Determinants and Consequences of Workers’ Remittances

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DETERMINANTS AND CONSEQUENCES OF WORKERS' REMITTANCES

by

Carlos Iván Vargas-Silva

A Dissertation
Submitted to the
Faculty of The Graduate College
in partial fulfillment of the
requirements for the
Degree of Doctor of Philosophy
Department of Economics
Dr. Susan Pozo, Advisor

Western Michigan University
Kalamazoo, Michigan
December 2006

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ACKNOWLEDGMENTS

During my dissertation process I received support, help and stimulus from a large number of people. I would like to start by giving thanks to my parents José and Cynthia, my wife Isabel, my brother Arnaldo and my classmates. I would also like to give a special thanks to my dissertation committee chair Dr. Susan Pozo for all the critical discussion, good insights and guidance throughout this period. This work is mine as much as it is hers. I am also grateful to Dr. Catalina Amuedo-Dorantes, Dr. Wei-Chiao Huang, Dr. Donald J. Meyer and Dr. Mark Wheeler for very useful comments. A todos Gracias.

Carlos Iván Vargas-Silva
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CHAPTER 1

INTRODUCTION AND MOTIVATION

1.1 INTRODUCTION

During the last two decades remittances have become an important source of external financing for developing countries (Ratha, 2003). Recently the World Bank announced that remittances have become more important than private lending for financing in developing countries (World Bank, 2003). Moreover, it is argued that remittances flows are less volatile than other sources of external financing such as foreign direct investment (FDI) (Neyapti, 2004).

Given the large increase in remittances during the last two decades and the apparent stability of these flows, policymakers in developing countries and international organizations around the world have become interested in the topic. These two groups are usually interested in increasing the flow of remittances to developing countries in diminishing the negative effects of remittances and finding ways to channel remittances into productive investments. An example of the later is the Multilateral Investment Fund (MIF) providing a $1.7 million grant to a pilot project that uses remittances as backup for loans for housing projects in Mexico (Inter-American Development Bank, 2005).

Policy makers in developed countries are also interested in remittances flows. It has often been argued that remittances can serve as a channel for money laundering and to finance terrorist activities. These policy makers want a larger share of remittances to
be sent through official channels with more supervision from receiving countries on the use of remittances. For instance, recently in a conference about remittances John B. Taylor, Under Secretary of Treasury of International Affairs under President George W. Bush administration, outlined one of the priorities of President Bush with respect to remittances:

"to make sure remittances channels are not abused by criminals or terrorists, we are working with the IMF, World Bank and FAFT to enhance country compliance with anti-money laundering and counter terrorist financing standards. It is in all of our interests to make formal channels more efficient and attractive for user so that legitimate flows need not flow outside these formal institutions", (Taylor, 2004).

Finally, there is a third party that is interested in remittances: the private business sector. The sending of remittances has been a profitable business for years for companies such as Western Union. Recently the banking sector has become interested in the transfer of remittances to developing countries. The banking sector is interested in remittances for two reasons. First, the sending of remittances is a profitable business itself. Second, offering this service can help in attracting migrants to open bank accounts. For instance, Banamex, one of the principal banks in Mexico, offers a special debit card (*tarjeta tricolor*) with which individuals in Mexico can withdraw money that is deposited in Citibank accounts by their family in the U.S. (Banamex, 2006).

1.2 REMITTANCES: WHO REMITS? HOW MUCH MONEY? WHERE IS IT GOING?

According to the Inter-American Development Bank (IDB) remittances received by Latin America Countries (LAC) in the year 2005 reached over 50 billion dollars (IDB, 2006). The biggest recipient of remittances was Mexico with over 20 billion dollars
(about 37 percent of the total). Table 1.1 contains the share and amount of remittances received by the five largest recipients of remittances in Latin America during the year 2005.

Table 1.1 – Remittances to Latin America in the Year 2005 in Billions of U.S. Dollars (Data Source: IDB).

<table>
<thead>
<tr>
<th>Country</th>
<th>Percent of Total</th>
<th>$ Amount</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mexico</td>
<td>37 %</td>
<td>20.03</td>
</tr>
<tr>
<td>Brazil</td>
<td>12 %</td>
<td>6.41</td>
</tr>
<tr>
<td>Colombia</td>
<td>8 %</td>
<td>4.13</td>
</tr>
<tr>
<td>Guatemala</td>
<td>6 %</td>
<td>2.99</td>
</tr>
<tr>
<td>El Salvador</td>
<td>5 %</td>
<td>2.83</td>
</tr>
<tr>
<td>Total to LAC</td>
<td>100 %</td>
<td>53.6</td>
</tr>
</tbody>
</table>

The majority of the remittance transfers to LAC originate in the U.S. It is estimated that about 33 billion U.S. dollars were sent from the U.S. to LAC in the year 2004. This is an increase of about 3 billion U.S. dollars from the previous year (IDB, 2006). The remittance outflows from the U.S. come mainly from states with large concentrations of Hispanics. Five states alone (California, New York, Texas, Florida and Illinois) sent more than 20 billion U.S. dollars in the year 2004. In total these five states accounted for about half of the total U.S. remittances outflows. Table 1.2 reports on the U.S. dollar amount sent from each of these five states.

Table 1.2 reports only on the aggregate amount of remittances sent from each state. These five states have large concentrations of Hispanic immigrants. An interesting question is which state sends more money per migrant? For instance, there is a big jump between remittances sent by California and remittances sent by other states. Are migrants in California more generous on average? In Table 1.3 we list the five states that sent the
most money per migrant. None of the states in Table 1.2 is in Table 1.3. This indicates that those states with large concentrations of Hispanics are not the ones sending more money per migrant.

Table 1.2 – Remittances by State in the Year 2004 in Billions of U.S. Dollars (Data Source: IDB).

<table>
<thead>
<tr>
<th>State</th>
<th>$ Amount</th>
</tr>
</thead>
<tbody>
<tr>
<td>California</td>
<td>9.61</td>
</tr>
<tr>
<td>New York</td>
<td>3.56</td>
</tr>
<tr>
<td>Texas</td>
<td>3.18</td>
</tr>
<tr>
<td>Florida</td>
<td>2.45</td>
</tr>
<tr>
<td>Illinois</td>
<td>1.53</td>
</tr>
</tbody>
</table>

Table 1.3 – Remittances Per Migrant and State in the Year 2004 in U.S. Dollars (Data Source: IDB).

<table>
<thead>
<tr>
<th>State</th>
<th>$ Amount</th>
</tr>
</thead>
<tbody>
<tr>
<td>Maryland</td>
<td>2,897</td>
</tr>
<tr>
<td>North Carolina</td>
<td>2,864</td>
</tr>
<tr>
<td>Alabama</td>
<td>2,797</td>
</tr>
<tr>
<td>Georgia</td>
<td>2,743</td>
</tr>
<tr>
<td>Virginia</td>
<td>2,671</td>
</tr>
</tbody>
</table>

Until this point we have been discussing the amount of remittances sent by migrants during the years 2004 and 2005. But it is also useful to see the trend of remittances across time. In Figure 1.1 we have U.S. remittances outflows to the entire world from 1991 to the year 2004. From Figure 1.1 it is evident that remittances have trended upward. This constant positive growth of remittances suggests that with time remittances will become even more important for receiving countries.
1.3 REMITTANCES AND OTHER EXTERNAL SOURCES OF FINANCING

At the worldwide level, remittances are second to FDI as a source of external financing in developing countries. But in many regions and countries remittances have passed FDI as a source of external financing. In Africa between the years 2000 and 2003 remittances averaged 17 billion dollars, while FDI averaged only 15 billion dollars. Still Official Development Assistance (ODA) remains Africa’s largest external source of financing with about 25 billion U.S. dollars per year (United Nations, 2005).

In Latin America in the year 2005 remittances flows to the region were more than FDI flows. More impressive is the fact that remittances were more than ODA in each single country in the region. Furthermore, in at least six countries (the Dominican Republic, El Salvador, Guyana, Haiti, Jamaica and Nicaragua) remittances accounted for 10 percent or more of the gross domestic product (GDP).
1.4 OVERVIEW

At this point the reader should be convinced of the large magnitude of remittances flows around the world and the importance of these flows for receiving countries. Now we can discuss how this dissertation expands on the previous knowledge about remittances.

In this dissertation we study the determinants and consequences of workers' remittances. We concentrate on the relationship between remittances and macroeconomic variables in the home countries. We use both microeconomic (individual) level data and macroeconomic (aggregate) level data. The microeconomic data is derived from the Legalized Population Survey. This survey contains detailed information on migrants in the U.S. and their remitting patterns. The macroeconomic level data corresponds to aggregate data on remittances from Mexico and the U.S. As we mentioned above, Mexico is the largest recipient of remittances in Latin America.

Following this introduction, in chapter two we present the theoretical background and discuss the relevant literature. In the third chapter we study the determinants of worker's remittances using the Legalized Population Survey. We match the survey data on remittances with macroeconomic variables from the emigrant's home country. We study how changes in the macroeconomic variables of the home country affect remittances. More precisely, we are interested on the effect that exchange rate changes and exchange rate volatility have on remittances. Knowledge of the effect of exchange rates on remittances can help the receiving countries to formulate policies that attract more remittances. Moreover, in the third chapter we explain how we can use the response of emigrants to exchange rates (level and volatility) as evidence about the motivation of
migrants to remit. The results of chapter 3 suggest that remittances respond positively to depreciations of the home currency and negatively to exchange rate volatility. This result implies that a fraction of the remittances transfer is used for investment purposes.

In the fourth chapter we use Mexican macroeconomic level data to study the relationship between remittances, exchange rates and money demand at the macroeconomic level. In the third chapter we gather evidence that remittances are affected by the exchange rate. But it is also possible that at the macroeconomic level exchange rates are affected by remittances. In the fourth chapter we use various econometric techniques to study the relationship between these variables, assuming that all variables are endogenous. Moreover, in the fourth chapter we also study the effect of remittances on money demand in Mexico. Results suggest that remittances appreciate Mexico's exchange rate and have a positive impact on Mexico's domestic money demand. The positive impact of remittances on the exchange rate suggests that remittances can have an effect similar to “Dutch Disease” and affect the tradable sector in Mexico negatively.

Finally, we study the business cycle characteristics of remittances in chapter 5. If remittances are counter-cyclical then receiving countries can use remittances to offset negative cyclical fluctuations in output. On the other hand, if remittances are procyclical then remittances cannot offset cyclical fluctuations in output. We use data from Mexico to test these propositions. Results suggest that remittances are countercyclical with respect to Mexico's business cycle.
CHAPTER 2

LITERATURE REVIEW AND THEORETICAL BACKGROUND

2.1 INTRODUCTION

In this chapter we present the theoretical background for this dissertation and discuss the empirical economic literature on remittances. The empirical literature on remittances can be grouped depending on the purpose of the study, the data used and the results. The main distinction is between the literature that studies the determinants of remittances and the literature that studies the impact of remittances on receiving countries. To facilitate the discussion the empirical literature is divided in three groups.

The first group includes those papers that use microeconomic level data to study the determinants of remittances. Most of these studies make use of survey data on the emigrants and/or the receiving households. This type of study is usually interested in the relationship between remittances and individual specific factors such as gender, age, marital status and household composition, among others.

The second group includes those papers that use macroeconomic level data to study the determinants of remittances. This type of study is usually interested on how variables like interest rate differentials, political uncertainty, exchange rates and home/host country economic conditions impact remittances. Time series data in one country or a panel of countries are usually used in these studies.
The third group includes those papers that study the impact of remittances in the receiving countries. Remittances can have an impact on inequality, education levels, and development, among others. Moreover, remittances can impact both microeconomic and macroeconomic level variables. As such these studies can use individual and/or aggregate level data.

However, not all the empirical literature on remittances fits into one of these groups. Towards the end of this chapter we mention some of the articles that are less easily classified.

In each of the following chapters we include a literature review specific to the material covered in that chapter. Please refer to those specialized literature discussions for more information about the specific topic. Not all the papers included in those discussions are discussed in this chapter.

Finally, it is important to note that this literature review concentrates on articles that use economic theory to study topics related to remittances. A large number of articles exist in other fields of the social sciences (e.g. sociology, political science, geography, psychology) that study similar topics. Those articles, while beyond the scope of this dissertation, contain important results and the reader is encouraged to consult them.

2.2 THEORETICAL CONSIDERATIONS AT THE MICRO LEVEL: THE MOTIVATION TO REMIT

There has been considerable debate about the motivation of emigrants with respect to sending remittances. Emigrants may remit for a variety of reasons. Emigrants
may have altruistic motives, self-interest motives, insurance motives and loan repayment motives. In what follows we discuss these four motivations to remit.

2.2.1 Altruism and Self-Interest

There is a group of studies with results supporting the notion that remittances are sent for altruistic purposes. In this case the emigrant cares about the household's welfare and remits to increase the welfare of the household. Theoretical models of this type include the consumption, education, health and other characteristics of the household in the emigrant's utility function. In this case assume that we have an emigrant that maximizes utility over two periods.² His/her utility depends on his/her consumption in the host country over the two periods \((c^1, c^2)\) and the household's consumption in the home country \((c^*)\). Letting \(\beta\) be a discount factor, we can represent emigrant's utility as:³

\[
\max U(c^1, c^*) + \beta V(c^2)
\]

(2.1)

Where: \(U_1 \geq 0, \ U_2 \geq 0 \text{ and } V_1 \geq 0\).

If emigrants remit for altruistic reasons then remittances \((r)\) should be strongly related with household characteristics, such as household income. To account for this fact we assume that the consumption of the household is determined by household income \((y^*)\) and the amount of remittances received for consumption \((\delta r)\). In this case \(\delta\) is the

---

¹ Home country refers to the country of origin of the individual, while host country refers to the country to which the individual migrated. Household refers to the family of the emigrant in the home country.
² All the variables in the model are in real terms.
³ \(U_1\) is the derivative of utility with respect to the emigrant's consumption in period 1.
fraction of remittances that is intended for family consumption, while \(1 - \delta\) is the fraction of remittances that is intended for investment purposes. Household consumption is given by:

\[
c^* = c^*(y^*, \delta r)
\]

(2.2)

Where: \(c^*_1 \geq 0\) and \(c^*_2 \geq 0\).

The results of another group of papers claim that emigrants send money for self-interest motives. One of the self-interest motives commonly mentioned is investment in the home country. Perhaps the emigrant does not have good investment opportunities available in the host country and therefore decides to invest in the home country. This investment takes place with remittances. There has also been the argument that emigrants send remittances because they can benefit from household gratitude when returning home. This gratitude may materialize as a portion of the household inheritance. If self-interest is the motivation for remittances then changes in the expected return to investment in the home and host country, changes in the amount and possibility of inheritance, and related factors should affect remittances. In our model a fraction of remittances, represented by \(1 - \delta\) is sent for investment purposes.

The emigrant's consumption in the second period \((c^2)\) is the sum of his/her income in that period \((y^2)\), any investments he/she made in the host country in period 1 \((b)\), plus any return on those investments \((ib)\) and the investment he/she made with remittances in the home country \(((1 - \delta)r)\), plus any return on that investment \(((1 + i')(1 - \delta)r)\). The emigrant's consumption in the second period is given by:

\[
c^2 = y^2 + (1 + i)b + (1 + i')(1 - \delta)r
\]

(2.3)
The emigrant uses his/her income in the first period \((y^1)\) to consume in the host country, invest in the host country and to send remittances (for both altruistic and investment purposes):

\[
y^1 = c^1 + b + r
\]  

(2.4)

The emigrant’s problem is to choose \(c^1, r\) and \(b\) to maximize (2.1) subject to (2.3) and (2.4). Our problem is then:

\[
\max U(c^1, c^*) + \beta V(c^2)
\]

subject to

\[
c^2 = y^2 + (1 + i)b + (1 + i^*)(1 - \delta)r
\]

\[
y^1 = b + c^1 + r
\]

The first order conditions for this problem imply that:

\[-U_1 + \beta V_1 (1 + i) = 0
\]

(2.6)

\[-U_1 + \delta U_2 c^* + \beta V_1 (1 + i^*)(1 - \delta) = 0
\]

(2.7)

If pure altruism is the motivation for remitting \((\delta = 1)\) then remittances will respond negatively to increases in household income, this is: \(\partial r / \partial y^* \leq 0\). On the other hand, if remittances are sent for investment purposes only, then remittances should not respond to increases in household income \((\partial r / \partial y^* = 0)\). If remittances are sent for both, investment and altruism then the effect of increases in household income on remittances is not certain.

If remittances are sent for investment purposes then remittances will respond to changes in the rate of return of investments in the home country. But if remittances are
sent for altruistic purposes only then remittances will not respond to changes in the rate of return of home country investments. See Stark (1995) for a broader discussion on altruism.

2.2.2 The Remittances Decay Hypothesis

Another idea that has received considerable attention in the literature is that if altruistic attachment decreases over time and altruism is the main motivation for remitting, then remittances should decrease over time. This idea is known as the remittances decay hypothesis. If the remittances decay hypothesis is correct we should see a strong negative relationship between remittances and the time since migration took place. In terms of theoretical models this implies that the utility obtained by the emigrant for household consumption is decreasing over time.

