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The Tale of Three *Amigos*: Remittances, Exchange Rates and Money Demand in Mexico

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JEL Codes: F22, F31, E41
Key words: Remittances, Exchange Rates, Money Demand

1. Introduction

According to the 2000 U.S. Census there are more than 18 million individuals of Mexican origin living in the U.S. (U.S. Census Bureau, 2006). A significant portion of these individuals sends a fraction of their earnings to family and friends in Mexico. In fact, Mexico is the largest recipient of workers' remittances in Latin America. During the year 2006, Mexico received more than 20 billion U.S. dollars in remittances (Inter-American Development Bank, 2007). Remittances are already the equivalent of one third of wage earnings in the formal sector of the Mexican economy. Moreover, in some states, workers' remittances exceed formal wage earnings (Banco de México, 2006).

Mexican immigrants working in the U.S. earn income in U.S. dollars and thus remit money home using U.S. dollars. Often, the transmission method used by the immigrant allows the household to receive the transfer in U.S. dollars (e.g. remittances that are hand-carried or banks that allow for transfers in U.S. dollars).[1] Therefore, the receiving household may face the choice of deciding whether to convert remittances into Mexican pesos or to keep remittances in U.S. dollars. If the household is using Mexican pesos to consume and invest, then it would make sense to convert remittances into Mexican currency. But the household may not want to convert all the money received from abroad into Mexican pesos. For instance, it is often argued that households in developing countries want to keep holdings of foreign currency in order to avoid the risk of unexpected depreciations. The existence of informal dollarization inside the country can also make it convenient to maintain stocks of both currencies.

[1] Home country is the country of origin of the immigrant. Host country is the destination country of the immigrant. Household refers to the family of the immigrant in the home country.

Previous studies suggest that households convert a fraction of the remittances received into local currency. This is evident from the studies showing that remittances respond to changes in exchange rates (El-Sakka and McNabb, 1999; Faini, 1994; Higgins et al., 2004; Yang, forthcoming). However, the relationship between remittances and the exchange rate may be more complicated. Another line of research has found that remittances appreciate the home country currency (Amuedo-Dorantes and Pozo, 2004; Bourdet and Falck, 2006). Exchange rate appreciation can give rise to a phenomenon similar to the Dutch disease. In the Dutch disease phenomenon there is an appreciation of the currency that makes the country's exports more expensive on international markets. As a result, there is a decrease in the competitiveness of the tradable sector.[2]

In this article we develop a model incorporating remittances and exchange rates as determinants of money demand in Mexico. The empirical estimation is conducted using variance decompositions (VDCs) and impulse response functions (IRFs) derived from a structural vector error correction model (SVEC). The use of a SVEC model can address the potential endogeneity between remittances and other macroeconomic variables.

This endogeneity appears to be present, for example, with respect to the exchange rate and remittances. As mentioned above, while some studies find that the exchange rate affects remittances, others find that remittances affect the exchange rate. The relationship between remittances and the exchange rate is likely to depend on the currency that the household uses to consume goods and services. At the same time, money demand depends on household income. Remittances represent an important share of income for a large portion of the households in Mexico. Thus, arguably, money demand is also

[2] The term "Dutch disease" originates from a similar phenomenon caused by the development of the natural gas industry in Holland, resulting in a export boom with large foreign exchange currency inflows. See Ebrahim-Zadeh (2003) for a broader discussion.

endogenously related to remittances and exchange rates. Previous studies have either ignored this simultaneity or have addressed the issue for only some of the variables.

Also, in contrast to previous studies, our estimation methodology allows for a dynamic response of the exchange rate and money demand to shocks in remittances. For instance, it may be possible for remittances to increase the demand for domestic currency in the short-run, but decrease the demand for domestic currency in the long-run.

The remainder of the article is organized as follows. Section 2 discusses money demand equations in an open economy. Section 3 explains the econometric methodology. Section 4 presents the data. Section 5 reports the results, while a deeper discussion of the results is included in Section 6. Section 7 concludes.

2. Money Demand in an Open Economy

The traditional variables in a money demand equation include domestic income and domestic interest rates. Income is included to account for the transactions motive for holding money. Interest rates determine the opportunity cost of holding money. Two variables commonly included in money demand equations in the context of an open economy are exchange rates and foreign interest rates. Exchange rates are included to account for the fact that households may consume foreign goods for which they need to pay with foreign currency. The exchange rate is the price of converting domestic currency into foreign currency. Foreign interest rates are included to account for the fact that households may hold assets denominated in a foreign currency.

Assume that the representative household maximizes the present value of utility over two periods. Following the traditional shopping-time model, assume that utility in

the first period depends on consumption and leisure. Utility in the second period depends on the remaining level of wealth (W).

