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Ball, Christopher and Lopez, Claude and Reyes, Javier

Quinnipiac University, Banque de France, University of Arkansas

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Christopher P. Ball (Quinnipiac University)
Claude Lopez (Banque de France)
Javier Reyes (University of Arkansas)

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Abstract

Remittances are private monetary transfers across borders and thus, often, involve different currencies. Yet the rapidly growing literature on the subject often ignores the role that exchange rate regimes play in determining the effect foreign-currency remittances have on a recipient economy. This paper uses a theoretical model and panel vector autoregression techniques to understand the effect of remittances on GDP, inflation, real exchange rate and money supply, depending on the exchange rate regimes. Furthermore, it allows a more detailed description of the short-run dynamics as it considers yearly but also quarterly data for 21 emerging countries. Our theoretical model predicts that remittances should temporarily increase inflation, GDP, the domestic money supply and appreciate the real exchange rate under a fixed regime, but temporarily decrease inflation, increase GDP, appreciate the real exchange rate and generate no change in the money supply under a flexible regime. These differences are largely borne out in the data. This adds to our understanding of the true effect of remittances on economies by showing that exchange rate regimes matter for the effects of remittances, especially in the short run for monetary conditions in an economy, and suggests that other results in the literature that do not control for regimes may be biased.

JEL Classification: F22 - International Migration; F33 - International Monetary Arrangements and Institutions; F41 - Open Economy Macroeconomics; C32 - Time-Series Models; C33 - Models with Panel Data

I. Introduction

Remittance flows are large, growing, and important for many economies. Beyond the increase in absolute terms, remittances have gained in importance relative to other flows. Indeed, Figures 1 and 2 show that remittances exceed foreign direct investment for many countries and are relatively large capital flows. Hence, understanding the impact of remittances on variables such as inflation and gross domestic output (GDP) is essential for policy makers of recipient economies as these are the critical components in policy response functions.

[INSERT FIGURES 1 AND 2]

The recent debate about the effects of remittances mostly focuses on the terms of trade. Works such as Amuedo-Dorantes and Pozo (2004), Bourdet and Falck (2006) and Lopez, Molina, and Bussolo (2007) show that remittances have an inflationary effect and lead to a real exchange rate appreciation (a.k.a., “the Dutch disease”).[1] Most recently, Narayan, Narayan, and Mishra (2011) investigate the short-run and long-run effects of remittances and institutional variables on inflation across 54 developing countries and confirm the inflationist effect of remittances. Yet, all these studies assume that the countries follow an unchanged exchange rate regime, which is a rather strong assumption: Table 1 shows that each one of the countries studied have observed at least one change in regime for the periods considered.[2]

As an alternative, Caceres and Saca (2006) explicitly controls for changes in the exchange rate regime when studying the impact of remittances. Yet, they focus on El Salvador’s economy while the country remains in a fixed regime and their findings confirm the inflationary effect of remittances.

[INSERT TABLE 1]

Other studies, such as Chami, Cosimano, and Gapen (2006), Acosta, Lartey, and Mandelman (2007), and Jansen, Naufal and Vacaflores (2007) use dynamic stochastic general

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[1] These results are consistent with the findings of other studies, such as Rajan and Subramanian (2005), focusing on foreign aid and growth.

[2] Most of the countries studied in Narayan, Narayan, and Mishra (2011) are already in Table 1.

equilibrium (DSGE) analysis to investigate the effect of a change in remittances on an economy and have reached similar conclusions regarding the positive effects of increases in remittances on inflation. However, the calibration of their models also assumes no change in the exchange rate regime while many of the countries studied display changes in regimes for the periods considered, as shown in Table 2.

Finally, Lartey (2008), looking at capital inflows in general, focuses on the short-run monetary effects of inflows under a fixed exchange rate regime and an interest-rate-rule-based flexible regime.[3] Interestingly, his DSGE simulations show that the optimal monetary policy in small open economies facing capital inflows, is an interest-rate-based regime that also responds to the short-run fluctuations in the nominal exchange rate.

While the literature has offered some consensus regarding the inflationary impact of remittances, these findings emerged from studies assuming an unchanged exchange rate regime for all the emerging countries observed. Ignoring the exchange rate regime and its potential changes may very well lead to spurious results.

[INSERT TABLE 2]

In this paper, we explicitly include the exchange rate regime when analyzing the impact of remittances on the economy. Furthermore, we use both quarterly and annual data in order to understand better the short-run effects (i.e at less than annual frequency) of a change in remittances on inflation, money supply, GDP and the real exchange rate. Unlike Lartey, Mandelman, and Acosta (2008) we focus on the monetary nature of remittance inflows.[4] Furthermore, we go beyond Lartey (2008) as we clearly focus on remittances themselves, include flexible exchange rate regimes explicitly and take the theoretical predictions to data.

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[3] To understand the difference between an interest-rate-rule-based regime like most inflation targeting regimes in general and a flexible exchange rate regime in particular see Ball and Reyes (2008).

[4] Lartey, Mandelman, and Acosta (2008) focus solely on understanding the real exchange rate appreciation that often results from remittance inflows. In doing this, they consider the role of exchange rate regimes in affecting the path of the real exchange rate. They focus on the actual production of traded and non-traded goods in the economy and employ annual sector-level production data.

The theoretical section derives clear predictions regarding the effects of remittances on inflation, GDP, Real Exchange Rate (RER), and nominal money supply. Under a fixed exchange rate regime, increased remittance flows temporarily increase the rate of inflation, GDP, the nominal money supply and cause RER appreciation. In contrast, under a flexible regime, increased remittance flows temporarily decrease the rate of inflation, increase GDP and cause the RER to appreciate but do not have any impact on the nominal money supply. Clearly, the model suggests that remittance flows are inflationary only under a fixed exchange rate.

The empirical section investigates the accuracy of the theoretical predictions using yearly and quarterly data for 21 emerging countries for the 1980-2010 period. Our findings highlight two key points. First, the data frequency matters. Indeed, a large portion of the responses occurs within the first year, which the yearly data is unable to capture. Second, the exchange rate regime matters. The impulse response functions (IRFs) derived from the panel vector autoregressive analysis support the theoretical predictions, confirming the increase in GDP for both regimes but showing a clear difference in responses for the other variables, especially for inflation and money supply. Such empirical evidence emphasizes the importance of accounting for the exchange rate regime when investigating the impact of remittances on the economy and when developing economic policies in order to deal appropriately with the repercussions of remittances.

The rest of the paper is organized as follows. Section 2 describes the theoretical model and its predictions. Section 3 focuses on the empirical analysis. Finally, Section 4 concludes.

II. A Monetary Model for Remittances

The model imagines a representative individual that maximizes utility based on consumption of traded and non-traded goods as well as money services. The utility function is assumed separable in all of its components and over time.

$$U\left(c_t^T, c_t^N, m_t\right) = \int_0^\infty \left[\gamma \log(c_t^T) + (1-\gamma)\log(c_t^N) + \alpha \log(m_t)\right] e^{-\rho t} dt \qquad (1)$$

where c_t^T, c_t^N, and $m_t\left(\equiv M_t / E_t\right)$ denote consumption of the traded good and the non-traded good, and real money balances in terms of the traded good, respectively. *M* is the nominal stock of money and *E* is the nominal exchange rate. The law of one price holds for tradable goods and the foreign price for the traded good is equal to one so E is the price of the traded good.

Individuals can hold internationally traded assets yielding the constant world interest rate, *r*, earn income from the sale of traded and non-traded goods, receive/give transfers to the government and receive exogenous foreign-currency remittances from abroad.[5] This is expressed in the following flow budget constraint

$$\dot{a}_t = ra_t + y_t^T + \frac{y_t^N}{e_t} + \tau_t - c_t^T - \frac{c_t^N}{e_t} - i_t m_t + f_t \tag{2}$$

where y_t^T represents the traded good, y_t^N, the non-traded good, $e_t\left(\equiv E / P_N\right)$, the real exchange rate, a_t, net asset holdings, τ_t, government transfers and, f_t, the value of remittances. P_N is the price of the non-traded good.

Production in this economy uses a single input: labor.[6] Full employment is assumed throughout so that total employment is the sum of the levels in each sector. Total employment is set to unity and l_t represents employment in the traded good sector, leaving $1-l_t$ in the non-traded sector. The production functions in each sector are:

$$y_t^T = A_t l_t^{\alpha} \qquad 0 < \alpha \leq 1 \tag{3.a}$$

and

[5] We assume exogenous remittance flows for a number of reasons. First, there is no consensus in the literature on how they are endogenous with respect to the domestic economy. Modeling remittances as depending positively or negatively on either domestic output or the real exchange rate would reflect a bias that is not founded on any empirical or theoretical grounds. This is similar to modeling a stochastic variable as being uniformly distributed when one has no reliable information on its true distribution. Second, as shown in Section 5, the exogeneity assumption does not drive our empirical results. Finally, we are interested on the nominal effects of an increase in remittances and the degree to which exchange rate regimes matter in determining those effects. To that end, why remittances increase is much less important than the increase itself.