In the same way it can be argued that remittances increase household income, as remittances can be invested in human capital or productive physical capital. In this case the emigrant remits less with time because the household needs less. According to Lucas and Stark (1985) “in a dynamic setting, one cannot rule out the possibility that remittances, sent with altruistic intent, have helped to raise today’s income”, p. 910.

2.2.3 Insurance Purposes

Another group of studies argues that remittances are sent for insurance purposes. The emigrant can be buying insurance against bad economic times in the host country by sending remittances to the household. This can happen because there is no insurance
option available to the migrant in the host country. The emigrant can also have a coinsurance agreement with the household. In this case the emigrant supports the household during bad economic times in the home country and the household supports the emigrant during bad economic times in the host country (Lucas and Stark, 1985). The result is an agreement in which the emigrant and the household are diversifying their risk. There will be evidence of insurance motivations if remittances respond to risk variables, e.g. emigrant’s income risk. The theoretical models of remittances and insurance will typically include a Von-Neumann type expected utility function in which emigrant’s or household income is uncertain. See Rapoport and Docquier (Forthcoming) or Amuedo-Dorantes and Pozo (2006) for some examples.

2.2.4 Loan Repayment

A final group of papers makes the case that the emigrant is paying back to the household for the investment made in his/her education when he/she was young. In this case there is an implicit loan arrangement between the household and the emigrant. In the first stage the household invests in the education of the emigrant and in the second stage the emigrant pays back with remittances. The motivation for the loan does not have to be education it can also be, for example, to cover the cost of migration. If this theory is correct we expect to see that emigrants whose parents invested more in their children’s education during their early age and those emigrants who come from countries where the costs involved with migration are higher will remit more. See Poirine (1997) and Rapoport and Docquier (Forthcoming) for a theoretical treatment of the loan repayment hypothesis.
2.3 EMPIRICAL LITERATURE: THE DETERMINANTS OF REMITTANCES USING MICROECONOMIC LEVEL DATA

The literature on the determinants of remittances is composed of micro-level studies that use survey data on households and/or emigrants and macro-level studies that use home and/or host country macroeconomic variables. The micro-level studies typically examine how the individual characteristics of remitters and recipients affect remittances. The macro-level studies typically study the effect that home and host country economic variables have on remittances. In this section we review those papers that use micro-level data to study the determinants of remittances.

One of the first articles in the remittances literature is by Lucas and Stark (1985). In this article the authors used household survey data to study the motivation for remitting in Botswana. Lucas and Stark (1985) found evidence of loan repayment and insurance motivations. Strong evidence in favor of altruism was not uncovered.

In order to test for the loan repayment motivation the authors constructed a dummy variable equal to one if the emigrant was the son (daughter), nephew (niece) or grandchild of the household head. The idea is that educational investments are more likely to be made on these children relative to other children living in the house (e.g. sons-in-law and daughters-in-law). They interact this dummy variable with the education level of the emigrant. The results show that the interaction between the two variables is positively related to remittances, which the authors take as evidence of the loan repayment hypothesis.

The insurance motivation for remittances was tested using data from a drought that occurred in Botswana at the time of the survey. They differentiated regions by the
seriousness of the drought (measured as rainfall in that year divided by the average rainfall in the last 30 years). They interact this variable with the log of the number of crop acres and number of cattle that the household owns. Here they argue that if there is a coinsurance agreement between the emigrant and the household, those households that have a higher risk of losing crops or cattle given the seriousness of the drought should receive more remittances (remittances will be use by the household to gain access to more water sources). This is in fact the result that they obtained. Still, Lucas and Stark (1985) argue that given the lack of enforceability of the insurance and loan repayment arrangements emigrant’s behavior may still imply that they care about the household’s welfare.

There have been a series of papers that, as in Lucas and Stark, did not find strong evidence in favor of altruism. Brown (1997) did not find evidence of altruism using survey data for the Pacific Islands (Tonga and Western Samoa). Brown found evidence favoring self-interest, mainly investment and asset accumulation, but no evidence in favor of the remittances decay hypothesis. As such altruism is unlikely to be the motivation for remitting. See also Ahlburg and Brown (1999), Brown (1994) and Connell (2000) for more on remittances in the South Pacific.

This result for the remittances decay hypothesis is consistent with results obtained by Funkhouser (1995). Using survey data for El Salvador and Nicaragua Funkhouser found that comparing emigrants from the two countries there were not large differences in the effect that the observable characteristics have on remittances. But there was some evidence of a difference in the self-selection of remitters from the pool of migrants in the
two countries. According to Funkhouser remitters from both countries are negatively selected out of the pool of migrants, but the emigrants from Nicaragua are much more so. Hoddinott (1994), using survey data from Kenya, rejects altruism and finds evidence of self-interest, specifically the interest in inheritance and loan repayment motivations. Hoddinott (1994) argues that if emigrants remit because the household members are threatening the emigrant with losing his right to inheritance, then remittances should respond to the credibility of this threat. For example, if the emigrant is an only son then the credibility of this threat is weak. Hoddinott (1994) found that as the number of adult sons of the household head increases (more competition for inheritance) remittances also increase. Another paper that rejected altruism as the main motivation for remittances is Mitra (2004). In this paper Mitra uses survey data for India to show that the principle of exchange (similar to some kind of self-interest motivation) is the main motivation for remittances.

Contradicting the results obtained by Lucas and Stark (1985), Brown (1997), Hoddinott (1994) and Mitra (2004), Agarwal and Horowitz (2002) in a study using survey data for Guyana found evidence in favor of altruism. In their paper Agarwal and Horowitz use the effect that the number of emigrants in each household has on remittances as an indicator of altruism vs. insurance. If the number of emigrants from a single family increases and remittances sent by each emigrant do not decrease, then it must be because individual emigrants are insuring themselves with the household. These individual emigrants need to “pay in” no matter the number of emigrants. If the number of emigrants increases, and remittances sent by each emigrant decrease, then it must be because more emigrants are remitting and the household needs for support from any
specific emigrant is lessened. Agarwal and Horowitz interpret this result as evidence of altruism. They found evidence of a negative relationship between the number of emigrants and remittances supporting altruism as the motivation for remittances.

Other papers have found evidence that remittances are in fact being used as insurance. Using Mexican survey data Amuedo-Dorantes and Pozo (2006) found evidence that remittances respond to variations in emigrant’s level of risk exposure. U.S. immigrants subject to greater levels of risk (as in the case of undocumented immigrants relative to documented immigrants) remit more. They interpret this as evidence that remittances are used for insurance purposes.

Gubert (2002) using data for Western Mali to test the possibility of a mutual insurance contract between the emigrant and the household. Following the idea of Lucas and Stark (1985) the author develops a number of variables that are representative of shocks to household income. The income shock variables are constructed using data from the crop production of the household. The author reports some evidence that remittances respond to these shocks variables, which he interprets as evidence of a coinsurance agreement between the household and the emigrant.

We have already mentioned the importance of the remittances decay hypothesis. But it may be possible that not only the length of the stay, but the planned duration of the stay can have an effect on remittances. Merkle and Zimmerman (1992) found that there is a negative relationship between remittances and the planned length of the stay of the emigrant in the host country. If the actual length of stay is included along with the planned length of stay, only the latter is significant.
2.4 EMPIRICAL LITERATURE: THE DETERMINANTS OF REMITTANCES USING MACROECONOMIC LEVEL DATA

El-Sakka and McNabb (1999) study the macroeconomic determinants of official remittances using macroeconomic level data for Egypt (see Feiler (1987) and Wahba (2003) for other studies related to Egypt). Their results show that home and host interest rate differentials and the difference between the official exchange rate and the black market exchange rate are significantly negative determinants of official remittances. This last result was also found by Katseli and Glytsos (1986). Some countries peg their currency at levels that differ significantly from the market rate. As a consequence these countries will have an overvalued currency and an excess demand for foreign exchange. If there is a black market premium the receiving households may decide to use the black market to convert remittances into local currency. This may induce the emigrant to send remittances through unofficial channels (where it will be easier to access the black market) instead of through official channels.

El-Sakka (2004), using data for Jordan, found that exchange rate misalignments (deviations from purchasing power parity) can have a negative impact on remittances. As the degree of misalignment increases the emigrant stops remitting and instead waits for the exchange rate correction to take place to select his new target.

One of the ideas in the El-Sakka and McNabb (1999) and El-Sakka (2004) papers is that exchange rates and interest rates are important determinants of remittances. Intuitively, depreciations of the home currency can increase the purchasing power of remittances in the home country. Similarly increases in the interest rate of the home
country relative to the interest rate of the host country increase the relative return to investment in the home country.

Faini (1994) tests the importance of exchange rates and interest rates as determinants of remittances using data from emigrants in Germany. Results show that interest rate differentials (home – host) and exchange rates (home currency per host currency) are positive and significant determinants of remittances. Contrary to El-Sakka and McNabb (1999), Faini (1994) finds that home and host country GDP are important determinants of remittances (home country GDP negatively impact remittances, while host country GDP positively impact remittances). Eldabawi and Rocha (1992) using fixed effects techniques also find that macroeconomic variables have an impact on remittances.

The result that interest rates and exchange rates are significant determinants of remittances is not universal. In one of the first macroeconomic papers about remittances Swamy (1981), using data from Greece, Turkey and Yugoslavia, found that most macroeconomic variables were not affecting remittances. Straubhaar (1986) found that interest rates and exchange rates were not affecting the flow of remittances to Turkey (see Sayan (2004) and Tuncay et al. (2005) for more studies related to Turkey).

Other papers test for exchange rate uncertainty as a determinant of remittances. If emigrants are risk averse, an increase in exchange rate uncertainty, which increases the uncertainty about the purchasing power of remittances in the home country, will have a negative effect on remittances flows. Higgins et al. (2004) study the effect of exchange rate uncertainty on remittances using data from nine countries. Results show that an increases in the volatility of the exchange rate decrease remittances. In another study
Hysenbegasi and Pozo (1998), using data for 23 countries show that the timing of remittances responds to exchange rate crisis.

Another question has been whether macroeconomic variables affect temporary and permanent residents in the same way. Glytsos (1997) studies this issue for Greeks residing in Australia and Germany. Results indicate that the behavior of permanent and temporary emigrants differs. Interest rates and changes in prices are important for temporary but not permanent emigrants, while the exchange rate is important for permanent emigrants only. Glytsos (1988) also found different remittance behavior between Greek immigrants in the U.S. (assumed to be permanent immigrants) and immigrants in Germany (assumed to be temporary immigrants). See Djajic (1989) for more on permanent vs. temporary migration.

2.5 EMPIRICAL LITERATURE: THE EFFECTS OF REMITTANCES IN THE RECEIVING COUNTRIES

There is controversy about the effect of remittances on home country economic development. Some researchers say that remittances affect economic development positively, while others argue that remittances affect economic development negatively. Part of this controversy is because remittances can impact a large number of variables in the receiving countries. The impact on some of these variables benefits development (e.g. higher education levels, more investment, less inequality), while the impact on another set of variables affects development negatively (inflation, decrease in labor supply, negative impact on the tradable sector). Next we review the literature in this area.
The main argument from those arguing that remittances have a positive impact on economic development is that remittances are often used for investment in the home countries. Moreover, some authors argue that remittances are a source for financing investment that is more stable than FDI (Neyapti, 2004; Ratha, 2003).

One of the main arguments of those arguing that remittances negatively affect economic development is that remittances can increase inflation or cause a phenomenon similar to Dutch Disease. After receiving remittances in a foreign currency, the household will exchange these remittances for local currency. This can create appreciation of the local currency and can crowd-out exports (see Rivera (2003)). Others argue that remittances increase the share of foreign currency exchanged in the black market limiting the monetary policy options available to the government (see Sarkar (2001)).

Remittances can also impact the labor supply, education levels and income distribution, among others. For instance, it is possible that after receiving remittances the labor supply of some household members decreases. After all, an increase in remittances is an increase in income and leisure is a normal good. Thus, the household will demand more leisure after receiving remittances.

As we mentioned above one of the main issues in the remittances literature concerns the fact that remittances may be causing a phenomenon similar to Dutch Disease in the receiving countries. Amuedo-Dorantes and Pozo (2004a) using data for 13 Latin American and Caribbean countries found that remittances were appreciating the real exchange rate. Bourdet and Falck (Forthcoming) also found some evidence of remittances causing a Dutch Disease using data for Cape Verde.
The effect of remittances on economic growth is strongly related to the way the household uses remittances. Zarate-Hoyos (2004), using data for Mexico, shows that households receiving remittances spent less in consumption than households that received no remittances. Not only do these remittances receiving households spend less in consumption but they also invest more.

The effect of remittances in the behavior of the receiving household is also studied by Hanson (2005). In this study he found that the receiving household is less likely to participate in the labor force. The result was stronger for women in the household. In a study for Western Mali, Azam and Gubert (2004) show that agricultural performance for households with an emigrant was no better than for the other households. In this case remittances were not used to invest in agricultural technology.

There could also be a relationship between receiving remittances and having a small business in the home country. Remittances can give the household the initial capital necessary to start a small business. This is especially important in developing countries where credit markets are not well developed. Amuedo-Dorantes and Pozo (Forthcoming) using data for the Dominican Republic found that the probability of business ownership decreases with the receipt of remittances. However, business ownership does attract remittances suggesting that those businesses are helped by these inflows. In a study for Mexico, Woodruff and Zenteno (2001) found evidence that remittances were affecting microenterprise development positively.

Glytsos (1993) using data for Greece found that remittances were promoting economic development, employment and capital formation. The effect of remittances on capital formation was also studied by Balderas (2005) using data for Mexico. Results
show that remittances have a positive effect (also larger than FDI) on gross capital formation.

Chami et al. (2005) using data for 113 countries found that remittances are negatively correlated with GDP growth. They argue that remittances are not intended to be a source for capital development, but are just compensatory transfers. On the other hand, Pradhan et al. (2005) using data for 39 developing countries found that remittances have a positive effect on economic growth.

Some authors argue that while the effect of remittances on economic growth is not clear, remittances can reduce poverty levels. Adams and Page (2003) using data from a cross-section of countries show that on average a 10 percent increase in remittances as a share of GDP will lead to a 1.6 percent decrease in the percent of people living in poverty.

Glytsos (2001) using data for five Mediterranean countries (Egypt, Greece, Jordan, Morocco and Portugal) found mix evidence on the role of remittances in economic development. Remittances were shown to be capable of boosting growth and of moderating recessions in some cases, while in others remittances affected growth negatively and accentuated recessions.

Remittances can also have an impact on the distribution of income. Different studies present mixed results about this issue. Usually in countries (or villages) with a long history of migration remittances are found to decrease inequality but in countries (or villages) without a long history of migration remittances increase inequality. In the first stage of migration only those households with high income are able to cover the cost of migration and benefit from remittances. This would initially increase income inequality.
But as migration becomes more frequent, the cost of migration decreases. This decrease in the cost of migration is the consequence of the development of a network of migrants in the host country. In this stage poor households will be able to send relatives abroad and benefit from remittances. This effect of remittances in inequality is important because if remittances decrease inequality, then it can be argued that remittances are politically stabilizing (Milanovic, 1987).

Stark et al. (1986) using data for Mexico found that the effect of remittances on inequality depends indeed in the composition of the village. Their results show that in a village with a large proportion of internal migrants (migrants within the same country) remittances from the U.S. increase income inequality, while remittances from internal emigrants decrease income inequality. The opposite result was true for villages with a large proportion of emigrants to the U.S. Taylor (1992), also using data for Mexico argues that remittances have a short term effect on inequality in addition to a long term effect through long term asset accumulation.

In a study using survey data from Nicaragua, Barham and Boucher (1998) found that remittances do increase income inequality. Milanovic (1987) found similar results for Yugoslavia. For a theoretical treatment of the relationship between remittances and inequality see Quibria (1997).

There are a number of papers that study the impact of remittances on schooling in the home country. There are several hypotheses that support the notion that remittances will increase education of children in the household. The receipt of remittances relaxes the income constraint of the household facilitating the enrollment of children in school. The household does not need to have the children involved in income generating
activities. It may also be possible that the senders of remittances explicitly want the children in the household to attend school. If we see remittances as an intergenerational process, the emigrants may plan to retire in the home country and these children will be supporting them financially. Edwards and Ureta (2003) using data for El Salvador found that remittances affect school retention positively. The effect of remittances on school retention was stronger than the effect of household income. Contrary to the results obtained by Edwards and Ureta, Borraz (2005) using data for Mexico found that remittances increased child education only slightly.

The issue of remittances and schooling can be more complicated than what the previous discussion suggests. When one of the parents migrates there is a disruptive effect on the family and this can affect the education of the children negatively. But as we mentioned above if the household receives remittances, then this relaxes the income constraint of the household and they can afford to send children to school. It seems that migration of one parent (or maybe both) has a negative impact on schooling, but remittances have a positive impact. In a study for the Dominican Republic Amuedo-Dorantes and Pozo (2004b) found that indeed while migration had a negative effect on the schooling attainment of the children left behind, remittances had a positive effect on schooling. The result was stronger for girls than for boys. Using data from Mexico, Hanson and Woodruff (2003) found that remittances and migration to the U.S. were both positively affecting the education of the children. The effect of migration was stronger for those households were the mother had a low level of education.
2.6 OTHER TOPICS

The literature on remittances is fairly broad. This chapter has reviewed a large part of this literature, but has not done justice to all concerns and inquiries carried out by researchers in this area. One additional concern that has been addressed is the banking behavior of emigrants. How does the banking behavior affect the amount of remittances sent and the preferred method for sending those remittances? This issue is strongly related to whether the emigrant is documented or undocumented. According to the Pew Hispanic Center / Kaiser Family Foundation 2000 Survey of Latinos, 43 percent of the respondents that send remittances did not have a bank account. Undocumented immigrants are less likely to have a bank account because of identification requirements imposed to open a bank account (especially after September 11, 2001). We expect undocumented immigrants to make more use of the informal sector to send remittances relatively to documented immigrants.

