Inter-American Development Bank
Banco Interamericano de Desarrollo (BID)
Research Department
Departamento de Investigación
Working Paper #571

International Remittances and Income Inequality: An Empirical Investigation

by

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October 2006

Cataloging-in-Publication data provided by the
Inter-American Development Bank
Felipe Herrera Library

Koechlin, Valerie.

International remittances and income inequality: an empirical investigation / Valerie Koechlin, Gianmarco León.

p. cm. (Research Department Working Papers ; 571)
Includes bibliographical references.

1. Migrant remittances. 2. Immigrant remittances. 3. Income distribution. I. León, Gianmarco. II. Inter-American Development Bank. Research Dept. III. Title. IV. Series.

HB523 .K633
304.8 K633----------dc22

Inter-American Development Bank
1300 New York Avenue, N.W.
Washington, DC 20577

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Abstract[*]

The aim of this paper is to provide comprehensive empirical evidence on the relationship between international remittances and income inequality. In simple cross-country regressions we find a non-monotonic link between these two variables when using ordinary least squares, instrumental variables; we also test our hypothesis using dynamic panel data methods. We provide evidence in support of existing theoretical work that accounts for network effects that describe how, in the first stages of migration history, there is an inequality-increasing effect of remittances on income inequality. Then, as the opportunity cost of migrating is lowered due to these effects, remittances sent to those households have a negative impact on inequality. We also show how education and the development of the financial sector can help countries to reach the inequality-decreasing section of the curve more quickly. Our results are robust to several empirical specifications, as well as for a wide variety of inequality measures.

JEL Classification: O1, O15, J16
Key Words: Migration, International Remittances, Income distribution

[*] We greatly thank Alberto Chong and participants in seminars held at the Universidad del Pacífico and the Inter-American Development Bank, who provided insightful comments and suggestions to previous versions of this paper. Sebastian Ipince provided excellent assistance during the initial stages of this research. The views and opinions in this paper should not be attributed to the Universidad del Pacífico (UP), the Inter-American Development Bank, or their corresponding executive directors. The standard disclaimer applies. Correspondence: León, Research Department, Stop B-900, Inter-American Development Bank, 1300 New York Avenue, NW, Washington, DC 20577, USA. Tel. (202) 623-1932; Fax (202) 623-2481. E-mail: *gianmarcol@iadb.org*

1. Introduction

During the last few years, a great migratory movement has been taking place around the world, probably the biggest in modern history. People are leaving their home countries looking for better job opportunities and a better quality of life in foreign countries. According to the United Nations (2003), there were around 175 million people living and working outside their home countries at the beginning of the twenty-first century. The World Bank (2006) estimates that the worldwide total amount of remittances is twice that of foreign aid. Moreover, these migratory and economic flows are likely to continue as long as labor demand from industrialized countries, with their ageing populations, continues to increase. The study of these financial flows and their effects on recipient countries has obviously become relevant.

Remittances flows have proven to be a stable source of capital for poor countries because they do not depend on the same external factors as other kinds of private capital flows. In fact, between 1980 and 2000, remittances inflows to developing countries ranged between 1 and 1.6 percent of GDP, while other private capital flows such as exports, FDI, and official aid were subject to cyclical fluctuations and external shocks (IMF, 2004). Examples of the volatility of private capital flows and steadiness (or countercyclicality) of remittances can be found in countries including Indonesia in 1997, Ecuador in 1999, and Argentina after 2001. On the other hand, remittances flows may generate negative effects on the macroeconomic environment. Several studies document the risks associated with these kinds of capital inflows. Bourdet and Falck (2003), for instance, document how the remittances flow generated real exchange appreciations and Dutch disease in Cape Verde. Along the same lines, IMF (2006) points out the pervasive effects of international remittances on output volatility, export competitiveness, credit ratings, and investment volatility. Other risks associated with remittances may be the financing of terrorist movements, or civil wars, as have been shown by Kapur (2004) for the case of Somalia in the 1991 conflict, where rural guerrillas were largely financed by international remittances.[1]

Despite the fact that a wide strand of economic research has investigated the effects of remittances on a variety of topics, there is no formal cross-country analysis of the impact of

[1] Kapur (2004) also mentions these kind of financing for separatist movements in Sweden, Canada, and the United Kingdom.

remittances on income inequality. In fact, the effect on income distribution is not yet clear.[2] For example, Adams (1989), using a sample of small rural communities in Egypt, found that international migration worsens income distribution in the home community. Nevertheless, using a very similar approach, Adams (1992) found that there is no significant effect of remittances on income inequality in rural Pakistan. On the other hand, Barham and Boucher (1998), using a sample from three coastal communities in Nicaragua, found that, when remittances are taken as an exogenous factor, they had an inequality-reducing effect. On the other hand, when remittances are taken as substitutes for local production (an endogenous factor), the effect was exactly the opposite. Taylor (1992) and Taylor and Wyatt (1996) noted that beyond the direct effect of remittances on income, remittances also relax the credit constraints for people with liquidity restrictions. Using a sample of 55 rural communities in Mexico, they found evidence that the effect of remittances on income was higher for those households with non-liquid assets. Remittances provide poorer households the possibility of access to the credit market, which in turn finance the accumulation of productive assets, increasing future income. This indirect effect on income tends to be equally distributed among income groups in Mexico, having the effect of improving the overall income distribution.

On the other hand, Stark, Taylor and Yitzhaki (1986), taking advantage of a natural experiment with two Mexican communities, one with a longer migration history, and the other with a shorter one, found that the impact of remittances on inequality depends on migration history and the degree to which opportunities to migrate are disseminated among households in the community. At the first stages of migration, only the richest households in the community can afford the high migration costs due to lack of information and the labor market risks implied. In this sense, the first effect observed is likely to be the rise of inter-household inequality. As more people migrate, however, the migration costs tend to diminish because of the information and assistance provided to potential migrants (network effects).[3] Based on these results, the

[2] Cross-country evidence for the impact of remitttances on poverty has been provided by Adams and Page (2003). For a sample of 74 countries, they found that international migration has a significant effect on poverty reduction. An increase of 10 percent in the number of migrants reduces the number of people living under the poverty line by about 1.9 percent.

[3] Anecdotal evidence on the formation of migrant networks in the host country and their close ties with home communities has been reported recently by the *Christian Science Monitor*. The town of Indaparapeo in Mexico, for example, receives remittances from migrants who have settled in the United States. A portion of this money is collected through public activities, and its expenditure is being coordinated by the community and the State governor. At this point, the money is being used for a program that provides college scholarships for poor young people in the town. See Campbell (2006).

authors conclude that the effect of remittances on income inequality depends on how migration eases the information flows and how contacts are disseminated within the community. If the contacts and the information are not monopolized, then migration and remittances among the poorest households will be more likely. According to the authors, this would reverse any negative effect on income inequality at the initial stages of migration.

