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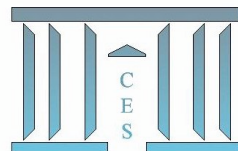
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**Macroeconomic Determinants of Migrants' Remittances :  
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Dramane COULIBALY

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# Macroeconomic Determinants of Migrants' Remittances: New Evidence from a panel VAR

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**Abstract:** This paper examines the macroeconomic determinants of migrants' remittances dynamics. The study uses panel VAR methods in order to compensate for both data limitations and endogeneity among variables. The analysis considers annual data for 14 Latin and Caribbean countries over the period 1990-2007. The results show evidence that host (U.S) economic conditions are an important factor explaining remittances dynamics, while home economic conditions do not have a significant influence on remittances.

*Keywords:* International migration, remittances, business cycles.

*JEL Classification:* F22, F24, O15, O54.

**Résumé:** Ce papier examine si les transferts des migrants répondent plus aux conditions économiques dans les pays d'accueil que celles dans les pays d'origine en utilisant une approche VAR en panel. L'utilisation du VAR en panel permet de bénéficier à la fois de l'avantage du modèle VAR (interaction endogène entre les variables) et de l'avantage des données de panel (taille de l'échantillon). Le modèle est estimé sur des données annuelles de 1990 à 2007 issues de 14 pays d'Amérique Latine et Caraïbes. Les résultats mettent en évidence que les conditions économiques du pays d'accueil des migrants (les Etats-Unis) sont un facteur important expliquant les envois de fonds des migrants, alors que les conditions économiques dans les pays d'origine n'ont pas une influence significative sur les envois de fonds.

*Mots-clés:* Migration internationale, transferts des migrants, cycles économiques.

*Classification JEL:* F22, F24, O15, O54.

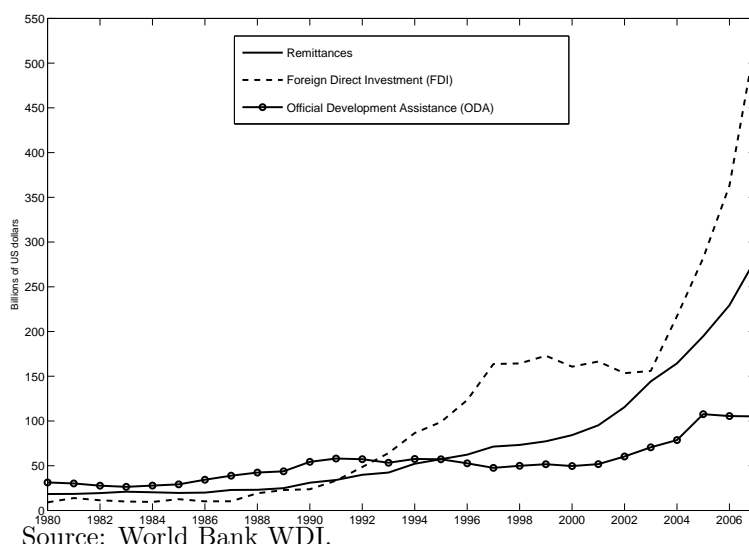
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# 1 Introduction

The recent years were marked by the increasing role of emigrants remittances in total international capital flows. In the aggregate, remittances are currently the second largest source of foreign exchange after foreign direct investment (Figure 1). For many developing countries, remittances represent a significant part of income (Figure 2).

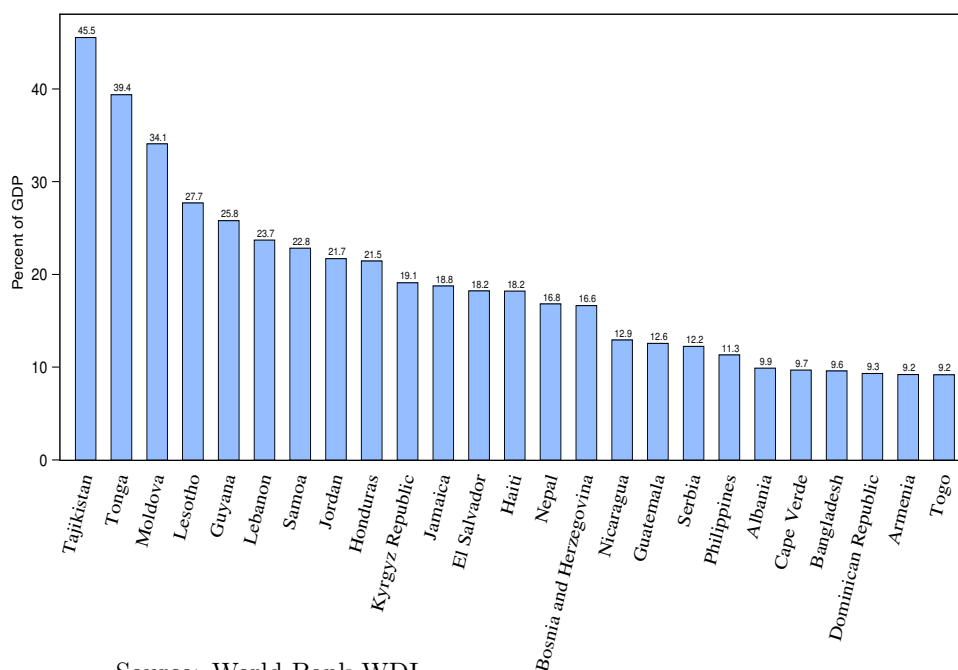
Figure 1: Remittances, Foreign Direct investment and Official Development Assistance received in Developing countries.