Using data for Mexican immigrants Amuedo-Dorantes and Pozo (2005) study the choice of the transfer mechanism for remittances. Results point to the fact that undocumented immigrants were more likely to use non-banking methods to remit. Amuedo-Dorantes and Bansak (2005) discuss the relationship between remittances and the banking behavior of emigrants. The results show that having a U.S. bank account does not increase remittances, but having a bank account increases the amount of money brought back by Mexican emigrants when they return to Mexico.

The relationship between remittances and the government transfer programs has also been studied in the literature. Taylor (2001) using survey data from California and Texas showed that government transfer programs in the U.S. were not increasing
remittances sent abroad. In this case government transfer programs were not crowding in remittances. Jensen (2003) using data from South Africa showed that government transfer programs in South Africa were crowding out private remittances from abroad. Cox, Eser and Jimenez (1998) using data from Peru showed that increases in social security payments can crowd out remittances. Presumably the receipt of the transfer payment from the government decreases the need of transfers from abroad.

2.7 CONCLUDING REMARKS

In this chapter we reviewed the theoretical and empirical literature on remittances. There does not seem to be a consensus on what is the main motivation behind remittances. The main debate is about whether remittances are mainly altruistic transfers and/or have some kind of self interest motivation. In the following chapters we will explore the relationship between remittances and macroeconomic variables in the home and host country to shed light on this issue.

Likewise, there is no consensus on the impact of remittances in the receiving country. A clear understanding of the impact of remittances in receiving countries is necessary in order to develop policies that promote the positive aspects of remittances and ameliorate the negative impacts. In the following chapters we also attempt to comprehend how macroeconomic variables relate to remittances.
CHAPTER 3

THE EFFECT OF FOREIGN EXCHANGE RISK AND RETURN ON WORKERS' REMITTANCES

3.1 INTRODUCTION

Over the last two decades we have observed a large increase in workers' remittances flows. In many developing countries workers' remittances have become the second largest source of external funding, just behind FDI. As a result, the determinants of workers' remittances and the effects that remittances have on the receiving countries have attracted the attention of policymakers around the world.

The literature on the determinants of remittances includes a series of studies that use microeconomic level data, for either one or a series of countries, to analyze the effects that individual specific factors have on remittances. These microeconomic studies include Agarwal and Horowitz (2002), Amuedo-Dorantes and Pozo (2005), Brown (1997), de la Briere et al. (2002), Funkhouser (1992, 1995), Hoddinott (1992, 1994), Lucas and Stark (1985) and Quinn (2005). Other studies use macroeconomic level data to study the effect that macroeconomic variables have on remittances. These macroeconomic studies include El-Sakka and McNabb (1999), Elbadawi and Rocha (1992), Faini (1994), Glytsos (1988, 1997), Higgins et al. (2004), Katseli and Glytsos (1986), Russell (1986), Straubhaar (1986) and Swamy (1981). See Chapter 2 for a discussion of theses studies.
This chapter combines microeconomic level data on U.S. immigrants with macroeconomic variables from the immigrant home country. The data that we use are from the Legalized Population Survey (LPS). This data set includes information on immigrants that were affected by the Immigration Reform and Control Act of 1986. These were undocumented immigrants who were given the opportunity of receiving amnesty and were granted legal temporary residency in the U.S. While this is a selected group, we are able to examine remitting patterns of a sample of individuals from a broad range of countries. As such, we can test hypotheses about how exchange rates and home country variables affect remittances. Cross-sectional data of this type are not available from other surveys.

There are two other studies that use the LPS to study remittances, Kojima (2003) and Funkhouser (1998). After controlling for the usual individual specific variables, Kojima included nonmeans-tested social transfers (social security, unemployment compensation, and workers compensation paid by the U.S. Government to emigrants) to examine their impact on remittances. Results show that these transfers were not affecting remittances. Funkhouser (1998) used data from the LPS to conduct an econometric exercise and compare the results when different methodologies are used. His results are robust when cross-year correlation in the error terms and separate coefficient vectors across years are allowed.

In this chapter, we take advantage of the multi-country nature of the LPS to establish the relationship between the level of remittances sent by the emigrant and indicators of the risk and return of remittances. These are proxied by exchange rate volatility and by changes in the exchange rate level, respectively.
In addition to changes in the exchange rate and exchange rate volatility, we include home country GDP per capita as a macroeconomic determinant of remittances. We also control for age, time in the U.S., income, education, entering the U.S. without a valid visa, having a spouse or children abroad, gender and marital status.

There are other papers that investigate the relationship between remittances and the exchange rate. For example Faini (1994), using macroeconomic level data for five Mediterranean countries, finds that a depreciation of the home country currency affects remittances positively. On the other hand, other studies are not able to find a significant relationship between remittances and exchange rates. See Straubhaar (1986) and Swamy (1981) for examples.

Other studies present evidence that an increase in the spread between the official and the black market exchange rates decreases remittances sent by official channels (Eldabawi and Rocha, 1992; El-Sakka and McNabb, 1999). Some articles focus on the effect of exchange rate uncertainty on remittances. For instance, Higgins et al. (2004) using macroeconomic level data on fourteen countries find that remittances respond negatively to increases in exchange rate uncertainty.

Finally, it is possible that the effect of exchange rates on remittances depends on the type of emigrant and the motivation for remitting. This is indeed the result obtained by Glytsos (1997). Glytsos (1997) finds that exchange rate depreciation affected remittances sent by permanent emigrants positively, but does not affect remittances sent by temporary emigrants. This result is important for our study given that the migrants in our sample can be considered permanent emigrants as they have more than eight years of residency in the U.S. and have decided to legalize their status.
This chapter combines four characteristics that are absent from previous studies about remittances and the exchange rate. First, we use microeconomic level data to test the impact of exchange rates on the level of remittances, while most other papers use macroeconomic level data (see Chapter 4 for an application with macroeconomic level data). Second, we use data on emigrants from 80 countries, far more than previous studies have used. Third, we use both currency returns and measures of exchange rate volatility versus just one of these measures. Finally, we use the utility maximizing framework to show how our results can be used to distinguish between competing theories (altruism vs. investment) with respect to the main motivation behind remittances.

The empirical results of this chapter indicate that remittances respond positively to the emigrant being male, having a spouse outside the U.S., having children outside the U.S., and the emigrant's income. Remittances are negatively related to the emigrant's age, time spent in the U.S., education level, the emigrant being female, and the emigrant having children. On the other hand, we get mixed results with respect to the relationship between GDP per capita of the home country and remittances.

The main purpose of this chapter, however, is to establish the relationship of remittances with exchange rate changes and exchange rate volatility using microeconomic level data. With respect to these variables, the results show that remittances are positively related to depreciations of the home country currency and negatively related to exchange rate volatility. The results, combined with the theoretical model developed in the paper, suggest that a fraction of remittances is sent for investment purposes.
3.2 THEORETICAL BACKGROUND

Faini (1994) developed a theoretical model of remittances in which he discussed the main implications of exchange rate depreciations (see Rapoport and Docquier (Forthcoming) and Chapter 2 of this dissertation for a survey of the theoretical literature on remittances). In Faini’s model, remittances are sent for household consumption only and there is no uncertainty in the exchange rate. In this section, we extend the Faini type model to allow a fraction of the remittances sent by the emigrant to be invested in the home country.4 We also include uncertainty in the exchange rate in our model.

The purpose of this section is to obtain testable predictions about the relationship of remittances with different economic variables. In particular, we wish to show how the impact of those variables can change depending on the motivation for remitting, for example, depending on whether remittances are sent for altruistic or investment purposes.5

Assume that we have an emigrant that maximizes the expected present value of utility over two periods. The emigrant’s utility depends on his/her consumption in the host country over the two periods \((c^1, c^2)\) and household consumption \((c^*)\).6 The consumption of the household depends positively on household income \((y^*)\) and remittances \((r)\).

In our model remittances are sent in the first period. The model allows the emigrant to send remittances for household consumption and investment in the home country. In this case, \(\delta\) is the fraction of remittances that is intended to be consumed by

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4 This treatment also differs from Faini in that we do not assume a functional form for our utility function.
the household. The household can use this fraction of remittances in any way they consider convenient. The amount of remittances received by the household for consumption in host currency terms is $\delta r$. A fraction of the remittances transfer, represented by $1 - \delta$, is sent for investment purposes. The amount of remittances for investment purposes in host country currency terms is $(1 - \delta) r$.

The exchange rate determines the purchasing power of remittances in the home country. A depreciation of the exchange rate implies that the household can consume more for each dollar of remittances. The exchange rate in the first period ($e^1$) is known to the emigrant. The exchange rate in the second period ($e^2$) is uncertain. The emigrant receives the return from investment in the home country in the second period when the exchange rate is uncertain. Therefore, uncertainty about the future exchange rate brings uncertainty about the return from the remittances invested in the home country.

The emigrant receives income ($y^1$) in the first period. The emigrant uses his/her income in period 1 to consume and to send remittances, this is:

$$y^1 = c^1 + r \quad (3.1)$$

The emigrant’s consumption in the second period is the sum of two terms. The first term is the emigrant’s income in period 2 ($y^2$). The second term includes the investment he/she made with remittances in the home country ($(1 - \delta)r$), plus any return on that investment $(i^*(1 - \delta)r)$ adjusted by the exchange rate. Consumption in the second period is given by:

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6 All the variables in the model are in real terms.
7 The exchange rate is defined as home currency per host currency, e.g. pesos per dollars.
The emigrant’s problem is to choose $c^1$ and $r$ to maximize emigrant’s utility subject to the constraints in Equation (3.1) and Equation (3.2). Letting $\beta$ be a discount factor, our maximization problem can be written as:

$$ \max_{(c,r)} U(c^1, c^*(\delta^1 r, y^*)) + \beta E(V(c^2)) $$

subject to

$$ y^1 = c^1 + r $$

$$ c^2 = y^2 + \left(\frac{(1 + i^*)(1 - \delta)}{e^2}\right)e^1 r $$

We assume that first derivatives are positive, second derivatives are negative, and that utility is additively separable. The first order condition for this problem implies that:

$$ -U_1 + \delta U_2 e^1 c^*_1 + \beta(1 + i^*)(1 - \delta)e^1 E\left[\frac{V_1}{e^2}\right] = 0 $$

(3.3)

3.2.1 Different Results: Altruism vs. Investment

Notice that if all remittances are for household consumption ($\delta = 1$) then (3.3) implies that $U_2 c^*_1 e^1 = U_1$. In this case the optimal remittances amount will not be a function of the second period exchange rate and thus will not be affected by uncertainty in the exchange rate. If the emigrants are remitting for pure altruism, they just care about this period exchange rate and the level of consumption obtained by their families. Only when remittances are sent for investment purposes are these flows affected by the uncertainty in the exchange rate.
The response of remittances after a depreciation of the exchange rate has two opposing effects (see Section 3.8 for explicit partial derivatives). First, after the depreciation, the household will be able to consume more with the same level of remittances. Moreover, the emigrant will be able to consume more in the future with the same level of remittances. This may induce the emigrant to substitute remittances with more present consumption. On the other hand, now each dollar of remittances is worth more in the home country and this may motivate the household to remit more. Which of these effects dominates is an empirical question.

Additionally, if remittances are for altruistic purposes: \( \frac{\partial r}{\partial y^*} \leq 0 \). In this case, an increase in household income will decrease remittances. After all, the family needs less support from the emigrant following the income growth. When remittances are sent for investment purposes only then \( \frac{\partial r}{\partial y^*} = 0 \) and we, therefore, should see no effect on the remittances flow after increases in household income.

The model suggests that remittances increase after an increase in emigrant’s income (\( \frac{\partial r}{\partial y^1} \geq 0 \)). This is what we expect if household consumption is a normal good. Also it is reasonable to assume that as the emigrant’s income increases, the emigrant becomes less risk adverse and is more willing to invest in risky assets.

If remittances are sent for investment purposes, an increase in the return to home country investments will combine income and substitution effects. The final effect of changes in the return to investment will depend on which effect dominates. From our model it is also clear that if remittances are for altruistic purposes only, changes in the return to investment in the home country will not affect remittances. If changes in the
return to investment in the home country are affecting remittances, then emigrants must be using remittances to invest in the home country.

According to the results presented above, we expect that there will be a relationship between remittances and the risk related to home country investments only if remittances are sent for investment purposes. In the empirical estimation we include exchange rate volatility as a proxy for the risk related to home country investments. Thus, if exchange rate volatility affects remittances, we will have evidence that a fraction of remittances is sent for investments purposes.

The model indicates that the response of remittances after a depreciation of the exchange rate has two opposing effects. In the empirical estimation we test how changes in the exchange rates affect remittances.

Finally, our model implies that if remittances are altruistic transfers there will be a negative relationship between remittances and household income. If remittances are for investment purposes it is unclear how they respond to increases in the return to investment of the home country. In the empirical estimation we include home country GDP growth. The interpretation of this variable is not straightforward. An increase in GDP can be related to higher household income, but it also indicates better investment opportunities in the home country. If emigrants are only remitting for altruistic purposes, then we expect a negative relationship between GDP growth and remittances. If emigrants are also remitting for investment purposes, then the effect of GDP growth on remittances is an empirical question.  

8 Interest rates are another possible proxy for the return to home country investments, but are not available for a large number of countries.
In addition to these variables, we add a number of variables to the estimation equation to control for demographic differences across emigrants. Table 3.1 contains a summary of the implications of the model with respect to the exchange rate and other variables.

Table 3.1 – Testable Hypotheses from the Model.

<table>
<thead>
<tr>
<th>Response of Remittances to Increases in:</th>
<th>Motivation of the Remitter:</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Altruism</td>
</tr>
<tr>
<td>Exchange Rate</td>
<td>&gt; 0</td>
</tr>
<tr>
<td></td>
<td>&lt;</td>
</tr>
<tr>
<td>Uncertainty Home Country Investments</td>
<td>None</td>
</tr>
<tr>
<td></td>
<td>&lt;</td>
</tr>
<tr>
<td>Household Income</td>
<td>&lt; 0</td>
</tr>
<tr>
<td>Home Country Return to Investment</td>
<td>None</td>
</tr>
<tr>
<td></td>
<td>&lt;</td>
</tr>
<tr>
<td>Emigrant’s Income</td>
<td>&gt; 0</td>
</tr>
</tbody>
</table>

3.3 DATA

The Immigration Reform and Control Act (IRCA) of 1986 gave undocumented immigrants in the U.S. the opportunity to obtain amnesty and become legal permanent residents. The IRCA consisted of two phases. In the first phase 1.8 million immigrants who applied, qualified for temporary legal residence. One of the requirements to qualify was living in the U.S. prior to the year 1982. The 1.8 million immigrants who qualified in that regard were given 18 months to satisfy an English language requirement and to learn U.S. civic matters. The second phase consisted of acquiring legal permanent residency. About 1.6 million of the 1.8 million successfully completed the second phase.
The data used in this paper comes from the LPS, the International Financial Statistics CD-ROM and the central banks of the countries represented in the sample. The LPS survey is composed of two parts: the 1989 survey (LPS1) sponsored by the Immigration and Naturalization Service, and the 1992 follow-up (LPS2) sponsored by the U.S. Department of Labor. The LPS1 includes information on 6,197 formerly undocumented immigrants who qualified for amnesty under IRCA and, hence, applied for permanent residency.

The LPS2 is a follow-up of the LPS1, in which 4,012 respondents were re-interviewed. There were 1,193 emigrants included in the LPS1 that were not included in the sample for the LPS2. From these 1,193 emigrants, 502 were not in the Legalization Application Processing System by January 1992, 2 were deceased, and 4 had been denied the temporary residency status. The remainders were still in the midst of the legalization process and waiting for a decision. After removing individuals with missing observations, we ended up with a sample of approximately 3,350 individuals originating from about 81 countries.

The dependent variable in this study is a dummy variable indicating whether the individual sent remittances in that year or a continuous variable specifying the amount remitted by the individual in that year. The emigrants interviewed in the LPS report the amount of remittances sent during the years 1987 and 1991. The independent variables consist of demographic variables and a series of country specific variables. The equation to be estimated is:

\[ Remittances_{it} = f(\text{Country Variable}_{it}, X_{it}) \]  

for individual i at time t.
The demographic variables included in $X_n$ are emigrant’s income, age, years of education, gender, marital status, an interaction term between marital status and gender, a dummy indicating if the emigrant has children, a dummy indicating if the emigrant has children living abroad, a dummy indicating if the emigrant has a spouse living abroad, a dummy indicating if the emigrant previously enter the U.S. without a valid visa, and the number of years living in the U.S. Table 3.4 in Section 3.9 reports on the descriptive statistics of these variables.