Along the same lines, McKenzie and Rapoport (2004) argue that, a priori, the effect of migration and remittances on income inequality cannot be determined, as it depends upon the initial income distribution and the position of potential migrants in that distribution. The authors also state that the first migrants will be those located on the higher steps of the income distribution, because they have both the means and the incentives to migrate. The inverted U-shaped effect first described by Stark, Taylor and Yitzhaki (1986) is here formalized in an endogenous migration cost model. The migration channels are formed after the settlement of migrant networks in the foreign country,[4] this will tend to lower migration costs, making migration affordable for lower-income households. The empirical evidence provided for Mexico supports the predictions of their theoretical model.

Based on the theoretical and empirical literature cited above, we expect a non-monotonic relationship between international remittances and income inequality. Because of high migration costs (passport, transportation, settlement, etc.), the people willing to assume the opportunity cost implied by the migration decision will be the ones located on the higher stages of the income distribution, and the remittances they send to their home countries will have a positive effect on inequality. As more people migrate, and migrant communities are settled in the foreign country, migration costs lowers as the migration channels set up. Due to this process, migration is made more accessible for poorer people, which will lead to and income equalizing effect.

We address this issue empirically in a cross-country set-up. Using data for 78 countries between 1970 and 2001, the aim of this paper is to provide comprehensive empirical evidence on the relationship between international remittances and income inequality. In simple cross-country regressions we find a non-monotonic link between these two variables when using

[4] Many sociological studies provide evidence of the beneficial effects of the formation of migrant networks in foreign countries. For example, Espinosa and Massey (1997) emphasize the role of social networks in lowering the information costs and dangers of crossing the Mexican border on the way to the United States. These networks may provide useful information on techniques and routes for entering the United States; also they can arrange way to provide temporary housing and financial assistance once they have crossed the border. Munshi (2003) finds that individuals with larger networks are more likely to be employed and to hold higher-paying jobs upon arrival in the United States.

ordinary least squares, instrumental variables, and panel data methods. We will provide evidence in support of existing theoretical work that accounts for network effects that, in the first stages of migration history generates an inequality-increasing effect of remittances. Then, as the opportunity cost of migrating is lowered due to these effects, remittances sent to those households have a negative impact on inequality. We also show how education and financial sector development can help countries to reach the inequality-decreasing section of the curve more quickly.

The rest of the paper is organized as follows. The next section describes the data and describes the empirical strategy that we will follow. Section 3 presents the first empirical evidence of the existence of a non-monotonic relationship between remittances and inequality using cross-section methodologies and instrumental variables. Section 4 will present the regression analysis using panel data techniques that deal with the fact that the inequality series may be persistent over time, which may be biasing our coefficients. Section 5 presents some evidence on the channels that may help countries to reach the inequality-decreasing section of the curve more quickly. Finally, Section 6 offers conclusions and closing remarks.

2. Data and Methodology

The inequality measure used to test our hypothesis comes from United Nations (2005).[5] This extensive dataset, which updates the Gini coefficients reported by Deininger and Squire (1997) and World Bank (2005), is comprised of comparable Gini coefficients from several sources; these include previous calculations by other authors as well as UN calculations based on household surveys. Furthermore, different criteria from different sources are homogenized in order to avoid problems of definition.[6] Data on income inequality is available for 133 countries from 1960 to 2001.

Our variable of interest, remittances received from workers abroad, was taken from the World Development Indicators (World Bank, 2005), which in turn collected the data from the

[5] Obviously, the Gini coefficient and similar indices also pose some problems. One is that the general coverage tends to be sparse and unbalanced. To minimize this problem, the data from the World Bank (2005) combines different sources. Still, the question is whether there is any better proxy than these indices for making broad cross-country comparisons on inequality, and the answer is no.

[6] The definition problems that can arise include whether the data is taken at the individual or household level; whether it correspond to income or expenditures; in the former case, whether it is net of taxes or not; or if it representative at the national or sub national levels. We only take into account data that is representative at the national level, based on income data and weighted to the individual level.

IMF *Balance of Payments Statistics Yearbook.* It should be noticed that the data collected by the IMF come from reports by each country's Central Bank, which compile statistics on official worker remittances flows, representing only money sent through official banking channels. Actual remittances flows may thus be underestimated, because there may be some (unknown) amount of money sent home by workers through private or unofficial channels.[7] Due to this limitation, the coefficients estimated may be interpreted as a lower bound of the real effect of remittances on income inequality. This data covers 166 countries for the period from 1970 to 2003.

The control variables to be used in our regressions follow the broad literature that estimates the determinants of income inequality in cross-country set ups (Deininger and Squire, 1997; Calderon and Chong, 2000, 2006; and others[8]). Following this literature, we use per capita GDP as a proxy for the level of economic development; liquid liabilities, or broad money (M3), takes into account the level of development of the financial sector. Our democracy measure, taken from the Polity project, is used to proxy for the political situation of the country, and the average years of secondary schooling represents the human capital accumulation of the population. These variables were taken from several sources, which include World Bank (2005), Polity IV, and Barro and Lee (1993).[9] The data available on our dependent and independent variables finally leaves us with a sample that covers 78 countries for the period 1970-2001.[10]

[7] For example, Freund and Spatafora (2005) estimated that informal remittances are equivalent to between 35 percent and 70 percent of the amount of oficial remittances. This difference is explained by the development of the local financial sector.

[8] See, for example, Ahluwalia (1976); Li, Squire, and Zhou (1998); Papanek and Kyn (1986); Sudhir and Kanbur (1993); Milanovic (1996); and Kuznets (1955), among others.

[9] The definition and sources of all the variables used can be found in Table 1.

[10] The countries included in the analysis are the following: Algeria, Argentina, Austria, Burundi, Bangladesh, Bolivia, Botswana, Brazil, Central African Republic, Chile, China, Cameroon, Colombia, Costa Rica, Denmark, Dominican Republic, Ecuador, Egypt, El Salvador, Fiji, Finland, France, Gambia, Ghana, Guatemala, Guyana, Honduras, Hungary, India, Indonesia, Iran, Ireland, Iran, Israel, Italy, Jamaica, Japan, Jordan, Kenya, Korea, Lesotho, Liberia, Lesotho, Mali, Mauritania, Mauritius, Malawi, Malaysia, Mexico, Nepal, Nicaragua, Nigeria, Norway, New Zealand, Pakistan, Panama, Papua New Guinea, Paraguay, Peru, the Phillipines, Poland, Rwanda, Senegal, Sierra Leone, Singapore, South Africa, Sri Lanka, Swaziland, Sweden, Swizerland, Thailand, Trinidad and Tobago, Tunesia, Turkey, Uganda, Uruguay, United States, Venezuela, Zambia, and Zimbabwe.

