Remittances and Economic Growth in Latin America and the Caribbean: The Impact of Human Capital Development

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Abstract

Remittances are one source of external financing for developing countries that have been increasing in both size and importance as of late. However, the issue about the impact on economic growth from remittances is still opened for discussion. This paper adds to this discussion by investigating the impact of remittances on growth through human capital using a panel data analysis for a sample of 14 Latin American and Caribbean (LAC) countries during the period 1975-2000. The results indicate that remittances have a positive impact on economic growth in the representative countries from the LAC region; however, the realization of this impact holds only when the remittance receiving country has a minimum threshold of human capital stock.

Key Words: Remittances, Human Capital, Growth, Latin America and the Caribbean
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Introduction

Remittances are one source of external financing for developing countries that have been increasing in both size and importance as of late. During 2006 inflows to developing countries of Foreign Direct Investment (FDI), remittances and Official Development Assistance (ODA) in billions of U.S. dollars were $324.7, $206.0 and $103.9, respectively (World Bank, 2007). Remittances are second to FDI, but greater than ODA inflows. Among developing countries Latin America and the Caribbean (LAC) have been the largest recipient of recorded remittances. Remittance inflows to developing regions in 2006 were $47.0 billion for East Asia and the Pacific (EAP), $32.0 billion for Europe and Central Asia (ECA), $53.0 billion for LAC, $25.0 billion for Middle East and North Africa (MNA), $41.0 billion for South Asia (SAS), and $9.0 billion for Sub-Saharan Africa (SSA) (World Bank, 2007, p.54). The remarkable increase in remittances’ size has awakened the interest of researchers in the development economics area as well as of policy makers to study the relationship between remittances and economic growth. However, the impact on economic growth from remittances is still an open discussion.

Some studies find negative and significant impacts of remittances on economic growth (Chami, Fullenkamp & Jahjah, 2003), or a negative but insignificant impact (International Monetary Fund [IMF], 2005). On the other hand, the positive impact of remittances on economic growth is associated with remittance’s potential for financing education and health (human capital development) and/or productive investments. Some of the studies that find remittances’ positive effect on growth are Acosta, Calderón, Fajnzylber and Lopez (2007); Catrinescu, Leon-Ledesma, Piracha and Quillin (2006); and Guiliano and Ruiz-Arranz (2006). Suggesting remittances’ contributions to education are Cox Edwards and Ureta (2003), Hanson and Woodruff (2003), López-Cordova (2006), and Rapoport and Docquier (2005). Suggesting remittances’ contributions to productive investments are Griffin (1976), Massey and Parrado (1998), and Woodruff and Zenteno (2001).
Even though the research on remittances has been growing, the interesting question about remittances’ impact on economic growth in developing economies is still opened for discussions. In order to add to this discussion, the purpose of the current study is to assess empirically the impact of remittances on economic growth through human capital. The empirical work is based on a model of endogenous growth in which the growth rate of total factor productivity (TFP) is modeled as being dependent on human capital and an interaction between human capital and remittances. Remittances’ potential to affect economic growth may be associated with remittances’ use for investment in education which can affect TFP. However, the impact of remittances on growth may be affected by the requirement of an adequate level of human capital in the remittance receiving economy, so that the level of human capital is conditioning the utilization of remittances. It may be that human capital has a role similar to that in Nelson and Phelps (1966) and Benhabib and Spiegel (1994) who suggest that human capital limits the adoption and implementation of new technologies; or that the level of human capital limits the absorptive capacity of an economy as in Borensztein, De Gregorio and Lee (1998). Therefore, in this study we test the complementarity between human capital and remittances on growth.

To estimate the effect of remittances on growth, we use cross-country growth accounting methods. A group of 14 countries from Latin America and the Caribbean is selected based on data availability over the period 1975-2000. We model the growth of TFP as a function of human capital and its interaction with remittances. The results indicate that remittances have a positive impact on economic growth, though the realization of this impact depends upon the level of human capital stock in the economy. This implies that a threshold of human capital stock is needed for remittances to exert a positive effect on growth. In addition, the level of human capital stock has a positive and significant effect on growth.

To accomplish this, this paper will proceed as follows. Section 2 will present an overview of remittances in LAC. Section 3 provides a review of the literature on remittances and growth. Section 4 describes the methodology and data. Section 5 presents a discussion of the results. Finally, section 6 presents conclusions and areas for further research.

1 Barbados (BRB), Bolivia (BOL), Brazil (BRA), Colombia (COL), Costa Rica (CRI), Dominican Republic (DOM), El Salvador (SLV), Guatemala (GTM), Honduras (HND), Jamaica (JAM), Mexico (MEX), Panama (PAN), Paraguay (PRY), and Trinidad and Tobago (TTO).
Overview of remittance inflows to Latin America and the Caribbean

Remittance inflows to developing countries have been increasing and becoming an important source of foreign exchange. In 2006 these inflows were estimated to be $206 billion, which is composed of: $47 billion to East Asia and Pacific; $32 billion to Europe and Central Asia; $53 billion to Latin America and the Caribbean; $25 billion to the Middle East and North Africa; $41 billion to South Asia; and $9 billion to Sub-Saharan Africa (World Bank, 2007, p. 54). Figure 1 shows that, since the late 1990s, LAC has been the largest recipient of reported remittances followed by East Asia and Pacific.

Remittances are one of the largest sources of external finance for the countries in the LAC region. Total remittance inflows to LAC grew from $5.7 billion in 1990 to $57 billion in 2006 (World Development Indicators, 2007), a ten-fold increase. IMF (2005, p. 72) reports that five countries (Mexico, Brazil, Colombia, El Salvador, and the Dominican Republic) from the LAC region belong to the group of the top 20 largest recipients of remittances during the period 1990-2003 (Figure 2), of which Mexico is second. Compared to FDI and ODA, remittance flows into LAC have become the second most important source of external finance, both in levels and as a percent of GDP (Figures 3 and 4). Figures 3 and 4 also show that while remittances have had a steady increase since the early 1990s, ODA in billions of U.S. dollars seems to be constant but seems to be decreasing as a percent of GDP, while FDI shows a downturn during the late 1990s and earlier 2000s. Therefore, remittances are less volatile than ODA and FDI as a source of foreign exchange. This shows the importance of remittances both in levels as well as a percent of GDP for the countries in the LAC region.