One of the country specific variables included in the estimation is the currency return of the home country between the year that remittances were reported and the previous year ($\Delta e_t$). Here the currency return of country $j$ at time $t$ is defined as:

$$\Delta e_{jt} = \log(e_{jt}) - \log(e_{j(t-1)}) \quad t = 1987 \text{ or } 1991.$$

Included as a measure of volatility in the exchange rate is the sum of the squares of the currency returns of the monthly exchange rate, defined as home currency per U.S. dollars, for the years in which remittances were reported. This is:\textsuperscript{10}

$$\sigma_{e,j} = \sum_{m=1}^{12} (\Delta e_{jm})^2 \quad m = 1, ..., 12.$$

As a proxy for the home country economic condition, we use the growth rate of the GDP per capita of the home country (GDP). The growth rate is taken between the year in which remittances were reported and the previous year. This variable can be indicative of household income, as some may argue that the economic situation of the household should be strongly related to the situation of the home country. Still this

\textsuperscript{9}See U.S. Department of Justice (1992) and U.S. Department of Labor (1996) for more details on the LPS.
variable does not provide us with information about the income distribution inside the country. On the other hand, an increase in GDP can be related to better investment opportunities in the home country. All home country variables are in real terms.

Table 3.5 in Section 3.9 reports on the definition of all the variables used in the estimation and their expected impact on the level of remittances, according to the model presented above or according to previous studies on remittances.

3.4 METHODOLOGY

We cannot estimate the determinants of remittances using ordinary least squares (OLS) because our remittance variable is censored at zero. If, for example, an emigrant is receiving monetary assistance from the family who still resides in the home country, remittances should be a negative number. Yet, in our data, they are set equal to zero. Also, given that about 40% of the emigrants in the sample did not remit, our remittances variable is a mix of a discrete and a continuous variable. Two methods commonly used to account for these statistical difficulties are reviewed below.

One of the most common solutions to this problem is to use the present version of the model proposed by Tobin (1958) commonly known as the Tobit model. One possible problem with this method is that the Tobit estimation assumes that there are no differences in the factors affecting the decision to send remittances and the factors affecting the amount of remittances sent. It is not clear whether this assumption is

\footnote{Andersen and Bollerslev (1998) show that this estimator is consistent for a general conditional variance specification.}
appropriate. The Tobit model estimation is conducted using maximum likelihood estimation.\textsuperscript{11}

A second solution to the censoring problem is to use the Heckman two-step procedure. In the first step, a probit model is estimated where the dependant variable is a dummy variable equal to one if remittances are positive. This first step gives information about the determinants of the decision to remit. Then, in a second step, we use those emigrants sending remittances to model the determinants of the dollar amount remitted. Remitters constitute a non-random sub-sample from our sample. As a result, we need a correction for sample selection. In this case, we use Heckman's (1979) sample selection correction.\textsuperscript{12}

In the estimation using the two-step Heckman procedure the decision to remit is separate from the decision of how much to remit. The problem with this methodology is that it is sensitive to identification exclusions. It is necessary to specify variables that affect the decision to remit or not remit, but not how much the individual remits. This is problematic in the remittances literature where the factors that affect the decision to remit and the amount of remittances have not been clearly differentiated. Given the concern of adopting one or the other approach to account for the censored dependent variable we use and present both techniques.\textsuperscript{13}

\textsuperscript{11} Studies that use this technique include Brown (1997) and Funkhouser (1995).
\textsuperscript{12} Studies that use this technique include Argawal and Horowitz (2002), Funkhouser (1995) and Hoddinott (1992).
\textsuperscript{13} Given the panel nature of the data a random effect Tobit estimation was also conducted. The results did not differ from the ones reported here. Results are available from the author upon request.
3.5 RESULTS FROM THE TOBIT ESTIMATION

The results using the Tobit model are presented in Table 3.2. A major objective of this chapter is to discern how country specific financial variables affect remittances. Specifically, how do measures of financial return and risk influence the decision to send money home? To this end, we specify several versions of a remitting equation. The first column of Table 3.2 includes the volatility of the exchange rate as the home country variable. The second column substitutes the currency return as the home country variable, and the third column reports the estimates when we use GDP per capita of the home country instead. The last column includes all three home country economic variables.

The results reveal that there is a positive and statistically significant relationship between the emigrant's income and remittances. If we think of household consumption as a normal good, this is what we would expect.

The length of stay in the U.S. has a negative impact on remittances. The effect of the length of stay is significant in all equations. This is consistent with the remittance-decay hypothesis that argues that the longer the stay of the emigrant in the host country, the smaller the amount of remittances he/she sends back home. If the emigrant is remitting for altruistic purposes, then we can say that the attachment to the household is decreasing with time.

The signs of age, education, gender (female = 1), and having children are negative and significant, while having a spouse or children abroad is positive and significant. Emigrants that have a spouse or children living abroad appear to have a stronger attachment to the household and as a consequence they remit more.
The relationship between the currency return and remittances is positive. This is evidence that emigrants remit more when their home currency depreciates. As the exchange rate depreciates, the emigrant sends more money back home because his/her family can consume more for each dollar of remittances.

The results also indicate that the relationship between remittances and increases in the volatility of the exchange rate is negative and significant. Increases in the volatility of the exchange rate increase the uncertainty about the return to investments in the home country. In this case, the emigrant may decide to invest in the host country where he/she endures no foreign exchange risk.

In summary, the Tobit results suggest that remittances have a negative relationship with factors such as age, gender (female), having a children, time in the U.S. and education. On the other hand, remittances have a positive relationship with income and having a child or spouse abroad. Finally, remittances seem to respond positively to currency appreciations and negatively to exchange rate volatility.

3.6 RESULTS FROM THE HECKMAN PROCEDURE

The results using the Heckman two-step methodology are reported in Table 3.3. In order to identify the model we exclude the education of the emigrant from the OLS estimation. To check for robustness we also conducted our estimations excluding entry status of the emigrant and time in the U.S. Our major results still hold.

The results for the demographic determinants of the amount of remittances sent seem to be consistent with the results from the Tobit estimation. One difference,
however, is the variable indicating if the emigrant is married. In the Tobit estimation this variable does not appear to significantly impact remittances. Yet, in the Heckman estimation, it seems to be affecting the likelihood of remitting positively and the amount remitted negatively.

In the Tobit estimation, home country GDP did not turn out to be significant. Using the results from the Heckman procedure, we can offer an explanation for this result. In the Heckman estimation, home country GDP affects the likelihood of remitting negatively, but the amount remitted positively. An increase in GDP growth can be related with better household economic conditions and less remittances from altruistic remitters. On the other hand, an increase in GDP growth can be related to better investment opportunities in the home country.

Another difference between the results of the Tobit and Heckman models is the exchange rate. In the Heckman estimation, depreciations in the exchange rate seem to affect the likelihood of remitting negatively, but still affect the amount remitted positively. As is the case in the Tobit estimation, exchange rate volatility affects the amount remitted negatively.

These results suggest that there are different factors affecting the amount of remittances sent and the likelihood of remitting. Moreover, the same variable can have two different effects. Remitting seems to be a two-stage decision. These results put into question those studies in the remittances literature that use only a Tobit model and implicitly assume that the factors affecting the amount remitted and the likelihood of remitting are the same.
**Table 3.2 - Results from the Tobit Estimation.**

<table>
<thead>
<tr>
<th>Variable</th>
<th>Column 1</th>
<th>Column 2</th>
<th>Column 3</th>
<th>Column 4</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Individual Specific Variables</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Income (0 to 9 Scale)</td>
<td>296.52</td>
<td>295.81</td>
<td>295.53</td>
<td>301.29</td>
</tr>
<tr>
<td></td>
<td>(15.18)*</td>
<td>(15.14)*</td>
<td>(15.10)*</td>
<td>(15.35)*</td>
</tr>
<tr>
<td>Age (Years)</td>
<td>-29.48</td>
<td>-29.29</td>
<td>-29.72</td>
<td>-27.80</td>
</tr>
<tr>
<td></td>
<td>(-6.33)*</td>
<td>(-6.26)*</td>
<td>(-6.39)*</td>
<td>(-5.91)*</td>
</tr>
<tr>
<td>Gender (Female = 1)</td>
<td>-605.76</td>
<td>-600.07</td>
<td>-617.39</td>
<td>-619.50</td>
</tr>
<tr>
<td></td>
<td>(-3.94)*</td>
<td>(-3.90)*</td>
<td>(-4.02)*</td>
<td>(-4.02)*</td>
</tr>
<tr>
<td>Married (Yes = 1)</td>
<td>156.48</td>
<td>166.73</td>
<td>175.18</td>
<td>142.02</td>
</tr>
<tr>
<td></td>
<td>(1.05)</td>
<td>(1.12)</td>
<td>(1.18)</td>
<td>(0.95)</td>
</tr>
<tr>
<td>Married*Gender</td>
<td>700.22</td>
<td>685.69</td>
<td>692.12</td>
<td>722.75</td>
</tr>
<tr>
<td></td>
<td>(3.87)*</td>
<td>(3.80)*</td>
<td>(3.84)*</td>
<td>(3.99)*</td>
</tr>
<tr>
<td>Spouse Abroad (Yes = 1)</td>
<td>1224.33</td>
<td>1236.02</td>
<td>1275.57</td>
<td>1216.40</td>
</tr>
<tr>
<td></td>
<td>(7.09)*</td>
<td>(7.15)*</td>
<td>(7.37)*</td>
<td>(7.64)*</td>
</tr>
<tr>
<td>Child (Yes = 1)</td>
<td>-1194.13</td>
<td>-1164.02</td>
<td>-1173.49</td>
<td>-1184.94</td>
</tr>
<tr>
<td></td>
<td>(-9.16)*</td>
<td>(-8.93)*</td>
<td>(-9.02)*</td>
<td>(-9.08)*</td>
</tr>
<tr>
<td>Child Abroad (Yes = 1)</td>
<td>1817.81</td>
<td>1813.82</td>
<td>1827.72</td>
<td>1824.13</td>
</tr>
<tr>
<td></td>
<td>(15.46)*</td>
<td>(15.41)*</td>
<td>(15.51)*</td>
<td>(15.47)*</td>
</tr>
<tr>
<td>Time in the U.S. (Years)</td>
<td>-118.61</td>
<td>-116.22</td>
<td>-117.35</td>
<td>-117.96</td>
</tr>
<tr>
<td></td>
<td>(-10.00)*</td>
<td>(-9.77)*</td>
<td>(-9.84)*</td>
<td>(-9.89)*</td>
</tr>
<tr>
<td>Years of Education (Years)</td>
<td>-89.51</td>
<td>-91.43</td>
<td>-93.93</td>
<td>-86.08</td>
</tr>
<tr>
<td></td>
<td>(-8.87)*</td>
<td>(-9.03)*</td>
<td>(-9.31)*</td>
<td>(-8.39)*</td>
</tr>
<tr>
<td>Undocumented Entry (Yes = 1)</td>
<td>11.60</td>
<td>7.84</td>
<td>5.20</td>
<td>-7.17</td>
</tr>
<tr>
<td></td>
<td>(0.11)</td>
<td>(0.07)</td>
<td>(0.05)</td>
<td>(-0.07)</td>
</tr>
<tr>
<td><strong>Country Specific Variables</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>$\sigma_e$</td>
<td>-887.54</td>
<td>-</td>
<td>-</td>
<td>-1338.40</td>
</tr>
<tr>
<td></td>
<td>(-3.89)*</td>
<td></td>
<td></td>
<td>(-2.47)**</td>
</tr>
<tr>
<td>$\Delta e$</td>
<td></td>
<td>73.70</td>
<td>-</td>
<td>111.48</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(1.77)**</td>
<td></td>
<td>(4.80)*</td>
</tr>
<tr>
<td>Home Country GDP</td>
<td></td>
<td>-</td>
<td>-6.54</td>
<td>15.15</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>(-0.16)</td>
<td>(0.35)</td>
</tr>
<tr>
<td>Observations</td>
<td>6,276</td>
<td>6,283</td>
<td>6,315</td>
<td>6,252</td>
</tr>
<tr>
<td>Uncensored Observations</td>
<td>3,776</td>
<td>3,779</td>
<td>3,795</td>
<td>3,764</td>
</tr>
<tr>
<td>LR Chi2</td>
<td>1003.52*</td>
<td>991.60*</td>
<td>997.02*</td>
<td>1016.73*</td>
</tr>
<tr>
<td>Log Likelihood</td>
<td>-37072.67</td>
<td>-37110.36</td>
<td>-37286.05</td>
<td>-36947.90</td>
</tr>
</tbody>
</table>

Note: A * means significant at the 1 percent, ** means significant at the 5 percent, and *** means significant at the 10 percent. t statistics are in parenthesis. The dependent variable is remittances in U.S. dollars.

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Table 3.3 – Results using the Heckman Procedure.

<table>
<thead>
<tr>
<th>Variable</th>
<th>Column 1</th>
<th>Column 2</th>
<th>Column 3</th>
<th>Column 4</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Likelihood of Remitting</td>
<td>Amount Sent</td>
<td>Likelihood of Remitting</td>
<td>Amount Sent</td>
</tr>
<tr>
<td>Income</td>
<td>.094</td>
<td>202.61</td>
<td>.092</td>
<td>213.99</td>
</tr>
<tr>
<td></td>
<td>(11.65)*</td>
<td>(8.52)*</td>
<td>(11.54)*</td>
<td>(9.10)*</td>
</tr>
<tr>
<td>Age</td>
<td>-0.013</td>
<td>-12.15</td>
<td>-0.013</td>
<td>-11.27</td>
</tr>
<tr>
<td></td>
<td>(-6.80)*</td>
<td>(-2.34)**</td>
<td>(-6.95)*</td>
<td>(-2.17)**</td>
</tr>
<tr>
<td>Gender</td>
<td>-0.063</td>
<td>-731.03</td>
<td>-0.066</td>
<td>-714.32</td>
</tr>
<tr>
<td></td>
<td>(-0.98)</td>
<td>(-4.83)*</td>
<td>(-1.02)</td>
<td>(-4.71)*</td>
</tr>
<tr>
<td>Married</td>
<td>.210</td>
<td>-247.24</td>
<td>.212</td>
<td>-219.30</td>
</tr>
<tr>
<td></td>
<td>(3.22)*</td>
<td>(-1.70)***</td>
<td>(3.24)*</td>
<td>(-1.50)</td>
</tr>
<tr>
<td>Gender*Married</td>
<td>.092</td>
<td>792.86</td>
<td>.090</td>
<td>794.57</td>
</tr>
<tr>
<td></td>
<td>(1.21)</td>
<td>(4.46)*</td>
<td>(1.18)</td>
<td>(4.48)*</td>
</tr>
<tr>
<td>Spouse Abroad</td>
<td>.266</td>
<td>1101.75</td>
<td>.273</td>
<td>1111.47</td>
</tr>
<tr>
<td></td>
<td>(3.17)*</td>
<td>(6.84)*</td>
<td>(3.25)*</td>
<td>(6.89)*</td>
</tr>
<tr>
<td>Child</td>
<td>-.320</td>
<td>-961.22</td>
<td>-.313</td>
<td>-954.64</td>
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<tr>
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<td>(-5.76)*</td>
<td>(-7.05)*</td>
<td>(-5.63)*</td>
<td>(-7.09)*</td>
</tr>
<tr>
<td>Child Abroad</td>
<td>.691</td>
<td>1070.15</td>
<td>.685</td>
<td>1138.25</td>
</tr>
<tr>
<td></td>
<td>(12.80)*</td>
<td>(6.26)*</td>
<td>(12.71)*</td>
<td>(6.77)*</td>
</tr>
<tr>
<td>Time in the U.S.</td>
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<td>-44.70</td>
<td>-.050</td>
<td>-43.02</td>
</tr>
<tr>
<td></td>
<td>(-10.32)*</td>
<td>(-2.91)*</td>
<td>(-10.29)*</td>
<td>(-2.86)*</td>
</tr>
<tr>
<td>Years of Education</td>
<td>-.047</td>
<td>- .049</td>
<td>-.049</td>
<td>- .050</td>
</tr>
<tr>
<td></td>
<td>(11.02)*</td>
<td>(-11.42)*</td>
<td>(-11.70)*</td>
<td>(-11.22)*</td>
</tr>
<tr>
<td>Undocumented Entry</td>
<td>-.033</td>
<td>146.10</td>
<td>-.029</td>
<td>107.84</td>
</tr>
<tr>
<td></td>
<td>(-0.73)</td>
<td>(1.51)</td>
<td>(-0.64)</td>
<td>(1.11)</td>
</tr>
</tbody>
</table>

Note: A * means significant at the 1 percent, ** means significant at the 5 percent, and *** means significant at the 10 percent. t statistics are in parenthesis.
Table 3.3 – Continued.