Table 1. Variable Definitions

Variable	Definition	Source
Gini coefficient	The Gini index measures the extent to which the distribution of income among individuals or households within an economy deviates from a perfectly equal distribution. A Gini index of 0 represents perfect equality, while an index of 100 implies perfect inequality.	United Nations (2004)
Remittances /GDP	Workers' remittances are current transfers by migrants who are employed or intend to remain employed for more than a year in another economy in which they are considered residents. Some developing countries classify workers' remittances as a factor income receipt (and thus as a component of GNI). The World Bank adheres to international guidelines in defining GNI, and its classification of workers' remittances may therefore differ from national practices. This item shows receipts by the reporting country. . The variable is expressed as a percentage of the GDP. Source: International Monetary Fund, Balance of Payments Statistics Yearbook and data files.	World Bank (2005)
Real GDP per capita	GDP per capita is gross domestic product divided by midyear population. Data are in constant 2000 US dollars.	
Initial real GDP per capita	GDP per capita is gross domestic product divided by midyear population. Data arefrom the first available year in the data set, usually 1970.	
GDP growth	GDP annual growth rate (%)	
Liquid liabilities	Liquid liabilities are also known as broad money, or M3 as a percentage of gross domestic product	
Polity	Index of democracy and autocracy calculated by the Polity project. This index ranges between –10 and 10, where highest values represent a more democratic regime as lower levels, a more autocratic regime. Data are available for the whole 20th century.	Polity IV
Years of secondary schooling	Average years of secondary schooling of the population. 5-year averages are available for the period 1960-2000 (the data from the original paper was actualized by the authors to include recent data).	Barro and Lee (1993)
Passport cost/GNI pc	Cost of obtaining a passport in each country. Figures were collected in October 2005 and in local currency, converted to US dollars at the prevailing interbank exchange rate. The standard used was made by collecting the price of a first-time adult passport valid for five years duration, of the standard number of pages and obtained via the standard processing period. When the country only issues 10-year passports, this is the price reported. The cost collected contains the cost of the passport itself, but not the cost of paying for photographs, birth certificates, or other such documents which are sometimes required along with the application for a passport.	McKenzie (2005)

The first stage of our empirical analysis will use cross-country averages for the period under analysis and run OLS models, as well as instrumental variables, in order to address the endogeneity problems that may arise from factors that simultaneously determine income inequality and remittances.

The instrumental variable used is the cost of obtaining a passport in each country. This variable, taken as a *proxy* of the barriers to exit a country, provides an excellent instrument since it is not related to income inequality, but strongly associated with the probability of migrating and sending remittances to the home country. Data on cost of passports are from McKenzie

(2005) and were collected in October 2005 in local currency, then converted to US dollars at the prevailing interbank exchange rate. The standard used was made by collecting the price of a first-time adult passport valid for five years duration, of the standard number of pages and obtained via the standard processing period. When the country only issues 10-year passports, this is the price reported. The cost collected contains the cost of the passport itself, but not the cost of paying for photographs, birth certificates, or other such documents, which are sometimes required along with the passport application.[11] Although these data correspond to the end of the period under study, it is plausible that the barriers to the exit posted by any government are time invariant, so the country ranking will remain unchanged and the data for the end of the period will reflect the situation for the whole period.[12]

We also prove a panel data analysis in order to address the possible autocorrelation problems raised by the fact that the inequality series may be persistent over time. As we will see, our results hold when using country level fixed effects and dynamic panel data GMM system estimators (Arellano and Bover, 1995; and Arellano and Bond, 1991).

Finally, we expand our analysis towards determining which channels can help countries to reach more quickly the point at which international remittances begin to reduce inequality. We do so by interacting our variable of interest with the educational level of the population and the financial development of each country.

3. Cross-Section OLS and IV Approach

In the spirit of Barro (1991), the main econometric approach to testing for the existence of a significant link between income inequality and remittances is to take simple averages for the period 1970-2001 and run a cross-country regression. The empirical specification will be as follows:

$$y_i = \alpha + \beta_1 X_i + \delta_1 rem_i + \delta_2 rem_i^2 + \varepsilon_i \qquad (1)$$

[11] In many countries there is not a single passport cost. Costs may differ for children and adults, for renewals, for expedited service, and even for duration and number of pages. Also, the justification for not dividing a 10-year passport price in half is that potential migrants must pay the full cost of the passport upfront (McKenzie, 2005).

[12] Chong and León (2006) show that the determinants of the barriers to exit a country (as proxied by the cost of obtaining a passport) do not vary with time. This supports our statement that the relative ranking of countries does not vary over time.

where y_i represents the income inequality indicator, as proxied by the Gini coefficient. Similarly, X_i represents the matrix of basic controls. Additionally, $\delta_1 rem_i + \delta_2 rem_i^2$ represents the vector of our variable of interest and the associated coefficients, international remittances. According to the theoretical and empirical literature on remittances and inequality (Stark, Taylor and Yitzhaki, 1986; Docquier and Rapoport, 2003; McKenzie and Rapoport, 2004; Gonzalez-Konig and Wodon, 2005), this relationship tends to have the shape of an inverted U. Although no formal cross-country analysis has been done yet, country-specific studies highlight the importance of network effects and the costs of migration in shaping the relationship between our variables of interest. Following the intuition behind the existence of a non-monotonic relationship between international remittances and inequality, we will expect a positive sign for δ_1 and a negative one for δ_2.

Figure 1 shows a simple quadratic fit plot after regressing income distribution on remittances and remittances squared. This figure shows the non-monotonic relationship existing between the two variables of interest in a simple non-formal analysis.

Figure 1. Quadratic Regression Fit of International Remittances on Income Inequality in a Cross-Section of Countries