Figures 5 and 6 show remittance inflows to the countries in our sample for the period 1979-2000, both in levels and a as a percent of GDP. Most of the countries show an increase in remittances over the period, with the exception of Panama. For Panama Figures 5 and 6 show that remittances both as a share of GDP and in levels have decreased during the period of the study.

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2 The data is from the online version.
3 That comprises the entire group of countries in Latin America and the Caribbean as grouped by the World Bank, not just the 14 countries in this study.
Review of Literature

The impact of remittances on economic growth is still an open discussion. Remittances are used either for consumption, investment, or both uses. Some strands of literature on remittances suggest that using remittances for consumption does not make any good contribution to economic growth. Another strand of literature argues that by easing liquidity constraints remittances can contribute to investment in physical and human capital and affect growth.

The association of remittances with consumption relates to the economics of the family which indentifies the existence of an altruistic relationship between the migrant and his/her family, so that remittances behave as compensatory transfers that ease bad economic conditions (Chami et al. 2003). On the relationship between remittances and investment, Rapoport & Docquier (2005) suggest that remittances have distributive effects that are associated with its effects on growth and present two models in which remittances promote investment in physical and human capital.

The first model, “Liquidity Constraint 1: Entrepreneurship”, considers that emigration does not have a direct effect on the labor market of the immigrant home country but has an indirect effect on the economy because of the migrants’ intergenerational transfers (remittances). The model presents three cases with two of them resulting in promoting entrepreneurship in the immigrant home economy. The second model, “Liquidity Constraint 2: Human Capital”, considers an economy where individuals have a two period life, so that in the first period the individual earns a minimum wage, receives a transfer from the previous generation and has the possibility to engage in an educational program. In the second period, the model assumes that migration occurs and at the end of the period migrants return to their home country and transfer their accumulated savings to the next generation. This model divides the home country population in four groups (A, B, C, and D) and distinguishes three cases, and under case number three groups B, C and D emigrate whose transfers (remittances) allow their next generation to invest in education. Thus, in these two models remittances are promoting both productive investment projects and educational development.

Arguments against remittances’ contributions to development include Böhning (1975) and Rempel and Lodbell (1978). In these studies, remittances are primarily used for consumption and housing expenditures. Chami et al. (2003) find a significant and negative growth effect of
remittances while modeling the causes of remittances based on the economics of the family and asymmetric information. However, it is argued that the estimate in this study is biased because of the instrumental variables estimator used for remittances (Catrinescu, et al., 2006, p.11; IMF, 2005); and as Lucas argues that the lack of significance of the interest rate gap differential in the first stage regression reduces the effectiveness in eliminating the bias of the estimate (as cited in Catrinescu et al., 2006, p.3). Rapoport & Docquier, (2005, p. 66) also argue that Chami et al. (2003) ignored the possibility that remittances could affect investment and human capital formation due to the existence of liquidity constraints, so that human capital, an important factor that affects growth, was absent in their analysis. On the importance of the association between remittances and growth, Glytsos (2005) finds that remittance spending differs across countries and that the negative effect of a decrease in remittances on growth is greater than the positive effect of increasing them. Guiliano and Ruiz-Arranz (2006) find that remittances promote growth in countries with less developed financial systems since remittances finance investment and help to alleviate liquidity constraints. Catrinescu et al. (2006) find that remittances have a positive impact on growth, although weakly, and suggest that the existence of good institutions could allow remittances to be invested in greater amount and more efficiently. Thus, it seems that there are some country conditions that affect the means by which remittances can affect growth. Investment and education are two of the possible channels.

The above discussion suggests that remittances may affect growth via human capital and investment. Endogenous growth theory supports modeling the growth of TFP as being affected by human capital. Romer (1990a) models the growth of total factor productivity as being affected by human capital employed in the research sector, and finds that the stock of human capital in an economy is a determinant of the rate of growth. Nelson and Phelps (1966) argue that including education (human capital) as an additional input in an aggregate production function to represent the relationship between education and aggregate output may be a gross misspecification; they argue that education promotes adoption and implementation of new technologies and model the growth of technology as being affected by an interaction of human capital in a catching up setting. Benhabib and Spiegel (1994) follow Nelson and Phelps (1966) and Romer (1990a) and model TFP growth as a function of human capital itself and its interaction in a catch-up setting. They suggest that the growth rates may differ among countries
because of differences in human capital stock levels. Thus, human capital enhances economic growth by affecting the growth of TFP both directly and through its interactions.

The literature on FDI and growth include interesting findings about the effects on growth from interactions of human capital and FDI. In this strand of literature, human capital affects the absorptive capacity of the economy and conditions the positive effects of FDI on economic growth (Borensztein et al., 1998). Borensztein et al. (1998) highlight the introduction of more advanced technologies through FDI and test the effect of the interaction between human capital and FDI on growth. They find a strong complementary effect between human capital and FDI on growth and that a minimum threshold of human capital is needed for FDI to exert a positive effect on growth. Xu (2000) finds that technology transfers from U.S. multinationals contributes to productivity growth in developed countries but not in developing countries, and that a threshold of human capital is required in the host country in order to benefit from the technology transfer spillover. Other studies that find positive and significant effects of the interaction between human capital and FDI on growth are Eller, Haiss and Steiner (2006) and Li & Liu (2005). Balasubramanyam, Salisu and Sapsford (1999) and Makki and Somwaru (2004) find a positive interaction though insignificant. Thus, the FDI literature shows how human capital stock affects the absorptive capacity of an economy and, consequently, the positive effects of capital inflows such as FDI on economic growth.