<table>
<thead>
<tr>
<th>Variable</th>
<th>Column 1</th>
<th>Column 2</th>
<th>Column 3</th>
<th>Column 4</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Likelihood of</td>
<td>Amount Sent</td>
<td>Likelihood of</td>
<td>Amount Sent</td>
</tr>
<tr>
<td></td>
<td>Remitting</td>
<td></td>
<td>Remitting</td>
<td></td>
</tr>
<tr>
<td>$\sigma_e$</td>
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<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>(-3.21)*</td>
<td>(-2.15)**</td>
<td></td>
<td></td>
</tr>
<tr>
<td>$\Delta e$</td>
<td></td>
<td>-.015</td>
<td>211.45</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>(-0.88)</td>
<td>(4.41)*</td>
<td></td>
</tr>
<tr>
<td>Home Country</td>
<td>-.033</td>
<td></td>
<td>-.033</td>
<td>67.44</td>
</tr>
<tr>
<td></td>
<td>(1.86)**</td>
<td></td>
<td>(-1.86)***</td>
<td>(1.77)**</td>
</tr>
<tr>
<td>GDP</td>
<td>233.95</td>
<td>375.65</td>
<td>238.58</td>
<td>560.37</td>
</tr>
<tr>
<td></td>
<td>(0.63)</td>
<td>(1.04)</td>
<td>(0.67)</td>
<td></td>
</tr>
<tr>
<td>Inverse Mills Ratio</td>
<td>6,276</td>
<td>6,283</td>
<td>6,315</td>
<td>6,252</td>
</tr>
<tr>
<td></td>
<td>3,776</td>
<td>3,779</td>
<td>3,795</td>
<td>3,764</td>
</tr>
<tr>
<td>Wald Chi2 Test</td>
<td>795.07*</td>
<td>809.50*</td>
<td>812.09*</td>
<td>845.52*</td>
</tr>
</tbody>
</table>

Note: A * means significant at the 1 percent, ** means significant at the 5 percent, and *** means significant at the 10 percent. T statistics are in parenthesis.
3.7 CONCLUDING REMARKS

This chapter uses data from the Legalized Population Survey (LPS) to study the determinants of workers' remittances. The LPS includes emigrants from different countries who have migrated to the U.S. in different time periods. By using data from the LPS, we concentrate on one specific group of emigrants. These are emigrants that were undocumented emigrants in the past but now have temporary legal residency and are either in the process of becoming permanent residents or have recently become permanent residents. While this is a selected group, we are able to obtain evidence on patterns of remitting from a sample of individuals from a broad range of countries. This is not available in other samples due to the difficulties of getting consistent remitting data on individuals from different countries.

Results from the estimation show that remittances are positively related to the emigrant's income and to the emigrant having a spouse or children outside the U.S. Remittances are negatively related to time spent in the U.S., age, having children, being female and years of education.

Our primary interest, however has been to establish the relationship between remittances and financial variables in the home country. We use changes in the exchange rate and exchange rate volatility to study how emigrants respond to changes in the purchasing power of remittances and the uncertainty related to home country investments. The results show that a depreciation of the home country currency affects remittances positively. This is evidence that emigrants remit more when the return to remittances increases. After a depreciation of the exchange rate, the purchasing power of remittances in the home country increases.

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The results also suggest that exchange rate volatility affects remittances negatively. An increase in the volatility of the exchange rate increases the uncertainty about the returns to remittances sent for investment purposes. This increase in uncertainty may induce the emigrant to invest in the host country where there is no foreign exchange uncertainty. This finding that exchange rate volatility affects remittances suggests that a fraction of remittances is sent for investment purposes.

The evidence regarding the relationship between the GDP per capita of the home country and remittances is mixed. Increases in home country GDP per capita seem to affect the likelihood of remitting negatively, but the amount remitted positively.

The results show that remittances are strongly influenced by demographic factors. But the results also show that financial factors related to the risk and return of remittances, specifically changes in the exchange rate and exchange rate volatility, are important determinants of remittances. Countries that want to increase the flow of inward remittances should pursue policies to stabilize their exchange rate and be aware that another consequence of exchange rate appreciation will be a decrease in remittances.
3.8 DERIVATIONS

Note: SOC is the second order condition for the problem, in our case the SOC is equal to:

\[ U_{11} + U_{22}(\delta c_1^* e^1)^2 + (\delta e^1)^2 U_{22}c_{11} + \beta[(1+i^*)(1-\delta)e^1]^2 E\left[\frac{V_{11}}{(e^2)^2}\right] \leq 0 \]

1. Derivative of remittances with respect to \( e^1 \):

\[
\frac{\partial r}{\partial e^1} = -\left( \frac{\delta U_{22}c_{11}^*}{SOC} + \frac{\beta(1+i^*)(1-\delta)E[V_{11}/e^2]}{SOC} \right)
- \frac{\left( U_{22}[\delta c_1^* e^1 r + U_{22}c_{11}^* \delta^2 e^1 r^2 + \beta[(1+i^*)(1-\delta)]^2 E[V_{11}/e^2] r e^1 \right)}{SOC} \geq 0 \quad (3.1.A)
\]

2. Derivative of remittances with respect to \( i^* \):

- Pure altruism case (\( \delta = 1 \)):

\[
\frac{\partial r}{\partial i^*} = 0 \quad (3.2.A)
\]

- Other cases (\( 0 \leq \delta < 1 \)):

\[
\frac{\partial r}{\partial i^*} = \frac{\beta r(1+i^*)(e^1(1-\delta)]^2 E[V_{11}/(e^2)^2] + \beta e^1(1-\delta)E[V_{11}/e^2]}{SOC} \geq 0 \quad (3.3.A)
\]

3. Derivative of remittances with respect to \( y^* \):

- Investment only case (\( \delta = 0 \)):

\[
\frac{\partial r}{\partial y^*} = 0 \quad (3.4.A)
\]

- Other cases (\( 0 < \delta \leq 1 \)):

\[
\frac{\partial r}{\partial y^*} = -\frac{\delta U_{22}c_{11}^* e^1}{SOC} \leq 0 \quad (3.5.A)
\]

4. Derivative of remittances with respect to \( y^1 \):

\[
\frac{\partial r}{\partial y^1} = \frac{U_{11}}{SOC} \geq 0 \quad (3.6.A)
\]
### 3.9 DESCRIPTIVE STATISTICS

**Table 3.4 - Descriptive Statistics.**

<table>
<thead>
<tr>
<th>Variable</th>
<th>Mean</th>
<th>Variable</th>
<th>Mean</th>
<th>Variable</th>
<th>Mean</th>
</tr>
</thead>
<tbody>
<tr>
<td>Amount Remit 1987</td>
<td>1,479.24</td>
<td>Gender LPS1</td>
<td>.46</td>
<td>Education LPS1</td>
<td>8.51</td>
</tr>
<tr>
<td>Amount Remit 1991</td>
<td>1,009.42</td>
<td>Spouse Abroad LPS2</td>
<td>.06</td>
<td>Education LPS2</td>
<td>8.67</td>
</tr>
<tr>
<td>Dummy Remit 1987</td>
<td>.64</td>
<td>Child LPS1</td>
<td>.68</td>
<td>Undocumented Entry LPS1</td>
<td>.21</td>
</tr>
<tr>
<td>Dummy Remit 1991</td>
<td>.55</td>
<td>Child LPS2</td>
<td>.85</td>
<td>Married LPS1</td>
<td>.63</td>
</tr>
<tr>
<td>Income LPS1</td>
<td>3.64</td>
<td>Child Abroad LPS2</td>
<td>.18</td>
<td>Married LPS2</td>
<td>.73</td>
</tr>
<tr>
<td>Income LPS2</td>
<td>4.30</td>
<td>Time U.S. LPS1</td>
<td>9.81</td>
<td>Gender*Married LPS1</td>
<td>.29</td>
</tr>
<tr>
<td>Age 1987</td>
<td>35.01</td>
<td>Time U.S. LPS2</td>
<td>12.81</td>
<td>Gender*Married LPS2</td>
<td>.31</td>
</tr>
<tr>
<td>Age 1991</td>
<td>39.01</td>
<td></td>
<td></td>
<td></td>
<td></td>
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</tbody>
</table>
Table 3.5 – Variable Description.

<table>
<thead>
<tr>
<th>Variable</th>
<th>Expected Sign</th>
<th>Source</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Dependent Variables</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Amount Remit</td>
<td></td>
<td>LPS</td>
<td>This is the amount remitted by the emigrant in U.S. dollars.</td>
</tr>
<tr>
<td>Dummy Remit</td>
<td></td>
<td>LPS</td>
<td>This is a dummy variable equal to 1 if the emigrant indicated sending remittances.</td>
</tr>
<tr>
<td><strong>Home Country Variables</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>( \Delta e )</td>
<td>+/-</td>
<td>IFS and Central Banks</td>
<td>This is the currency return of the home currency between the year that the emigrant indicated having sent remittances and the previous year.</td>
</tr>
<tr>
<td>( \sigma^e )</td>
<td>-</td>
<td>IFS and Central Banks</td>
<td>This is the sum of the square currency returns of the monthly exchange rate of the home currency for the year that the emigrant indicated having sent remittances.</td>
</tr>
<tr>
<td>Home Country GDP</td>
<td>+/-</td>
<td>IFS</td>
<td>This is the growth rate of the GDP per capita of the home country between the year in which the emigrant indicated having sent remittances and the previous year.</td>
</tr>
</tbody>
</table>
Table 3.5 – Continued.

<table>
<thead>
<tr>
<th>Variable</th>
<th>Expected Sign</th>
<th>Source</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Individual Variables</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Income</td>
<td>+</td>
<td>LPS</td>
<td>This is the income level indicated by the emigrant using a 0 to 9 scale (0, 1, 2, 3, 4, 5, 6, 7, 8, 9).</td>
</tr>
<tr>
<td>Age</td>
<td>+/-</td>
<td>LPS</td>
<td>This is the age of the emigrant at the time when he reported sending remittances.</td>
</tr>
<tr>
<td>Gender</td>
<td>-</td>
<td>LPS</td>
<td>This is a dummy variable equal to 1 for female and 0 for male.</td>
</tr>
<tr>
<td>Married</td>
<td>+/-</td>
<td>LPS</td>
<td>This is a dummy variable equal to 1 if the emigrant is married or living with a partner in the same house.</td>
</tr>
<tr>
<td>Spouse Abroad</td>
<td>+</td>
<td>LPS</td>
<td>This is a dummy variable equal to 1 if the emigrant indicated having a spouse living abroad.</td>
</tr>
<tr>
<td>Child</td>
<td>+/-</td>
<td>LPS</td>
<td>This is a dummy variable equal to 1 if the emigrant indicated having sons or daughters abroad or children living in the same house in the U.S.</td>
</tr>
<tr>
<td>Child Abroad</td>
<td>+</td>
<td>LPS</td>
<td>This is a dummy variable equal to 1 if the emigrant indicated having any sons or daughters living abroad.</td>
</tr>
<tr>
<td>Time in the U.S.</td>
<td>-</td>
<td>LPS</td>
<td>This is the number of years that the emigrant has been permanently residing in the U.S.</td>
</tr>
<tr>
<td>Years of Education</td>
<td>+</td>
<td>LPS</td>
<td>This is the number of years of education indicated by the emigrant.</td>
</tr>
<tr>
<td>Undocumented Entry</td>
<td>-</td>
<td>LPS</td>
<td>This is a dummy variable equal to 1 if the emigrant entered the U.S. previously without valid papers.</td>
</tr>
</tbody>
</table>
Table 3.6 - Countries of Origin of Immigrants in the LPS.

<table>
<thead>
<tr>
<th>Country</th>
<th>Country</th>
<th>Country</th>
<th>Country</th>
</tr>
</thead>
<tbody>
<tr>
<td>Argentina</td>
<td>France</td>
<td>Lebanon</td>
<td>Sierra Leone</td>
</tr>
<tr>
<td>Australia</td>
<td>Germany</td>
<td>Liberia</td>
<td>South Africa</td>
</tr>
<tr>
<td>Bahamas</td>
<td>Ghana</td>
<td>Malaysia</td>
<td>Spain</td>
</tr>
<tr>
<td>Bangladesh</td>
<td>Greece</td>
<td>Mali</td>
<td>St. Kitts and Nevis</td>
</tr>
<tr>
<td>Barbados</td>
<td>Grenada</td>
<td>Mexico</td>
<td>St. Lucia</td>
</tr>
<tr>
<td>Belize</td>
<td>Guatemala</td>
<td>Netherlands</td>
<td>St. Vincent and Gren.</td>
</tr>
<tr>
<td>Bolivia</td>
<td>Guyana</td>
<td>New Zealand</td>
<td>Sweden</td>
</tr>
<tr>
<td>Brazil</td>
<td>Haiti</td>
<td>Nicaragua</td>
<td>Switzerland</td>
</tr>
<tr>
<td>Canada</td>
<td>Honduras</td>
<td>Nigeria</td>
<td>Syrian Arab Republic</td>
</tr>
<tr>
<td>Chile</td>
<td>Hong Kong</td>
<td>Norway</td>
<td>Taiwan</td>
</tr>
<tr>
<td>China</td>
<td>India</td>
<td>Pakistan</td>
<td>Thailand</td>
</tr>
<tr>
<td>Colombia</td>
<td>Indonesia</td>
<td>Panama</td>
<td>Togo</td>
</tr>
<tr>
<td>Cote d'Ivoire</td>
<td>Iran</td>
<td>Paraguay</td>
<td>Tonga</td>
</tr>
<tr>
<td>Costa Rica</td>
<td>Iraq</td>
<td>Peru</td>
<td>Trinidad and Tobago</td>
</tr>
<tr>
<td>Cyprus</td>
<td>Ireland</td>
<td>Philippines</td>
<td>Turkey</td>
</tr>
<tr>
<td>Dominican Republic</td>
<td>Israel</td>
<td>Poland</td>
<td>Uganda</td>
</tr>
<tr>
<td>Ecuador</td>
<td>Italy</td>
<td>Portugal</td>
<td>United Kingdom</td>
</tr>
<tr>
<td>Egypt</td>
<td>Jamaica</td>
<td>Romania</td>
<td>Uruguay</td>
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<tr>
<td>El Salvador</td>
<td>Japan</td>
<td>Samoa</td>
<td>Venezuela</td>
</tr>
<tr>
<td>Ethiopia</td>
<td>Jordan</td>
<td>Senegal</td>
<td>Vietnam</td>
</tr>
<tr>
<td>Fiji</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
CHAPTER 4

REMITTANCES, EXCHANGE RATES AND MONEY DEMAND

4.1 INTRODUCTION

In the previous chapter we discussed the relationship between remittances and exchange rates using microeconomic (individual) level data on U.S. immigrants. In this chapter we re-examine this relationship using macroeconomic (aggregate) level data. Long time series on remittances are not available for large numbers of countries. Because of this, in this chapter we focus our attention on one country, Mexico. In this chapter we also add money demand to the discussion. This variable is important, given that the relationship between remittances and exchange rates depends on the currency used by households to consume and invest. Finally, in this chapter we recognize that the macroeconomic relationship between remittances and exchange rates is endogenous, accounting for this endogeneity we examine the effects of remittances on the exchange rate.

Mexico is the largest recipient of remittances in Latin America. According to the Inter-American Development Bank in the year 2005 Mexico received more than 20 billion dollars of the 54 billion dollars of remittances that were sent to Latin America. These 20 billion dollars in remittances in 2005 represent a twenty five percent increase in Mexican remittances inflows from the previous year (Inter-American Development Bank,
Moreover, since the 1960s, remittances inflows into Mexico have averaged an annual growth rate of 13 percent (Federal Reserve Bank of Dallas, 2004).

Mexican migrants working in the U.S. earn salaries in U.S. dollars. A large portion of these migrants sends back a fraction of their earnings to their families in Mexico. Often the transfer mechanism used by the emigrant allows the household to receive the transfer in U.S. dollars (e.g. remittances that are hand carried or a bank that allows for transfers in U.S. dollars). Thus, the 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 for the household to convert remittances into Mexican currency. But it is possible that the household does not want to convert all remittances 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 involved with unexpected depreciations. Also, the existence of informal dollarization inside the country can make it convenient to maintain stocks of both currencies.

Previous studies for various countries suggest that households convert a fraction of the remittances received into local currency. This is evident from the studies showing that remittances react significantly to changes in the exchange rate (El-Sakka and McNabb, 1999; Faini, 1994; Higgins et al., 2004). A clear understanding of the effects of exchange rates on remittances is of vital importance for receiving countries. For example, countries that want to increase the flow of inward remittances need to consider the effects of alternative exchange rate policies on the flow of remittances.
It is also possible to argue that the relationship between remittances and exchange rates is endogenous. Previous literature has found that remittances appreciate the home country exchange rate (Bourdet and Falck, Forthcoming; Amuedo-Dorantes and Pozo, 2004 a). This also has important consequences for receiving countries. Exchange rate appreciation can give rise to a phenomenon similar to Dutch disease. In the Dutch disease phenomenon there is an appreciation of the exchange rate that makes the country's exports more expensive in international markets. As a result, there is a negative impact on the competitiveness of the tradable sector.14

This study uses variance decompositions (VDCs) and impulse response functions (IRFs) derived from a structural vector error correction model (SVECM) to examine the relationship between remittances, exchange rates and money demand in Mexico. The use of SVECM models can address the endogeneity problem between remittances and other macroeconomic variables. This endogeneity appears to be present 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 endogenous variables included in the estimation are Mexico's income (Y), U.S. income (Y*), Mexico's real exchange rate in Mexican pesos per U.S. dollars (Q), interest rate differentials between Mexico and the U.S. (I-I*), Mexico's M1 (M) and remittances (R).