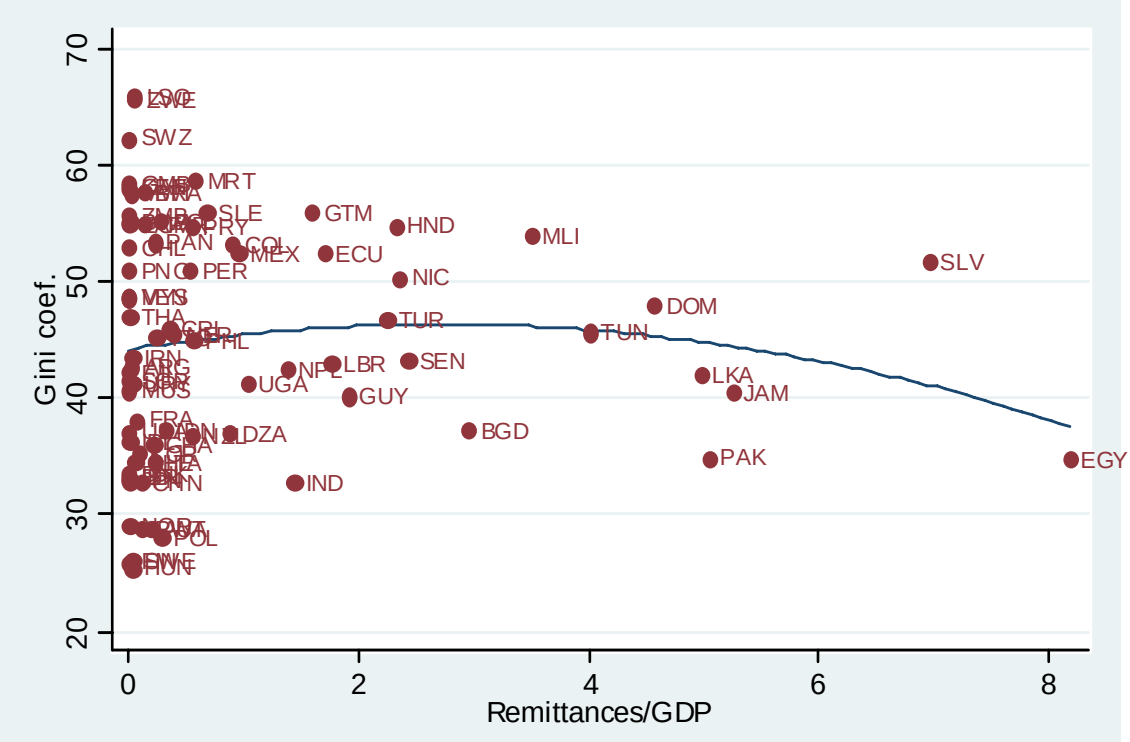
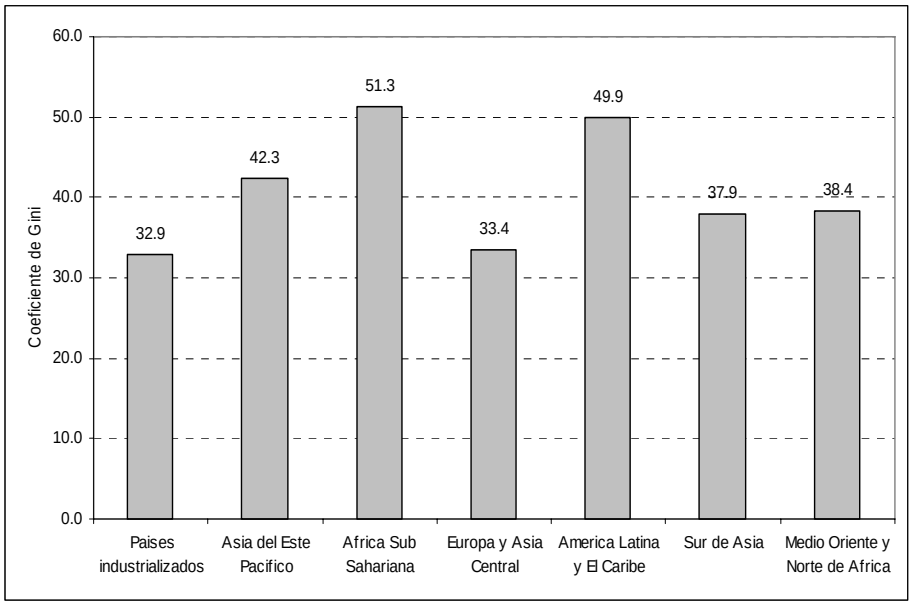
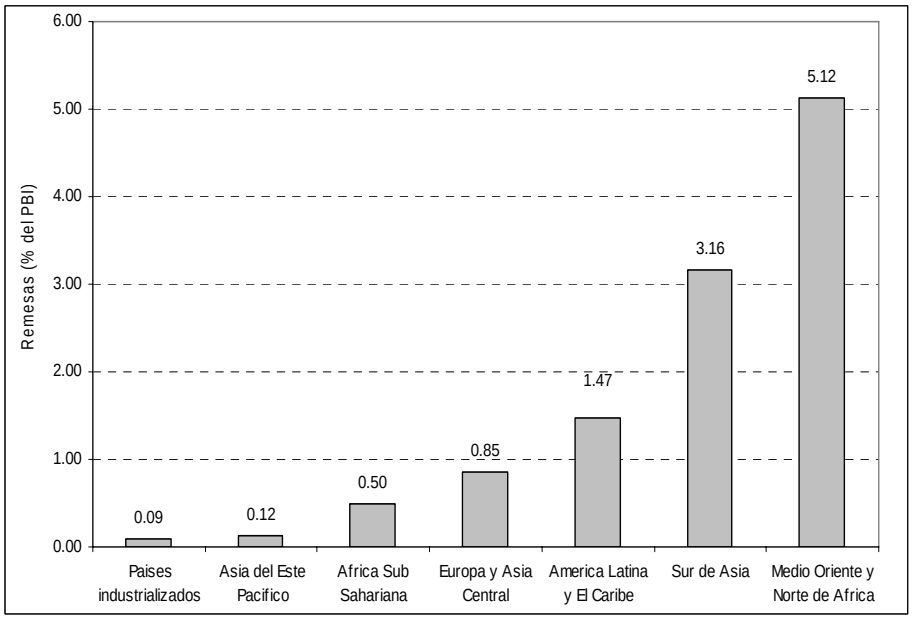


Figure 2. Average Gini Coefficient and Remittances, by Region[13]





Our benchmark regression follows the wide literature on the determinants of income distribution. The set of control variables include the level of initial gross domestic product per capita, the GDP growth rate, liquid liabilities (M3) as a percentage of gross domestic product, a

[13] Data correspond to simple averages for the period under analysis (1970 to 2001).

democracy measure and the average years of secondary schooling. Summary statistics and the correlation matrix for these variables are in Tables 2 and 3, respectively.

Table 2. Summary Statistics

Variable	Obs	Mean	Std. Dev.	Min	Max
Cross section					
Gini coef.	78	44.51	10.16	25.47	65.80
Remittances /GDP	78	1.19	2.54	0.00	17.64
Log(Initial GDP pc)	78	7.35	1.50	4.88	10.27
GDP growth	78	1.67	1.84	-2.83	7.36
M3/GDP	78	45.56	27.71	12.50	160.66
Polity	78	1.80	5.97	-8.78	10.00
Years of secondary schooling	78	1.15	1.00	0.06	4.38
Passport cost/GNI pc	65	4.21	8.95	0.12	50.91
5-year panel					
Gini coef.	231	42.69	10.00	19.79	69.08
Remittances /GDP	231	1.23	3.06	0.00	22.90
Log(GDP pc)	231	7.69	1.51	4.95	10.50
GDP growth	231	2.08	2.85	-5.51	11.02
M3/GDP	231	47.54	30.73	8.86	190.51
Polity	231	3.68	6.47	-9.75	10.00
Years of secondary schooling	231	1.39	1.03	0.05	5.09

Table 3A. Correlation Matrix, Cross-Section
(p-value below correlation coefficients)