The household consumes goods which are available for purchase using Mexican pesos (C) and goods that are available for purchase using U.S. dollars (C^*). Leisure (L) depends positively on the holdings of Mexican pesos (M) and U.S. dollars (M^*), and negatively on C and C^*. Intuitively, in order to consume the household needs both, time and money. Holding money balances (of domestic and foreign currency) reduces the time involved in shopping, since the household does not need to spend time obtaining money from another source (e.g. a visit to the bank). Wealth in the second period depends on the return to investments in the host and home country, and money holdings.

Allowing β to be the discount factor, the representative agent two-period utility function is

$$V = U_1\left(\underset{(+)}{C}, \underset{(+)}{C^*}, \underset{(+)}{L}\left(\underset{(-)}{C}, \underset{(-)}{C^*}, \underset{(+)}{M}, \underset{(+)}{M^*}\right)\right) + \beta U_2\left(\underset{(+)}{W}\right). \tag{1}$$

In the first period, the household consumes both kinds of goods (C and C^*), invests in domestic and foreign assets (B and B^*), holds domestic and foreign currency (M and M^*) and receives income (Y). Remittances represent an increase in the household's income. In this framework, the household receives a transfer in U.S. dollars from the immigrant (R). Hence, the constraints for the household can be written as

$$Y + QR = C + M + B + QC^* + QM^* + QB^*, \tag{2}$$

$$W = M + (1 + I)B + QM^* + Q(1 + I^*)B^*, \tag{3}$$

where I and I^* are the domestic and foreign interest rates, respectively, and Q is the real exchange rate, defined as domestic currency per unit of foreign currency (i.e. Mexican pesos per U.S. dollars).

The key difference between Equation (2) and the budget constraint in the traditional open economy shopping-time model is the second term in the left hand side (*QR*). In this case, the household is receiving a transfer from abroad. Given the objective function (Equation (1)), subject to the constraints (Equation (2) and Equation (3)), the necessary first-order conditions imply:[3]

$$\frac{U_{1C} + U_{1L}L_C}{U_{1C^*} + U_{1L}L_{C^*}} = \frac{1}{Q}, \tag{4}$$

$$\frac{U_{1L}L_M}{U_{1C} + U_{1L}L_C} = 1 - \frac{1}{(1+I)}, \tag{5}$$

$$\frac{U_{1L}L_{M^*}}{U_{1C^*} + U_{1L}L_{C^*}} = 1 - \frac{1}{(1+I^*)}. \tag{6}$$

Equation (4) states that the marginal rate of substitution between domestic and foreign goods equals their relative price, that is, the exchange rate. Equations (5) and (6) state that the marginal rate of substitution between cash balances and consumption equals the opportunity cost of holding money. It can be shown that the demand for domestic and foreign currency can be expressed as a function of the parameters of the model Y, Q, I, I^* and R. This implies that demand for domestic and foreign currency in an open economy can be expressed as:

$$M = f(Y, R, Q, I, I^*), \tag{7}$$

$$M^* = f(Y, R, Q, I, I^*). \tag{7'}$$

Thus, money demand equations in an open economy should include variables such as domestic income, remittances, domestic interest rates, foreign interest rates and the

[3] $U_{1L} = \frac{\partial U_1}{\partial L}$, $U_{1C} = \frac{\partial U_1}{\partial C}$, $U_{1C^*} = \frac{\partial U_1}{\partial C^*}$, $L_M = \frac{\partial L}{\partial M}$, $L_{M^*} = \frac{\partial L}{\partial M^*}$, $L_C = \frac{\partial L}{\partial C}$, $L_{C^*} = \frac{\partial L}{\partial C^*}$.

exchange rate. Intuitively, an increase in remittances (or income in general), will encourage the household to increase money holdings for transaction purposes.

On the other hand, remittances in Mexico can be seen as a macroeconomic phenomenon. There are a large number of households receiving remittances. This may encourage the use of the U.S. dollar as a medium of exchange. Consequently, the household may be able to buy more goods and services in Mexico using U.S. dollars. This suggests that from a macroeconomic perspective, remittances can lead to substitution of Mexican pesos with U.S. dollars.

3. Methodology

This article uses impulse response functions (IRFs) and variance decompositions (VDCs) derived from a structural vector autoregression (VAR) to study the relationship between remittances, exchange rates and money demand in Mexico. The use of a VAR addresses the potential endogeneity between remittances and other macroeconomic variables. Moreover, this methodology allows us to observe the dynamic relationship among the variables.