The literature on the determinants of remittances is dominated by two approaches: one approach focusing on micro-economic aspects, and the other focusing on macro-economic factors. In the micro-economic approach, Lucas and Stark (1985) were the first to build a formal model for analyzing the motivations to remit. These authors point out that remittances are sent for many of reasons, ranging from pure altruism motives to pure self-interest motives. According to Lucas and Stark (1985), migrant workers can be classified as altruistic if remittances increase with declines in family income at home, while self-interest motives would dominate if remittances were positively related with home economic performances. Some empirical papers (Lucas and Stark, 1985; Ilahi and Jafarey, 1999; Agarwal and Horowitz, 2002; Adams, 2009, among others) have tried to test the altruistic hypothesis against the self-interest hypothesis using micro-economic variables.

At the same time, other researchers have used macroeconomic variables to analyze the macroeconomic factors that impact remittances. In order to cap-

Figure 2: Top remittances-recipient in 2008 (remittances as percent of GDP)



Source: World Bank WDI.

ture host economic conditions, host country GDP (income) is generally used as explanatory variable, since this variable can reflect economic prosperity of migrant in host country. Elbadawi and Rocha (1992), El-Sakka and McNabb (1999) and Lianos (1997) found a significant positive effect of host income on remittances. Some previous papers also used host unemployment rate to proxy for host economic conditions. Higgins et al. (2004) showed evidence of a significant positive effect of host unemployment rate on remittances, while Lianos (1997) found an ambiguous impact of host unemployment rate on remittances.

To capture economic conditions in home country (altruistic motivation), generally, the variable employed is GDP in home country. The idea is that, if the altruistic motives dominates, the more depressed income in the home country is, the more remittances increase. On contrary, if the self-interest motives dominates, the more expanded income in the home country is (improvement in home economic conditions), the more remittances increase. El-Sakka and McNabb (1999) and Lianos (1997) showed a non significant impact of home income on remittances, while Higgins et al. (2004) indicated

a positive relationship between home income and remittances. Higgins et al. (2004) also found that exchange rate uncertainty (a measure of risk in home country) is an important determinant of remittances.

To check for the assumption of self-interest motivations, some previous studies have also used variables designed to capture portfolio effects due to the difference in financial returns between home and host countries. Therefore, the difference between the domestic and foreign interest rates may be used to investigate self-interest motivations. The studies by Swamy (1981) and Elbadawi and Rocha (1992) did not find a significant effect of this difference in interest rates, while El-Sakka and McNabb (1999) reported it with a negative and highly significant impact. Lianos (1997) considered the foreign and domestic interest rates separately and found positive and significant impact for the domestic interest rate, but inconclusive result for the foreign interest rate under different formulations.

Sayan (2006) investigates the correlation between remittances and business cycles using data from 12 developing countries during 1976-2003. This study found that countercyclicality or procyclicality of remittances is not commonly observed across these countries.

The techniques used by the papers mentioned above to investigate the relationship between remittances and macroeconomic variables are generally a single-equation-based approach. To tackle the interaction problem between remittances and its potential determinants, Huang and Vargas-Silva (2006) employ a VAR context by investigating whether remittances respond to the macroeconomic factors of host or home country. There is a potential causal link between remittances and home economic conditions. On the one hand, for altruistic or self-interest motives, remittances respond to home economic conditions. On the other hand, remittances can influence home economic variables. Huang and Vargas-Silva (2006) use in their VAR system: net remittances sent from the U.S. (or remittances received in Mexico), variables capturing the U.S. economic activity, variables capturing Mexico economic (or weighted average of variables capturing economic activity in the five biggest recipients of remittances from the U.S - Mexico, Brazil, Colombia, El Salvador and Dominican Republic-, weights given by the share of received remittances). These authors found evidence that the host country (the U.S.) economic conditions seem to be the most important factor explaining remittances.

Contrary to Huang and Vargas-Silva (2006), in order to examine the response of remittances to host and home country economic considerations, this paper employs the panel VAR method. The use of panel VAR techniques allows to benefit from both the advantages of VAR approach and panel techniques. As mentioned above, the VAR approach addresses the endogeneity

problem by allowing the endogenous interaction between the variables in the system. The panel techniques tackle the problem of data limitation by taking the data from various countries. Moreover, the asymptotic results are easier to derive from a panel data.

This study uses data for 14 Latin American and Caribbean countries (Belize, Bolivia, Colombia, Dominican Republic, Ecuador, El Salvador, Guatemala, Guyana, Haiti, Honduras, Jamaica, Mexico, Nicaragua and Peru). These 14 countries were selected in order to facilitate the choice of host country. Indeed, the United States (U.S.) is the major destination of migrant from these countries, then the U.S. is considered as the only host country.

The results from this paper suggest that the economic conditions in host country (the U.S.) seem to be more important in explaining the fluctuations in remittances received in the 14 Latin American and Caribbean countries. By including both host and home country macroeconomic variables in panel VAR system, remittances respond significantly to host macroeconomic variables, while they do not respond to home GDP.

The remainder of the paper is organized as follows. Section 2 presents a simple theoretical model that presents the potential macroeconomic determinants of remittances. Section 3 describes the data used in the econometric estimation. Section 4 presents the econometric methodology. Section 5 presents the empirical results and the interpretations of these empirical results. Finally, Section 6 concludes.

## 2 Theoretical framework

This section presents a simple two-period model that describes the behavior of a representative migrant born in home country and working in host country. The model presented here has the same basic implications of most other remittance models.<sup>1</sup>

In the first period, the migrant is assumed to maximize her or his utility by allocating her or his income between transfers to her or his family in the home country, her or his own consumption in the host country and saving. The migrant has the possibility to acquire financial/non-financial assets in both countries. These assets are assumed to yield a certain rate of return. In the second period, the agent consumes the saving made in the first period. Formally, the utility of migrant is given by:

$$U_m(C_1^m, C_2^m, C^f) = u(C_1^m) + \beta u(C_2^m) + \gamma u(C^f) \quad (1)$$

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<sup>1</sup>See Rapoport and Docquier (2005) for a review of the literature.

where  $u'(C) > 0$  and  $u''(C) < 0$  for  $C \in \{C_1^m, C_2^m, C^f\}$   $\beta \in (0, 1]$  is the migrant's time discount rate,  $\gamma \in (0, 1]$  is the degree of altruism towards the family,  $C_t^m$  is migrant's consumption at time  $t$  ( $t = 1, 2$ ),  $C^f$  denotes the migrant's family's consumption at home.