	Gini coef.	Remittances /GDP	Log(Initial GDP pc)	GDP growth	M3/GDP	Polity	Years of secondary schooling
Remittances /GDP	-0.084						
	0.467						
Log(Initial GDP pc)	-0.402	-0.139					
	0.000	0.226					
GDP growth	-0.284	-0.025	0.215				
	0.012	0.830	0.059				
M3/GDP	-0.435	0.104	0.527	0.276			
	0.000	0.367	0.000	0.014			
Polity 2	-0.291	-0.178	0.686	0.152	0.282		
	0.010	0.120	0.000	0.183	0.012		
Years of secondary schooling	-0.538	-0.128	0.837	0.256	0.531	0.614	
	0.000	0.263	0.000	0.024	0.000	0.000	
Passport cost/GNI pc	-0.054	-0.059	-0.507	-0.287	-0.362	-0.394	-0.384
	0.669	0.640	0.000	0.020	0.003	0.001	0.002

Table 3B. Correlation Matrix, Five-Year Panel Data
(p-value below correlation coefficients)

	Gini coef.	Remittances /GDP	Log(GDP pc)	GDP growth	M3/GDP	Polity
Remittances /GDP	-0.040					
	0.547					
Log(Initial GDP pc)	-0.378	-0.161				
	0.000	0.015				
GDP growth	-0.119	-0.085	0.077			
	0.071	0.196	0.243			
M3/GDP	-0.360	0.117	0.505	0.167		
	0.000	0.075	0.000	0.011		
Polity 2	-0.196	-0.143	0.577	-0.012	0.208	
	0.003	0.030	0.000	0.852	0.002	
Years of secondary schooling	-0.517	-0.072	0.776	0.075	0.493	0.521
	0.000	0.274	0.000	0.256	0.000	0.000

The endogeneity problem is addressed using standard instrumental variables techniques. As the costs of migration have an endogenous component (labor market relations, information costs, etc.[14]) and an exogenous component (imposed by home country governments), we will take advantage of the exogenous nature of these costs to instrument our remittances measure. As mentioned above, our proxy for barriers to exit is the cost of obtaining a passport. It is expected that this cost will affect negatively the level of remittances by limiting the migration flows, and it is also expected that these barriers to exit will not have any effect on income distribution within a country.

[14] See Carrington et al. (1996).

Table 4. Cross-Section Regressions for Gini Coefficient

	Gini coef.			
	OLS	OLS	IV	IV
Remittances/GDP	-0.474	-1.180	20.639	17.959
	(1.84)*	(1.56)	(4.42)***	(3.70)***
$(\text{Remittances/GDP})^2$		0.049	-7.271	-2.878
		(1.25)	(2.52)**	(2.57)**
Initial GDP pc	1.474	1.318	2.883	5.388
	(1.10)	(0.95)	(2.00)*	(2.74)***
GDP growth	-0.712	-0.703	-0.194	1.041
	(1.56)	(1.57)	(0.30)	(1.69)*
M3/GDP	-0.067	-0.070	-0.138	-0.154
	(2.24)**	(2.32)**	(3.35)***	(2.92)***
Polity	-0.050	-0.009	-0.254	-0.149
	(0.23)	(0.04)	(1.02)	(0.71)
Years of secondary schooling	-5.978	-6.042	-2.837	-7.405
	(4.00)***	(3.98)***	(1.72)*	(3.86)***
Constant	45.445	47.098	22.341	16.505
	(5.36)***	(5.23)***	(2.36)**	(1.38)
Continental dummies	No	No	No	Yes
Observations	78	78	65	65
F test of excluded instruments			7.70	3.95
p-value			0.0074	0.0520
R-squared	0.36	0.37	0.50	0.64

Robust t-statistics in parentheses. * significant at 10%; ** significant at 5%; *** significant at 1%. The instrumental variable used on the IV regressions is the cost of obtaining a passport. This variable was always significant at the conventional levels on the first stage regressions.

Table 4 presents the OLS and instrumental variables results. The first column uses a linear specification using OLS, while the second one tests for a quadratic specification. Finally, the third and fourth columns use instrumental variables for our quadratic specification; the difference between these columns is the inclusion of dummy variables that control for heterogeneities between continents.

As for the initial GDP per capita, we find positive and statistically significant coefficients in the specifications including instrumental variables. Unlike previous evidence presented by Deninger and Squire (1997), who find no empirical support for a linear or quadratic relationship between GDP per capita and income inequality, we find that countries that were more developed in the 1970s are more likely to have a more equal income distribution. As was expected, we obtain a negative and significant coefficient for GDP growth, which indicates that countries with higher growth rates tend to lower their levels of income inequality; at the same time, our proxy for development of the financial system also has a negative and significant coefficient. As has been stated in the literature, credit constraints are one of the main factors aggravating income

inequality. In this sense, more developed financial markets will tend to reduce income inequality. Unsurprisingly, human capital accumulation, as proxied by the average years of secondary schooling, is also significant and yields a negative sign. Finally, we find no significant association between our political variable and income inequality. This finding is consistent with those in Chong (2004), where he presents evidence in support of a non-linear relationship between inequality and democracy.

In regard to our variable of interest, we find that in the linear specification we obtain a positive and significant association between international remittances and income inequality; this relationship does not seem statistically robust, however, since neither the linear nor the quadratic term is statistically significant when we include the quadratic term in the OLS regression, Nevertheless, when we instrument our interest variable we find strong statistical evidence in support of our hypothesis: in both specifications, we find a positive and significant coefficient for the linear term as well as a negative and significant term for the quadratic term. Moreover, the coefficients found for the effect of international remittances on income inequality are robust and stable since the inclusion of several other controls do not seem to affect either their magnitude or significance.[15] These results confirm our initial intuition that remittances increase inequality at the first stage of migration history but at some later point reduce income inequality. This relationship holds when using different measures of income inequality and different specifications of the empirical model (see robustness checks below).

The magnitude of the coefficients found can help us find the inflection point where remittances lead to a more equal distribution of income. Deriving equation (1) with respect to y_i we are able to maximize the function, finding a local maximum. Then, we have:

$$\frac{\partial y_i}{\partial rem_i} = \delta_1 + 2 * \delta_2 rem_i = 0$$

$$rem_i = \frac{\delta_1}{2*(-\delta_2)} \qquad (2)$$

[15] Column 4 in Table 4 shows the results when including continental controls, although we also try including other variables similar to those shown and the coefficients and significance of remittances did not vary significantly. These results are available upon request to the authors.