IRFs show the predictable response of each variable after a shock to another variable in the system. For example, if the IRF of remittances after a shock to the exchange rate is positive, then presumably remittances respond positively to innovations in the exchange rate. VDCs show the portion of the forecast error variance for each variable that is attributable to its own innovations and to innovations from the other variables in the system.

In order to compute VDCs and IRFs the residuals must be orthogonalized. In this article, Bernanke's (1986) structural decomposition is used to produce orthogonal

residuals. Bernanke's decomposition is an alternative to the conventional Cholesky decomposition. The recursive ordering imposed by the Cholesky decomposition may be overly restrictive. The Cholesky decomposition is not unique, which means that results for IRFs and VDCs will depend on the ordering of the variables. A possible solution is to try different orderings and compare the IRFs and VDCs for each ordering. But this is only valid if the true model is recursive and just the ordering is unknown.[4] In Bernanke's methodology, a just-identified structural model of the residuals is specified and estimated. The specification of the structural model is based on theoretical considerations.

Our main focus is on the relationship between remittances, exchange rates and money demand. However, in Section 2 we showed that money demand depends on variables other than remittances and exchange rates, such as income and interest rates. Moreover, remittances and exchange rates may also depend on these variables. Therefore, by including only remittances, exchange rates and money demand in the estimation, we could reach a misleading conclusion. In order to obtain accurate inferences, we also need to include a series of control variables to account for the U.S. and Mexico's income, as well as interest rates in both countries.

The endogenous variables included in the estimation are Mexico's income (Y), U.S. income (Y*), Mexico's real exchange rate defined as Mexican pesos per U.S. dollars (Q), the interest rate differential between Mexico and the U.S. (I-I*), Mexico's M1 (M)

[4] Bernanke (1986) argues that "if it is not believed that the true economic model is recursive, then the 'orthogonal' shock series obtained by the conventional approach have no particular meaning."

and remittances (R).[5] The specification of the structural model is given in Equations (8) to (13). Equations (8) to (13) give a structure for the VAR contemporaneous innovations, lagged relationships among the variables are not restricted. Lower case letters represent the first stage VAR residuals of the corresponding variables:

$$y^* = u_1, \tag{8}$$

$$y = a_1(i - i^*) + a_2 m + u_2, \tag{9}$$

$$q = a_3 y + a_4(i - i^*) + a_5 r + u_3, \tag{10}$$

$$(i - i^*) = a_6 y^* + a_7 y + a_8 q + a_9 m + u_4, \tag{11}$$

$$r = a_{10} y^* + a_{11} y + u_5, \tag{12}$$

$$m = a_{12} y + a_{13} q + a_{14}(i - i^*) + a_{15} r + u_6. \tag{13}$$

Equation (8) is based on the assumption that innovations to U.S. income are contemporaneously uncorrelated with innovations to other variables. Equation (9) is Mexico's IS curve. Equation (9) includes *m* to allow for real balance effects. Equation (10) relates Mexico's exchange rate with Mexico's income, the interest rate differential and remittances. The inclusion of remittances in Equation (10) is justified by evidence that remittances have important effects on exchange rates (Amuedo-Dorantes and Pozo, 2004 and Bourdet and Falck, 2006). The interest rate differential reflects the fact that the exchange rate may be impacted by capital inflows (other than remittances), that are attracted by differences in the return to investment between the two countries.

Equation (11) is an inverse money supply function together with Mexico's Central Bank reaction function. The inclusion of *y*, *y** and *q* implies that Mexico's

[5] In order to limit the size of our system we include an interest rate differential instead of individual interest rates. Moreover, interest rate differentials also provide us with the difference in return to investment between the two countries, one of the main determinants of capital flows.

Central Bank responds to contemporaneous shocks in the world's economic conditions (proxied by y^*), domestic output, and exchange rates. In Equation (12), we have that r is a function of y and y^*. This is consistent with the evidence that remittances respond significantly to changes in the home and host country economic conditions (Katseli and Glytsos, 1986; Vargas-Silva and Huang, 2006).

Money demand is represented by Equation (13). As we discussed in Section 2, money demand depends on domestic variables such as income and interest rates (see Equation (7) and Equation (7')). Further, as argued in Section (2), in the open economy context, exchange rates, foreign interest rates and remittances also affect money demand. Hence, these variables are also included in Equation (13).

4. Data

In 1994 Mexico experienced a financial crisis. This crisis brought a large depreciation of the Mexican currency, which sent inflation soaring and set off a recession. To place some distance between the crisis and the empirical analysis, the data used in the estimation is restricted to the period January 1996 - November 2006.[6]

The real exchange rate is defined as Mexican pesos per U.S. dollars, and is constructed using the consumer price index of both countries. The consumer price indexes are seasonally adjusted, while the nominal exchange rate is not. Before the year 1995, Mexico operated under a crawling peg exchange rate system. There was a narrow target band for the nominal exchange rate (the Mexican peso *vis-á-vis* the U.S. dollar). The upper limit of the band was raised slightly each day by a preannounce amount, allowing for a gradual devaluation of the Mexican peso. In response to the crisis,

[6] Main results are robust to the use of January 1995 - November 2006 as the sample period.