The resource constraints of migrants is given by the following equations:

$$C_1^m + X + I = Y^m \quad (2)$$

$$C_2^m = (1 + r)I \quad (3)$$

where  $X$  is the amount that migrant sends to sustain consumption of the family at home,  $I$  represents the amount invested of current income  $Y^m$  that migrant earns in host country and  $r$  denotes the overall portfolio return.<sup>2</sup>

The consumption of migrant's family  $C^f$  depends on the income earned by migrant's family at home,  $Y^f$ , and the remittances received from migrant,  $X$ . For simplicity, the consumption of migrant's family is additively separable in  $Y^f$  and  $X$ . Formally,

$$C^f = Y^f + X \quad (4)$$

The migrant's maximization program can be decomposed in two steps. In the first step, given her income in the host country, the migrant decides how much to allocate to consumption, savings and transfers to the family. Second, given total savings, the migrant solves a portfolio allocation problem, by deciding how much to invest in the home and host countries.

The first step of the representative migrant's problem is to maximize her or his utility subject to the constraints (2) and (3), in order to decide how much to allocate to consumption, savings and transfers to the family:

$$\begin{aligned} \text{Max}_{\{C_1^m, C_2^m, I, X\}} \quad & u(C_1^m) + \beta u(C_2^m) + \gamma u(Y^f + X) \\ \text{subject to} \quad & C_1^m + X + I = Y^m \\ & \text{and } C_2^m = (1 + r)I \end{aligned}$$

This optimization problem can be formulated via the following Lagrangian:

$$L = u(C_1^m) + \beta u(C_2^m) + \gamma u(Y^f + X) + \lambda(Y^m - C_1^m - X - I) + \mu((1 + r)I - C_2^m) \quad (5)$$

The optimal solution of the program is given by the following equations:

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<sup>2</sup>For simplicity there is no transfer cost. This assumption does not impact the results

$$u'(C_1^m) = \lambda \quad (6)$$

$$\beta u'(C_2^m) = \mu \quad (7)$$

$$\lambda = \mu(1 + r) \quad (8)$$

$$\gamma u'(C^f) = \lambda \quad (9)$$

Equations (6) -(9) are the first order conditions relatively to  $C_1^m$ ,  $C_2^m$ ,  $I$  and  $X$ , respectively.

Combining equations (7) and (8) yields

$$\beta(1 + r)u'(C_2^m) = \lambda \quad (10)$$

Since  $u''(C^f) < 0$  and  $C^f = Y^f + X$ , equation (9) shows that the more the degree of altruism is strong (large  $\gamma$ ), the more remittances sent to sustain consumption,  $X$ , are large.

Using equations (6) and (10), the derivative of optimal level of remittances sent to sustain consumption in home country  $X^*$  with respect to  $Y^m$  and  $Y^f$  are given by the following equations:

$$\frac{\partial X^*}{\partial Y^m} = \frac{\beta(1 + r)^2 u''(C_1^m) u''(C_2^m)}{D} > 0 \quad (11)$$

$$\frac{\partial X^*}{\partial Y^f} = \frac{\gamma u''(C^f) [u''(C_1^m) + \beta(1 + r)^2 u''(C_2^m)]}{D} < 0 \quad (12)$$

where  $D = \gamma u''(C^f) [u''(C_1^m) + \beta(1 + r)^2 u''(C_2^m)] + \beta(1 + r)^2 u''(C_1^m) u''(C_2^m) > 0$

Equation (11) shows that the optimal level of transfer to sustain consumption of family at home,  $X^*$ , is an increasing function of the income of migrant in host country,  $Y^m$ , i.e. migrant sends more money to sustain consumption at home if his economic conditions improve. On the contrary, equation (12) shows that the optimal level of transfer to sustain consumption is a decreasing function of the income of family at home, i.e migrant sends more money to sustain consumption at home if home economic conditions deteriorate.

The second step of the optimization problem is the portfolio allocation. In this step, given the optimal investment amount  $I^*$  and the exogenous return on assets in both countries  $r^{host}$  and  $r^{home}$ , the migrant chooses the asset mix  $I^{host}$  and  $I^{home}$  that maximizes the return of the portfolio. This program is formalized as follow

$$\begin{aligned} & \text{Max}_{\{I^{host}, I^{home}\}} [r^{host} I^{host} + r^{home} I^{home}] \\ & \text{subject to } I^{host} + I^{home} = I \end{aligned}$$

The optimal choices of  $I^{host}$  and  $I^{home}$  are given as follows:

$$\begin{cases} I^{host*} = 0 \text{ and } I^{home*} = I^* \text{ if } r^{host} < r^{home} \\ I^{host*} = I^* \text{ and } I^{home*} = 0 \text{ if } r^{host} > r^{home} \\ I^{host*} \in [0, I^*] \text{ and } I^{home*} = I^* - I^{host*} \text{ if } r^{host} = r^{home} \end{cases} \quad (13)$$

Condition (13) shows that self-interested remittances,  $I^{home}$ , is positively (negatively) determined by the return on assets in home (host) country. Thus, self-interest remittances are positively related to improvements in the economic conditions of home country: in response to an improvement in the economic conditions of home country, migrant sends more money in order to exploit investment opportunities in the home country.

The total amount of worker's remittances,  $REM$ , is the sum of altruistic remittances,  $X^*$ , and self-interest remittances,  $I^{home*}$  (remittances sent in order to exploit investment opportunities in home country):  $REM = X^* + I^{home*}$ .