[6] Including labor this way was inspired by Chapter 4 of Carlos A Végh's manuscript under preparation for his forthcoming book, current version (2007).

$$y_t^N = B_t \left(1 - l_t\right)^{\beta} \qquad 0 < \beta \leq 1 \tag{3.b}$$

where A_t and B_t represent technology parameters and the production functions are concave.

Individuals maximize (1) subject to (2), (3.a), and (3.b). Doing so yields the following optimality conditions.

$$\frac{\gamma}{c_t^T} = \lambda \tag{4}$$

$$\frac{1-\gamma}{c_t^N} = \frac{\lambda}{e_t} \tag{5}$$

$$\frac{\alpha}{m_t} = \lambda i_t \tag{6}$$

$$\alpha A_t l_t^{\alpha-1} = \frac{\beta B_t \left(1-l_t\right)^{\beta-1}}{e_t} \tag{7}$$

Equations (4) and (5) are the typical consumption equations for optimization. Expression (6) is the optimality condition for real money balances showing that money must vary inversely with the nominal interest rate and the marginal utility of consumption. Equation (7) states that the marginal productivity of labor must be equal across the two sectors of the economy, a result that follows from assuming perfect labor mobility within the country.

Combining (4) and (5) yields an expression for the real exchange rate that must hold at all points in time.

$$e_t = \frac{c_t^N}{c_t^T}\left(\frac{\gamma}{1-\gamma}\right) \tag{8}$$

For later reference, combining (4) and (6) yields an expression for real money demand in terms of the traded good,

$$m_t = \frac{\alpha}{\gamma}\frac{c_t^T}{i_t}\,. \tag{9.a}$$

Likewise, (5) and (6) yield real money demand in terms of the non-traded good

$$n_t = \frac{\alpha}{1-\gamma}\frac{c_t^N}{i_t} \qquad (9.b)$$

where $n\left(\equiv M/P_N\right)$.

i. Equilibrium Conditions

Interest parity requires

$$i_t = i_t^* + \varepsilon_t \qquad (10)$$

where i represents the domestic nominal interest rate, i^* the foreign (world) interest rate and, ε, the depreciation rate of domestic currency.

Market clearing in the non-traded goods market implies

$$y_t^N = c_t^N \qquad \textit{for all } t. \qquad (11)$$

In a perfect foresight equilibrium, traded and non-traded good consumption are both constant. That traded consumption is constant follows from (4). To show that home good consumption is constant requires the real exchange rate also be constant in equilibrium. We posit this here and include a proof in the Mathematical Appendix. Thus, in equilibrium, $e_t = \overline{e}$, $y_t^N = \overline{y}$, and $c_t^N = \overline{c}^N$.

Government revenue from money creation is given back to individuals via government transfer, τ, and this leads to the economy's overall resource constraint:

$$\dot{k}_t = rk_t + y_t^T + f_t - c_t^T \qquad (12)$$

where k is the sum of asset holdings of individuals, a, plus official asset holdings (reserves) of the government (central bank), h, therefore $k \equiv a + h$.

Rearranging and integrating (12) forward yields an expression for the traded good consumption in equilibrium.

$$\bar{c}^T = rk_0 + \bar{y}^T + \bar{f}\ , \tag{13}$$

which says traded good consumption depends on the flow of returns from the initial asset holdings, the constant flow of remittances and traded good production. It is known to be constant (piecewise linear) by (4).

Combining (13) and (11) with (8) yields an expression for the equilibrium real exchange rate.

$$\bar{e} = \frac{y^N}{rk_0 + y^T + f} \cdot \frac{\gamma}{1-\gamma} \tag{14}$$

where y^N and y^T are given by (3.a) and (3.b).

ii. Monetary Regimes and Economic Dynamics

To generate dynamics in this model, we assume that non-traded good prices adjust according to a Calvo-type (Calvo, 1983) pricing mechanism.

$$\dot{\pi}_t = -\theta\left(y_t^N - \bar{y}^N\right) \qquad \theta > 0 \tag{18}$$

where $\bar{y}^N$ is the steady state level of non-traded good production and θ is a constant parameter. Under this formulation the non-traded good price level is pre-determined at every point in time, but the rate of change of the non-traded good price level – i.e., "the inflation rate" – is not. In the short-run, output is assumed to be demand determined so that non-traded goods market equilibrium as described by (11) is maintained at all times.[7]

Fixed Exchange Rate Regime (FIX)

Under a FIX the initial level of the nominal exchange rate, $\bar{E}_0$, and its rate of change, $\bar{\varepsilon}$, are set by the central bank. The central bank maintains this regime by adjusting international reserve levels (and hence the nominal money supply) endogenously. By interest parity, constant currency depreciation implies that the nominal interest rate is constant in this regime, $\bar{i} = i^* + \bar{\varepsilon}$. By (9.a), in steady state, $\mu = \bar{\varepsilon}$ where μ is the rate of nominal money supply growth.

[7] Note that this is actually Calvo's (1983) original formulation which was done in continuous time.

The economy's behavior is governed by the following two differential equations.

$$\dot{\pi}_t = \theta\left(\bar{y}^N \;\; \bar{l} \;\; - \frac{1-\gamma}{\gamma} \cdot e_t \bar{c}^T \right) \tag{19}$$

$$\dot{e} = e_t(\bar{\varepsilon} - \pi_t) \tag{20}$$

where $\bar{y}^N \;\; \bar{l} \;\; = B \;\; 1 - \bar{l} \;\; ^{\beta}$. Thus, changes in the steady state employment allocation change the steady state level of non-traded good production. (19) governs the control and (20) the state variable in this economy.

Result 1. Under a fixed exchange rate regime, an increase in remittances generates an increase in inflation. For a proof see the Mathematical Appendix.

Result 2. Under a fixed exchange rate regime, an increase in remittances generates an increase in the nominal money supply. For a proof see the Mathematical Appendix.

[INSERT FIGURE 3]

Figure 3 is the phase diagrammatic representation of the model under a FIX, the dynamics of which are described by equations (19) and (20). In Figure 3, the economy's initial steady state is at point A. Since increased remittances always lead to an appreciation of the real exchange rate (i.e.,the "Dutch disease"), the final steady state must have a lower real exchange rate, $e_t\left(\equiv E/P_N \right)$. Under a FIX regime, the nominal exchange rate, *E*, is constant while an increase in home goods prices leads to a fall in *e* during the transition. More specifically, the initial impact of increased remittance flows is an increase in real money demand. Since output is demand determined in this model and real money demand reflects the representative individual's underlying demand for goods and services, the increase in real money demand results in an increase in GDP. The central bank responds by increasing the nominal money supply to offset the increase in money demand and maintain equilibrium in the money market, leaving the nominal interest rate and exchange rate unchanged as required by the FIX regime, leading to Result 2.

Upon impact, inflation jumps upward to point B, leaving the real exchange rate unchanged. This generates the home good price dynamics necessary to reach the new steady state. As the economy adjusts to the new level of inflows, the real exchange rate and inflation fall continuously which leads to Result 1 throughout transition. In the new steady state, point C, inflation returns to its initial level and the real exchange rate is at a lower level.

Flexible Exchange Rate Regime (FLEX)

Under a FLEX the initial level, $\bar{M}_0$, and the rate of growth of the nominal money supply, $\bar{\mu}$, are set by the central bank. The central bank maintains the regime by allowing the nominal exchange rate to adjust endogenously. By $\dot{m} = m(\bar{\mu} - \varepsilon_t)$ and $\dot{m} = 0$, it follows that $\bar{\mu} = \varepsilon$ in steady state. Likewise, constant currency depreciation implies by interest parity that the nominal interest rate is constant, $\bar{i} = i^* + \bar{\varepsilon}$, in steady state.

The system's dynamics are captured in terms of real money balances, of the non-traded good, $n \equiv M / P^N$, and the non-traded good inflation rate, π. Under a FLEX, n is a predetermined variable since M is exogenous and constant and P^N is predetermined. π remains a control variable. Differentiating the definition of real money balances with respect to time yields

$$\dot{n}_t = n_t(\bar{\mu} - \pi_t). \tag{21}$$

Using (8) and (9.a), substitute into (18) for c^N and rearrange to obtain

$$\dot{\pi}_t = \theta\left(\bar{y}^N(\bar{l}) - \frac{1-\gamma}{\alpha} i_t n_t\right) \tag{22}$$

where, again, $\bar{y}^N(\bar{l}) = B(1-\bar{l})^{\beta}$.