Mexico's Central Bank adopted a free-floating exchange rate system. Calvo and Reinhart (2002) argue that Mexico, among other countries, has occasionally exhibited "fear of floating" and that there has been some intervention on the part of the Mexican authorities to manipulate the exchange rate. However, most of the evidence points out to the fact that Mexico has maintained a free-floating exchange rate. For instance, Edwards and Savastano (1999) find that in terms of exchange rate volatility, Mexico does not appear to be different from other floaters, and conclude that Mexico has a free-floating exchange rate system. Moreover, Edwards (2002) argues that "Mexico's experience can be used as an illustration of one way in which a floating regime might work in an emerging country."[7]

Income is measured as seasonally adjusted industrial production for both the U.S. and Mexico. The interest rate differential is measured as the gap between Mexico's Government three-month bond rate (CETES interest rate) and the U.S. three-month Treasury bill rate.

As a monetary aggregate we include Mexico's real M1.[8] This variable is seasonally adjusted. Because Mexican banks are allowed to accept deposits in U.S. dollars, M1 is composed of domestic and foreign currency. Therefore, in each of the estimations we include one of the two components of M1: the domestic component or the foreign component. First, as a proxy for domestic money demand in Mexico, we include the domestic component of M1 (Mexican pesos in circulation plus checking deposits in Mexican pesos). Second, as a proxy for the holdings of U.S. dollars in Mexico, we

[7] Levy-Yeyati and Sturznegger (2000), using different techniques, also provide evidence that Mexico has a free-floating exchange rate.

[8] M1 is a measure of money balances, assuming that markets clear, M1can be taken as a measure of both money demand and money supply. For robustness purposes, we repeated our estimations using M2 as the monetary aggregate. The main results did not change.

include the foreign component of M1 (U.S. dollars deposited in checking accounts in Mexico). The sum of the domestic and foreign component is equal to total M1 in Mexico.

Finally, we include remittances in our estimation. We use total family remittances as a measure of Mexico's inward remittances. This variable is seasonally adjusted and expressed in real terms. There are various issues concerning the macroeconomic remittances data. First, there is no single definition of the term remittances. Second, there may be a large portion of remittances that are sent through informal channels, making it more difficult for the government to track these flows. Table 1 reports the level and the percentage growth of three possible measures of Mexico's inward remittances, for the period under consideration in this article. Columns (1) and (2) report total family remittances, columns (3), (4) and (5) report on the portion of remittances sent as money orders, while columns (6) to (8) report on the portion of remittances sent as electronic transfers. From Table 1, it is clear that there has been a large increase in remittances since 1996. On average, total family remittances have increased by 17 percent per year. A secular decline in the cost of transferring money and increased availability of places to send money abroad are likely partly responsible for the upward trend in remittances.

There has been also a shift towards sending remittances as electronic transfers. The increase in electronic transfers is especially evident since the year 2001. The reason for the large increase in electronic transfers is not clear. One possibility is the increasing use of the services offered by companies like Western Union.

A second possibility is the increase in the percentage of Mexican immigrants with bank accounts in the U.S. In the past, because of identification requirements to open a bank account, only a small fraction of the Mexican immigrants in the U.S. had bank

accounts. But this situation has changed with the increasing acceptance of the *matrícula consular* card as a form of identification. The *matrícula consular* card is an identification issued by Mexican consulates around the U.S. to individuals of Mexican origin living in the U.S. According to the U.S. State Department (2002), during the first nine months of 2002, Mexican immigrants opened around 175,000 bank accounts using the *matrícula consular* card. These immigrants can deposit money in their bank accounts in the U.S. and the household can withdraw the money in Mexico by visiting a bank or by using an automatic teller machine.

The source of all the U.S. data is the Federal Reserve Bank of St. Louis. The source of all the Mexican data is Mexico's Central Bank. Data are in monthly frequency, and with the exception of interest rates, all variables are used in logarithms.

5. Results

We start the analysis by testing all variables for stationarity. We apply the Dickey and Fuller (1981) and the Kwiatkowski et al. (1992) stationary tests to each of the series. The results indicate that all the variables have one unit root.