The results of this theoretical model, in a macroeconomic framework, can be summarized as follows. Since an increase in migrant income allows migrant to send more money for altruistic motives and to make more investment that can take place in host or home country, an improvement in the economic conditions of the host country has a positive effect on the total remittances (altruistic remittances plus self-interest remittances). While the relationship between total remittances and the conditions in the home country is ambiguous. If the altruistic motive dominates, a negative relationship is to be expected. However, since improvement in home economic conditions will reflect an increase in expected return on assets, if the motive for remitting is to exploit investment opportunities, remittances will respond positively to improvement in the economic conditions of the home country.

This model allows to hypothesize how the total remittances respond to changes in the economic conditions of host and home countries. The empirical section of this paper estimates those responses.

### 3 Data

Annual data over the period 1990-2007 from 14 Latin American and Caribbean countries (Belize, Bolivia, Colombia, Dominican Republic, Ecuador, El Salvador, Guatemala, Guyana, Haiti, Honduras, Jamaica, Mexico, Nicaragua

and Peru) where remittances represent a significant part of income (Figure 3) are used. These 14 countries are selected in order to facilitate the choice of host country. Indeed, the United States (U.S.) is the major destination of migrant from these countries, thus the U.S. is the only host country considered (Figure 4). Figure 4 shows that the U.S. receives more than 90 percent of migrants from Mexico, Honduras, Nicaragua, El Salvador and Belize, more than 80 percent of migrants from Guatemala and Dominican Republic, more than 60 percent of migrants from Jamaica, Guyana, Colombia, Bolivia and Peru, and 54.2 percent of migrants from Ecuador. So, the U.S. macroeconomic variables are used to capture economic conditions in host country. The U.S. variables used are: U.S. real GDP per capita, U.S. Federal Fund Rate (U.S. FFR). The U.S. real GDP is used to measure the income in host country. The U.S. Federal Fund rate (U.S. FFR) is used to reflect expected future changes in U.S. economy.<sup>3</sup> An increase in the U.S. FFR can impact remittances through two channels. First, it should have a negative effect on the economic conditions of host country which leads to a fall in remittances. Second, it has a positive effect on return on asset of the U.S and this has a negative effect on self-interest remittances.

To capture the economic conditions of home country, real GDP per capita of home country (Home GDP) is used. Real GDP of home country is used to capture improvement in economic conditions of the home country. As mentioned above, the predicted effect of this variable in a model of remittances depends on what are the motives of immigrant workers to remit. If they are altruistic, in presence of downturns in the home economy, migrant would send more money to sustain family members. On the other hand, if immigrant workers are self-interested, remittances will respond positively to an improvement in the economic conditions of the home country.

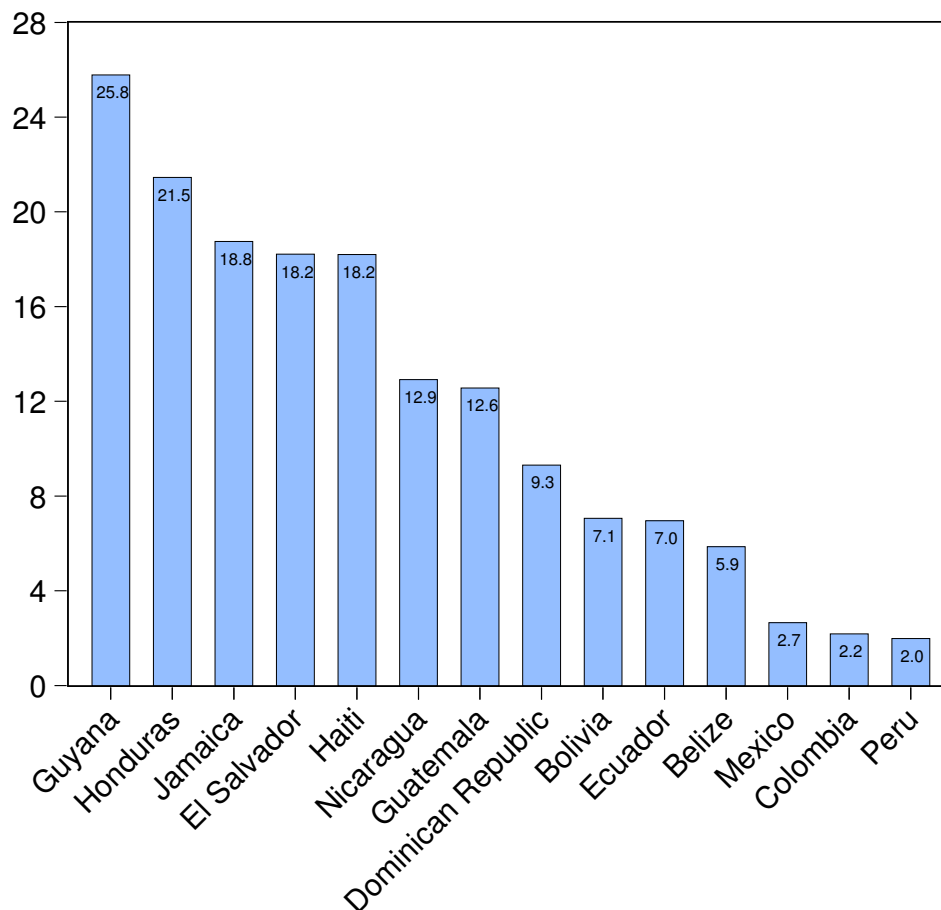
Table 1 reports the results of the unit root tests for the variables. Since host variables (U.S. GDP and U.S. FFR) are the same for all the countries in the panel, a standard Augmented Dickey Fuller (ADF) test is employed. For remittances (REM) and home GDP, the panel unit root test of Im, Pesaran and Shin (2003) (IPS) is employed. The results of the unit root tests show that all the variables are  $I(1)$ .