Result 3. Under a flexible exchange rate regime, an increase in remittances generates a decrease in inflation. For a proof see the Mathematical Appendix.

Result 4. Under a flexible exchange rate regime, an increase in remittances implies no change in the nominal money supply, by assumption.[8]

[INSERT FIGURE 4]

Figure 4 is the phase diagrammatic representation of the model under a FLEX, the dynamics of which are described by equations (21) and (22). In Figure 4, the economy's initial steady state is at point A. Since increased remittances always lead to an appreciation of the real exchange rate (i.e.,the "Dutch disease"), the final steady state must have a lower real exchange rate, $e_t\left(\equiv E/P_N\right)$. Under a FLEX regime, the nominal exchange rate, E, jumps to its new, lower steady state value immediately. P_N, a state variable, is slower to adjust. The initial impact of the increased remittance flow is an increase in real money demanded. Since output is demand determined and real money demand reflects the representative individual's underlying demand for goods and services, the increase in real money demand again results in an increase in GDP. Under a FLEX, the central bank does not respond by changing the nominal stock of money which leads to Result 4. The drop in the nominal exchange rate clears the real money market in terms of the traded good. But this leaves the real money balances in terms of the non-traded good, n, unchanged and thus the n-money market out of equilibrium (relatively to steady state). To reach the new steady state equilibrium in this market, real money balances, $n\left(\equiv M/P_N\right)$, must increase during transition. Since the nominal stock of money, M, remains constant, the price of non-traded goods must decrease. From a real economy perspective, this comes about because the nominal exchange rate fell, lowering returns to producing the traded good and thus encouraging a reallocation of resources from traded and into non-traded good production. This is an increase in non-traded good production relative to non-traded good demand and thus leads to a decline in the price of non-traded goods. Graphically, upon impact, inflation jumps downward to point B. This

[8] No formal proof here is needed since Result 4 holds by our assumptions of the flexible exchange rate regime. That is, we have assumed that the central bank holds the stock of nominal money constant and allows the nominal exchange rate to adjust.

generates the home good price dynamics necessary to reach the new steady state and leads to Result 3. Since the rate of nominal money stock growth is constant, real money balances, n, rise continuously throughout the transition. In the new steady state, point C, inflation returns to its initial level and real money balances are higher.

III. Empirical Analysis

i. Testable Predictions

The model predicts that the exchange rate regime matters most clearly for the inflation and money supply responses to an increase in remittances. Under a FIX, inflation rises, leading to the increase in money supply that offsets the increase in real money demand. Under a FLEX, inflation falls while the money supply remains unchanged, thereby generating an increase in real money demand. Finally, the model suggests that, under both regimes the real money demand, and thus GDP, increase in the short-run and that the real exchange rate always appreciates.

ii. Data Description

Our model suggests that the transition paths differ across regimes; hence the frequency of the data may matter. As a result, we consider annual and quarterly data for the CPI, nominal money supply (M2), real GDP, real effective exchange rate (REER) and remittances. It should be noted that an appreciation of the real exchange rate (RER) in the theoretical model is denoted by an increase of the REER empirically.

The annual data is collected from the World Development Indicators of the World Bank. Quarterly data on CPIs, and nominal money supplies are from the International Monetary Fund's International Financial Statistics. Real GDP, remittances and REER are from the central banks of each country.[9]

The exchange rate classifications are based on the monthly data found in Reinhart and Rogoff (2004) and Ilzetzki, Reinhart and Rogoff (2010).[10] We use the following four

[9] The original data is transformed into logarithms.
[10] Our final regime classification data is available upon request.

classifications: (1) “float/free float”, (2) “pegged in band/ managed float/other managed”, (3) “crawling peg, crawl-like, stabilization” and (4) “conventional peg, currency board”.[11] Our dummy variables are then constructed so that classification (1) is a float (FLEX) and classifications (2) – (4) are all considered fix (FIX). This reflects our view that only (1) reflects a truly floating regime and all others are degrees of intervention.[12] The period considered is 1980:1 to 2010:4.[13] We construct our quarterly data from the monthly using the following rule: if the regime is classified as FLEX for 2 or more months, then the quarter is classified as FLEX; otherwise, it is classified as FIX. We do similarly when constructing the annual data: if the regime is classified as FLEX for 2 or more quarters, then the year is classified as FLEX; otherwise, it is classified as FIX. Our sample includes a number of countries that have implemented multiple regime changes. For example, Ecuador, Indonesia, Mexico and Turkey present three regime switches during the time period considered.

To our knowledge, this is the first study to employ quarterly analysis of the impact of remittances on the economy. Focusing on a higher frequency can have several implications such as allowing for a more detailed description of the regimes. Higher frequency provides more information since each yearly observation is composed of four quarterly ones. This extra set of observations is key, especially when trying to understand the behavior of the economy under a FLEX, which is the less well represented regime in the sample. Higher frequency also allows one to capture within-year dynamics, which obviously cannot be done with yearly data. However there is a trade-off between more time-series information (higher frequency) and wider cross-sectional information (number of countries) since fewer countries report quarterly remittances. We select the countries with the most data under both frequencies and perform the analysis including 21 countries: Brazil, Bulgaria, Colombia, Costa Rica, Croatia, Czech Republic,

[11] We remove all uncertain regimes from our data.
[12] Our results are, however, robust to counting (1) and (2) as FLEX and (3) and (4) as FIX. The only exception is inflation under FLEX which is quite sensitive to the degree of flexibility of exchange rate. This comforts us in our choice of considering as FLEX only purely floating exchange rates. Results are available upon request.
[13] All data and exchange rate regime classifications are available upon request.

Dominican Republic, Ecuador, Egypt, El Salvador, Indonesia, Israel, Mexico, Moldova, Pakistan, Peru, Poland, Romania, Slovakia, Turkey, and Venezuela.

A preliminary investigation of the variables demonstrates that they are non-stationary, and not co-integrated.[14] Hence, our analysis focuses on the growth rates of inflation, real GDP, remittances, nominal money supply and on the changes in the REER.

iii. Methodology

To account for the variable endogeneity and benefit from the panel setting of the data, the empirical behavior of the variables is modeled using the Panel Vector Autoregressive approach.

The initial econometric model takes the following reduced form:

$$Y_{i,t} = \Gamma(L)Y_{i,t} + u_{i,t} \tag{23}$$

where $Y_{i,t}$ is the 5 x 1 dependent and endogenous vector of variables with $Y_{it} = [\Delta \ln(CPI_{i,t}), \Delta \ln(GDP_{i,t}), \Delta \ln(REER_{i,t}), \Delta \ln(Money_{i,t}), \Delta \ln(remittances_{i,t})]'$. $\Gamma(L)$ is a matrix polynomial in the lag operator (with $\Gamma(L) = \Gamma_1 L + \Gamma_2 L^2 + \ldots + \Gamma_s L^s$). $u_{i,t}$ is the model error.

Since the main argument of this paper is the impact of the different regimes – FIX and FLEX – on each variable, we include dummy variables to account for the exchange rate regime (D_{flex} for flexible and D_{fix} for fixed).[15] The exchange rate regimes are assumed to be exogenous. The econometric model becomes:

$$Y_{i,t} = \Gamma_{flex}(L)Y_{i,t}.D_{flex_{i,t}} + \Gamma_{fix}(L)Y_{i,t}.D_{fix_{i,t}} + u_{i,t} \tag{24}$$

We then derive the impulse response functions (IRFs) from Equations (23) and (24), relying on the Cholesky decomposition to orthogonalize the residuals. To do so, the variables must be ordered such that variables placed higher in the ordering have a contemporaneous impact on all variables lower in the ordering. Hence, the first variable should be the most exogenous. A

[14] The results are available upon request.

[15] In order to avoid any bias due to changes in regime, a regime change is accounted for only if it lasts a least 3 periods.

careful ordering of the variables allows identifying the response of inflation and money supply to a positive shock on remittances.

The theoretical model considers remittances as the most independent of the internal conditions of a country while they should have a large effect on the other variables. Although this assumption can be questioned based on the Granger Causality Test results presented in Table 3, where it can be seen that the nominal money supply, among others, granger causes remittances. Other studies, such as The World Bank (2006), have shown that remittances do respond to external factors that are independent of the country's internal conditions and, therefore, not considered in our model. These factors include, for example, a reduction in transaction costs in the country where migrants live, tightened security in the sending country which encourages migrants, especially those that are undocumented, to remit more, and economic conditions in the country where the migrant works. Given that the empirical exercise here is to test for differences between the effects that remittances have on the economy under a FIX versus a FLEX, we include remittances as the first variable in our ordering, while the ordering of the remaining variables differs depending on the exchange rate regime considered. Following our initial analysis, and based on the arguments and results of Amuedo-Dorantes and Pozo (2004), we consider an alternative ordering where remittances respond to changes in the REER as a check on our initial results.