Next we conducted the Johansen (1988) cointegration test. The results indicate that the variables are cointegrated. This means that a structural vector error correction model (SVEC), instead of an unconditional structural vector autoregressive model should be used in the empirical estimation. Akaike's criterion (AIC) is used to determine the optimal lag length. The AIC indicates an optimal lag length of 8. Q-statistics indicate an absence of serial correlation in each equation of the SVEC, indicating that the lag length is adequate.

The VDC of remittances is reported in Table 2. In Table 2 and in the tables that follow, we report point estimates with standard errors in parentheses. The standard errors are calculated using 2,000 bootstrap simulations. Table 2 indicates that after 24 periods (two years), the exchange rate explains 29 percent of the forecast error variance in remittances. It also seems that U.S. income explains a significant portion of the variance in remittances (34 percent after 24 periods). This is not surprising, since U.S. income should be strongly correlated with the remitting capabilities of Mexican immigrants residing in the U.S.

In Figure 1 we present the response of remittances after a one standard deviation shock to the exchange rate. In Figure 1 and in the figures that follow, the upper and lower bounds represent a two-standard deviation confidence interval. The confidence intervals are computed via Monte Carlo simulation with 2,000 draws. Remittances increase in response to a positive shock to the exchange rate (depreciation), but the confidence interval contains zero. We therefore cannot conclude that the effect of exchange rates on remittances is either positive or negative.

The VDC of Mexico's real exchange rate is reported in Table 3. Up to 47 percent of the variation in exchange rates is explained by remittances. Likewise, money seems to have an important impact on the exchange rate. In traditional economic models, an expansion of the domestic money supply (more Mexican pesos available) depreciates the domestic currency (decreases the price of Mexican pesos).

The response of the exchange rate to a shock in remittances is shown in Figure 2. The exchange rate appreciates after a positive shock to remittances. The appreciation

exceeds one percent and the response is significant for up to fifteen periods (one year and three months) after the shock.

The VDC of domestic money demand is reported in Table 4. Remittances explain 38 percent of the variance in money after two years. There is also evidence that interest rate differentials have important effects on Mexico's domestic money demand. Interest rate differentials reflect the difference in return between holding domestic assets (assets denominated in the domestic currency) and foreign assets (assets denominated in a foreign currency).

The response of domestic money demand to a shock in remittances is shown on Figure 3. Domestic money demand seems to respond positively after shocks to remittances. At its peak, the impact is close to one percent, and is significant for eleven months. This suggests that households increase their holdings of domestic currency after positive shocks to remittances.

We also conduct an estimation replacing the portion of Mexico's M1 that is in Mexican pesos, with the portion of Mexico's M1 that is in U.S. dollars. The VDC of holdings of U.S. dollars is reported in Table 5. The results suggest that remittances do not have a significant impact on the forecast error variance of holdings of U.S. dollars in Mexico. The only variable that explains a significant portion of the variance is Mexico's income. The IRF of holdings of U.S. dollars after a shock to remittances is shown in Figure 4. The result in Figure 4 is surprising. It seems that remittances have a negative effect in the holding of U.S. dollars in Mexico. While the result is only significant for two periods, the drop in holdings of U.S. dollars exceeds two percent.

6. Interpreting the Results

The high percentage of the variation in remittances explained by the exchange rate suggests that households convert a fraction of the remittances received into local currency. If households are not converting remittances into local currency, then the immigrant should not be concerned about the exchange rate.

Moreover, if the household is converting remittances into local currency then immigrants should adjust the amount of the transfer in response to changes in the exchange rate. For instance, after a real depreciation of the Mexican peso, each U.S. dollar of remittances will be worth more to the household. This means that the household needs fewer U.S. dollars to consume a certain bundle of goods. If the purpose of the transfer is to make a certain bundle of goods available to the household, then the emigrant should decrease the amount of U.S. dollars that he/she is sending back home. Furthermore, if the immigrant is making a long-term investment with remittances or remitting to build a retirement nest-egg, then fewer U.S. dollars will be required to reach certain target levels of investment.

On the other hand, now each U.S. dollar of remittances is worth more in the home country. If the immigrant has investments in both countries, but plans to return eventually to Mexico, then it may be better to take of advantage of the depreciation by investing more in Mexico. Also, it is possible that the immigrant wants to send more because each U.S. dollar of remittances will benefit his/her family more. For instance, it is possible that after the depreciation the household will be able to send their children to a better school by receiving some more U.S. dollars, and that this was not possible before the depreciation.

In summary, remittances may increase or decrease after a depreciation of the Mexican currency. Hence, whether remittances increase or decrease boils down to which of these two effects dominates. Results in Figure 1 suggest that the response of remittances after a shock to the exchange rate is positive but not significant. We do not have evidence that one of these effects dominates the other.