Table 2 reports the results of the seven cointegration tests (panel v test, panel rho test, panel non parametric test, panel parametric test, group mean rho test, group mean non parametric test and group mean parametric test) proposed by Pedroni (1999, 2004). These tests are based on the null hypothesis of no cointegration, and heterogeneity is allowed under the alternative

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<sup>3</sup>According to Bernanke and Blinder (1992), the U.S. Federal Fund Rate is the best measure of the U.S. monetary policy.

Figure 3: Remittances Inflows in Latin American and Caribbean countries, 2007 (percent of GDP).



Source: WDI.

hypothesis. The null hypothesis of no cointegration cannot be rejected by these tests. Particularly, the group mean parametric t-test and panel v test significantly accept the null hypothesis of no cointegration. Simulations made by Pedroni (2004) show that, in small samples ( $T \approx 20$ ), the group mean parametric t-test is more powerful than the other tests, followed by the panel v test. As a result, the empirical properties of the variables indicate that estimating the VAR in first differences without imposing any cointegration relationships is more appropriate.

Table 1: Unit root test

Variables	ADF test	IPS test
$\ln(U.S.GDP)$	-1.9007 (0.6126)	
$\Delta \ln(U.S.GDP)$	-2.5127 (0.0155)	
$U.S.FFR$	-2.7756 (0.0826)	
$\Delta U.S.FFR$	-2.5127 (0.0155)	
$\ln(REM)$		0.6223 (0.7331)
$\Delta \ln(REM)$		7.9113 (0.0000)
$\ln(HomeGDP)$		3.0703 (0.9989)
$\Delta \ln(HomeGDP)$		-6.8505 (0.0000)

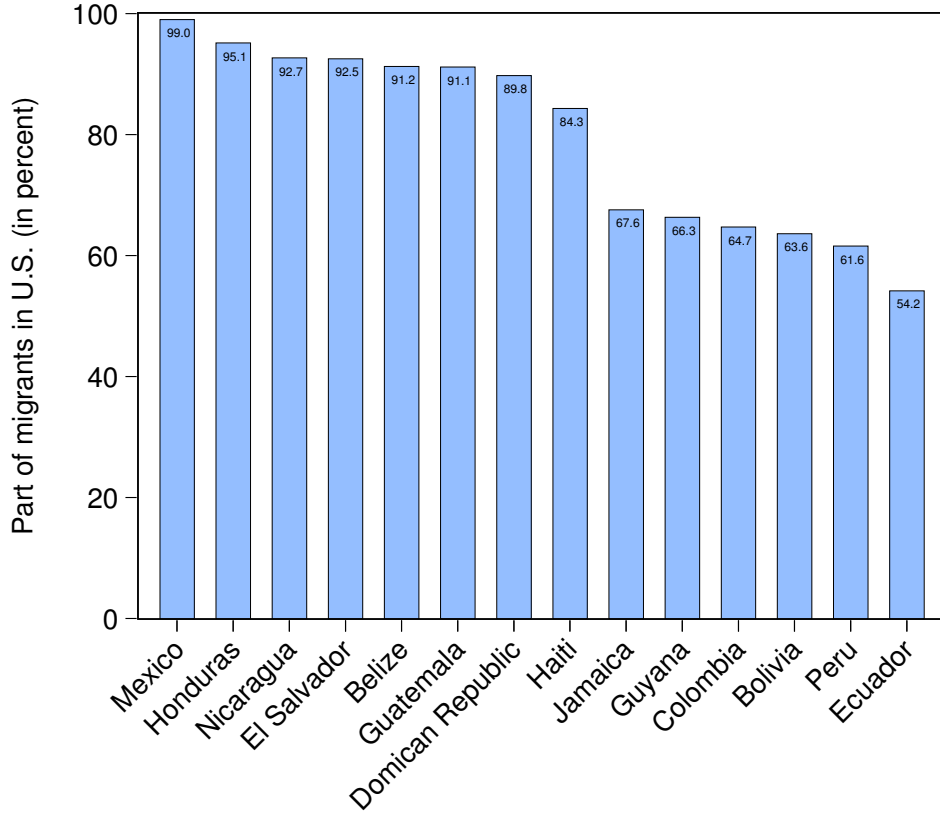
Notes: P-values are given in parentheses.

Table 2: Panel cointegration tests

Within-dimension		
	Statistic	p-value
Panel v test	-1.0084	0.2399
Panel rho test	2.6187	0.1129
Panel non parametric test	1.9190	0.0633
Panel parametric test	1.0734	0.0734
Between-dimension		
	t-stat	p-value
Group rho test	4.1120*	0.1001
Group non parametric test	2.1241*	0.1418
Group parametric test	1.0593	0.2276

Notes: P-values are given in parentheses.

Figure 4: Part of migrants in U.S.



Source: Database on Immigrants and Expatriates (OECD).

## 4 Econometric methodology

The impulse response functions (IRFs) and variance decompositions (VDC) are computed from the panel VAR. As mentioned above, the panel VAR approach allows to benefit both for the advantages of VAR approach and panel techniques. The VAR approach addresses the endogeneity problem by allowing endogenous interactions between the variables in the system. The panel techniques tackle the problem of data limitation by taking the data from various countries and the asymptotic results are easier to derive for panel data.

The initial econometric model takes the following reduced form:

$$Y_{it} = \Gamma(L)Y_{it} + u_i + \epsilon_{it} \quad (14)$$

$Y_{it}$  is a vector of stationary variables including:  $\Delta \ln(U.S. GDP)$ ,  $\Delta U.S. FFR$ ,  $\Delta \ln(REM)$  and  $\Delta \ln(Home GDP)$ .  $\Gamma(L)$  is a matrix polynomial in the lag operator with  $\Gamma(L) = \Gamma_1 L^1 + \Gamma_2 L^2 + \dots + \Gamma_p L^p$ ,  $u_i$  is the country specific effect and  $\epsilon_{it}$  is idiosyncratic error.