This literature review suggests that the impact of remittances on economic growth depends on whether remittances are used for consumption or investment. However, it is important to note that one of the uses of remittances is for investment in education, which contributes to the development of human capital in the remittance receiving countries. In addition, the endogenous growth literature points out the role of human capital in affecting the growth rate of TFP, in which not only human capital itself but also its interactions have a role. This study aims to test the hypothesis regarding the impact of remittances through human capital on economic growth in the remittance receiving economy. It uses cross-country growth accounting methodology and tests the effect of the interaction between human capital and remittances on growth. This study covers a specific region of the world which is Latin America and the Caribbean and which has been receiving large amounts of remittances.
Methodology and Data

The growth model

In this section we present an endogenous growth model based on growth accounting methods that shows the relationship between the growth rate of GDP per worker and the growth rate of physical capital, human capital and TFP. This is cross-country growth accounting. In the model, human capital affects growth as an additional input and through TFP. It is through the interaction between human capital and remittances that remittances affect growth. The model is in line with endogenous growth theory in which the growth rate of TFP is a function of human capital. The model demonstrates a channel by which remittances affect economic growth.

We model TFP as a function of human capital. This approach is in Benhabib and Spiegel (1994), Nelson and Phelps (1966) and Romer (1990a) among others. Benhabib and Spiegel (1994, p.155) model the growth of TFP as a function of exogenous technological progress, endogenous technological progress which involves a human capital direct effect and is adopted from Romer (1990a), and a technology catch-up factor that depends on human capital and is adapted from Nelson and Phelps (1966). Temple (1999, p.125) argues that cross country growth accounting allows for the modeling of the growth rate of TFP as a function of observable variables. Additionally, Romer (1990b, p. 270) argues that the human capital level may affect the growth of technology directly and through the catching-up process. We model the growth rate of TFP as a function of human capital and the interaction between human capital and remittances.

The model starts with an augmented Cobb-Douglas production function in which output per worker is dependent upon physical capital, human capital, and labor. We assume constant returns to scale which allows specifying the production function in its intensive form to analyze the growth of output per worker. The production function is given by

$$ Y = AK^\alpha H^\beta L^{1-\alpha-\beta} $$  \hspace{1cm} (3.1)

where $Y$ is output, $A$ represents total factor productivity, $K$ is physical capital, $H$ is human capital, and $L$ is labor force. The intensive form of the production function is given by

$$ y = A k^\alpha h^\beta $$  \hspace{1cm} (3.2)
where \( y \) is the ratio of output to labor \((Y/L)\), \( k \) is the ratio of physical capital to labor \((K/L)\), and \( h \)

is the ratio of human capital to labor \((H/L)\). Taking log differences of equation (3.2) and expanding it to the cross-section and time dimension gives

\[
\Delta \ln(y_{it}) = \Delta \ln(A_{it}) + \alpha \Delta \ln(k_{it}) + \beta \Delta \ln(h_{it})
\]

(3.3)

where \( i = 1,\ldots, N \) and represents the number of cross sections/countries, and \( t = 1,\ldots, T \) and represents the time dimension.

In Equation (3.3), the growth of TFP, \( \Delta \ln(A_{it}) \), can be replaced by a function of some observable factors (Temple, 1999, p. 125). One of the earlier studies that specify the growth of TFP as a function of human capital is Nelson and Phelps (1966); they argue that education, a proxy for human capital, contributes to the adoption and implementation of new technologies. In Nelson and Phelps’ (1966) specification, \( \dot{A} = c(H) \frac{T(t)-A(t)}{A(t)} \), the rate for closing the gap between a theoretical and actual level of knowledge depends on the level of human capital, which is given by the function \( c(H) \). Romer (1990a, p. S83) models the growth of TFP as \( \dot{A} = \delta H \dot{A} \), where \( H \) is total human capital employed in research and affects the growth of TFP. Benhabib and Spiegel (1994, p.161) model the growth of TFP as \( [\log A_T(H_t) - \log A_0(H_t)] = c + gH_t + mH_t[(Y_{max} - Y_t)/Y_t] \), which includes a term for exogenous technological progress \( c \), a term for endogenous technological progress which represents domestic innovation ability of a country and is the human capital direct effect \( gH_t \), and a term for the technology catch-up effect in which \( H_t \) is human capital \( mH_t[(Y_{max} - Y_t)/Y_t] \).

In this study we are not interested in any catching-up effect, but on the effect of remittances on TFP through human capital.

The literature about the effect of remittances on economic growth is still an open discussion. Chami et al. (2003) find a negative effect of remittances on growth. However, this study has been criticized for not addressing the problem of autocorrelated errors in panel regressions and for not having appropriate instruments for the remittance variable which yields biased estimates (Catrinescu et al., 2006, p.10 & 11). Catrinescu et al. (2006, p.13) also find that remittances affect growth positively when they are endogeneized and are tested in conjunction with institutional variables. Other studies have found positive association between remittances and
education. Cox-Edwards and Ureta’s (2003) study of remittances and schooling in El Salvador find that remittances have a large and significant contribution to school retention. Hanson and Woodruff (2003) find that children at Mexican households having migrants completed more years of schooling and argue that this is related to migrant remittances which relax credit constraints and increase the educational attainment of children. Lopez-Cordova (2006) finds that an increase in the fraction of Mexican households receiving remittances has a significant effect in reducing illiteracy in children six to 14 years of age and in improving school attendance in children five-years of age. These studies suggest that remittances contribute to human capital development which may be one channel for remittances to affect TFP. We model the growth of TFP to depend upon an exogenous component, the individual effect of human capital, and an interaction between human capital and remittances. That is

\[ \Delta \ln(A_{it}) = \gamma_{A0} + \gamma_{A1} \ln(h_{it}) + \gamma_{A2} (\ln h_{it}) \ast (\ln RE_{it}) \]  