[INSERT TABLE 3]

Under a FIX, the central bank must intervene to keep the nominal exchange rate stable. Hence, a change in remittances leads to a change real money demand, proxied here by GDP, and in the nominal money supply, then, in inflation and, finally, in the REER. The resulting orderings are thus:

$$Model1: \quad \Delta \ln(remittances_{i,t}), \Delta \ln(GDP_{i,t}), \Delta \ln(Money_{i,t}), \Delta \ln(Inflation_{i,t}), \Delta \ln(REER_{i,t})$$
$$Model2: \quad \Delta \ln(remittances_{i,t}), \Delta \ln(Money_{i,t}), \Delta \ln(GDP_{i,t}), \Delta \ln(Inflation_{i,t}), \Delta \ln(REER_{i,t})$$

Under a FLEX, the central bank does not intervene. Hence, a change in remittances leads to a change in real money demand (i.e., GDP) and in RER then in inflation and, finally, in the nominal money supply. The resulting orderings are:

$$\begin{aligned}
&Model\ \ 3: \quad \Delta\ln(remittances_{i,t}), \Delta\ln(REER_{i,t}), \Delta\ln(GDP_{i,t}), \Delta\ln(Inflation_{i,t}), \Delta\ln(Money_{i,t}) \\
&Model\ \ 4: \quad \Delta\ln(remittances_{i,t}), \Delta\ln(GDP_{i,t}), \Delta\ln(REER_{i,t}), \Delta\ln(Inflation_{i,t}), \Delta\ln(Money_{i,t})
\end{aligned}$$

iv. Estimation and Empirical Results

Since the time dimension (T = 30 for yearly data and 120 for quarterly data) of the panel is larger than the cross-sectional dimensions (N = 21), we estimate the system of equations using seemingly unrelated regression (SUR).[16] Yet, the consistency of the estimator relies on the absence of fixed effects and serial correlation in the error terms. The lag length of each panel is selected so there is no serial correlation remaining in the residuals. The SUR estimation and the generalized least square dummy variable (LSDV) estimation generate similar results allowing us to conclude that there are no fixed effects in the data.

Both equations (23) and (24) are estimated for each data set, at quarterly and annual frequencies. The resulting IRFs, reported in Figures 5 to 9 along with the corresponding 95% confidence intervals, show the impact of a change in remittances for the cases of combined and dissociated regimes, respectively. The IRFs under a FIX (FLEX) are robust to the ordering suggested by Models 1 and 2 (3 and 4), hence we report only a set of IRFs per regime.[17] It should be noted that there are not enough observations in the flexible regime case for a relatively reliable estimation on annual data.

The IRFs highlight the behavior of each variable depending on the regime considered and the frequency of the data. Table 4.a reports a statistically significant difference in the responses of inflation, and money supply to a change in remittances when using quarterly data and comparing across exchange rate regimes.

[16] Bun (2001) discusses in detail the case when T is larger than N.

[17] Similarly, the results are robust to the ordering when the data does not discriminate between the regimes

Table 4.b summarizes the theoretical predictions and our empirical results. At first glance, we clearly see that the IRFs based on quarterly data provide more information as more results are statistically significant. Focusing on quarterly IRFS, the empirical results are consistent with our theoretical predictions. Finally, they show that combining both regimes may be misleading: a FIX being more common than a FLEX, across the countries considered, drives the results when the regimes are not dissociated.

[INSERT TABLE 4]

A closer look at the IRFs allows a more detailed comparison of the results. Since our model predicts that only the paths for inflation and the money supply should significantly differ across exchange rate regimes, we focus on those two variables first. The annual results (Figures 5 and 6) and quarterly results (Figures 7, 8 and 9) are quite similar but the latter show stronger statistical evidence, hence we focus on them.

[INSERT FIGURES 5 and 6]

Figure 7 shows that, under a FIX, an increase in remittance inflows has a contemporaneous and positive impact on inflation that lasts 8 periods. The response of the money supply is also positive and remains significant for 3 periods. The REER and GDP both respond positively on impact.

Figure 8 reports that, under a FLEX, the impact of an increase in remittance inflows is negative on inflation, contemporaneous and positive for GDP and RER, and positive but very small and lagged on the money supply. Finally, a comparison of both Figures 7 and 8 with Figure 9, where controls for the regimes are ignored, confirms that ignoring the exchange rate regimes can lead to spurious results, at least in terms of understanding the effect of increased remittance flows on inflation (bottom left panel in all three figures).

[INSERT FIGURES 7, 8, and 9]

Overall, the variables' responses to increased remittances agree in direction and timing across the annual and quarterly results for the FIX regime.[18] Furthermore, the increase in frequency allows a better understanding of the short-run dynamic, which, in turn, presents the most significant responses in line with the theoretical prediction.

v. Theory versus Empirical Evidence and Further Discussion

The empirical results are consistent with our model's prediction for inflation, GDP, REER and broadly for the money supply as well:

- Under a FIX, we observe a positive change in inflation, GDP and the money supply and a REER appreciation.
- Under a FLEX, we observe a negative change in inflation, positive change in GDP and REER appreciation. While theory predicts no change in the money supply, we do observe a much smaller change in the money supply under a FLEX than a FIX. We interpret this result as being in the right direction in terms of magnitude across regimes (i.e., smaller under a FLEX) and as evidence that countries likely don't practice pure floating regimes in practice.

The results with respect to the real exchange rate are in line with the theoretical prediction in direction, yet there is no clear difference in magnitude. The lack of exogenity of remittances in the data is a potential explanation. Studies such as Amuedo-Dorantes and Pozo (2004) suggest that remittances may in part react to RER movements. To explore the role of such reverse causality for our results, we generate a new set of IRFs where REER is the most exogenous variable, followed by remittances and then the other variables in the same order as before.

Table 5.a confirms that, under the new ordering, the IRFs still statistically differ according to the exchange rate regime. These results are similar to Table 4.a. Finally, Table 5.b

[18] There is not enough data under the FLEX to obtain a meaningful results, while the case that does not account for exchange rate regimes is driven by the countries under a FIX.

summarizes the dynamic responses of inflation, money supply and REER which coincide with those reported in Table 4.b.[19]

[INSERT TABLES 5.a. AND 5.b]

The responses of GDP, inflation and the money supply are robust to the new ordering. However, the REER response changes noticeably and becomes insignificant. While this suggests that reverse causality may exist between remittances and the REER, it also implies that assuming exogenous remittances is not driving our results for inflation and the money supply.[20]

Our work argues theoretically and empirically that exchange regimes are important for understanding the effect of remittance inflows on small open economies. The responses of both inflation and the nominal money supply differ across regimes in accordance with theory, although this has been largely ignored in other studies.

Figure 9 suggests that, at this level of aggregation and frequency, the inflationary effects from fixed regimes tend to dominate in the data. This helps explain why works such as Caceres and Saca (2006), focusing on countries with a FIX, often emphasize the inflationary aspect of remittances, and studies such as Lopez, Molina and Bussolo (2007) focus attention on monetary policies to combat the inflationary effects of remittances. Our results thus hint at the likely direction of the bias in the estimates in the literature.

IV. Conclusions

Remittance flows to emerging markets have been increasing in recent years. For many countries, they exceed official flows, including foreign direct investment. The literature on remittances has focused on real effects and trade-theoretic models while deemphasizing the monetary nature of the transfers. Hence, the potential impact of exchange rate regimes and the short-run effects so critical for monetary policy decision makers has been largely ignored.

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[19] The corresponding IRFs and their 95% confidence interval are available upon request from the authors.

[20] Which is also confirmed by previously reported results using GDP as the most exogenous variable

In this paper, we aim to fill this gap by analyzing the responses of inflation, GDP, the RER, and the nominal money supply to changes in remittances, under different monetary regimes.

First, our work shows theoretically how exchange rate regimes matter and makes simple predictions. Under a fixed regime, increased remittance flows temporarily increase inflation, GDP, the nominal money supply and cause RER appreciation. Under a flexible regime, increased remittance flows temporarily lower inflation, increases GDP and cause RER appreciation.