Solving equation (2) with the empirical values found for δ_1 and δ_2 in column 3 of Table 4,[16] we find that remittances begin to have a negative effect on the Gini coefficient (inequality decreasing) when, *ceteris paribus*, they represent 1.42 percent or more of GDP, which is roughly the level seen in countries like Nepal, India or Guatemala. Sixty of the 78 countries included in our sample fall in the inequality-increasing section of the curve; we can find within this group all the industrial countries in our sample as well as all the countries from Europe and Central Asia, with the exception of Turkey. As predicted by the model, this means that in the increasing part of the curve, a 2SD-increase in international remittances (about 0.6 percent the GDP), which is roughly like moving from a country with the level of remittances of Uganda (1.03 percent) to another with the level of Ecuador (1.7 percent), will increase the Gini coefficient by about 0.3. In the same line, in the inequality-decreasing section of the curve, a 2SD-increase in the level of remittances will lead to a reduction of the Gini coefficient of about 0.10.

Our results are also robust to other income inequality measures. Table 5 shows selected coefficients after using the same regressions as those of our benckmark specification from Table 4, but changing the dependent variable for the income shares held by the top 20 percent, top 40 percent, bottom 20 percent, bottom 40 percent, as well as for the middle 20 percent and the ratios between the top and bottom 20 percent and top and bottom 40 percent.

[16] Column 3 of Table 4 is taken as our benchmark specification since it is the one that most closely follows the specifications previously used in the literature.

Table 5. Remittances and Inequality: Alternative Measures of Inequality

	Quadratic specification	
	(Remittances/GDP)	(Remittances/GDP)
Top 20 / Bottom 20	9.601	-3.956
	(2.94)***	(2.16)**
Top 40 / Bottom 40	3.325	-1.308
	(2.99)***	(2.14)**
Top 20	12.913	-4.528
	(3.34)***	(2.25)**
Bottom 20	-2.660	0.827
	(2.42)**	(1.54)
Top 40	9.770	-3.305
	(3.06)***	(2.03)**
Bottom 40	-6.137	2.004
	(2.78)***	(1.81)*
Middle 20	-3.634	1.296
	(3.15)***	(2.15)**

Robust t-statistics in parentheses.*significant at 10%; ** significant at 5%; *** significant at 1%. We show only our interest coefficients. The benckmark regression used to obtain these coefficients is the one used on column 3 of Table 4. Full results are available upon request to the authors.

According to the endogenous migration costs literature (Carrington et al., 1996), and the network effects hypothesis (McKenzie and Rapoport, 2004), we will expect an increase in the income share held by the richest percentiles of the income distribution at the first stages of migration history. This share will then decrease as the endogenous migration costs start diminishing and the poorest households start migrating and sending remittances back home. Along the same lines, we expect that, when using the income shares held by the bottom percentiles, they will diminish in the first instances but increase after a given point.

Results in Table 5 confirm the predictions of previous theoretical work and our intuition. The coefficients found in the quadratic specifications are statistically significant at the 5 percent level and yield the expected signs. The coefficients of the ratios between high and low income percentiles follow the same patterns as those found for the Gini coefficient in Table 4. The results for the income shares held by the lowest percentiles are U-shaped, decreasing in the first stages and then turning positive. That same pattern is also followed by the regressions that use as

their dependent variable the income share held by the richest percentiles, which means that, at the initial stages of migration history, the income share held by the richest percentiles will increase (increasing income inequality also), but at some point these shares will start to decrease. The exact opposite pattern is followed in the regressions that use as their dependent variable the income share held by the poorest percentiles. Also, as can be seen in the last row of Table 5, the income shares held by the middle quintile display the same movement as those of the poorest quintiles, decreases in the initial stages of migration and will start increasing at some point.

4. Panel Data GMM-IV Method

The structure of our data also allows us to test our hypothesis using panel data methodologies. We use the standard panel data approach of a two-way error component model. This empirical approach allows us to control for time invariant country characteristics. The equation to be estimated is then:

$$y_{it} = \alpha + \beta_1 X_{it} + \delta_1 rem_{it} + \delta_2 rem_{it}^2 + \mu_i + \varepsilon_{it} \qquad (3)$$

In equation (3), y_{it} again represents our inequality measure for year t in country i, and X_{it} is a matrix for all our control variables. rem_{it} and rem_{it}^2 are our interest variable and its quadratic term, respectively, which represents the inverted U-shaped relationship mentioned above. Finally, μ_i is a country specific, time invariant error term, and ε_{it} is a random disturbance. In the empirical implementation of this model, we use a five-year average panel to minimize the problems that may arise from missing data and balance our panel as far as we can.

Previous panel data research shows that inequality has been highly stable in recent decades (Li, Squire, and Zhou, 1998). Moreover, it has been estimated that the correlation of inequality between the 1960s and 1980s is around 0.85 (Bruno et al., 1998). Indeed, the ratio of incomes of the richest five percent to the poorest five percent of countries has barely moved, from 33.2 in 1960 to 31.7 in 1985 (Bruno et al., 1998). In this sense, income inequality may be considered a persistent series, so we should control for a potential serial correlation that may be biasing our coefficients. Problems of simultaneity or reverse causation may arise as well. To minimize these problems, we also use fixed-effects dynamic panel data GMM-IV techniques suggested by Arellano and Bover (1995). The advantage of this method is that we are able to

estimate simultaneously a regression in levels and a regression in differences, with each equation using its own specific set of instrumental variables.

The consistency of the GMM estimator depends on whether lagged values of the explanatory variables are valid instruments in the regression. We address this issue by considering two specification tests suggested by Arellano and Bond (1991) and Arellano and Bover (1995). The first is a Sargan test of over-identifying restrictions, which tests the overall validity of the instruments by analyzing the sample analog of the moment conditions used in the estimation process. Failure to reject the null hypothesis gives support to the model. The second test examines the hypothesis that the error term $\varepsilon_{i,t}$ is not serially correlated. We test whether the differenced error term (that is, the residual of the regression in differences) is first and second-order serially correlated. A first-order serial correlation of the differenced error term is expected even if the original error term (in levels) is uncorrelated, unless the latter follows a random path. A second-order serial correlation of the differenced residual indicates that the original error term is serially correlated and follows a moving average process of at least an order of one. If the test fails to reject the null hypothesis of absence of second-order serial correlation, we conclude that the original error term is serially uncorrelated and use the corresponding moment conditions. A detailed explanation of these methods can be found in Appendix 1.

Table 6 shows the results for the panel data models. The first and second columns show the results for the models using country and time fixed effects for a linear and quadratic specification, respectively. The following columns use the dynamic panel data methods.