(3.4)

where \( h_{it} \) is the ratio of human capital to labor in country \( i \) and directly affects the growth of \( A_{it} \), and \( RE_{it} \) is remittances as share of GDP in country \( i \) and indirectly affects the growth of \( A_{it} \). Inserting (3.4) into (3.3) then yields

\[ \Delta \ln(y_{it}) = \gamma_{A0} + \gamma_{A1} \ln(h_{it}) + \gamma_{A2} (\ln h_{it}) \ast (\ln RE_{it}) + \alpha \Delta \ln(k_{it}) + \beta \Delta \ln(h_{it}) \]  

(3.5)

Equation (3.5) states that the growth rate of output per worker in country \( i \) is affected by the level of human capital stock, the interaction between the level of human capital stock and remittances, and the growth rates of both physical and human capital. Equation (3.5) allows for testing as to whether remittances contribute to growth through human capital. In addition, some control variables are added to equation (3.5) as well as the individual remittance variable. This yields the following econometric model

\[ \Delta \ln(y_{it}) = \gamma_{A0} + \gamma_{A1} \ln(h_{it}) + \gamma_{A2} (\ln h_{it}) \ast (\ln RE_{it}) + \phi_1 (\ln RE_{it}) \]

\[ + \phi_2 \ln(l_{it}) + \phi_3 \ln(G_{it}) + \phi_4 \pi_{it} + \alpha \Delta \ln(k_{it}) + \beta \Delta \ln(h_{it}) + a_i + \mu_t + \varepsilon_{it} \]  

(3.6)

where \( a_i \) denotes the unobservable country effect; \( \mu_t \) denotes the unobservable time effects which are represented by time dummies in (3.6); and \( \varepsilon_{it} \) is the idiosyncratic error which is assumed to be independently and identically distributed with zero mean and variance \( \sigma^2 \).
Investment $I_{it}$, government $G_{it}$ and inflation $\pi_{it}$ are added as control variables; these variables have been found to affect economic growth in earlier studies. Barro and Sala-i-Martin (2004, p.518) present a set of control and environmental variables that are frequently included as determinants of the growth rate in cross-countries studies. Among these variables are the control variables added to equation (3.6). Investment in the neoclassical growth model is a proxy for the effect of the savings rate (Barro & Sala-i-Martin, 2004, p.519). In the augmented Solow model, investment, in addition to population growth rate and human capital level, affects income per capita (Mankiw, Romer & Weil, 1992, p.418). Temple (1999, p.137) defines investment in physical capital as one of the proximate sources of growth in addition to investment in human capital and research and development. He also argues that the correlation between investment rates and growth is robust. Positive impacts of investment on economic growth are observed in Barro (1995, p.6), Barro & Sala-i-Martin (2004, p.532), and Mankiw, Romer and Weil (1992, p.420) among others. In this study investment is expected to have a positive effect on growth.

Government consumption proxies for government expenses that, although they do not have a direct effect on productivity, distort private decisions, thus an increase in government consumption will negatively affect the growth rate of output per worker (Barro & Sala-i-Martin, 2004, p.519). Barro and Sala-i-Martin (1995, p.434) also argue that government consumption proxies for political corruption and other undesirable government aspects, as well as for direct effects of nonproductive public expenditures and taxation. An important issue regarding the use of government consumption as a control variable involves controlling for the effect of taxes on growth. Barro and Sala-i-Martin (2004, p.519) discuss about directly controlling for the effect of taxes and blame inadequate data on public finance. Bassanini and Scarpetta (2001) argue that government consumption represents the size of government whenever taxes are not controlled for. Barro and Sala-i-Martin (1995, p.434; 1996, p. 526) find negative and significant relationships between government consumption and economic growth. In this study government proxies for the size of government and is expected to have a negative effect on growth.

Inflation can be used to proxy for macroeconomic stability (Barro & Sala-i-Martin, 2004, p.520). Romer (2006, p.550) argues that one of the potential additional costs of inflation is that high variability of inflation can depress long term investment since this can be regarded as a signal of government malfunctioning that can result in government policies that hurt capital holders.
Temple (1999, p.144) states that the presence of high inflation is accompanied by the presence of exchange rate volatility, political instability and other undesirable factors. Bruno and Easterly (1998); Cukierman, Kalaitzidakis, Summers and Webb (1993); and Fischer (1993) find negative relationships between inflation and investment, and between inflation and growth. Even though these studies give evidence of a negative relation between inflation and growth, there is little evidence on a causal relationship (Romer, 2006, p.250). Additionally, Temple (1999, p.144) states that the association between inflation and growth is controversial. In this study inflation is expected to have a negative impact on growth.

**The Data**

The data set used covers 14 Latin American countries over the period 1975-2000 which is subdivided into five overlapping five-year periods. The dependent variable is the growth rate of real GDP per worker during a five-year period, and is calculated by running a least squares regression of the log of the real GDP series on a constant and a time trend. The rate of growth is computed as \( r = e^b - 1 \), where \( b \) is the estimate on the time trend. The data for this variable is obtained from Penn World Table version 6.2.

The series for capital stock per worker is constructed using the perpetual inventory method. The growth rate of this variable over a five-year period is also computed using the least squares method. The remittance variable refers to workers’ remittances, compensation of employees, and migrants’ transfers, and is obtained from the World Development Indicators CD-ROM (2005). Workers’ remittances are private transfers from migrant workers who reside in the host country for more than a year to people in their home country; compensation of employees is the income of migrants who have lived in the host country for less than a year; and migrant transfers are transfers from one country to another at the time of migration of the net worth of migrants who live in the host country for more than a year. This is the definition frequently used in the literature (Acosta et al., 2006; Catrinescu et al., 2006; among others) and adopted by the IMF (2005, p.97) and the World Bank (2006, p. 85). Remittances are expressed as a share of GDP.