Second, our work shows empirically how these predictions hold in the data. Using a panel vector autoregressive approach that controls for regime differences, we explore impulse response functions specific to each regime and to two different levels of frequency in the data: annual and quarterly. While most studies use annual data, to our knowledge, this is the first study to also use quarterly data for a panel with remittances. Our results highlight two key points. First, the data frequency matters since the biggest part of the responses to an increase in remittances occurs within the first year. Hence yearly data is unable to capture fully these short-run dynamics. Second, the theoretical predictions for inflation, RER, GDP and the money supply are largely borne out in the data, especially in the quarterly case, and our results are robust to the potential for reverse causality between the real exchange rate and remittances. As a result, we conclude that the impact of remittances on the economy's inflation and money supply differs depending on exchange rate regimes. Hence, exchange rate regimes do matter and should not be ignored when investigating the effects of remittance flows on economies and deriving economic policies appropriate for dealing with them.

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Table 1. Selected Empirical Studies and Exchange Rate Regimes

Amuedo-Dorantes and Pozo (2004)

1979 - 1998	Number of Regimes	FIX (y/n)	FLEX (y/n)
Argentina	3	yes	yes
Belize	1	yes	no
Bolivia	3	yes	yes
Colombia	2	no	yes
Dominican Republic	3	yes	yes
Jamaica	3	yes	yes
Mexico	3	yes	yes
Nicaragua	2	yes	no
Peru	2	no	yes
Trinidad & Tobogo	3	yes	yes

Bourdet and Falck (2006)

1975 - 2005	Number of Regimes	FIX (y/n)	FLEX (y/n)
Cape Verde	3	yes	yes

Caceres and Saca (2006)

1995 - 2004	Number of Regimes	FIX (y/n)	FLEX (y/n)
El Salvador	1	yes	no

Lopez, Molina, and Bussolo (2007)

1990-2003	Number of Regimes	FIX (y/n)	FLEX (y/n)
Argentina	3	yes	yes
Belize	1	yes	no
Bolivia	2	yes	no
Brazil	3	yes	yes
Chile	2	no	yes
Colombia	2	no	yes
Costa Rica	3	yes	yes
Dominican Republic	2	no	yes
Ecuador	3	yes	yes
El Salvador	3	yes	yes
Guatemala	2	no	yes
Haiti	2	yes	yes
Honduras	3	yes	yes
Jamaica	3	yes	yes
Mexico	3	yes	yes
Nicaragua	2	yes	no
Panama	1	yes	no
Paraguay	2	no	yes
Peru	2	no	yes
Venezuela	3	yes	yes

Rajan and Subramanian (2005)

1980s	Number of Regimes	FIX (y/n)	FLEX (y/n)	1990s	Number of Regimes	FIX (y/n)	FLEX (y/n)
Bangladesh	n.a.	n.a.	n.a.	Bolivia	2	yes	no
Bolivia	3	yes	yes	Cameroon	2	yes	no
Botswana	1	yes	no	Costa Rica	2	no	yes
Burundi	3	yes	yes	Egypt	2	yes	no
Congo	1	yes	no	Ethiopia	3	yes	yes
Honduras	1	yes	no	Indonesia	2	yes	no
Jamaica	3	yes	yes	Jordan	3	yes	yes
Kenya	3	yes	yes	Kenya	3	yes	yes
Madagascar	2	yes	no	Mauritius	3	yes	yes
Malawi	2	yes	yes	Morocco	n.a.	n.a.	n.a.
Papua New Guinea	1	yes	no	Panama	1	yes	no
Senegal	1	yes	no	Philippines	3	yes	yes
Sri Lanka	3	yes	yes	Senegal	2	yes	no
Swaziland	1	yes	no	Sri Lanka	2	no	yes
Tanzania	2	no	yes	Tanzania	2	no	yes
Zambia	3	yes	yes	Tunisia	2	no	yes

Notes: Based on Levy-Yeyati and Sturzenegger (2005) three way classification (Fix, Flex, Intermediate). The only cases where the entire sample wasn't covered, the countries in question had three regimes during the subsample and therefore had three in the overall. For example, Levy-Yeyati and Sturzenegger (2005) only have data on Cape Verde for 1998 – 2002. Since Cape Verde had three regimes between 1998 and 2002, they must have had three regimes between 1975 and 2003 as well.

Table 2. Selected Theoretical Studies and Exchange Rate Regimes

Acosta , Lartey, and Mandelman (2007)			
1991Q1 - 2006 Q2	**Number of Regimes**	**FIX (y/n)**	**FLEX (y/n)**
El Salvador	3	yes	yes

Chami, Cosimano, and Gapen (2006)			
post-Korean War (1955 - 2005)	**Number of Regimes**	**FIX (y/n)**	**FLEX (y/n)**
USA	2	yes	yes

Jansen, Naufal, and Vacaflores (2007)			
1990 - 2004	**Number of Regimes**	**FIX (y/n)**	**FLEX (y/n)**
Bolivia	2	yes	no
Brazil	3	yes	yes
Colombia	2	no	yes
Ecuador	3	yes	yes
El Salvador	3	yes	yes
Guatemala	2	no	yes
Honduras	3	yes	yes
Mexico	3	yes	yes
Panama	1	yes	no
Peru	2	no	yes

Notes: Based on Levy-Yeyati and Sturzenegger (2005) three way classification (Fix, Flex, Intermediate).

Table 3. P-values for Granger causality tests

	Inflation does not Granger cause Remittances	Money does not Granger cause Remittances	GDP does not Granger cause Remittances
	Annual data		
All	0.33	0.30	0.13
FIX	0.19	0.42	0.03
	Quarterly data		
All	0.15	0.26	0.09
FIX	0.12	0.05	0.09
FLEX	0.01	0.01	0.01

Table 4.a. Impulse Response Functions:
Statistical difference between the two regimes (FIX-FLEX)

Quarterly data				
T	GDP	Inflation	Money	RER
1	-0.26	0.53*	0.86*	0.43
2	0.05	0.72*	0.96*	-0.42
3	-0.41*	0.92*	0.96*	-0.68*
4	0.50*	0.71*	0.59*	0.45*
5	0.18*	0.45*	0.45*	0.15
6	-0.25*	0.31*	0.28*	-0.28*
7	0.04	0.21*	0.15*	0.03
8	0.14*	0.13*	0.11*	0.14*
9	-0.05	0.08*	0.08*	-0.05
10	-0.04	0.06*	0.05*	-0.03

* stand for statistical evidence that the coefficients of the IRF from the different regimes are different at, at least, a 10% probability level.

Table 4.b. Impulse Response Functions summary

	Inflation		Money		GDP		REER	
Theory	t=0	t>0	t=0	t>0	t=0	t>0	t=0	t>0
FIX	↑	Convergence toward the steady state	↑	Convergence toward the steady state	↑	Convergence toward the steady state	↑	Convergence toward the steady state
FLEX	↓		↔		↑		↑	
Annual data								
FIX	↔	decay	↔	decay	↑*	decay	↔	decay
All	↔	Osc. decay[21]	↔	decay	↑*	decay	↔	decay
Quarterly data								
FIX	↑*	decay	↑*	decay	↑*	Osc. decay	↑*	decay
FLEX	↓*	decay	↔	Osc. decay	↑*	Osc. decay	↑*	decay
All	↑*	decay	↑*	decay	↑*	Osc. decay	↑*	decay

↑ (↓) stands for an increase (a decrease), ↔ for no significant change, and * means that the response is significant at 5% probability level.

[21] Osc. stands for oscillating.

Table 5.a. Impulse Response Functions:
Statistical difference between the two regimes (FIX-FLEX)
Reverse Causality

	Quarterly data			
t	GDP	Inflation	Money	RER
1	0.45	0.53*	-0.40*	NA
2	-0.46	0.73*	1.79*	-0.48*
3	-0.66	0.92*	0.97*	0.33
4	0.38*	0.71*	0.31*	0.16*
5	0.12*	0.43*	0.35*	0.05*
6	-0.28*	0.30*	0.24*	0.06*
7	-0.01	0.21*	0.10*	0.05*
8	0.11*	0.13*	0.07*	0.03*
9	-0.05	0.08*	0.06*	0.02*
10	-0.05	0.05*	0.03*	0.02*

* stand for statistical evidence that the coefficients of the IRF from the different regimes are different at, at least, a 10% probability level.