Table 6. Panel Data Analysis: Fixed Effects and GMM-IV Methods

	Gini coef.			
	Fixed effects	Fixed effects	GMM-IV	GMM-IV
Gini (first lag)			0.8613	0.6707
			(8.70)***	(3.95)***
Remittances/GDP	-0.078	0.310	0.8239	1.5027
	(0.35)	(0.79)	(2.05)**	(1.66)*
(Remittances/GDP)^2		-0.026	-0.0602	-0.0692
		(1.52)	(3.00)***	(2.08)**
Log(GDP pc)	-3.696	-3.225	1.6072	1.4145
	(1.61)	(1.40)	(1.55)	(0.38)
GDP growth	0.032	0.039	-0.0358	0.4195
	(0.25)	(0.30)	(0.12)	(0.87)
M3/GDP	0.026	0.019	0.0178	0.0680
	(0.83)	(0.62)	(0.74)	(0.66)
Polity	-0.052	-0.049	-0.2511	0.0998
	(0.52)	(0.48)	(1.87)*	(0.22)
Years of secondary	-2.662	-2.716	-2.5255	-6.2149
schooling	(2.21)**	(2.27)**	(1.32)	(1.23)
Constant	74.456	71.027	-0.8885	10.8822
	(4.43)***	(4.18)***	(0.11)	(0.69)
Period dummies	Yes	Yes	Yes	Yes
Continental dummies	No	No	No	Yes
Observations	231	231	167	167
Number of countries	73	73	55	55
R-sq	0.19	0.19		
Rho	0.86	0.85		
Hansen test of overid. restrictions			18.18	8.11
P-value			1.00	1.00
Test for AR(1)			-3.41	-2.06
P-value			0.00	0.04
Test for AR(2)			1.60	0.63
P-value			0.11	0.53

Robust t-statistics in parentheses. * significant at 10%; ** significant at 5%; ***significant at 1%.

The panel data GMM-IV method includes in the instruments matrix lagged values of the variables in levels and in differences (as described in the methodological section). Also, we include in this matrix some external (strictly exogenous) instruments such the countries legal origin, the absolute value of its geographical latitude, and an index of ethno-linguistic fractionalization.

The fixed effects models in the first two columns of Table 6 show no statistical relationship between international remittances and income inequality, either in the linear or in the quadratic specification. Although one must take in account that these results may be driven by the problems mentioned above, such as autocorrelation and endogeneity, which will make our estimates biased and inefficient. Nevertheless, we find that our specifications have a very high explanatory power, as shown by the R-square, moreover, great part of the variation of the Gini coefficient is explained by the country specific (time invariant) characteristics, as can be seen in the high values of the Rho.

The problems that may be biasing our coefficients in the fixed effects model are solved using the GMM-IV models in columns 3 and 4 of Table 6. As mentioned above, the consistency of the estimators heavily relies on the robustness of the instruments used, as well as the autocorrelation structure of the error term. In columns 3 and 4 we show the Sargan tests of overidentified restrictions. The values obtained reject the hypothesis of not robust instruments. The autocorrelation structure of the error terms are tested using the AR(1) and AR(2) tests. We expect to accept the first order serial correlation for the differenced error term, but to reject the second order serial correlation. Accepting that the differenced error term has these characteristics is the same as saying that the error term of the levels equation shows no serial correlation, which is a desirable property. The values obtained for these tests fail to reject the first-order serial correlation and do reject the hypothesis that the differenced error term is AR(2).

The positive and significant coefficients found for the first lag of the Gini coefficient confirms previous evidence pointing out that the Gini coefficient is a persistent series over time, which may have been biasing the coefficients estimated using fixed effects models in columns 1 and 2. Finally, regarding to our interest variable, we obtain a positive and significant coefficient for the linear term of remittances and a negative and significant one for the quadratic term. The evidence found using the dynamic panel data models are highly consistent with the results found in Table 4, which gives support to the underlaying hypothesis of the existence of a non monotonic relationship between international remittances and income inequality. Moreover, the results obtained using different econometric methods and alternative measures of income inequality show the robustness of our results.

5. Possible Interactions

Up to this point, we have shown that there exists an inverted U curve in the relationship between international remittances and income inequality. But, what drives one country or another to be in the upward or downward-sloping section of the curve? In order to address this question, we test several interactive terms in our benchmark regressions of Table 4. Particularly, we test if the level of financial development and the years of education help countries to reach faster the inequality increasing section of the curve in regard to its relationship with income inequality.

Several studies have documented the relevance of financial mechanisms as a channel to lower the costs of sending remittances and making it easier for lower income households to have access to the money sent by their relatives working in foreign countries (World Bank, 2006). It has been shown that households with a higher average level of education tend to invest money received from remittances in the accumulation of human capital and durable assets, increasing their capacity to generate higher incomes in the long term. To test this hypothesis, we include in equation (1) the interactive terms mentioned above. We will have:

$$y_i = \alpha + \beta_1 X_i + \delta_1 rem_i + \delta_2 rem_i^2 + \lambda_1 rem_i * Z_i + \varepsilon_i \qquad (5)$$

where Z_i represents our interest interactions, namely, financial development (as proxied by the liquid liabilities), and education (proxied by the average years of secondary schooling). Deriving this equation with respect to rem_i and maximizing this function, we will have:

$$\frac{\partial y_i}{\partial rem_i} = \delta_1 + 2 * \delta_2 rem_i + \lambda_1 Z_i = 0$$

$$rem_i = \frac{\delta_1 + \lambda_1 Z_i}{2 * (-\delta_2)} \qquad (6)$$

From equation (6), it is clear that a negative sign on the coefficient of the interactive term will move the inflexion point to the left, leading to some countries that were on the inequality increasing section of the curve to be in the inequality decreasing section. In Table 7 we include the interactive term between remittances and years of secondary education and with our measure of financial development. The regressions shown are the same as those in column 3 of Table 4, but including the corresponding interactive term. When we include the quadratic term for remittances, we find a negative and significant coefficient for the interaction between average years of secondary schooling and remittances, as well as statistically significant coefficients for

our remittances coefficients. This result has the effect of moving the curve to the left and lowering the inflection point, which means that countries with higher educational levels receiving remittances will more quickly reach the turning point at the inequality-decreasing section of the curve. Several studies point out the effect of higher educational levels on the way households diversify their investment porafolio. In this sense, an plausible interpretation of the results obtained for the interaction between education and international remittances is that falimiles with a higher educational levels will tend to invest the remittances received in productive assets with a higher rate of return, which will increase long-term income.

Table 7. Interactive Terms between International Remittances, Years of Schooling and Financial Development

	Gini coef.	
Remittances/GDP	23.825	28.245
	(4.73)***	(4.69)***
$(\text{Remittances/GDP})^2$	-7.354	-10.153
	(2.50)**	(3.27)***
Log(Initial GDP pc)	2.481	2.003
	(1.64)	(1.19)
GDP growth	-0.146	-0.400
	(0.23)	(0.59)
M3/GDP	-0.043	-0.090
	(0.55)	(1.84)*
Polity	-0.237	-0.205
	(0.97)	(0.84)
Years of secondary schooling	-3.327	-1.461
	(2.12)**	(0.81)
(Remittances/GDP)*(M3/PBI)	-0.095	
	(1.17)	
(Remittances/GDP) * (Years of secondary schooling		-4.430
		(1.96)*
Constant	22.402	25.225
	(2.35)**	(2.33)**
Observations	65	65
R-sq	0.50	0.52

Robust t-statistics in parentheses. * significant at 10%; ** significant at 5%; ***significant at 1%. The benckmark specification used on these regressions is the one shown on column 3 of Table 4. The instrumental variable used is the cost of obtaining a passport, which was always significant at the conventional levels on the first stage regressions.