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4 The first period for the remittance variable is represented by observations on the years 1979 and 1980 because of data limitations.
5 It is described in the appendix.
The level of human capital stock is represented by an index as in Collins and Bosworth (1996, p.151). The index is constructed based on data on educational attainment of the total population aged 15 and over from the Barro and Lee (2000) data set and the social returns to schooling for each educational level. For country \( i \) the index is given by

\[
H_t = \sum R_j P_j.
\]

The index weights the share of the population \( P_j \) with education level \( j \) by \( R_j \) which is the social return to education estimate. The education levels are as follows: no schooling; incomplete primary education; complete primary education; incomplete secondary education; complete secondary education; incomplete tertiary education; and complete tertiary education. The social return to education estimates are those of Psacharopoulos (1994) and are obtained from Loayza, Fajnzylber and Calderón (2004, appendix A), these estimates are for no education = 1, incomplete primary education = 1.68, complete primary education = 2.69, incomplete secondary education = 3.91, complete secondary education = 5.53, incomplete college education = 5.87, and complete college education = 8.80. The growth rate of the human capital index is the exponential growth rate given by 

\[
r = \ln \left( \frac{P_n}{P_1} \right) / n,
\]

where \( P_n \) and \( P_1 \) are the last and initial observation in each five-year overlapping period, \( n \) is the number of periods, and \( \ln \) is the natural logarithm operator.

The data on government consumption and investment both as a share of GDP is obtained from Penn World Table version 6.2. The data on inflation is from the International Financial Statistics CD-ROM (2007). Complete definitions and data sources are provided in Table1. Descriptive statistics are provided in Table 2.

**Empirical Results**

The purpose of the empirical analysis is to estimate the impact of remittances through human capital on growth. Specifically, we examine the effect of the interaction between human capital and remittances on growth rates of output per worker through the growth rate of TFP.
The results indicate that remittances have a positive impact on economic growth, though the realization of this impact depends upon the level of human capital stock in the economy. This means that for countries with low levels of human capital stock, remittances have a negative impact on growth. In addition, the coefficient on the level of human capital stock is positive and significant. The regressions are based on panel data for the period 1975-2000, and the methods of estimation are pooled OLS, random effects, and random effects 2SLS. These regressions are run using data from a sample of 14 Latin American and the Caribbean countries and 70 observations.

Table 3 reports the results on the association between economic growth and remittances, human capital and the control variables. The standard growth determinants behave as follows. The growth rate of the physical capital stock per worker is positively and significantly related to economic growth. The growth rate of total human capital in the labor force is positive though not significant. Government consumption as a share of GDP has the expected negative sign, but it is insignificant. Inflation is negative and insignificant. Investment as share of GDP, surprisingly, is negatively related to economic growth though not at a significant level. The results regarding the association between human capital and remittances and economic growth are quite interesting. The pooled OLS results indicate that the coefficient on remittances is negative but insignificant, while the coefficient on the interaction between remittances and human capital is positive though insignificant. The usual random effects estimation reports the same qualitative results as those obtained with the pooled OLS; however, and interestingly, the interaction between remittances and human capital is positive and significant at the 10% level.

A potential problem with the estimates of model 2 is that they may be biased because of reverse causality, measurement error and omitted variables. Reverse causality implies that improved economic conditions due to increases in economic growth may increase remittance inflows. Measurement error in remittances may arise because official recorded remittances are smaller than the true size of remittances. The World Bank (2006, p. 85) states that because of unrecorded remittance flows through both formal and informal channels the true size of remittances may be 50% greater than recorded remittances. Omitted factors may affect both remittances and economic growth, which leads to biased estimates on remittances and the interaction between

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6 P-value is 0.087.
human capital and remittances. Therefore, to address this problem, use of the instrumental variable technique is required. Catrinescu et al. (2006) argue that contradictory results on the relationship between remittances and economic growth have been found because of lack of correct control of endogeneity of remittances. To manage the endogeneity problem of remittances a random effects 2SLS (EC2SLS) model is estimated following Baltagi (2005, chapter 7).

Model 3 in Table 3 is based on EC2SLS estimation. The instruments used are the first lag of investment as a share of GDP, the second lag of real per capita GDP, the first lag of the human capital index, two indexes based on economic conditions in the U.S., and an instrument based on the per capita GDP of the top-eight migrant receiving countries. Rapoport and Docquier (2005, p.10) argue that empirical models that explain remittances include income of both the sender and the receiver countries as explanatory variables. Lueth and Ruiz-Arranz (2006) find a significant effect of per capita GDP of the receiver country on remittances, while Ziesemer (2006) finds a significant effect of the second lag of per capita GDP of the receiver country on remittances. Following Ziesemer (2006) we include the second lag of per capita GDP of the receiver country as an instrument which proxies for economic conditions in the remittance receiving country.

Vargas-Silva and Huang’s (2006) study on the effects of both host and home country economic conditions on remittances includes two indices of the economic conditions in the rest of the world (ROW)\(^7\) in the set of explanatory variables that explain U.S. net aggregate remittances. Their results suggest that host country (U.S.) economic conditions are significant in explaining remittances. To construct the indices, they weight the CPI and exchange rate from each of the five countries in the ROW by the share of remittances of each country in the total amount of remittances of the group (see Vargas-Silva and Huang, 2006, p. 89-90). We do the opposite of Vargas-Silva and Huang (2006); we construct two indexes based on the economic conditions of the U.S., one based on the U.S. CPI and the other based on the U.S. unemployment rate\(^8\). We weight each five-year overlapping average of the U.S. CPI and the U.S. unemployment rate by the share of remittances of each LAC country in the total amount of remittances received by the group of 14 LAC countries during the period of the study. The other instrument which is based

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\(^7\) ROW represents Brazil, Colombia, Dominican Republic, El Salvador and Mexico.