An issue in estimating this model concerns the presence of fixed effects. Since fixed effects are correlated with the regressors due to lags of the dependent variable, following Love and Zicchino (2006), forward mean differencing (the Helmert procedure) is used in order to remove the fixed effects. In this procedure, all variables in the model are transformed to deviations from forward means. Let  $\bar{y}_{it}^m = \sum_{s=t+1}^{T_i} y_{is}^m / (T_i - t)$  denotes the means constructed from the future values of  $y_{it}^m$  a variable in the vector  $Y_{it} = (y_{it}^1, y_{it}^2, \dots, y_{it}^M)'$ , where  $T_i$  denotes the last period of data available for a given country series. Let  $\bar{\epsilon}_{it}^m$  denotes the same thing of  $\epsilon_{it}^m$ , where  $\epsilon_{it} = (\epsilon_{it}^1, \epsilon_{it}^2, \dots, \epsilon_{it}^M)'$ . The transformations are given by:

$$\tilde{y}_{it}^m = \delta_{it}(y_{it}^m - \bar{y}_{it}) \quad (15)$$

and

$$\tilde{\epsilon}_{it}^m = \delta_{it}(\epsilon_{it}^m - \bar{\epsilon}_{it}^m) \quad (16)$$

where  $\delta_{it} = \sqrt{(T_i - t) / (T_i - t + 1)}$ . For the last year of data, this transformation cannot be calculated, since there are no future value for the construction of the forward means. The final transformed model is thus given by:

$$\tilde{Y}_{it} = \Gamma(L)\tilde{Y}_{it} + \tilde{\epsilon}_{it} \quad (17)$$

where  $\tilde{Y}_{it} = (\tilde{y}_{it}^1, \tilde{y}_{it}^2, \dots, \tilde{y}_{it}^M)'$  and  $\tilde{\epsilon}_{it} = (\tilde{\epsilon}_{it}^1, \tilde{\epsilon}_{it}^2, \dots, \tilde{\epsilon}_{it}^M)'$

This transformation is an orthogonal deviation, in which each observation is expressed as a deviation of average future observations. Each observation is weighed to standardize the variance. If the original errors are not autocorrelated and have a constant variance, the transformed errors should exhibit similar properties. Thus, this transformation preserves homoscedasticity and does not induce serial correlation (Arellano and Bover, 1995). The lagged values of regressors are used as instruments to estimate the transformed model by the generalized method of moments (GMM).

After estimating the parameters of the panel VAR, the impulse response functions (IRFs) and the variance decomposition (VDC) are computed using

the Cholesky decomposition.<sup>4</sup> The assumption behind the Cholesky decomposition is that series listed first in the VAR order impact the other variables contemporaneously, while series listed later in the VAR order impact those listed first only with lag. Therefore, variables listed first in the VAR order are considered to be more exogenous. The U.S. GDP is placed first in the ordering, followed by the U.S. FFR. This ordering structure implies that innovations in the U.S. GDP can contemporaneously influence the implementation of monetary policy by the Federal Reserve. While, changes in the U.S. FFR will impact the U.S. GDP only with a lag. Remittances is placed after the U.S. variables and home GDP is placed last in the ordering. Then remittances are assumed to contemporaneously impact home GDP, while remittances respond to home GDP only with a lag. The robustness analysis shows that changing this ordering does not significantly impact the results.

## 5 Empirical results

This section presents the impulse response functions and the variance decomposition from the panel VAR. The correct lag length selection is essential for a VAR model: too short lags fail to capture all the system's dynamics, resulting from omitted variable bias; while too many lags suffer from a loss of degrees of freedom, because of over-parametrization. The Akaike Information Criterion (AIC) and the Schwarz Bayesian Criterion (SBS) indicate more than three lags as the appropriate lags for most countries. Two lags and three lags are better than one lag, and three lags are better than two lags. Greater lags than three are not possible due to a nearly singular matrix of determinants. Using the maximal lag as possible two lags are chosen. Then, the estimated panel VAR is the following:

$$\begin{pmatrix} \Delta \ln(U.S.GDP) \\ \Delta U.S.FFR \\ \Delta \ln(REM) \\ \Delta \ln(HomeGDP) \end{pmatrix} = \Gamma_1 \begin{pmatrix} \Delta \ln(U.S.GDP)(-1) \\ \Delta U.S.FFR(-1) \\ \Delta \ln(REM)(-1) \\ \Delta \ln(HomeGDP)(-1) \end{pmatrix} + \Gamma_2 \begin{pmatrix} \Delta \ln(U.S.GDP)(-2) \\ \Delta U.S.FFR(-2) \\ \Delta \ln(REM)(-2) \\ \Delta \ln(HomeGDP)(-2) \end{pmatrix} + \begin{pmatrix} \epsilon_1 \\ \epsilon_2 \\ \epsilon_3 \\ \epsilon_4 \end{pmatrix}$$

The estimate results of the 4-variable panel VAR(2) are given in Table 3. The IRFs are displayed in Figures 5 and 6. The VDC results are reported in Tables 4 and 5

Figure 5 shows that remittances positively respond to a shock on U.S. GDP, but negatively respond to a shock on U.S. FFR. The response of remittances to U.S. GDP is significant until at least seven years, and the response

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<sup>4</sup>The panel VAR is estimated by using the package provided by Inessa Love. This package is a Stata programs for Love (2001) and it is used in Love and Zicchino (2006).