The relationship between remittances and the exchange rate is also evidenced by the significant percentage of the variance in exchange rates that is explained by remittances. There seems to be a bi-directional relationship between remittances and the exchange rate. Moreover, the Mexican currency tends to appreciate after shocks to remittances. This is consistent with the results of previous studies using different methodologies (e.g. Amuedo-Dorantes and Pozo, 2004 and Bourdet and Falck, 2006). Remittances appreciate the home country currency, making the country's exports more expensive on international markets. This, in turn, may have a negative impact in the competitiveness of the tradable sector.

There are various potential explanations for this finding. It could be the case that households in Mexico demand more local currency after receiving remittances. The increase in demand for Mexican pesos appreciates the Mexican currency. It is also possible that households simply demand more goods after receiving remittances. Given the limited supply of non-tradable goods in Mexico, this may increase the price of non-tradable goods. The price of tradable goods is determined by the world price and can be taken as exogenous. In the traditional Balassa-Samuelson framework the real exchange rate is taken as the ratio of the price of tradable goods over the price non-tradable goods.

The Mexican peso appreciates because the price of non-tradable goods rises, while the price of tradable goods stays constant.

The VDCs also indicate that there is a bi-directional relationship between remittances and money. Furthermore, the IRFs indicate that remittances are affecting domestic money demand positively. This is consistent with the evidence that remittances are being converted into domestic currency. An increase in the volume of remittances increases household income. As such, the household may want to increase domestic money holdings for transaction purposes. Remittances are another useful variable to use when estimating domestic money demand in Mexico.

Alternatively, if the household is using U.S. dollars to consume, the increase in remittances should have a positive impact on the holdings of U.S. dollars. These two possibilities are not mutually exclusive, that is, the household may hold more of both currencies. The IRFs suggest to the contrary, that remittances affect the holdings of U.S. dollars negatively.

We find it interesting that remittances have a negative impact on the holdings of U.S. dollars. One possible explanation lies with the relative stability of the Mexican economy after the 1994 crisis. It is possible that the relative stability encouraged Mexicans to hold more local currency and fewer U.S. dollars. At the same time, the relative stability may have encouraged some remitters (e.g. those that remit for investment purposes or to build a retirement nest-egg), to remit more.[9]

[9] We thank an anonymous referee for suggesting this explanation.

7. Concluding Remarks

The aim of this article was to analyze the relationship between remittances, exchange rates and money demand in Mexico. Variance decompositions and impulse response functions derived from a structural vector error correction model were used for the empirical estimation.

The results indicate that remittances have a positive impact on domestic money demand. This suggests that increases in remittances have a similar impact on domestic money demand as increases in other sources of income. After the increase in income, the household holds more money for transactions purposes. We also detect a bi-directional relationship between remittances and the exchange rate. Furthermore, positive shocks to remittances tend to appreciate Mexico's real exchange rate.

While remittances may serve as a source of external financing for Mexico, the results suggest that remittances appreciate the Mexican peso, thereby disadvantaging export industries in world markets. If the flow of remittances to Mexico continues to increase, the Mexican government may find it advantageous to devise policies that minimize the negative impact of remittances on the tradable sector.

The present article has provided evidence on the existence of a bi-directional relationship between remittances and macroeconomic variables of the home country. Future studies should treat remittances as a variable that is endogenous to other home country macroeconomic variables and not as an exogenous flow of money from abroad.

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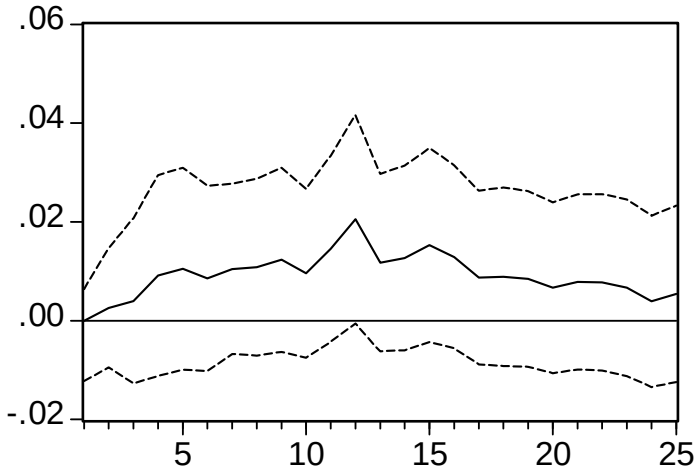
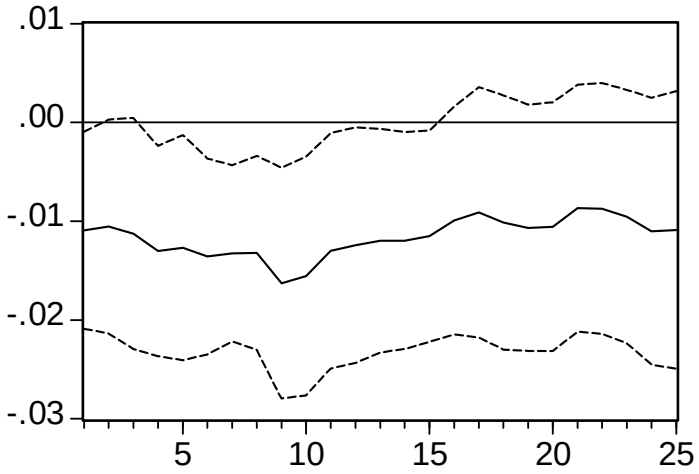
Figure 1. Response of Remittances after a Shock to the Exchange Rate.