\(^8\) Adams and Page (2005) consider the US as one of the two main labor receiving countries.
on the economic conditions of the top-eight migrant receiving countries\(^9\) is adopted from Acosta et al. (2007). The per capita GDP of each of these migrant receiving countries is weighted by the inverse of the distance of each of these countries to each LAC country. The validity of the instruments is a key issue for the consistency of the instrumental variable estimator, for that purpose we report the Sargan test of overidentifying restrictions in Table 3; we fail to reject the null hypothesis that the instruments are uncorrelated with the error process. The Hausman test for random effects appropriateness of models 2 and 3 is also reported in Table 3; it justifies the use of random effects estimation.

Model 3 is the main model in this study. Note that this model includes remittances and the level of human capital stock individually, so the significance of the interaction term can not be the result of the omission of any of these two factors. In model 3 the coefficient on remittances is negative and significant. However, and interestingly, the coefficient on the interaction between human capital and remittances is positive and significant\(^10\) and suggests that remittances have a positive impact on growth, but only for certain levels of the human capital index. In addition, the coefficient on the level of human capital stock is positive and significant. The values of the coefficients on remittances and on the interaction term in model 3 indicate that countries with an index value of total human capital greater than 0.95 will benefit from the positive effect of remittances on growth. In our sample, the average value of the human capital index for eight out of the 14 countries is greater than 0.95, so these countries pass this threshold\(^11\); conversely, remittances have a negative predicted effect on six out of the 14 LAC countries\(^12\).

The positive effect of an increase in remittances on growth is dependent upon the level of the human capital stock in the economy. An increase in remittances as a share of GDP of 0.026 (one standard deviation) which is an increase of 130% relative to the sample mean in an economy with a index of human capital stock of 0.98 (the sample average) increases the growth rate of output per worker by 0.2%. If the same increase in remittances happens in an economy that has a value for the human capital index of 1.39 (as in the case of Panama), the maximum value in the

\(^{9}\) Canada, France, Germany, India, Saudi Arabia, Spain, United Kingdom, and United States are the top migrant receiving countries for our sample of LAC countries. Acosta et al. (2007) have ten countries as the top migrant receiving countries.

\(^{10}\) P-value is 0.067.

\(^{11}\) Barbados, Colombia, Costa Rica, Jamaica, Mexico, Panama, Paraguay, and Trinidad and Tobago pass the threshold.

\(^{12}\) Bolivia, Brazil, Dominican Republic, El Salvador, Guatemala, and Honduras do not pass the threshold.
sample, then the rate of growth increases by 2.5%. An example gives a better picture of the effect of remittances on growth. The average of the human capital index in Guatemala during the period 1975 to 2000 is 0.63, well below the threshold of 0.95. If remittances increase by one standard deviation, the growth rate decreases by -1.8%. However, if Guatemala’s human capital stock increases to the sample mean value, 0.98, growth increases by 0.2%, and if the increase is to the level of the human capital stock of Panama, 1.23, the maximum average value during the period of the study, Guatemala’s growth increases by 1.6%. Looking at the values of the human capital index for the year 1995, ten out of the 14 countries in the sample pass the threshold of 0.95\textsuperscript{13}; the average value of the index for this year is 1.04. This means that an increase in remittances of one standard deviation, a 130% increase, in a country with an index value of 1.04 for human capital stock increases growth in the remittance receiving country by 0.5%. This result is in the range of 0.5% and 1.3% increase in the growth rate due to a 100% increase in remittances as a share of GDP found by Acosta et al. (2007, p.94). They argue that the increase in the growth rate due to increases in remittances hold for the representative country in the world as well as for the representative country from the LAC region. Thus, our result is in line with that of Acosta et al. (2007). If we allow for a 100% increase in remittances and take the 1.04 value of the human capital index in 1995, the increase in the growth rate is 0.4% which is very close to the lower value of Acosta et al. (2007). On the whole, taking the average value for the human capital index, an increase in remittances has a positive impact on growth in the countries of the LAC region.

The interesting point about the results from Table 3 is the significant complementary effect between human capital and remittances on the growth of output per worker. Remittances seem to promote economic growth depending upon the level of the human capital stock in the economy. This implies that human capital is an important factor in determining the utilization of remittances and their effect on economic growth. Koechlin and Léon (2006, p.25) find that the interaction between education and remittances (a negative coefficient) significantly contributes to decrease income inequality. They suggest that it is likely that families with a relatively high educational level use remittances for productive investments which increase long-term income. A strong complementary effect between human capital and FDI on growth is found in

\textsuperscript{13} Barbados, Bolivia, Colombia, Costa Rica, Dominican Republic, Jamaica, Mexico, Panama, Paraguay and Trinidad and Tobago.
Borensztein et al. (1998). They interpret their result in that the advanced technology embedded in FDI can promote economic growth only through the interaction with the countries’ absorptive capacity, which is dependent upon human capital. They find a threshold for the stock of human capital from which FDI starts having a positive effect on economic growth. In our study, it seems that the absorptive capacity of the country is also conditioning the positive effect of remittances on economic growth. Thus, it may be that countries with relatively higher human capital levels use remittances for investment in education, which fosters human capital development and in productive economic projects that promote investment which increases long-term growth.

Benhabib and Spiegel (1994, p. 165) finds that human capital has a positive and significant effect in attracting physical capital. Giuliano and Ruiz-Arranz (2006) suggests positive effect of remittances on economic growth because remittances finance investment in countries with less developed financial systems. Aggarwal, Demirgüç-Kunt and Martinez Peria (2006) find a positive impact of remittances on the financial sector and argue that that is a channel for remittances to promote development. On the other hand, the negative coefficient on remittances implies that remittances make a negative contribution to growth in countries with low level of human capital. This may be the case as in Chami et al. (2003) who argue that remittances are compensatory transfers based on an altruistic relationship between the migrant and her/his family, so remittances are a source of money that helps the family to overcome economic problems.