Table 3: Estimate results of 4-variable panel VAR(2) model

	$\Delta \ln(U.S.GDP)$	Dependent variables		
		$\Delta U.S.FFR$	$\Delta \ln(REM)$	$\Delta \ln(HomeGDP)$
$\Delta \ln(U.S.GDP)(-1)$	0.862 (8.07)***	0.695(8.07)***	5.821(1.95)**	0.325(1.17)
$\Delta \ln(U.S.GDP)(-2)$	0.278(3.56)***	-0.157(-1.06)	8.148(2.46)**	0.813(1.99)**
$\Delta U.S.FFR(-1)$	-0.632(-4.94)***	0.315(3.95)***	-6.999(-2.14)**	0.470(1.34)
$\Delta U.S.FFR(-2)$	-0.089(-1.84)*	-0.141(-1.66)*	-0.757(-0.39)	0.356(2.18)**
$\Delta \ln(REM)(-1)$	0.004(1.46)	-0.001(-0.509)	0.128(1.988)**	0.014(2.51)**
$\Delta \ln(REM)(-2)$	0.002(0.86)	0.000(0.64)	-0.028(-0.51)	-0.004(-0.63))
$\Delta \ln(HomeGDP)(-1)$	(0.080)(2.21)**	0.033(1.05)	1.709(1.64)**	0.231(2.69)***
$\Delta \ln(HomeGDP)(-2)$	0.034(0.90)	0.021(0.635)	0.728(0.69)	0.016(0.18)
N obs	217			

The 4-variable panel VAR (2) model is estimated by GMM, country fixed effects are removed prior to estimation (by forward mean differencing). Reported numbers show the coefficients of regressing the column variables on lags of the row variables. Heteroskedasticity adjusted t-statistics are in parentheses. \*, \*\*, \*\*\*, indicate significance at 10%, 5% and 1% level, respectively.

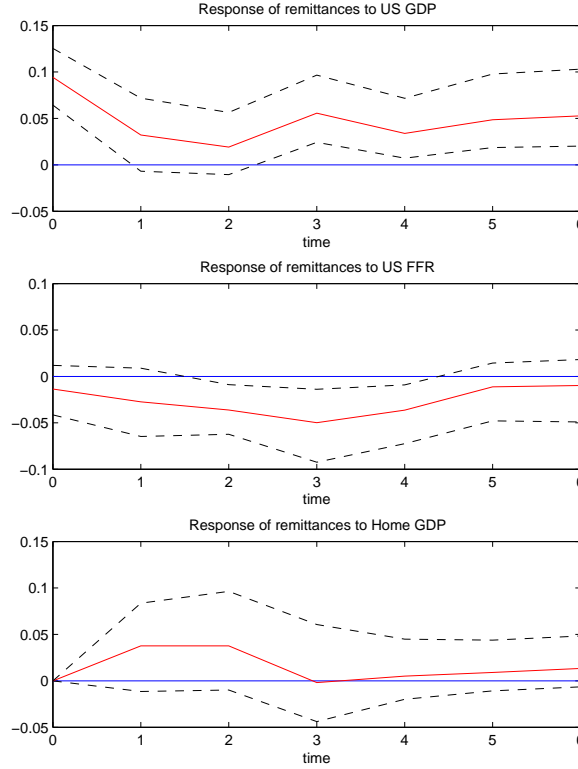
of remittances to U.S. FFR is significant until four periods. The response of remittances to a shock on home GDP is insignificant. The variance decomposition results in Table 4 confirms these findings. The results in Table 4 show that U.S. GDP and U.S. FFR explain about 26 and 7% of the fluctuations in remittances after 10 years, respectively. While home GDP explains only 4% of the fluctuations in remittances after ten years.

For robust analysis, the IRFs and the VDC are re-evaluated by changing the ordering in the VAR. In this new ordering, home GDP is placed before remittances, thus remittances is the last variable in the system. For this new ordering, the impulse response functions are displayed in Figure 6 and the variance decomposition results are reported in Table 5. The results from this new ordering are not significantly different to those before.

The results can be interpreted as follow. An increase in U.S GDP reflecting an improvement of migrant economic situation leads to an increase in remittances sent from the U.S. An increase in U.S. FFR reflecting a monetary contraction leads to a decrease U.S. output and to a decrease in remittances sent from the U.S. The fact that remittances do not respond to home income can be interpreted as the combining of altruistic and self-interested motives leading to a mitigated effect.

To sum up, host economic conditions are an important factor driving remittance cycles while home economic conditions do not have a significant influence on remittances. This result is line with previews studies using macroeconomic variables (El-Sakka and McNabb, 1999; Lianos, 1997; and, Huang and Vargas-Silva, 2006). As mentioned above, El-Sakka and McNabb (1999)

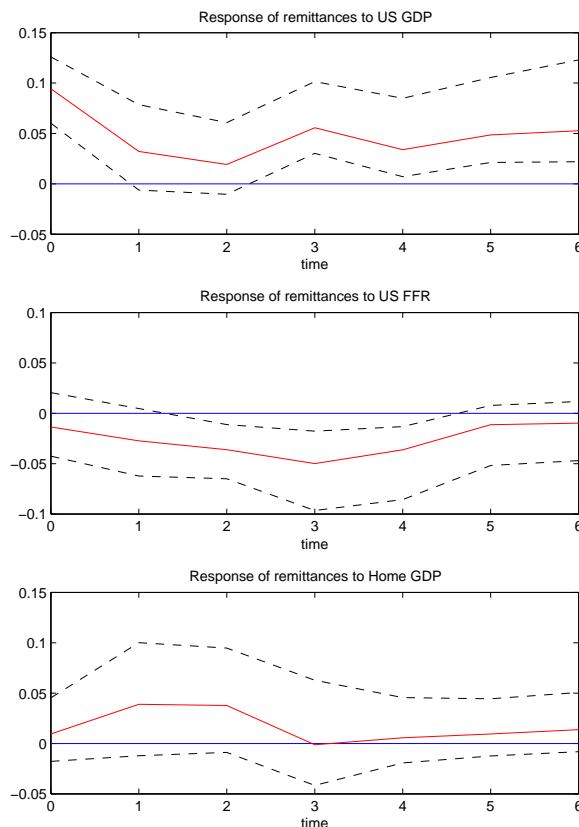
Figure 5: Impulse responses of remittances