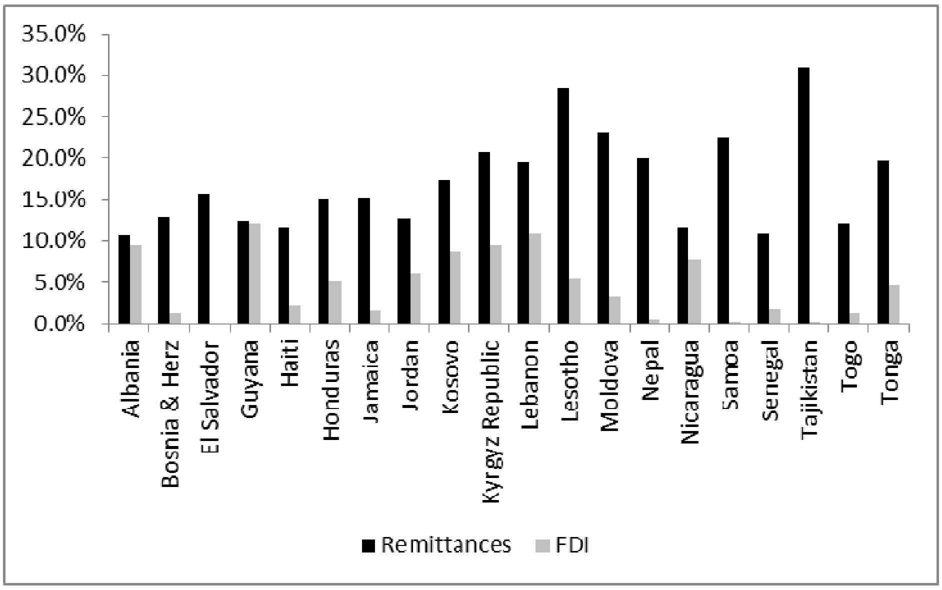
Table 5.b. Impulse Response Functions summary
Reverse Causality

	Inflation		Money		GDP		REER	
Theory	t=0	t>0	t=0	t>0	t=0	t>0	t=0	t>0
FIX	↑	Convergence toward the steady state	↑	Convergence toward the steady state	↑	Convergence toward the steady state	↑	Convergence toward the steady state
FLEX	↓		↔		↑		↑	
Annual data								
FIX	↔	decay	↔	decay	↑*	decay	↔	decay
All	↔	Osc. decay[22]	↔	decay	↑*	Osc. decay	↔	decay
Quarterly data								
FIX	↑*	decay	↑*	decay	↑*	Osc. decay	↔	decay
FLEX	↓*	decay	↔	decay	↑*	Osc. decay	↔	decay
All	↔	Osc. decay	↑*	decay	↑*	Osc. decay	↔	decay

↑ (↓) stands for an increase (a decrease), ↔ for no significant change, and * means that the response is significant at 5% probability level.

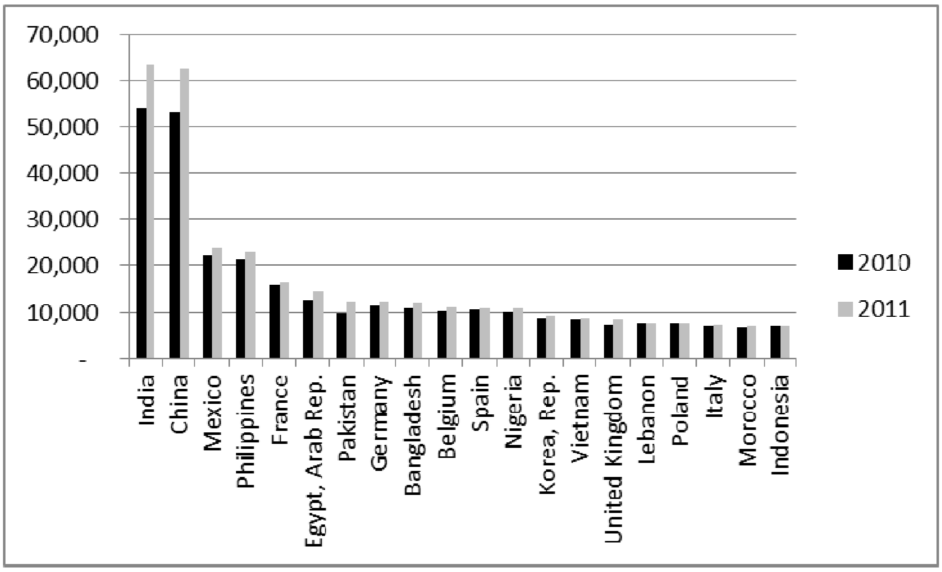
[22] Osc. stands for oscillating

Figure 1. Remittances versus Foreign Direct Investment (as percentage of GDP), 2010



Source: World Bank (2011).

Figure 2. Top 20 Remittance Recipient Countries (Millions of US$)



Source: World Bank (2011).

Figure 3. Shock Under FIX

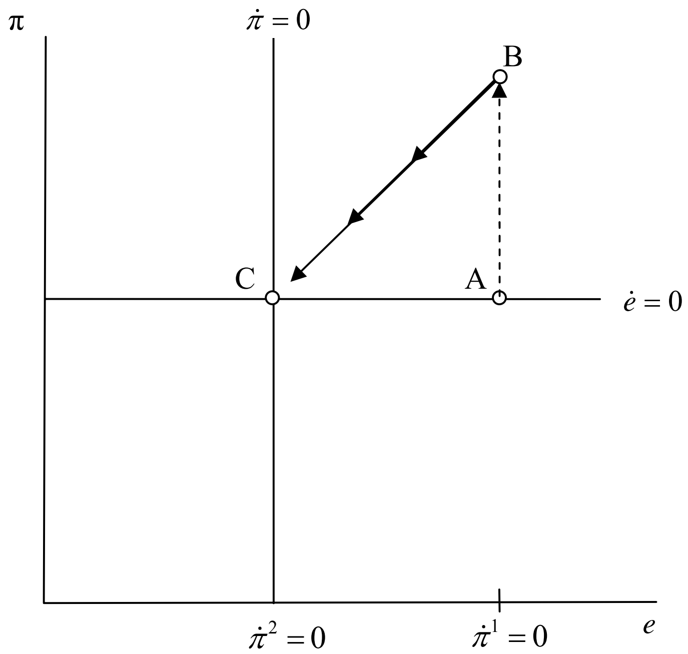


Figure 4. Shock Under FLEX

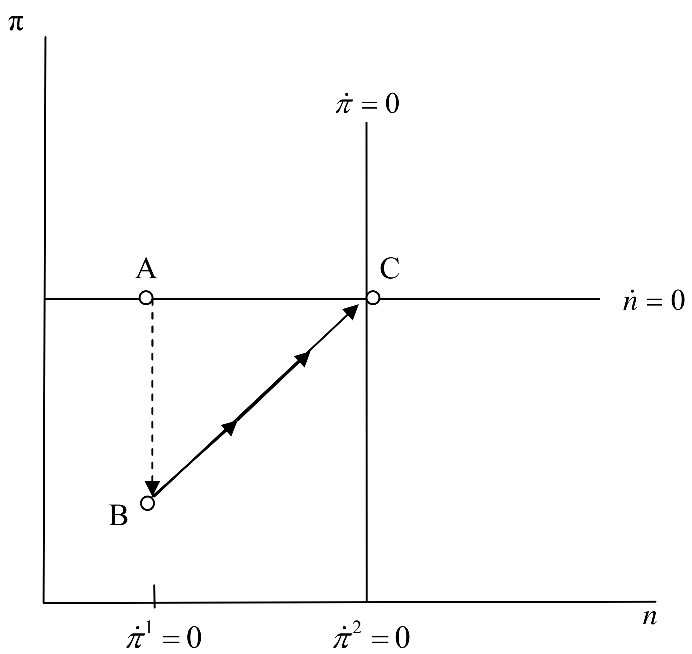


Figure 5. Annual FIX Impulse Responses[1]

$$Model1: \quad \Delta\ln(remittances_{i,t}), \Delta\ln(GDP_{i,t}), \Delta\ln(Money_{i,t}), \Delta\ln(Inflation_{i,t}), \Delta\ln(RER_{i,t})$$

$$Model2: \quad \Delta\ln(remittances_{i,t}), \Delta\ln(Money_{i,t}), \Delta\ln(GDP_{i,t}), \Delta\ln(Inflation_{i,t}), \Delta\ln(RER_{i,t})$$