Several previous studies have analyzed the relationship between remittances and the exchange rate (Amuedo-Dorantes and Pozo, 2004 a; Bourdet and Falck, Forthcoming; El-Sakka and McNabb, 1999; Faini, 1994; Higgins et al., 2004; Yang, 2006). There are

14 The term “Dutch disease” comes from a similar phenomenon caused by the development of the natural gas industry in Holland resulting in an export boom with large foreign exchange currency inflows. See Corden (1984) for a broader discussion.
three major differences between this study and previous studies. First, unlike the current study, previous studies do not incorporate money demand in the analysis. Later in this chapter we discussed how the relationship between remittances and the exchange rate may depend to a great extent on the relationship between remittances and money demand. Second, we use SVECM to address the endogeneity problem between our variables. In previous studies this endogeneity was either ignored or address for only some of the variables on each estimation. Finally, our estimation methodology allows for a dynamic response of remittances (exchange rate) to the exchange rate (remittances). For instance, it is possible that a depreciation of the Mexican currency will bring an increase in remittances in the short-run, but a decrease of remittances in the long-run.

Results show that there is bi-directional relationship between remittances and the exchange rate. Furthermore, positive shocks to remittances seem to appreciate Mexico’s real exchange rate. This suggests that remittances may be causing a phenomenon similar to Dutch Disease in Mexico and having a negative impact in the competitiveness of the tradable sector. It is also shown that remittances impact domestic money demand. Remittances have a positive effect on domestic money demand. On the other hand, results also suggest that shocks to remittances may decrease the demand for U.S. dollars in Mexico.

4.2 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 purposes of holding money, while interest rates are included to account for the opportunity cost of
holding money. Different authors have proposed a series of additional variables to be included in the money demand equation in the context of an open economy (e.g. Arango and Nadiri, 1981; Hamburger, 1977; Hueng, 2000; Mundell, 1963; Pozo and Wheeler, 2000). Two variables commonly proposed are exchange rates and foreign interest rates. Exchange rates are included to account for the fact that households consume foreign goods for which they need to pay with foreign currency. The exchange rate is the price for converting domestic currency into foreign currency. Foreign interest rates are included to account for the fact that households may want to hold assets denominated in domestic and foreign currency in their portfolios.

Following the traditional shopping-time model (see McCallum (1993) and Walsh (2003)) let’s assume that the representative household maximizes the present value of utility over two periods. Utility in the first period depends on consumption and leisure. The household consumes goods which are available for purchase in 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 two things: time to go shopping and money to spend. The household may already hold money balances or alternatively he/she can obtain money from another source (e.g. a visit to the bank to withdraw money, selling real assets to convert a less liquid asset into money). Holding money balances (of domestic and foreign currency) reduces the time involved in shopping, because the household does not need to spend time obtaining money from another source.
Utility in the second period depends on the amount of wealth left ($W$). Wealth depends on future income, the return of investments in the host and home country, and money holdings.

Allowing $\beta$ to be the discount factor, the representative agent two-period utility function is:

$$V = U_1(C, C^*, L(C, C^*, M, M^*) + \beta U_2(W)) \quad (4.1)$$

In the first period the household, consumes both kinds of goods ($C$ and $C^*$), invests in domestic and foreign assets ($B$ and $B^*$) and holds local and foreign currency ($M$ and $M^*$). The household receives income ($Y$) in each period. In the first period the household receives a remittances transfer in U.S. dollars from the emigrant ($R$). The constraints for the household can be written as:

$$Y + QR = C + M + B + QC^* + QM^* + QB^* \quad (4.2)$$

$$W = Y + M + (1 + I)B + QM^* + Q(I + I^*)B^* \quad (4.3)$$

Where $I$ and $I^*$ stand for the domestic and foreign interest rates, respectively, and Q is the real exchange rate defined as domestic currency per foreign currency (i.e. Mexican pesos per U.S. dollars).

The main difference between Equation (4.2) 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. It can be shown that if we maximize Equation (4.1) subject to the constraints in Equations (4.2) and (4.3), we obtain that demand for domestic and foreign currency can be expressed as a function of
$Y, Q, I, I^*$ and $R$. This means that money demand in an open economy will take the form:

$$M = f(Y, R, Q, I, I^*)$$  \hspace{1cm} (4.4)

$$M' = f(Y, R, Q, I, I^')$$  \hspace{1cm} (4.4')

Thus, money demand equations in an open economy should include variables such as foreign interest rates, exchange rates and remittances.

4.3 REMITTANCES, MONEY DEMAND AND THE EXCHANGE RATE

Remittances can affect money demand in two ways. First, we have the microeconomic effect of remittances on the money demand of the receiving household. An increase in remittances is an increase in the income available to the household. As such the household will want to increase money holdings for transaction purposes. If the household is using Mexican pesos for everyday transactions then the increase in remittances should have a positive effect on the domestic money balances of households in Mexico. If the household is using U.S. dollars to consume then the increase in remittances should have a positive effect on the holdings of U.S. dollars of households in Mexico. These two possibilities are not mutually exclusive, that is the household may hold more of both currencies. Figure 4.1 summarizes this idea:
On the other hand, remittances in Mexico are also a macroeconomic phenomenon. There are a large number of households receiving remittances. As remittances flows from the U.S. to Mexico increase, there will be more access to U.S. dollars in Mexico. This may encourage the use of the U.S. dollar as a medium of exchange. As a result the household will 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 from Mexican pesos to U.S. dollars. Figure 4.2 summarizes this idea:

### Figure 4.2 – The Effect of Remittances on Holdings of Domestic and Foreign Currency: A Macroeconomic Perspective.

\[ \text{Remittances} \rightarrow \text{U.S. Dollars} \rightarrow \text{Goods Available for Purchase with U.S. Dollars} \rightarrow \text{Domestic Money Demand} \]

Thus, the relationship between remittances and domestic money demand can be either positive or negative. In this chapter we use VDCs and IRFs to test the impact of remittances on the demand for Mexican pesos and U.S. dollars.
There are several explanations for the effect of remittances on the exchange rate. For instance, as explained above, it is possible that households in Mexico demand more local currency after receiving remittances. The increase in demand for Mexican pesos will appreciate the Mexican currency. Thus, we should add one more step to Figure 4.1, that is:

**Figure 4.3 – The Effect of Remittances on the Exchange Rate: The Domestic Money Demand Channel.**

\[
\uparrow \text{Remittances} \rightarrow \uparrow \text{Household} \rightarrow \ldots \rightarrow \uparrow \text{Household Domestic} \rightarrow \downarrow \text{Exchange Rate} \\
\text{Income} \quad \text{Money Demand} \quad \text{(Appreciation)}
\]

It is also possible that households simply demand more goods after receiving remittances. Given the limited supply of non-tradable goods in Mexico, this will 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 exchange rate is taken as the ratio of the price of tradable goods over the price non-tradable goods. The Mexican currency appreciates because the price of non-tradable goods rises, while the price of tradable goods stays constant.

**Figure 4.4 – The Effect of Remittances on the Exchange Rate: The Relative Price Channel.**

\[
\uparrow \text{Remittances} \rightarrow \uparrow \text{Price Non-Tradable} \rightarrow \text{Price of Tradable} \rightarrow \downarrow \text{Exchange Rate} \\
\text{Goods} \quad \text{Goods Exogenous} \quad \text{(Appreciation)}
\]
Moreover, if the household is converting remittances into home currency then migrants should adjust the amount of the remittances transfer in response to changes in the exchange rate. For example, after a depreciation of the Mexican peso each dollar of remittances will be worth more to the household. This means that the household can consume more with the same amount of remittances (in U.S. dollars). If the purpose of remittances is to make a certain bundle of goods available to the household, then the emigrant will decrease the amount of money that he/she is sending back home. Furthermore, if the emigrant is making a long term investment (e.g. retirement) with remittances then a smaller amount of remittances will be enough to reach certain target level of investment.

On the other hand, each dollar of remittances is worth more now in the home country. If the emigrant 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 emigrant wants to send more because each 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 children to a better school by receiving some more remittances and that this was not possible before the depreciation. In summary, remittances may increase or decrease after a depreciation of the Mexican currency. These two possibilities are summarized in Figure 4.5.

The causality between remittances and exchange rates can go both ways. In this chapter we use VDCs and IRFs to test both possibilities. We proceed in two steps. First, we test if remittances react to changes in the exchange rate. Then we test if exchange rates react to changes in remittances.
4.4 METHODOLOGY

This study uses impulse response functions (IRFs) and variance decompositions (VDCs) derived from a structural vector error correction model (SVECM). 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 will 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. Sims (1982) argues that the strength of Granger-causal relationships can be measured with VDCs. Granger causality is a technique for determining whether one time series is useful in forecasting another.\(^\text{15}\) If, for example, innovations to remittances explain a significant portion of the forecast error variance in Mexico's M1, then

\(^{15}\) There are of course other measures of causality between economic variables, besides Granger-causality. Granger (2005) stated that "although most writers did not quite accept the definition of causality, saying that the definition used was not 'real causality but only Granger causality,' although no one would define 'real causality' for me....I have since become involved in fairly heated debates about what is causality and there are now various alternative definitions available to applied economists. But I let demand for the product determine its current worth and continue to maintain a belief that whatever the final definition that we all agree on might be, it will contain my own as a component."
remittances Granger cause Mexico's M1. On the other hand, if remittances do not explain a significant portion of the forecast error variance in Mexico's M1, then remittances do not Granger cause Mexico's M1.

In order to compute VDCs and IRFs the residuals must be orthogonalized. In this chapter we use Bernanke's (1986) structural decomposition to produce orthogonal residuals. 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. This means that meaningful VDCs are derived.

Bernanke's decomposition is an alternative to the more commonly used Cholesky decomposition. The problem with the Cholesky decomposition is that the recursive ordering that it imposes 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 will only be valid if it is known that the true model is recursive (rare in economics) and it is only the ordering that is unknown (Fackler, 1990). This means that the Cholesky decomposition imposes a particular type of contemporaneous structure in the economy that is not necessarily consistent with economic theory.

The specification of the structural model is given in Equations (4.5) to (4.10). Lower case letters represent the first stage VECM residuals of the corresponding variables. Remember, Equations (4.5) to (4.10) give a structure for the contemporaneous relationship between the residuals of the VECM, and in the VECM estimation all the
variables are still related through lags. That is, all the equations contain lags of the other variables.

\[ y^* = u_1 \]  
\[ y = a_1(i - i^*) + a_2 m + u_2 \]  
\[ q = a_3 y + a_4 r + u_3 \]  
\[ (i - i^*) = a_5 y + a_6 y + a_7 q + a_8 m + u_4 \]  
\[ r = a_9 y^* + a_{10} y + a_{11} q + u_5 \]  
\[ m = a_{12} y + a_{13} q + a_{14}(i - i^*) + a_{15} r + u_6 \]  

Equation (4.5) is based on the assumption that innovations to U.S. income are contemporaneously uncorrelated with innovations to other variables. This means that U.S. income is not responding contemporaneously to shocks in other variables. Equation (4.6) is Mexico’s IS curve. Equation (4.6) includes \( m \) to allow for real balance effects, that is, we allow the money supply to affect output. Equation (4.7) relates Mexico’s exchange rate with Mexico’s income and remittances. The inclusion of remittances in Equation (4.7) is justified by the previous evidence indicating that remittances have important effects on exchange rates (Bourdet and Falck, Forthcoming and Amuedo-Dorantes and Pozo, 2004a).

Equation (4.8) 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 Central Bank responds to contemporaneous shocks in world economic conditions (proxied by \( y^* \)), domestic output and exchange rates. In Equation (4.9) we have that \( r \) is a function of \( y, q \) and \( y^* \). This is consistent with the evidence in the remittances literature
suggesting that remittances respond significantly to changes in the exchange rate (Faini, 1994) and home and host country economic conditions (Katseli and Glytsos, 1986; Vargas-Silva and Huang, 2006).

Equation (4.10) is the money demand function. As is common in the literature the demand for money balances depends on domestic income and domestic interest rates. As we discussed in Section 4.2, in the open economy context we should also allow exchange rates, foreign interest rates and remittances to affect money demand. Hence these variables are also included in Equation (4.10).

4.5 DATA

The data used in this chapter are of monthly frequency. The data covers the period from January 1995 to February 2006. As a measure of income for both countries we use industrial production. We include income in both countries to control for home and host country economic conditions. Both variables are seasonally adjusted. The real exchange rate is defined as Mexican pesos per U.S. dollars and is constructed using the CPI of both countries. The CPI of both countries are seasonally adjusted while the nominal exchange rate is not. We also include an interest rate differential. The interest rate differential is the difference between Mexico’s Government three month bond rate and the U.S. three-month Treasury bill rate.

As a monetary aggregate we include Mexico’s real M1. This variable is seasonally adjusted and is expressed in real terms. In Mexico banks are allowed to accept deposits in U.S. dollars. This means that M1 is composed of local currency 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 fraction of M1 that is in Mexican pesos (that is currency in circulation plus checking deposits in Mexican pesos). Second, as a proxy for the holdings of foreign currency in Mexico we include the fraction of M1 that is denominated in U.S. dollars (that is checking deposits in U.S. dollars). The sum of these two measures is equal to total M1 in Mexico.

Most of the estimations are conducted using the fraction of M1 that is denominated in Mexican pesos. We use the fraction of M1 in U.S. dollars to investigate the effect of remittances in the holdings of foreign currency.

Finally, we include remittances in our estimation. This variable is in real terms and is seasonally adjusted. The data on remittances that we used in the empirical estimation is obtained from Mexico’s Central Bank. The amounts reported by Mexico’s Central Bank may differ from the amounts reported by other sources (e.g. Inter-American Development Bank). The main reason for the difference in the amount of remittances reported by different sources is that a fraction of remittances is sent through unofficial channels (e.g. cash in the mail, carried by persons). Entities differ in the way they adjust their measure of remittances to account for unofficial transfers.

Table 4.1 reports the level of remittances received each year for the period under consideration in this study. From Table 4.1 it is clear that there has been a large increase in remittances since 1995. On average, total remittances have increased by 17 percent per year. Moreover, with the exception of the year 2006 (which includes only two months of information), total remittances are steadily growing in each period.
In Table 4.1 we report on the transmission method for sending remittances across the border. Table 4.1 indicates that there has been 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. Two possibilities are the increasing use of the services offered by companies like Western Union and the increase in the percentage of migrants with bank accounts in the U.S. According to the U.S. Department of State (2002), during the first nine months of 2002, Mexican migrants opened around 175,000 bank accounts using the *matrícula consular* card. Migrants with these accounts, can deposit money in a bank account in the U.S. and the household can withdraw the money in Mexico by either visiting a bank or by using an automatic teller machine (ATM).

The source of all the U.S. data is the Federal Reserve Bank of St. Louis. The source of the all the Mexican data is Mexico’s Central Bank. Finally, all the variables with the exception of the interest rates are in logarithms.

4.6 RESULTS

We start our analysis by testing our variables for stationarity. Different authors (e.g. Ohanian, 1988) have caution about interpreting VDCs and IRFs estimated with non-stationary data. We apply the Dickey-Fuller (1981) and the Kwiatkowski-Phillips-Schmidt-Shin (1992) stationary tests to each of our series. We check for up to two unit roots in each case. The results indicate that all our variables have one unit root.

Next we conducted the Johansen (1988) cointegration test. Engle and Granger (1987), among others, have discussed the importance of testing for cointegration. The
results from the cointegration test indicate that our variables are cointegrated. This means that a SVECM, 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 10. Q-statistics indicate an absence of serial correlation in each equation of the SVECM, indicating that the lag length is adequate.

The VDC of remittances is reported in Table 4.2. In Table 4.2 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 4.2 indicates that the exchange rate explains a significant portion of the forecast error variance in remittances. This suggests that the exchange rate granger causes remittances. Also, from Table 4.2 we see that U.S. income has an important impact on remittances. U.S. income is strongly related with the remitting capabilities of the migrant.

The IRF of remittances after a shock to the exchange rate is reported in Figure 4.6. In Figure 4.6 and the following IRF figures the bold line represents the response of the variable and the thin lines represent 95 percent confidence intervals. The confidence intervals are computed via Monte Carlo simulation with 2,000 draws. From Figure 4.6 we see that the confidence interval contains zero, and thus we cannot conclude that the effect of exchange rates on remittances is either positive or negative.
<table>
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<th>Year</th>
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<th>Money Orders</th>
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<td>Growth Rate</td>
<td>Amount</td>
<td>Growth Rate</td>
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</tr>
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<td>1996</td>
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</tr>
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</tr>
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<td>2002</td>
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<td>0.69</td>
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<tr>
<td>2005</td>
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<td>2006</td>
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<tr>
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<td>9.06</td>
<td>16.97</td>
<td>1.48</td>
<td>2.49</td>
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</tbody>
</table>

Note: These numbers were calculated by the authors using the information published by Mexico's Central Bank. The amounts reported in Table 1 may differ from the amounts reported by other sources (e.g. Inter-American Development Bank). The category "Others" includes checks, cash and in-kind transfers. The amount reported for the year 2006 includes data until February only and thus are not included in the average.
Table 4.2 – Variance Decomposition of R.

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<td>(10.9)</td>
<td>(9)</td>
<td>(10.4)</td>
<td>(11.3)</td>
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</table>

Note: These numbers are point estimates and standard errors are in parenthesis. 2,000 bootstrap simulations are used to construct the standard errors. A * indicates that the point estimate is at least twice as large as its standard error.

Figure 4.6 – IRF of Remittances after a Shock to the Exchange Rate.