Notes: Estimated regressions use two lags of each variable. The Cholesky decomposition ordering is:  $\Delta \ln(U.S. GDP)$ ,  $\Delta U.S. FFR$ ,  $\Delta \ln(REM)$ ,  $\Delta \ln(Home GDP)$ . The solid line shows the response of remittances to a shock on variables in the system. The dashed lines indicate five standard confidence band around the estimate. Error are generated by Monte-Carlo with 500 repetitions

and Lianos (1997) found a positive impact of host GDP on remittances, but no significant impact of home GDP. Particularly, the findings from this paper are very related to the results from the vector autoregressive analysis by Huang and Vargas-Silva, 2006. Using average data on Brazil, Colombia, the Dominican Republic, El Salvador, Mexico, Huang and Vargas-Silva, 2006 found that that remittances respond more to changes in the macroeconomic conditions of the U.S., than to changes in the macroeconomic conditions of the home country. The results from this paper are also in line with the results in Sayan (2006). The paper by Sayan (2006) examines the link between remittances and business cycles of 12 developing countries over the period 1976-2003. The results from this study suggest evidence that the cyclical

Figure 6: Impulse responses of remittances (changing in VAR ordering)



Notes: Estimated regressions use two lags of each variable. The Cholesky decomposition ordering is:  $\Delta \ln(U.S. GDP)$ ,  $\Delta U.S. FFR$ ,  $\Delta \ln(REM)$ ,  $\Delta \ln(Home GDP)$ . The solid line shows the response of remittances to a shock on variables in the system. The dashed lines indicate five standard confidence band around the estimate. Error are generated by Monte-Carlo with 500 repetitions

property of remittances depends on country under consideration.

These results suggest some important policy implications. First, since remittances seem to not respond to home economy conditions, if remittances-receiving countries want to receive more remittances they should consider individual and demographic variables (Huang and Vargas-Silva, 2006). Second, in their planning for future growth of remittances, labor-exporting countries should explicitly account for future economic prospects of the major destination countries of their emigrants.

Table 4: Variance decomposition of remittances in Model 1

Percentage of the variation in remittances explained by			
Horizon	U.S. GDP	U.S. FFR	Home GDP
2	13.49	0.1	0.02
5	17.08	7.11	3.37
10	25.66	7.10	4.07

Notes: estimated regressions use two lags of each variable. The Cholesky decomposition ordering is:  $\Delta \ln(U.S. GDP)$ ,  $\Delta U.S. FFR$ ,  $\Delta \ln(REM)$ ,  $\Delta \ln(Home GDP)$ .

Table 5: Variance decomposition of remittances in Model 2

Percentage of the variation in remittances explained by			
Horizon	U.S. GDP	U.S. FFR	Home GDP
2	13.49	1.27	2.17
5	16.27	5.74	3.67
10	25.66	7.10	4.32

Notes: estimated regressions use three lags of each variable. The Cholesky decomposition ordering is:  $\Delta \ln(U.S. GDP)$ ,  $\Delta U.S. FFR$ ,  $\Delta \ln(Home GDP)$ ,  $\Delta \ln(REM)$ .

## 6 Conclusion

This paper examines whether the host or the home country's economic conditions influence remittances flows. To conduct this empirical study, a panel VAR approach is employed in order to benefit from both the advantages of VAR approach and panel techniques. Annual data over the period 1990-2007 from 14 Latin American and Caribbean countries (Belize, Bolivia, Colombia, Dominican Republic, Ecuador, El Salvador, Guatemala, Guyana, Haiti, Honduras, Jamaica, Mexico, Nicaragua and Peru). These 14 countries were selected in order to consider the U.S. as the only host country, since the U.S. is the major destination of migrant from these countries. The results from this paper show evidence that host economic conditions seem to be an important factor driving remittances cycles, while home economic conditions do not have a significant influence remittances.

These results have some important policy implications. First, since remittances do not respond to home economic conditions, if recipients countries want to receive more remittances, they should pay attention to individual and demographic variables rather than home macroeconomic variables (Huang and Vargas-Silva, 2006). Second, in their planning for future growth of remittances, remittances recipient countries should explicitly take into account

future economic prospects in the major destination countries of their emigrants. In other words, receiving countries should figure out that remittances is another channel through which host economy shocks transmit. This is particularly relevant for countries that receive a high amount of remittances.

Since remittances are explained by exogenous factors that are independent of home business cycles, and, since remittances can impact home economy, remittance shocks can be considered as a source of fluctuations of home economy. This should be the goal of the future research.

# Appendix

## A.1 Countries included in the sample

These fourteen home countries are: Belize, Bolivia, Colombia, Dominican Republic, Ecuador, El Salvador, Guatemala, Guyana, Haiti, Honduras, Jamaica, Mexico, Nicaragua and Peru. The United States is the only host country.

## A.2 Variables and their sources

This appendix provides the definition and data sources for the variables used in the regressions that are reported in this paper.

- Remittances: Sum of worker's remittances, migrant transfers in real terms (constant 2000 US\$). The data source is World Development Indicator (World bank).
- Home GDP: Real GDP per capita (constant 2000 US\$) of home country. The data source is World Development Indicator (World Bank).
- U.S (Host) GDP:Real GDP per capita (constant 2000 US\$) of United States. The data source is World Development Indicator (World Bank).
- U.S. FFR: U.S. Federal Funds Rate. The data source is International Financial Statistics (International Monetary Fund).

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