In the same line, column 2 of Table 7 provides evidence on the effect of the interaction of the development of the financial markets and international remittances on income inequality. Although we find a statistically insignificant coefficient for this interactive term, the result yields with a negative sign.[17] Countries with a higher development of financial markets will allow an easier and cheaper transmtion of international remittances (Freund and Spatafora, 2005); lower transaction costs will allow poorer households to receive remittances at earlier stages of migration history, compared to how long they would have wait if financial markets were less developed. This effect will tend to move the inflection point of our inverted U to the left, allowing countries with a higher development of the financial markets which receives remittances to reach the downward sloping portion of the curve easier.

6. Summary and Conclusions

This paper has provided comprehensive empirical evidence on the relationship between international remittances and income inequality. Using several cross section techniques, instrumental variables, as well as panel data methodologies that address the problems of endogeneity and serial correlation, we have found robust evidence of an inverted U-curve between these variables.

Our findings provide empirical support for previous theoretical work on endogenous migration costs. These theories explain how the formation of migrants' networks in the foreign country has the effect of lowering the migration costs for low income potential migrants, making the relationship between remittances and inequality as one, shaping an inverted U curve. The intuition behind the existence of an inverted U curve is that, in the initial stages of migration history, with high migration and information costs, the opportunity cost of the migration decision can only be afforded by people in the higher stances of income distribution. The remittances sent by these migrants have the effect of increasing levels of income inequality. As noted in several sociological studies, migrants in each country tend to establish a community that keep close relation with their home communities. These networks have the effect of lowering opportunity costs for new migrants due to connections in the labor market, and settlement and information costs, for example. The network effects will then make migration affordable for households in

[17] When testing the regression using continental dummies we obtain a significant coefficient for the interactive term, although these results are not as robust as those shown for the interactions between remittances and years of secondary schooling.

the lowest levels of income distribution. When this happens, the migration and remittances sent by these migrants will tend to reduce income inequality.

Also, using interactive terms in our regression analysis, we show how countries with higher educational levels, on the one hand, and higher levels of financial sector development, on the other, can more quickly reach the inequality-decreasing section of the relationship.

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Appendix 1. The System GMM Estimator

A basic outline of the GMM-System method is presented below. For ease of exposition, each section of the system is presented separately although as mentioned above, the entire system is estimated jointly.

(i) System in First Differences. We eliminate the unobserved country-specific effects by specifying the regression equation (2a) in first differences:

$$y_{i,\tau} - y_{i,\tau-1} = (y_{i,\tau-1} - y_{i,\tau-2})\,\phi + (X_{i,\tau} - X_{i,\tau-1})\gamma_1 + (S_{i,\tau} - S_{i,\tau-1})\,\gamma_2 + (\varepsilon_{i,\tau} - \varepsilon_{i,\tau-1})$$

For this specification, the choice of instruments requires dealing with two problems. First, the possible endogeneity of the explanatory variables, Z = [X' S']', which is reflected in the correlation between these variables and the error term. Second, the new error term, (å*i,* ô - å*i,* ô-*1*), is correlated by construction with the differenced lagged dependent variable, (*yi,* ô-*1* - *yi,* ô-*2*). According to this procedure, we allow for the possibility of simultaneity and reverse causation, instead of assuming *strict exogeneity* (i.e., no correlation between the explanatory variables and the error term at all leads and lags). We adopt the more flexible assumption of *weak exogeneity*, with the current explanatory variables being affected by past and current realizations of the dependent variable, but not by its future innovations. Under the assumptions that (a) the error erm, å, does not exhibit serial correlation, and (b) the explanatory variables are weakly exogenous, the following moment conditions apply:

$$E[y_{i,\tau-s} \cdot (\varepsilon_{i,\tau-s} - \varepsilon_{i,\tau-1})] = 0; \quad para \quad s \geq 2, \quad y \quad t = 3,...,T \quad y$$

$$E[Z_{i,\tau-s} \cdot (\varepsilon_{i,\tau-s} - \varepsilon_{i,\tau-1})] = 0; \quad para \quad s \geq 2, \quad y \quad t = 3,...,T$$

The GMM-IV estimator is based on the moment conditions and is known as the *differences* estimator. Although asymptotically consistent, this estimator has low asymptotic precision and large biases in small samples, which leads to the need to complement it with the regression equation in levels.

(ii) System in Levels. For this part of the system, the country-specific factor is not directly eliminated but must be controlled for by the use of instrumental variables. The appropriate instruments for the regression in levels are the lagged *differences* of the corresponding variables if the following assumption holds. Although there may be correlation between the levels of the right-hand side variables and the country-specific effect, there is no correlation between the

differences of these variables and the country-specific effect. This assumption results from the following stationarity property:

$$E[y_{i,\tau+p} \cdot \eta_i)] = E[y_{i,\tau+q} \cdot \eta_i)] \quad y \quad E[Z_{i,\tau+p} \cdot \eta_i)] = E[Z_{i,\tau+q} \cdot \eta_i)]; \quad \forall p$$

Therefore, the additional moment conditions for the second part of the system (the regression in levels) are given by the following equations:

$$E[(y_{i,\tau-s} - y_{i,\tau-s-1}) \cdot (\eta_i - \varepsilon_{i,\tau})] = 0; \quad para \quad s = 1, \quad y$$

$$E[(Z_{i,\tau-s} - Z_{i,\tau-s-1}) \cdot (\eta_i - \varepsilon_{i,\tau})] = 0; \quad para \quad s = 1$$

Using the moment conditions, we employ a Generalized Method of Moments (GMM) procedure to generate consistent estimates of the parameters of interest. The weighting matrix for GMM estimation can be any symmetric, positive-definite matrix, and we obtain the most efficient GMM estimator if we use the weighting matrix corresponding to the variance-covariance of the moment conditions. Since this variance-covariance is unknown, Arellano and Bond (1991) and Arellano and Bover (1995) suggest the following two-step procedure: first, assume that the residuals, å*i,t*, are independent and homoskedastic both across countries and over time. This assumption corresponds to a specific weighting matrix that is used to produce first-step coefficient estimates. We construct a consistent estimate of the variance-covariance matrix of the moment conditions with the residuals obtained in the first step, and we use this matrix to reestimate our parameters of interest (i.e. second-step estimates). Asymptotically, the second-step estimates are superior to the first-step ones in so far as efficiency is concerned. In this paper, the moment conditions are applied so that they correspond to all available periods, as opposed to each moment condition corresponding to a particular time period. In the former case, the number of moment conditions is independent of the number of time periods, whereas in the latter case, it increases more than proportionally with the number of time periods. Most of the literature dealing with GMM estimators applied to dynamic models of panel data treats the moment conditions as applying to a particular time period.