFFECTS OF REMITTANCE FUNDS FOR
SCHOOLING UNDER DIFFERENT DOMESTIC
U.S. IMMIGRATION POLICIES

	Current	LA Average
Current ($s = 0.08$)	$h_m = 14.9113$ $h_{nm} = 4.1260$ $h^e = 4.8947$ $\theta = 0.6446$	$h_m = 14.1479$ $h_{nm} = 3.9039$ $h^e = 4.4451$ $\theta = 0.6041$
Double ($s = 0.16$)	$h_m = 15.1331$ $h_{nm} = 4.0713$ $h^e = 5.4810$ $\theta = 0.5925$	$h_m = 17.7450$ $h_{nm} = 5.0326$ $h^e = 5.7246$ $\theta = 0.7104$

engage in schooling investments due to enhanced job creation. Increased human capital formation by recipient households would be larger and not solely to migrate. The net effect from education access and lower payroll taxes larger potential is brain gain.

V. Conclusion

The calibration exercises indicate that higher remittances are associated with a macroeconomic equilibrium where human capital formation by recipient households increases. This observation is consistent with the evidence presented by Cardona and Medina (2005) who find for Colombian households that emigration and remittances help relax household credit constraints on the financing of education. In fact, remittance recipient households spend on average 11% more on education. The schooling investments financed with remittances not only enhance the earning prospects of recipients at home and abroad but can generate job creation spillovers as businesses post vacancies in reaction to the rise in the supply of human capital. This indirect effect of remittances can potentially increase both human capital and employment across all households as the labor market becomes thicker. Our contribution is to consider the effects of remittances not only on recipient households but also the rest of the economy using a macroeconomic model which we calibrate to data from AMCO to conduct policy simulations. We identify potential gains from remittances on education and employment but find that they could be much larger with more access to schooling and less distortions in the labor market.

Our findings are also consistent with other studies which analyze the determinants of re-

mittances. Gaviria and Mejia (2005) study among Colombian emigrants what are the determinants of remittances, the degree of attachment to their homeland, and their desire to return. They use a survey conducted by Radiocadena Nacional de Colombia linking the characteristics of migrants with those of household members staying behind. The average amount of remittances is increasing in the years of schooling of the senders and only decreases very slightly over time. Among receivers, 13.0% of households report investing remittances in education as their primary use. Gaviria (2004) points out that remittances are an option for households with access to the resources that need to be invested in human capital and to bear the costs of migration. This points to migration as an option for households, to enhance income generation and risk diversification, which is subject to positive selection on the basis that only those with a minimum human and financial capital can settle abroad. Results consistent with the latter characterization are obtained by Soto and Walker (2002), who analyze the motivations of Colombian migrants in the US. They find that obtaining higher wages is the primary motivation. In fact, the evidence points to positive self-selection of migrants as their schooling years and wage before migration both exceed the national average.

The simulation exercises illustrate the positive role of remittances on aggregate education and employment as a result of the decisions by recipient households. The macroeconomic benefits of remittances in Colombia would be much larger if progress could be made in lowering the costs of education for households and the costs of job creation for businesses. As with other capital inflows, the extent to which remittances are invested productively, and are

catalysts to other investments, depends on the flexibility that workers and businesses have to

adjust their skills and scale of operation to match each other in the market.

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