Note: Confidence intervals are computed via Monte Carlo simulation with 2,000 draws. Ranges indicated represent 95% confidence intervals.

The VDC of Mexico’s exchange rate is reported in Table 4.3. The fifth column in Table 4.3 reports the percentage of the forecast error variance of the exchange rate that is
explained by remittances. The results in Table 4.3 indicate that remittances explain a significant portion of the forecast error variance in exchange rates. Remittances explain up to 54.8 percent of the variation in exchange rates. This suggests that the exchange rate is Granger caused by remittances.

Also from Table 4.3, money seems to having an important impact on the exchange rate. In traditional economic models, an expansion of the domestic money supply (more Mexican currency available) depreciates the domestic currency (price of Mexican currency decreases).

The response of the exchange rate to a shock in remittances is shown in Figure 4.7. The exchange rate is responding negatively and significantly after positive shocks to remittances. This indicates that the exchange rate appreciates after shocks to remittances. The response is significant for up to 18 periods (one year and a half) after the shock.

### Table 4.3 – Variance Decomposition of Q.

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Note: These numbers are point estimates and standard errors are in parenthesis. 2,000 bootstrap simulations are used to construct the standard errors. A * indicates that the point estimate is at least twice as large as its standard error.
Figure 4.7 – IRF of the Exchange Rate after a Shock to Remittances.

Note: Confidence intervals are computed via Monte Carlo simulation with 2,000 draws. Ranges indicated represent 95% confidence intervals.

The VDC of domestic money demand is reported in Table 4.4. The results indicate that remittances have an important impact on Mexico’s domestic money demand. There is also evidence that interest rate differentials affect Mexico’s domestic money demand. Interest rate differentials represent the differential in return between holding domestic (assets denominated in domestic currency) and foreign assets (assets denominated in foreign currency).

The response of domestic money demand to a shock in remittances is shown on Figure 4.8. Domestic money demand seems to respond positively after 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 4.5. The results suggest that remittances do
not explain a significant percentage of the forecast error variance in the holdings of U.S. dollars in Mexico. The IRF of holdings of U.S. dollars after a shock to remittances is shown in Figure 4.9. The result in Figure 4.9 is surprising. It seems that remittances have a negative effect in the holding of U.S. dollars in Mexico.

Table 4.4 – Variance Decomposition of M in Pesos.

<table>
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Note: These numbers are point estimates and standard errors are in parenthesis. 2,000 bootstrap simulations are used to construct the standard errors. A * indicates that the point estimate is at least twice as large as its standard error.

Figure 4.8 – IRF of Domestic Money Demand after a Shock to Remittances.

Note: Confidence intervals are computed via Monte Carlo simulation with 2,000 draws. Ranges indicated represent 95% confidence intervals.
Table 4.5 – Variance Decomposition of M in U.S. Dollars.

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<td>(7.6)</td>
<td>(27.5)</td>
<td>(7.2)</td>
<td>(10.7)</td>
<td>(12)</td>
<td>(22.3)</td>
</tr>
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<td>12</td>
<td>15.5</td>
<td>41.9</td>
<td>9.4</td>
<td>8.6</td>
<td>11.1</td>
<td>13.4</td>
</tr>
<tr>
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<td>(23.2)</td>
<td>(9.2)</td>
<td>(10.8)</td>
<td>(11.2)</td>
<td>(19.2)</td>
</tr>
<tr>
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<td>37.2</td>
<td>13.7</td>
<td>13.6</td>
<td>7.6</td>
<td>8.2</td>
</tr>
<tr>
<td></td>
<td>(14.1)</td>
<td>(19.8)</td>
<td>(10.3)</td>
<td>(12.4)</td>
<td>(10.2)</td>
<td>(16.2)</td>
</tr>
<tr>
<td>36</td>
<td>14.8</td>
<td>39.6</td>
<td>13.9</td>
<td>18.7</td>
<td>7</td>
<td>6</td>
</tr>
<tr>
<td></td>
<td>(13.3)</td>
<td>(19.8)*</td>
<td>(11)</td>
<td>(13.7)</td>
<td>(10.4)</td>
<td>(16.1)</td>
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<tr>
<td>48</td>
<td>11.7</td>
<td>37.9</td>
<td>16.5</td>
<td>22.7</td>
<td>6.5</td>
<td>4.6</td>
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<td></td>
<td>(13.4)</td>
<td>(19.6)</td>
<td>(12.1)</td>
<td>(14.5)</td>
<td>(10.9)</td>
<td>(16)</td>
</tr>
</tbody>
</table>

Note: These numbers are point estimates and standard errors are in parenthesis. 2,000 bootstrap simulations are used to construct the standard errors. A * indicates that the point estimate is at least twice as large as its standard error.

Figure 4.9 – IRF of Demand for U.S. Dollars after a Shock to Remittances.

Note: Confidence intervals are computed via Monte Carlo simulation with 2,000 draws. Ranges indicated represent 95% confidence intervals.

4.7 INTERPRETING THE RESULTS

The high percentage of the variation in remittances that the exchange rate explains suggests that households convert some fraction of the remittances received into local
currency. If households are not converting remittances into local currency, then the migrant should not care about the exchange rate. The fact that remittances respond to exchange rate shocks suggests that migrants care about exchange rate changes. The relationship between remittances and the exchange rate is also evidenced by the result indicating that remittances explain a significant percentage of the variance in exchange rates. There seems to be a bi-directional causal relationship between remittances and the exchange rate.

Furthermore, the IRFs indicate that the exchange rate appreciates after shocks to remittances. This is consistent with the results of previous studies using different methodologies (e.g. Bourdet and Falck, Forthcoming and Amuedo-Dorantes and Pozo, 2004). Remittances may give rise to a phenomenon similar to Dutch Disease and may have a negative effect on the competitiveness of the tradable sector in Mexico.

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. The IRFs also suggest that it may be the case that remittances affect the holdings of U.S. dollars negatively. There is no intuitive explanation for this result. But we have to keep in mind that the result is only significant in one period.

4.8 CONCLUDING REMARKS

The aim of this chapter was to analyze the relationship between remittances, exchange rates and money demand in Mexico. Variance decomposition and impulse response functions derived from a vector error correction model were used for the empirical estimation. The use of vector error correction models can address the
endogeneity problem between remittances and other macroeconomic variables. This endogeneity appears to be present with respect to the exchange rate and remittances. Bernanke’s structural decomposition was used to produce orthogonal residuals.

Results indicate that there is bi-directional relationship between remittances and the exchange rate. Previous studies have either ignored this endogeneity or have address the endogeneity for only some of the variables. Furthermore, the results suggest that positive shocks to remittances tend to appreciate Mexico’s real exchange rate. While remittances are a potential source of external financing for Mexico, these results imply that remittances appreciate the exchange rate and thus may affect the competitiveness of the tradable sector negatively. As the flow of remittances from the U.S. to Mexico increases, the Mexican government may find it advantageous to devise policies that minimize the negative impact of remittances on the tradable sector while at the same time not discourage the flow of remittances.

Finally, results indicate that remittances have a positive impact on domestic money demand. This suggests that the household convert a fraction of the remittances transfer into domestic currency.
CHAPTER 5

REMITTANCES, FDI AND THE BUSINESS CYCLE: THE CASE
OF MEXICO AND THE U.S.

5.1 INTRODUCTION

In this chapter we document the business cycle properties of worker's remittances flows to Mexico. A clear understanding of the business cycle and how it relates to remittances is important for developing countries so that they may react adequately to cyclical fluctuations in output. This is especially important for those countries with large remittances inflows.

In the previous remittances literature a number of studies have found evidence that home country economic conditions affect remittances (El-Sakka and McNabb, 1999; Elbadawi and Rocha, 1992; Faini, 2004; Glytsos, 1988; Higgins et al., 2004; Quinn, 2005; Straubhaar, 1986). There is also evidence in the literature that host country economic conditions affect remittances (Vargas-Silva and Huang, 2006). Other studies have focused on the effect that remittances in turn have on home country economic conditions. These studies provided evidence that remittances affect home country economic variables (Amuedo-Dorantes and Pozo, 2004; Glytsos, 2001; Zarate-Hoyos, 2004).

Given the existing evidence on the relationship of remittances with home and/or host country economic conditions, we can expect the timing, periodicity and amount of
workers' remittances to be related to variations in the output of the home and host countries. In fact the World Bank reports that:

"Like FDI, remittances are a more stable source of external finance than debt. Indeed, remittances tend to be counter-cyclical, buffering other shocks, since economic downturns encourage additional workers to migrate abroad and those already abroad increase the amount of money they send to families left behind" (World Bank, 2003).

The idea that remittances are counter-cyclical appears to originate from economic studies that show that a large percent of remittances are sent for altruistic purposes (e.g. Agarwal and Horowitz, 2002). If household income decreases then emigrants will remit more to compensate for the decrease. Others argue that there is a contractual insurance agreement between the household and the emigrant (e.g. Lucas and Stark, 1985). In this case emigrants will send their insurance payments to the home country during economic downturns. If indeed remittances are countercyclical then home countries can count on remittances to offset negative cyclical fluctuations in output. This means that contrary to other capital inflows like FDI that are presumably procyclical, remittances can be used to buffer negative shocks in output.

On the other hand, remittances are also known to be sent for other purposes, such as investment (see Brown, 1997) or interest in inheriting from the household's fortune (see Hoddinott, 1994). These incentives for remitting may decrease after economic downturns in the home country. In this case remittances will be procyclical. If remittances are procyclical with respect to home country output then receiving countries cannot count on remittances to offset negative cyclical fluctuations in output. Moreover, remittances will accentuate recessions (see Glytsos, 2001).
The relationship between remittances and the business cycle of the host country is also important. If remittances to the home country are not responsive to the host country business cycle, then there will be no drastic decreases in remittances after downturns in the host economy. On the other hand, if remittances are strongly correlated with the host country business cycle, remittances can become another channel by which negative fluctuations in the host economy can affect the recipient countries.

Furthermore, some authors argue that remittances flows are more stable than other capital inflows such as FDI (Neyapti, 2004; Ratha, 2003). If this is the case, then using remittances as a source of external financing can bring more stability to the economy relative to using other capital inflows.

In spite of the large body of literature on the determinants of remittances, surprisingly little is known about their business cycle characteristics. In one of the few studies in the topic, Sayan (2004) using the Hodrick and Prescott (1980) filter found that there is a strong positive correlation between the cyclical component of remittances from Germany to Turkey and the cyclical component of Turkish output. He also finds a negative but weak correlation between the cyclical component of remittances and the cyclical component of German output. These results indicate a positive correlation between remittances and home country output, but no correlation between remittances and host country output.

In this study, we explain this issue using the case of the U.S. and Mexico. We denote the host country as the U.S. and the home country as Mexico. We test three hypotheses regarding the business cycle relationship between U.S. output, Mexico’s

16 Some authors have focused on the relationship between other inflows (e.g. FDI, foreign aid) and the business cycle. See Pallage and Robe (2001) for a discussion of the relationship between foreign aid the business cycle.
output, Mexico’s inward FDI and Mexico’s inward remittances. These are stated below in the form of three hypotheses:

Hypothesis 1: Remittances are countercyclical with respect to the home country business cycle.

Hypothesis 2: Remittances are not responsive to changes in the host country business cycle.

Hypothesis 3: Remittances are less volatile than FDI flows.

This chapter uses data from Mexico and the U.S. to test hypotheses 1-3. The empirical estimation is conducted in four steps. First, we estimate the cyclical component of Mexico’s remittance inflows, Mexico’s inward FDI, and the gross domestic product (GDP) of Mexico and the U.S. To this end we use two different techniques: the Hodrick-Prescott (1980) filter and the Baxter-King (1995) filter. Second, we compare the standard deviation of each cyclical component. Third, we estimate the correlation between the cyclical components. Finally, to account for the possibility of remittances leading or lagging the cyclical fluctuations in Mexico’s GDP and U.S. GDP, we also conduct our estimations including leads and lags of remittances.

Results confirm the argument that the volatility of the cyclical component of remittances is smaller than the volatility of the cyclical component of FDI. Also the results reveal that there is a negative correlation between the cyclical component of remittances and the cyclical component of Mexico’s GDP. This means that Mexico should consider using remittances as part of it’s response to negative cyclical fluctuations in output. Finally, the empirical results show that remittances are procyclical with respect
to the U.S. business cycle. Our results are robust to the use of two alternative measures of remittances.

5.2 METHODOLOGY

Lucas (1981) among others, has emphasized that macroeconomic variables experience repeated fluctuations about their long-term growth paths. These repeated fluctuations are referred to as business cycles. In order to decompose macroeconomic variables into a slow moving component (or trend) and a cyclical component it is common to use some kind of filter.

There is controversy about the appropriate filter to use to obtain the cyclical component of a series (see Baxter and King, 1995; Christiano and Fitzgerald, 2003; Cogley and Nason, 1995; Guay and St-Amant, 1997; Harvey and Haeguer, 1993; Osborn, 1995; Stock and Watson, 1980). One way to avoid this controversy is to show that the results of the estimation are robust to the use of different filters. In this chapter we use two filters to obtain the cyclical components. We use the filter proposed by Hodrick and Prescott (1980) (HP) and the band-pass filter introduced by Baxter and King (1995) (BK) and evaluated by Stock and Watson (1998) and Christiano and Fitzgerald (2003).

The best known filter used to obtain the cyclical component of a series is the HP filter. In what follows we give a short description of this filter. Let’s assume that we have a series $x_t$, that is the sum of a growth component ($g_t$) and a cyclical component ($c_t$), that is $x_t = g_t + c_t$. Hodrick and Prescott (1980) proposed the minimization of the following equation with respect to $g_t$ for determining the growth component of a series:
The first term in (5.1) is simply the square of the cyclical component of the series \(c_i\). Over long time periods the average of \(c\) should be near zero. The second squared term of (5.1) penalizes variability in the growth component series. The second term of (5.1) is the sum of the squared second differences. In this case \(\lambda\) is an arbitrary penalty parameter. A higher \(\lambda\) implies a smoother series. In this chapter we follow Hodrick and Prescott (1997) and set \(\lambda\) equal to 1,600.\(^{17}\)

More recently, Baxter and King (1995) proposed a band pass filter as an alternative to the HP filter. Next we explain the intuition behind the BK filter.

While the HP filter is known as a high pass filter due to its removal of low frequency components (slow moving components), the BK is a band pass filter that also removes the high frequency components (irregular or fast moving components). This means that the BK filter will remove high frequency and low frequency components leaving the business cycle frequencies. Assume that we have a series \(x_i\), and we apply a moving average to this time series, \(x_i^* = \sum_{h=-k}^{k} a_h x_{i-h} = a(L)x_i\), where \(a_h\) is the moving average weight and \(L\) is the lag operator. Let \(\beta(w)\) be the ideal low pass filter\(^{18}\) and \(a_k(w)\) its finite representation at frequency \(w\), where \(a_k(w) = \sum_{h=-k}^{k} a_h e^{-jwh}\). The low pass filter selects a finite number of moving average weights \(a_h\) to minimize:

\[
\min_{\{a_h\}} Q = \int_{-\pi}^{\pi} |\beta(w) - a(w)|^2 dw
\]

\(^{17}\) Hodrick and Prescott (1997) show that results are consistent for different values of \(\lambda\).

\(^{18}\) In order to construct an ideal low pass filter we would need an infinite-order moving average. This is why we use an approximation using a finite moving average.
We define \( w_H \) and \( w_L \), the upper and lower frequencies as 32 quarters and 6 quarters, respectively. This indicates that we are defining the business cycle component as fluctuations lasting no fewer than 6 quarters and no more than 32 quarters. The frequency representation of the band pass weights becomes \( a_k(32) - a_k(6) \), in this case we are simply subtracting the weights of two low pass filters. The idea of defining business cycles between 6 and 32 quarters comes originally from Burns and Mitchell (1946).

In Figure 5.1 we have the cyclical component of Mexico’s inward remittances using the HP (dashed line) and BK (solid line) filters. From Figure 5.1 we can see that the BK filter generates a smoother cyclical series than the HP filter.

**Figure 5.1 – Cyclical Component of Mexico’s Remittances**

Estimated with HP and BK.

After obtaining the cyclical component of each series we calculate the correlations between the cyclical component of remittances and FDI with the cyclical component of U.S. GDP and Mexico’s GDP. It is also possible that the cyclical components of our series are related in lags or leads. We test this possibility calculating
the correlation of the cyclical components using up to three lags and leads of remittances and FDI.

5.3 DATA

The data used in this chapter are in real terms, at quarterly frequencies and in logarithms. In correlations involving U.S. GDP all variables are in U.S. dollars, in this case the variables are deflated using the U.S. consumer price index. In correlations involving Mexico’s GDP, all variables are in Mexican pesos, and variables are deflated using Mexico’s consumer price index.

The data covers the period from the first quarter of 1981 to the first quarter of 2005. We have two measures of remittances. First, we use Mexico’s current transfer credit as a measure of Mexico’s inward remittances. This variable is obtained from the International Monetary Fund (IMF). The Dissemination Standards Bulletin Board contains information about the data reported by the countries to the IMF. According to the Dissemination Standards Bulletin Board, Mexico Summary Methodology for the Balance of Payments, in Mexico’s current transfer credit “the most important heading is family remittances, which consist of resources sent by Mexicans residing in the United States to their families in Mexico. The data is mainly obtained from companies that specialize in the transfer of such funds” (IMF, 2005).