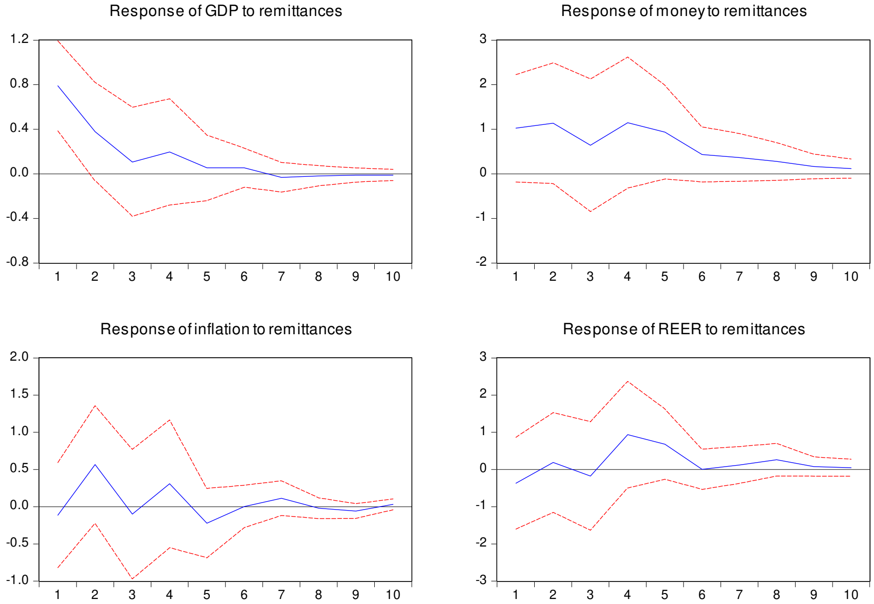
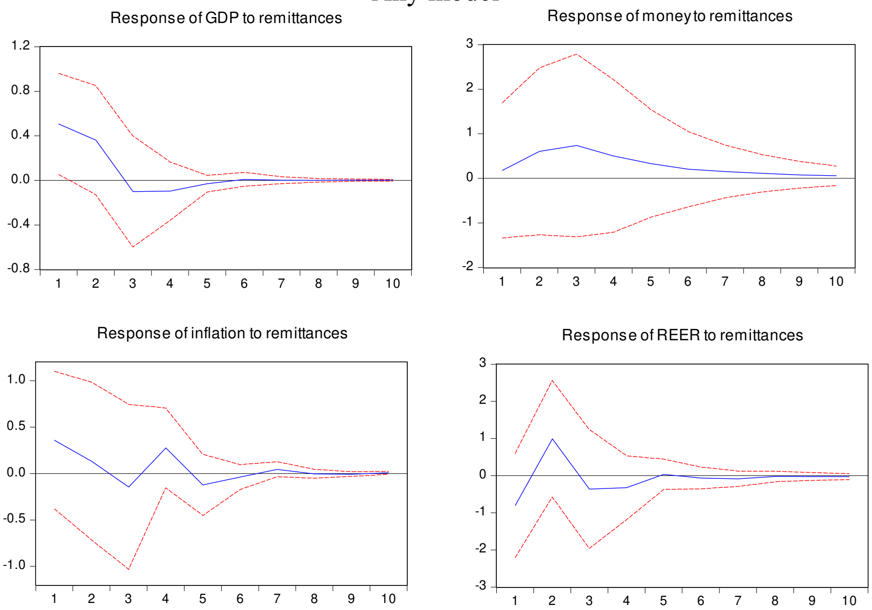


Figure 6. Annual Both Regimes Impulse Responses[2]

Any model



[1] The IRFs are identical for both orderings – Model 1 and Model 2.

[2] The IRFs are identical for all orderings.

Figure 7. Quarterly FIX Impulse Responses[3]

$$Model1:\ \Delta\ln(remittances_{i,t}),\Delta\ln(GDP_{i,t}),\Delta\ln(Money_{i,t}),\Delta\ln(Inflation_{i,t}),\Delta\ln(RER_{i,t})$$

$$Model2:\ \Delta\ln(remittances_{i,t}),\Delta\ln(Money_{i,t}),\Delta\ln(GDP_{i,t}),\Delta\ln(Inflation_{i,t}),\Delta\ln(RER_{i,t})$$

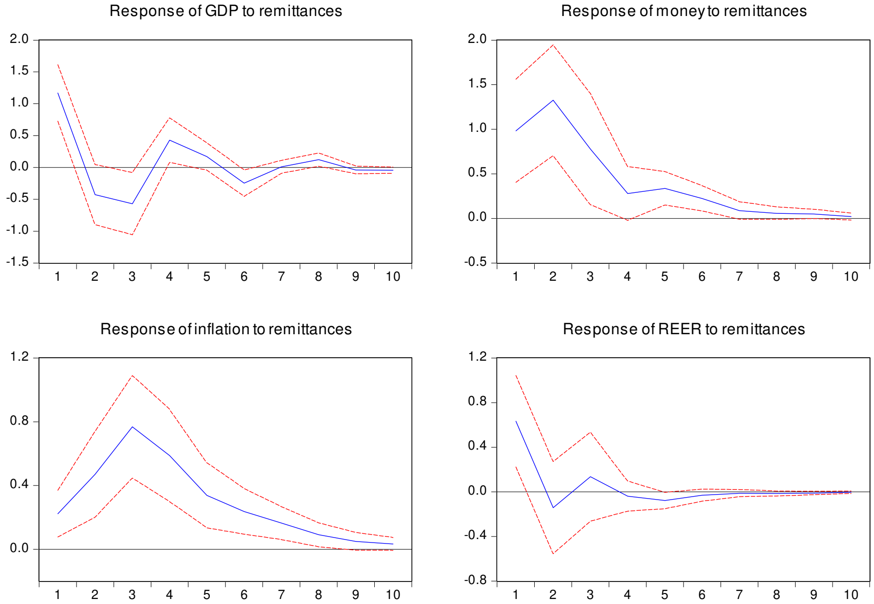
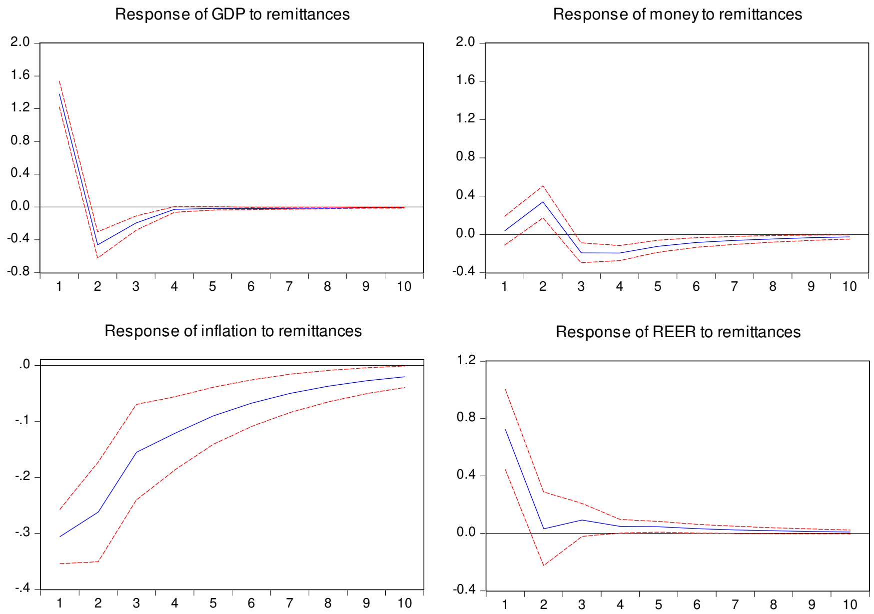


Figure 8. Quarterly FLEX Impulse Responses[4]

$$Model\ \ 3:\ \Delta\ln(remittances_{i,t}),\Delta\ln(RER_{i,t}),\Delta\ln(GDP_{i,t}),\Delta\ln(Inflation_{i,t}),\Delta\ln(Money_{i,t})$$

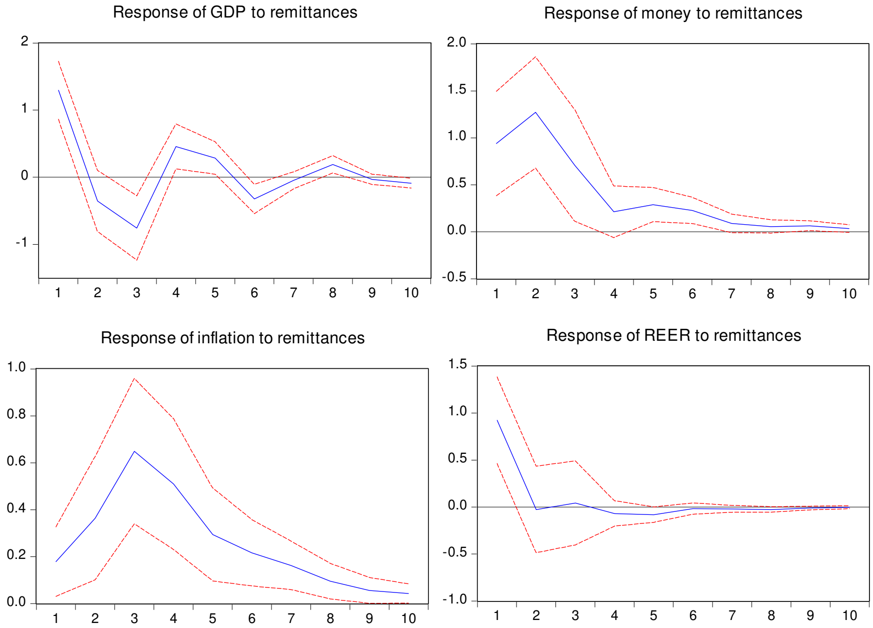
$$Model\ \ 4:\ \Delta\ln(remittances_{i,t}),\Delta\ln(GDP_{i,t}),\Delta\ln(RER_{i,t}),\Delta\ln(Inflation_{i,t}),\Delta\ln(Money_{i,t})$$



[3] The IRFs are identical for both orderings – Model 1 and Model 2.
[4] The IRFs are identical for both orderings – Model 3 and Model 4.