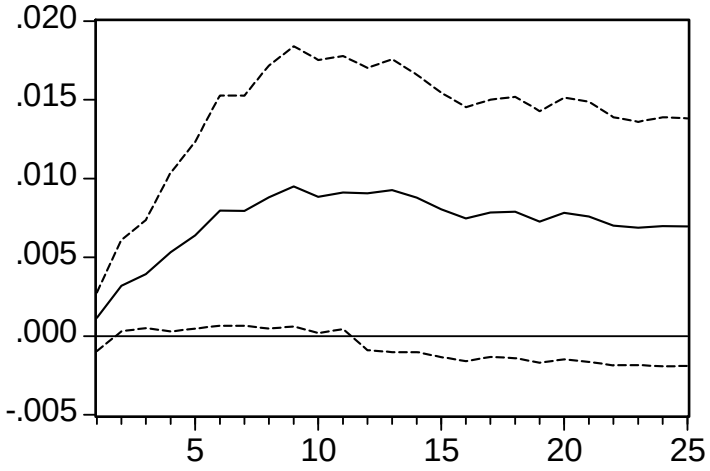
Note: Ranges represent two-standard deviation confidence intervals.

Figure 2. Response of the Exchange Rate after a Shock to Remittances.



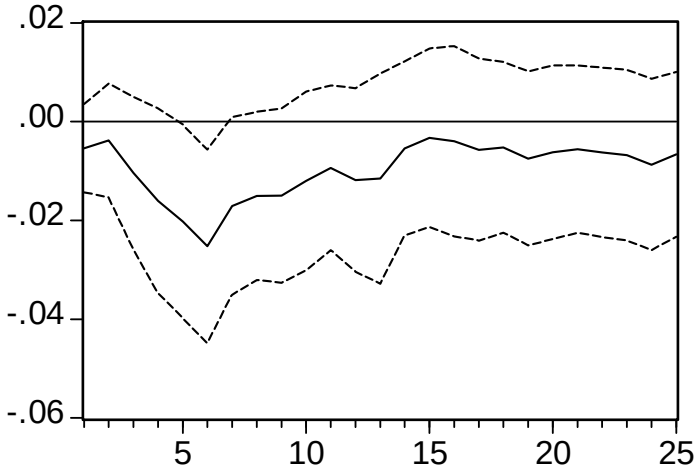
Note: Ranges represent two-standard deviation confidence intervals.

Figure 3. Response of Domestic Money Demand after a Shock to Remittances.



Note: Ranges represent two-standard deviation confidence intervals.

Figure 4. Response of Demand for U.S. Dollars after a Shock to Remittances.



Note:. Ranges represent two-standard deviation confidence intervals.

Table 1. Remittances by Year and Transmission Method (Billions of U.S. dollars).

Year	Total Family Remittances		Money Orders			Electronic Transfers		
	Amount	Growth Rate	Amount	Growth Rate	% of Total	Amount	Growth Rate	% of Total
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
1996	4.2	14.0	1.5	4.3	36.0	2.2	16.1	52.6
1997	4.9	14.1	1.7	12.9	35.5	2.6	17.2	54.2
1998	5.6	14.6	1.9	7.9	33.3	3.3	20.9	57.8
1999	5.9	4.9	1.5	-25.6	24.5	3.9	19.1	66.6
2000	6.6	10.6	1.4	-1.0	21.8	4.6	16.5	70.6
2001	8.9	30.3	0.8	-58.0	9.0	7.8	51.7	87.5
2002	9.8	9.8	0.7	-15.7	7.0	8.8	12.3	89.6
2003	13.4	31.1	1.6	86.0	12.1	11.5	26.9	85.9
2004	16.6	21.5	1.9	14.9	11.3	14.5	23.0	87.3
2005	20.0	18.7	1.9	-0.9	9.3	17.9	21.1	89.3
2006 (up to November)	21.3	16.5	1.3	-26.6	5.9	19.8	20.6	92.8
Average (excluding 2006)	9.6	17.0	1.5	2.5	20.0	7.7	22.5	74.1

Note: Transmission methods not reported include checks, cash and in-kind transfers. The amount reported for the year 2006 includes data until November only; as such the comparison period used to construct the growth rate is January 2005 – November 2005 and January 2006 – November 2006.