To check the robustness of our results we also use the U.S. net remittances transfer with the rest of the world as a measure of Mexico’s inward remittances. U.S. net remittances are obtained from the U.S. Bureau of Economic Analysis. In this study we are only interested on Mexico, but according to the U.S. Department of Commerce
around 50 percent of the remittances sent from the U.S. go to Mexico. We use net remittances and not remittances outflows because remittances outflows are not published in quarterly frequency.

The output measures that we use are Mexico's GDP and the U.S. GDP. To check for consistency we also conducted our estimation using the U.S. GNI instead of U.S. GDP, but the results did not differ significantly. All the data, with the exception of U.S. net remittances, is obtained from the IMF.

5.4 PRELIMINARY DATA ANALYSIS

First, we conduct a series of Dickey and Fuller (1979) and Kwiatkowski et al. (1992) stationarity tests for our series in levels. We check for up to two unit roots in each case. The results indicate that all of our variables have one unit root. Next we apply the two filters to obtain the cyclical components of each series (HP and BK) and conduct unit root tests on the cyclical components. The cyclical components of all the series are stationary.

Figure 5.2 displays the two measures of remittances (solid lines) and their respective trends (dashed lines) estimated using the HP filter. Two points are evident from Figure 5.2. First, both measures of remittances have been increasing over time. Second, Mexico's inward remittances appears to be more volatile that U.S. net remittances.19

Figure 5.3 displays Mexico's inward remittances and Mexico's inward FDI (solid lines) and their respective trends (dashed lines). Mexico's inward FDI seems to be more

19 There is large drop in U.S. net remittances in the third quarter of the year 2001. This drop is due to the attacks of September 11, 2001. We also conducted our estimation removing this quarter from our data but results did not change.
volatile than remittances. Moreover, since the mid 1990s there has been a decreasing trend in FDI and an increasing trend in remittances.

Figure 5.2 – U.S. Remittances to Mexico, Mexico’s Inward Remittances and Respective Trends Estimated with HP (Billions of U.S. Dollars and Logarithms).

Figure 5.3 – Mexico’s Inward Remittances, Mexico’s Inward FDI and Respective Trends Estimated with HP (Figures are in Billions and Logarithms).
5.5 EMPIRICAL REGULARITIES

5.5.1 Remittances are Less Volatile than FDI Flows

Table 5.1 reports the standard deviations of the cyclical components of each series. The first two columns report the standard deviations when all variables are in U.S. dollars and the last two columns report all variables when remittances are in Mexican pesos. The first row reports the standard deviation of Mexico’s inward FDI, the second row reports the standard deviation of Mexico’s inward remittances and the third row of U.S. net remittances.

As has been found in previous studies in most cases FDI flows are more volatile than remittances. More specifically, the standard deviation of FDI seems to be around the double of the standard deviation of Mexican remittances inflows. There is a smaller gap (and sometimes negative gap) between the standard deviation of FDI and the standard deviation of remittances when U.S. net remittances are used. Remittances seem to be a more stable source of financing than FDI.

Table 5.1 – Standard Deviations of the Cyclical Components.

<table>
<thead>
<tr>
<th>Variable</th>
<th>Standard Deviation Series in U.S. Dollars</th>
<th>Standard Deviation Series in Mexico’s Pesos</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>HP</td>
<td>BK</td>
</tr>
<tr>
<td>MEX FDI</td>
<td>0.44</td>
<td>0.21</td>
</tr>
<tr>
<td>MEX REM</td>
<td>0.16</td>
<td>0.09</td>
</tr>
<tr>
<td>U.S. REM</td>
<td>0.25</td>
<td>0.12</td>
</tr>
</tbody>
</table>

Note: HP = Hodrick-Prescott, BK = Baxter-King.

5.5.2 Remittances are Counter-cyclical with Respect to Mexico’s GDP

Table 5.2 reports the correlations between the cyclical components of remittances and FDI with Mexico’s GDP. The first two rows report the correlation of Mexico’s
inward remittances with Mexico’s GDP. The third and fourth rows report the correlation of U.S. net remittances with Mexico’s GDP. Finally, the fifth and sixth rows report the correlation of Mexico’s inward FDI with Mexico’s GDP. The columns indicate the specific lag or lead in the remittances or FDI series (three lags to three leads).

The results show that, using both the HP and the BK filters, lags of the cyclical component of remittances are strongly and negatively correlated with the cyclical component of Mexico’s GDP. This result is consistent for both measures of remittances.

Also from Table 5.2 we see that leads of FDI flows are positively correlated with Mexico’s GDP. This indicates that while remittances are counter-cyclical, FDI is procyclical. A negative relationship between remittances and Mexico’s output is what we expect if remittances are sent mostly for altruistic and insurance purposes.

5.5.3 Remittances are Pro-Cyclical with Respect to Host Country GDP

Table 5.3 reports the correlations between the cyclical components of remittances and FDI with U.S. GDP. The table follows the same guidelines as the previous table. From Table 5.3 we see that remittances are positively correlated with U.S. GDP. Remittances will respond directly with the ups and downs of the U.S. economy. This suggests that remittances are another channel by which cyclical fluctuations in the U.S. economy will affect Mexico. Moreover, Table 5.3 reveals that remittances are more correlated with U.S. GDP than FDI.
<table>
<thead>
<tr>
<th></th>
<th>Three Lags</th>
<th>Two Lags</th>
<th>One Lag</th>
<th>Current Period</th>
<th>One Lead</th>
<th>Two Leads</th>
<th>Three Leads</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>A. Mexico’s Inward Remittances</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>HP</td>
<td>-0.1963*</td>
<td>-0.0970</td>
<td>-0.2338*</td>
<td>-0.0669</td>
<td>-0.0233</td>
<td>0.1262</td>
<td>-0.0755</td>
</tr>
<tr>
<td>BK</td>
<td>-0.5295*</td>
<td>-0.3964*</td>
<td>-0.2511*</td>
<td>-0.1556</td>
<td>-0.1120</td>
<td>-0.0803</td>
<td>-0.0242</td>
</tr>
<tr>
<td><strong>B. U.S. Net Remittances</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>HP</td>
<td>-0.2347*</td>
<td>-0.1592</td>
<td>-0.1577</td>
<td>0.0233</td>
<td>0.0084</td>
<td>-0.0002</td>
<td>-0.0326</td>
</tr>
<tr>
<td>BK</td>
<td>-0.4286*</td>
<td>-0.4848*</td>
<td>-0.3939*</td>
<td>-0.1956*</td>
<td>-0.0382</td>
<td>0.0109</td>
<td>-0.0313</td>
</tr>
<tr>
<td><strong>C. Foreign Direct Investment</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>HP</td>
<td>-0.0722</td>
<td>0.0213</td>
<td>-0.1320</td>
<td>-0.0468</td>
<td>-0.0498</td>
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<tr>
<td>BK</td>
<td>-0.1322</td>
<td>-0.1060</td>
<td>-0.1419</td>
<td>-0.1352</td>
<td>-0.0027</td>
<td>0.2384*</td>
<td>0.4857*</td>
</tr>
</tbody>
</table>

*Note: A * means significant at the 5 percent level, HP = Hodrick-Prescott, BK = Baxter-King. The estimations include lags and leads of remittances and FDI.
Table 5.3 – Correlation of Remittances and FDI with U.S. GDP.

<table>
<thead>
<tr>
<th></th>
<th>Three Lags</th>
<th>Two Lags</th>
<th>One Lag</th>
<th>Current Period</th>
<th>One Lead</th>
<th>Two Leads</th>
<th>Three Leads</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>A. Mexico’s Inward Remittances</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>HP</td>
<td>-0.0142</td>
<td>0.0334</td>
<td>-0.0030</td>
<td>0.0586</td>
<td>0.1492</td>
<td>0.1895</td>
<td>0.1011</td>
</tr>
<tr>
<td>BK</td>
<td>-0.1147</td>
<td>-0.1284</td>
<td>-0.0737</td>
<td>0.0490</td>
<td>0.1896</td>
<td>0.2789*</td>
<td>0.2823*</td>
</tr>
<tr>
<td><strong>B. U.S. Net Remittances</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>HP</td>
<td>0.0976</td>
<td>-0.0197</td>
<td>-0.0235</td>
<td>0.0280</td>
<td>-0.0057</td>
<td>-0.0287</td>
<td>-0.0796</td>
</tr>
<tr>
<td>BK</td>
<td>0.2134*</td>
<td>0.1673</td>
<td>0.1961*</td>
<td>0.2357*</td>
<td>0.2332*</td>
<td>0.1879</td>
<td>0.0891</td>
</tr>
<tr>
<td><strong>C. Foreign Direct Investment</strong></td>
<td></td>
<td></td>
<td></td>
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<td></td>
</tr>
<tr>
<td>HP</td>
<td>-0.1177</td>
<td>-0.0056</td>
<td>0.0165</td>
<td>0.0926</td>
<td>0.0674</td>
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<tr>
<td>BK</td>
<td>-0.1413</td>
<td>-0.0334</td>
<td>0.0525</td>
<td>0.0840</td>
<td>0.0649</td>
<td>0.0366</td>
<td>0.0396</td>
</tr>
</tbody>
</table>

Note: A * means significant at the 5 percent level. HP = Hodrick-Prescott, BK = Baxter-King. The estimations include lags and leads of remittances and FDI.
5.6 CONCLUDING REMARKS

The aim of this chapter was to document the business cycle properties of remittances flows to Mexico. The results indicate that the cyclical component of FDI flows is more volatile than the cyclical component of remittances flows. This suggests that promoting remittances as a source of external financing can bring more stability to the economy, than using other capital inflows such as FDI.

There is also evidence of a strong and negative correlation between the cyclical component of remittances (measured as both Mexico’s inward remittances and U.S. net remittances) and the cyclical component of Mexico’s GDP. This suggests that remittances will increase during bad economic times in Mexico. In that sense remittances can be used by Mexico to offset negative output shocks.

The cyclical component of remittances is positively correlated with the cyclical component of U.S. GDP. This indicates that remittances respond to the U.S. business cycle. In this case migrants will send more money when their economic condition is better.

Remittances seem to be less volatile than FDI. This supports the argument that remittances are a more stable source of external financing than FDI (Ratha, 2003). The cyclical component of remittances is also negatively and significantly correlated with the cyclical component of home country GDP. Thus, as countries become more dependent on remittances, they should give serious consideration to using remittances as part of their response to negative cyclical fluctuations in output. Finally, remittances are procyclical with respect to host country output which means that recipient countries should be aware
that another channel by which external shocks will affect their economies is through remittances.
CHAPTER 6

CONCLUSIONS AND POLICY IMPLICATIONS

6.1 CONCLUSIONS

The purpose of this dissertation was to study the relationship between worker’s remittances and macroeconomic variables in the home country. To this end we used data on remittances at the microeconomic (individual) level and macroeconomic (aggregate) level. When using microeconomic level data on remittances, we pair the information on migrant’s remittances with macroeconomic variables of the migrant’s home country. In some instances we conduct the analysis using data for a large sample of countries (81 countries), while in others we concentrate in a country specific case (Mexico).

In Chapters 1 and 2 we introduced the topic and reviewed the relevant literature. In these chapters we highlight the magnitude of remittances around the world and the importance of remittances for receiving countries. Remittances to Latin America in the year 2005 reached over 50 billion dollars. Furthermore, the literature review shows that there is no consensus about the main motivation behind remittances or about the impact of remittances in receiving countries.

In Chapter 3 we study the effect that changes in the exchange rate and exchange rate volatility have on remittances. The analysis is conducted using survey data on migrants in the U.S. This kind of data on remittances of migrants from a large number of countries is not widely available. We used one of the few surveys containing multi-
country data of this type the Legalized Population Survey (LPS). The LPS contains
detailed information about migrants and their remitting patterns. After controlling for
different characteristics of the migrant (e.g. income, education, marital status, home
country GDP) we find evidence that remittances respond positively to exchange rate
depreciations and negatively to exchange rate volatility.

Some countries are already avoiding exchange rate appreciation because an
appreciation makes their domestic products more expensive on international markets.
According to our results another consequence of exchange rate appreciations for
receiving countries will be a decrease in remittances.

The finding that remittances respond positively to exchange rate depreciations
also implies that migrants tend to send more remittances (in U.S. dollar terms) when
remittances are worth more in the home country. This contradicts the notion that migrants
simply want their families to consume a certain consumption bundle or that migrants
invest a target amount in the home country. Instead the findings suggest that given the
right incentives migrants will remit more. For instance, programs that compensate
migrants for remitting (e.g. higher interest rates for remittances deposits, better prices on
goods for remittances receiving families, matching programs and tax exemptions for
remittance recipients) have the potential to increase the flow of remittances.

The other important finding of Chapter 3 is that remittances decrease with
exchange rate volatility. This also has important implications for remittance receiving
countries. First, exchange rate policies that promote exchange rate stabilization will
increase the flow of remittances. Moreover, the fact that migrants care about exchange
rate volatility suggests that some portion of the remittances transfer is send for
investment purposes. Exchange rate volatility represents the risk involved in home country investments. If receiving countries decrease the risk involved with home country investments then migrants will remit more.

In Chapter 4, we study remittances and home country macroeconomic variables from a macroeconomic perspective. Again we revisit the relationship between remittances and the exchange rate, but we acknowledge that at the aggregate level the relationship between these two variables is endogenous. Hence we used an estimation technique that addresses this endogeneity.

In Chapter 4 we also place special attention to the impact of remittances on money demand. The estimation is conducted using monthly data on remittances from Mexico, the biggest recipient of remittances from the U.S. Mexico is also one of the few countries in the world that has been collecting information on remittances at the monthly frequency for a significant period of time (in this case for more than one decade).

The results of the fourth chapter suggest that there is a bi-directional relationship between remittances and the exchange rate. Moreover, it seems that remittances appreciate the exchange rate. This implies that remittances may have an effect similar to Dutch Disease in Mexico. In this case an increase in remittances appreciates the exchange rate and makes Mexican products more expensive in other countries. This in turn has a negative effect on the tradable sector in Mexico and its ability to export to the rest of the world. Thus, countries receiving large inflows of remittances should be aware that there will be a negative effect on the tradable sector due to the exchange rate appreciation. Policies that ameliorate this effect may be needed when large inflows of remittances take place.
Other results in Chapter 4 suggest that remittances have a positive effect on domestic money demand. This implies that households in Mexico convert some fraction of the remittance transfer into Mexican pesos. It is therefore important for monetary authorities in Mexico to include remittances in the set of variables considered when conducting monetary policy, in particular when forecasting money demand.

Finally, in Chapter 5 we used data from Mexico and the U.S. to study the relationship of remittances with Mexico’s and the U.S.’s business cycles. In Chapter 5 we used two series of remittances, Mexico’s remittances inflows and U.S. remittances outflows to the rest of the world.

If remittances are counter-cyclical then receiving countries can use remittances to offset negative cyclical fluctuations in output. On the other hand, if remittances are procyclical then remittances cannot offset cyclical fluctuations in output. Are remittances a possible stabilizing factor in Mexico? The results in Chapter 5 suggest that indeed remittances in Mexico can be used to ameliorate cyclical fluctuations in output. Moreover, the results imply that remittances are less volatile than FDI flows. Thus, remittances flows are not only countercyclical, but they are also more stable than other capital inflows.

6.2 POLICY IMPLICATIONS

The main policy implications from these conclusions are summarized below in five main points:

1) Migrants will increase their transfers if their transfers are worth more in the receiving country. If the government wants to increase the flow
of inward remittances, it should give more incentives for migrants to remit. Two possibilities are higher interest rates for remittance deposits and tax breaks for remittances receivers.

2) Remittances will appreciate the exchange rate. This implies that remittances inflows may be a source of Dutch Disease. Exchange rate appreciation will make Mexican products more expensive on international markets, having a negative impact on the tradable sector. Remittances should be accompanied by policies that protect the tradable sector of the economy.

3) Migrants that invest in their home countries will respond to changes in the level of risk of their investments. A decrease on the level of risk of investments in the receiving countries will increase the flow of inward remittances. The government should pursue policies that diminish the level of risk of investments in the home country in order to attract more remittances. Two possibilities are focusing on interest rate stability and exchange rate stability.

4) Remittances are an important determinant of money demand. A large inflow of remittances will have a positive impact on money demand. When forecasting money demand in order to conduct monetary policy, central banks need to also account for remittances.

5) Remittances tend to be countercyclical. Remittances will increase during negative cyclical fluctuations in output. The government should
used remittances as part of its response to cyclical fluctuations in output.

6.3 LIMITATIONS AND FUTURE RESEARCH

The analysis conducted in this dissertation has various limitations. First, the analysis using micro-level data is based on former undocumented migrants that have been recently granted temporary residency in the U.S. This is a selected group of migrants. As other surveys with information on migrants from a large number of countries become available, future research should try to corroborate our results using data on others groups of migrants.

The analysis using macro-level data is conducted using data from Mexico. The results of this dissertation do not necessarily hold for smaller countries (e.g. El Salvador) or for countries in other regions of the world (e.g. Middle East). As the number of countries with large time series data on remittances in monthly frequency increases, future research should try to corroborate our results using time series data from other countries.
REFERENCES


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