Figure 9. Quarterly Both Regimes Impulse Responses[5]

Any model



[5] The IRFs don't present substantial changes for different orderings.

Mathematical Appendix

Most of the proofs in this section rely on one or more of the following equations. We present them here to avoid clutter in the exposition below.

Differentiating (14) yields

(A.1.) $$\frac{d\bar{e}}{df} = \frac{-y^N}{\left(rk_0 + y^T + f\right)^2} \cdot \frac{\gamma}{1-\gamma} < 0 .$$

Implicitly differentiating (7) yields

(A.2.) $$\frac{dl}{de} = -\frac{1}{\frac{\beta}{\alpha}\frac{B}{A}\left(\beta-1\right)\left(1-l\right)^{\beta-2} l^{1-\alpha} - \frac{\beta}{\alpha}\frac{B}{A}\left(1-\alpha\right)\left(1-l\right)^{\beta-2} l^{-\alpha}} > 0 .$$

(A.1) and (A.2) together imply

(A.3.) $$\frac{dl}{df} = \frac{dl}{de}\frac{de}{df} < 0 .$$

Using (3.b) in equilibrium condition (11) and differentiating with respect to remittances,

(A.4.) $$\frac{dc_t^N}{df} = -\beta B\left(1-l\right)^{\beta-1}\frac{dl}{df} > 0$$

Since c^N increases while the real exchange rate falls, by (15), c^T must also increase and by more than the increase in c^N. From (13) with (3.a) and using (15) to sign,

(A.5) $$\frac{d\bar{c}_t^T}{df} = \alpha A l^{\alpha-1}\frac{dl}{df} + 1 > 0 .$$

Proof that Real Exchange Rate Is Constant in Equilibrium

Suppose instead that the real exchange rate increases. An increase in the real exchange rate generates an increase in labor in the traded sector, by (A.2). By (3.b), an increase in l leads to a contraction in non-traded good output which, by (11), leads to a fall in non-traded consumption. But, by (5), this leads to a contradiction since we can't have an increase in the real exchange rate and a fall in non-traded consumption. Similar logic holds for a decrease in the real exchange rate, proving the proposition that the only equilibrium is one where the real exchange rate is constant.

Result 1: Under a fixed exchange rate regime, an increase in remittances generates an increase in inflation.

Proof: Across steady states the increase in remittances leads to a lower real exchange rate, e, by (A.1), to higher traded and non-traded good consumption, $\bar{c}^T$ and $\bar{c}^N$, by (A.4) and (A.5), and thus to higher non-traded good output, $\bar{y}^N$, by (11). On impact, traded good consumption and the steady state level of non-traded good production in equation (19) both jump to their new, higher levels. Since the real exchange rate will be lower in the new steady state, it must be that traded good consumption changes by more than the steady state non-traded good output. Starting from steady state and given that the real exchange rate, e, is a predetermined, it follows that the right hand side of (19) turns negative upon impact of the shock to remittances. For this to hold and for the real exchange rate to reach it's new, lower steady state level, the inflation rate must increase upon impact to generate the necessary dynamics according to (20). This is represented in the phase diagram in Figure 1 and proves Result 1.

Result 2: Under a fixed exchange rate regime, an increase in remittances generates an increase in the nominal money supply.

Proof: This result follows from the central bank maintaining a fixed nominal exchange rate. Rewriting (9.a) as $\frac{M_t}{E_t} = \frac{\alpha}{\gamma}\frac{c_t^T}{i_t}$. When remittances increase, traded good consumption jumps upward once upon impact by (A.5). By open economy interest parity (10), the nominal interest rate can only change if the foreign nominal interest rate or rate of nominal currency depreciation change. Neither have changed and thus the domestic nominal interest rate is constant as well. By the fixed regime, the nominal exchange rate is constant as well. Everything else in (9.a) is a constant parameter. Thus, the increase in traded good consumption on the right-hand side of (9.a) must be offset by an increase in the nominal stock of money on the left-hand side of (9.a) for this optimality condition to hold at all points in time. This proves Result 2.

Result 3: Under a flexible exchange rate regime, an increase in remittances generates a decrease in inflation.

Proof: Across steady states the increase in remittances leads to a lower real exchange rate by (A.1), to higher traded and non-traded good consumption, $\bar{c}^T$ and $\bar{c}^N$, by (A.4) and (A.5), and thus to higher non-traded good output, $\bar{y}^N$, by (11). Real money balances in terms of the non-traded good, n, is predetermined and thus constant on impact. Likewise, i remains unchanged since under the FLEX, the nominal exchange rate jumps to its new level on impact to maintain equilibrium in the money market described by (9.a). The steady state level of non-traded good production is not constant, however, and jumps on impact to its new, higher level. The result is that, the right hand side of (22) turns positive upon impact. For this to hold and for the real exchange rate to reach it's new, lower steady state level, the inflation rate must decrease upon impact to generate the necessary dynamics according to (22). This is represented in the phase diagram in Figure 2 and proves Result 3.

Remittances and The Real Economy: Effects of the "Dutch disease"

In our model, remittances will always cause a real appreciation and a resource allocation á la the "Dutch disease" independent of the economy's monetary regime. To see this, equate (7) and (14), use (3.a) and (3.b), and rearrange to obtain an expression in terms of labor, remittances, and parameters.[23] Totally differentiating this shows that increasing remittances, *f*, requires a fall in the amount of labor employed in the traded good sector, *l*. This is the so-called "resource movement effect".

(A.6) $$\frac{dl}{df} = \frac{1}{\left(\frac{\gamma}{1-\gamma}\frac{\alpha}{\beta}AB\right)\ \alpha-1\ \ l_t^{\alpha-2} - \left(\frac{\gamma}{1-\gamma}\frac{\alpha}{\beta}AB\right)\alpha l_t^{\alpha-1} - A\alpha l_t^{\alpha-1}} < 0$$

To see the "spending effect" (i.e., the effect on the real exchange rate), rewrite (7) in terms of the real exchange rate[24] and differentiate with respect to traded good sector labor.

(A.7) $$\frac{de}{dl} = -\frac{\beta}{\alpha}\ \beta-1\ \ 1-l\ ^{\beta-2} l^{1-\alpha} + \frac{\beta}{\alpha}\ 1-\alpha\ \ 1-l\ ^{\beta-1} l^{-\alpha} > 0$$

which says that an increase in labor to the traded sector increases the real exchange rate.

Combining (A.6) and (A.7), gives the full "Dutch disease" effect.

(A.8) $$\frac{de}{df} = \frac{de}{dl}\frac{dl}{df} < 0\,.$$

That is, an increase in remittances always generates a fall in the real exchange rate in this economy.

Furthermore, the income effect from increased wealth in the form of remittance inflows leads to an increase in consumption of both goods. By (A.8) and (8) the final change in both levels of consumption must be such that traded good consumption increases by more than home good consumption. Analytically, by (3.b) and (11),

(A.9) $$\frac{dc_t^N}{df} = -\beta B\ \ 1-l\ ^{\beta-1}\frac{dl}{df} > 0\,.$$

Again, since c^N increases yet the real exchange rate falls, by (A.8), c^T must also increase and by more than the increase in c^N. From (13) with (3.a) and using (A.8) to sign,

(A.10) $$\frac{dc_t^T}{df} = \alpha A l^{\alpha-1}\frac{dl}{df} + 1 > 0$$

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[23] $\left(\frac{\gamma}{1-\gamma}\frac{\alpha}{\beta}AB\right)l_t^{\alpha-1} - \left(\frac{\gamma}{1-\gamma}\frac{\alpha}{\beta}AB\right)l_t^{\alpha} - ra_0 - Al_t^{\alpha} - f_t = 0$

[24] $e = \frac{\beta}{\alpha}\frac{B\ \ 1-l\ ^{\beta-1}}{An^{\alpha-1}}$

which imposes a restriction on the magnitude of the resource allocation effect in the traded sector such that $\left|\alpha A l^{\alpha-1} \frac{dl}{df}\right| < 1$.