Conclusions

This paper contributes to the body of literature regarding the impact of remittances on economic growth by investigating on the impact of remittances through human capital on growth in a group of countries from Latin America and the Caribbean for the period 1975-2000. An endogenous model of growth based on cross-country growth accounting methods is estimated using pooled OLS, random effects and random effects 2SLS techniques. The main results come from the random effects 2SLS estimation because it is the econometric method that allows for controlling endogeneity of remittances in the panel data setting.

The empirical results of this study are in line with Rapoport and Docquier’s (2005) models examining the contributions of remittances to investment in both physical and human capital, as
well as with the other studies that find contributions of remittances to economic growth. The results show a significant and complementary effect between human capital and remittances on the growth rate of output per worker. In addition, the level of human capital stock positively and significantly affects the growth rate of TFP which is in line with endogenous growth theory as in Romer (1990b, p. 270) who argues that the human capital level may affect the growth of technology directly and through the catching up process (a human capital interaction term), and as in Benhabib and Spiegel (1994) who find positive effects of human capital on growth while modeling TFP as dependent on human capital.

An important finding of this study is the significant and complementary effect between human capital and remittances on economic growth. That is, the effect of remittances on growth is dependent upon the level of human capital stock in the remittance receiving economy. After instrumenting for the possible endogeneity of remittances, an increase in remittances as a share of GDP of 130% (one standard deviation) relative to the sample mean in a LAC economy with an index of human capital stock of 0.98 (the sample average) would lead, on average, to a 0.2% increase in the growth rate of output per worker. It is likely that countries with higher educational levels use remittances for investment in education which foster human capital development and for investment in productive projects such as small businesses which contributes to long term growth. Therefore, remittances promote growth in the representative country of the LAC region through human capital. It would be interesting to assess the impact of remittances on growth through human capital using a larger sample of countries as well as for other developing regions of the world. In addition, the effects of remittances on the level of human capital could be explored.

Acknowledgement

We thank Jose De Gregorio from the Central Bank of Chile and Harald Badinger from the University of Economics and Business Administration, Vienna for their helpful comments.
References


Appendix 1. Perpetual Inventory Method

The perpetual inventory method (PIM) is used to compute the capital stock series. In order to compute the initial capital stock values, we follow the procedure outlined in Easterly and Levine (2001, p. 55-56). The data used is in constant 2000 prices and obtained from the Penn World Tables (PWT) version 6.2. This data is available since 1950 for most of the countries. The PIM is based on the capital accumulation equation \( K_t = K_{t-1}(1 - \delta) + I_t \), where \( K_t \) is real capital stock in period \( t \), \( I_t \) is gross investment in period \( t \), and \( \delta \) is the depreciation rate assumed to be 0.07. In order to use the capital accumulation equation we need to estimate the initial capital stock \( K \). To estimate the initial capital stock, we assume that the country is at the steady state capital output ratio \( K/Y \), where \( K \) and \( Y \) are initial capital and output respectively. At the steady state \( k = K/Y \), \( g \) is the growth rate of real output, and \( i = I/Y \). From the capital accumulation equation and the steady state assumption, define the capital output ratio as \( k = i/(g + d) \). The next step is to compute values for \( i \), \( g \) and \( d \). Thus, \( i \) is the average of the investment rate during the first ten years of available data for each country. The investment rate which is the ratio of Investment to real GDP is taken from PWT version 6.2. The growth rate of output \( g \) is computed by applying the least squares growth rate method during the first ten years of data on the log of real GDP per capita chain. Real GDP per capita chain is taken from PWT version 6.2. Now that we have the values for \( i \), \( g \) and \( d \) we can compute \( k = i/(g + d) \) for each country, and since \( k = K/Y \) we also need to compute initial output \( Y \). Initial \( Y \) is given by the average of real GDP chain for the years 1950-1952. Real GDP chain is from PWT version 6.2. Now we are able to estimate the initial capital stock for the year 1950, which is given as \( K_{initial} = Y_{initial} * k \). Once we have estimated the initial capital stock, we input it into the capital accumulation equation to get the next year (1951) capital stock value, and next values are generated in a similar way. To compute capital stocks per worker, we divide each year’s capital stock value by the number of workers. We compute workers by dividing real GDP chain by real GDP per worker; this data is also from PWT version 6.2.
<table>
<thead>
<tr>
<th>Variable name</th>
<th>Variable definitions</th>
<th>Source</th>
</tr>
</thead>
<tbody>
<tr>
<td>Growth</td>
<td>Five-year average growth rate of real GDP per worker.</td>
<td>Own calculations.</td>
</tr>
<tr>
<td>Capital growth</td>
<td>Five-year average growth rate of real capital per worker.</td>
<td>Own calculations.</td>
</tr>
<tr>
<td>Human capital growth</td>
<td>Five-year growth rate of the human capital index.</td>
<td>Own calculations.</td>
</tr>
<tr>
<td>Remittances</td>
<td>Log of five-year average of remittances as a share of GDP.</td>
<td>World Development Indicators CD-ROM, World Bank 2005.</td>
</tr>
<tr>
<td>Human capital</td>
<td>Log of human capital index.</td>
<td>Own calculations.</td>
</tr>
<tr>
<td>Human capital * remittances</td>
<td>Interaction of the log of human capital index and log of remittances.</td>
<td>Own calculations.</td>
</tr>
<tr>
<td>Inflation</td>
<td>Log of 1 plus the five-year average of the proportionate change of GDP deflator.</td>
<td>GDP deflator is from the International Financial Statistics CD-ROM, IMF 2007.</td>
</tr>
<tr>
<td>U.S. CPI index</td>
<td>Five-year average of the U.S. CPI weighted by each LAC country remittance share. ( w_t \times \text{U.S. CPI} ), ( w_t ) = remittance total value over the period 1979-2000 for each LAC country divided by the remittance total that results from adding the total of each LAC country over the period 1979-2000.</td>
<td>U.S. CPI is from the International Financial Statistics CD-ROM, IMF 2007.</td>
</tr>
<tr>
<td>U.S. unemployment index</td>
<td>Five-year average of the U.S. unemployment rate weighted by each LAC country remittance share. ( w_t \times \text{U.S. unemployment rate} ), ( w_t ) is the same as in the U.S. CPI index.</td>
<td>U.S. unemployment rate is from the International Financial Statistics CD-ROM, IMF 2007.</td>
</tr>
<tr>
<td>Return to schooling</td>
<td>Social returns to schooling for each educational level.</td>
<td>Loayza, Fajnzylber and Calderón (2004, appendix A).</td>
</tr>
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</table>
Table 2. Summary statistics, five-year averages for the period 1975-2000