Table 2. Variance Decomposition of Remittances.

Horizon	USY	Y	Q	I-I*	R	M
	(1)	(2)	(3)	(4)	(5)	(6)
6	27.9 (13)*	3.8 (5.1)	51.5 (18.3)*	2.0 (4.7)	11.7 (11.9)	3.1 (5.1)
12	32.3 (13.2)*	5.9 (6.2)	41 (16.5)*	6.7 (5.4)	11.2 (10.4)	2.9 (6.2)
24	34.0 (14.8)*	6.5 (7.3)	28.5 (9.9)*	7.3 (6.1)	10.1 (9.9)	13.6 (7.4)
36	37.1 (15.2)*	6.8 (8.1)	22.0 (9.8)*	8.4 (6.5)	9.7 (8.8)	16 (8.4)
48	39.9 (16.1)*	7.6 (9.5)	17.8 (9.2)	9.2 (7.7)	8.6 (8.7)	16.9 (9.0)

Note: A * indicates that the point estimate is at least twice as large as its standard error.

Table 3. Variance Decomposition of the Real Exchange Rate.

Horizon	USY	Y	Q	I-I*	R	M
	(1)	(2)	(3)	(4)	(5)	(6)
6	18.7 (9.1)*	3.2 (7.5)	13.8 (6.7)*	5.3 (11)	47.1 (17)*	11.9 (9.7)
12	16.4 (11.1)	2.8 (7.1)	11.2 (7.9)	5.1 (12.2)	43.1 (18.2)*	21.4 (10.4)*
24	15.3 (10.4)	2.1 (6.6)	9.6 (6.2)	4.6 (13.2)	36.2 (17.4)*	32.2 (13)*
36	12.5 (8.9)	1.7 (5.9)	7.8 (5.1)	4.1 (13.9)	32.9 (16.2)*	41 (15.9)*
48	11.1 (9.2)	1.3 (5.2)	6.4 (4.9)	3.5 (14.3)	27.8 (17.1)	49.9 (17.8)*

Note: A * indicates that the point estimate is at least twice as large as its standard error.

Table 4. Variance Decomposition of M in Pesos.

Horizon	USY	Y	Q	I-I*	R	M
	(1)	(2)	(3)	(4)	(5)	(6)
6	4	7.9	1.7	37.1	27.4	21.9
	(5.1)	(7.7)	(3.8)	(16.4)*	(13.9)	(11.7)
12	6.2	9.6	2.7	35.5	33.8	12.2
	(7.2)	(8.1)	(4.6)	(17.1)*	(14.6)*	(13.1)
24	8.4	11.8	3.1	29.3	37.9	9.5
	(8.5)	(8.8)	(5.3)	(17.4)	(17.2)*	(14.2)
36	11.5	12.8	3.7	23.7	42.2	6.1
	(9.1)	(9.5)	(6.6)	(17.7)	(19.3)*	(15.0)
48	13.9	14.1	4.2	21.5	43.7	2.6
	(11.2)	(10.4)	(7.3)	(18.4)	(19.8)*	(16.2)

Note: A * indicates that the point estimate is at least twice as large as its standard error.

Table 5. Variance Decomposition of M in U.S. Dollars.

Horizon	USY	Y	Q	I-I*	R	M
	(1)	(2)	(3)	(4)	(5)	(6)
6	4.7	44.8	3.3	8.1	13.6	25.5
	(5.9)	(22.1)*	(6.9)	(7.4)	(9.8)	(17.4)
12	6.1	40.7	4.7	9.7	12.8	26.0
	(7.7)	(20.0)*	(7.2)	(10.2)	(8.8)	(18.2)
24	7.3	38.8	5.3	12.6	11.4	24.6
	(9.0)	(18.6)*	(7.9)	(14.4)	(7.9)	(19.3)
36	9.2	36.5	5.8	13.8	10.9	23.8
	(9.7)	(17.9)*	(9.6)	(17.7)	(7.6)	(22.8)
48	11.9	34.1	7.0	16.9	10.1	20.0
	(11.4)	(17.1)	(13.4)	(18.0)	(6.7)	(24.0)

Note: A * indicates that the point estimate is at least twice as large as its standard error.