<table>
<thead>
<tr>
<th>Variable</th>
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<th>Std. dev.</th>
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<td>0.02343</td>
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<td>0.07475</td>
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<tr>
<td>Physical capital growth</td>
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<td>0.02830</td>
<td>-0.03669</td>
<td>0.09546</td>
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<td>0.01279</td>
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<td>0.18392</td>
<td>0.59580</td>
<td>1.38871</td>
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<td>0.17807</td>
<td>0.04470</td>
<td>0.10403</td>
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<td>0.65444</td>
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<td>3.30528</td>
</tr>
<tr>
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<td>0.02573</td>
<td>0.00028</td>
<td>0.11323</td>
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</tbody>
</table>

Note: Rem/GDP is remittances as a share of GDP, while remittances are the log of Rem/GDP.
<table>
<thead>
<tr>
<th>Dependent variable: Growth rate of GDP per worker</th>
<th>Model 1</th>
<th>Model 2</th>
<th>Model 3</th>
</tr>
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<tr>
<td>Explanatory variables</td>
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<td></td>
</tr>
<tr>
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<td>-0.0400</td>
<td>-0.1819*</td>
</tr>
<tr>
<td></td>
<td>(1.13)</td>
<td>(1.13)</td>
<td>(1.70)</td>
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<tr>
<td>physical capital growth</td>
<td>0.3354**</td>
<td>0.3354**</td>
<td>0.3693***</td>
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<tr>
<td></td>
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<td>(2.19)</td>
<td>(2.63)</td>
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<td>0.2225</td>
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<td>(1.12)</td>
<td>(0.86)</td>
</tr>
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<td>-0.0098</td>
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<tr>
<td></td>
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<td>(1.57)</td>
<td>(1.79)</td>
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<td></td>
<td>[0.141]</td>
<td>[0.117]</td>
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<tr>
<td>human capital stock</td>
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<td>0.0619*</td>
<td>0.2112*</td>
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<tr>
<td></td>
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<td>(1.95)</td>
<td>(1.93)</td>
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<td></td>
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<td>[0.054]</td>
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<tr>
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<td>0.0102*</td>
<td>0.0415*</td>
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<tr>
<td></td>
<td>(1.71)</td>
<td>(1.71)</td>
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<tr>
<td></td>
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<tr>
<td></td>
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<td>(1.45)</td>
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<td></td>
<td>(0.16)</td>
<td>(0.16)</td>
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<tr>
<td>inflation</td>
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<td>-0.0002</td>
<td>-0.0011</td>
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<td></td>
<td>(0.12)</td>
<td>(0.12)</td>
<td>(0.23)</td>
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<tr>
<td>d8085</td>
<td>-0.0311**</td>
<td>-0.0311***</td>
<td>-0.0283***</td>
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<tr>
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<td>(2.66)</td>
<td>(2.66)</td>
<td>(3.16)</td>
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<tr>
<td>d8590</td>
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<td>(0.81)</td>
<td>(0.81)</td>
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<td>(0.47)</td>
<td>(0.06)</td>
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<tr>
<td>d9500</td>
<td>-0.0051</td>
<td>-0.0051</td>
<td>-0.0029</td>
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<tr>
<td></td>
<td>(0.73)</td>
<td>(0.73)</td>
<td>(0.30)</td>
</tr>
<tr>
<td>R-squared</td>
<td>0.4526</td>
<td>0.4526</td>
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<td>Hausman test for random effects</td>
<td>6.06</td>
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<tr>
<td>P-value for Hausman test</td>
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<td>Sargan test for overidentifying restrictions</td>
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<td>P-value for Sargan test</td>
<td>0.6010</td>
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</table>

Asterisks indicate significance at the 10% (*), 5% (**) and 1% (***) levels respectively. Model 1 is pooled OLS with fully robust standard errors. Model 2 is the usual random effects model with fully robust standard errors. Values in parenthesis are t-values, while values in brackets are p-values for the variables of interest.
Figure 1. Remittance inflows to developing country regions, 1970-2006


Figure 2. Top-twenty recipients of remittances, 1990-2003

Source: IMF, Balance of Payments Statistics Yearbook; and IMF staff calculations.
Figure 3. Remittances, FDI and ODA inflows to Latin America and the Caribbean, 1970-2006

Source: own calculations using data from the World Development Indicators online version 2007.

Figure 4. Remittances, FDI and ODA inflows to Latin America and the Caribbean, 1970-2006

Source: own calculations using data from the World Development Indicators online version 2007.
Figure 5. Remittances, FDI and ODA inflows as percent of GDP to LAC, 1979-2000

Panel A


Panel B
Figure 6. Remittances, FDI and ODA inflows in billions of U.S. dollars to LAC, 1979-2000

Panel A

Panel B