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ARE REMITTANCES MANNA FROM HEAVEN? A LOOK AT THE BUSINESS CYCLE PROPERTIES OF REMITTANCES

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Key words: Remittances, Business Cycles, Foreign Direct Investment

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1. Introduction

The composition of capital inflows into Latin America has changed dramatically over the last couple of decades. Current recorded workers' remittance inflows in the region have surpassed inflows of foreign direct investment (FDI) and official development assistance (ODA). A decline in the cost of transferring money, increased availability of places that facilitate the transfer money and the increase in the stock of migrants are all partly responsible for the upward trend in remittance flows (World Bank 2006). These developments have stimulated a keen interest in understanding the nature and economic consequences of remittance inflows, as well as the appropriate policy response to these flows.

The impact of remittances varies vastly across countries, due to differences in financial systems, migration patterns and the stage of economic development. These differences underline the need for individual country studies to facilitate cross-country comparisons and establish stylized facts. In this article we are concerned with the case of Mexico, the largest recipient of remittances in Latin America. In 2006, Mexico's inward remittances accounted for more than 30 percent of the remittance inflows in Latin America, reaching over 23 billion US dollars (Inter-American Development Bank 2007). Remittances are already the equivalent of one third of wage earnings in the formal sector of the Mexican economy and have exceeded formal wage earnings in some Mexican states (Banco de Mexico 2006). Most of these money transfers originate in the US,

making remittances an important development in the economic relationship between the US and Mexico.

Our interest is on the business cycle properties of workers' remittances. Lucas (1981), among others, have emphasized that macroeconomic variables, such as output, experience repeated fluctuations around their long-term growth paths. These repeated fluctuations in output are commonly referred to as business cycles. The cyclical fluctuation of remittances is clearly visible in Figure 1, which plots remittances in Mexico across time.[1] Remittances are represented by the solid line, while the dashed line represents the trend of remittances (or growth component). We can observe that there are regular deviations of the series from the trend. We intend to study those cyclical fluctuations and their relationship with cyclical fluctuations in US and Mexico's output.

A clear understanding of the business cycle and its relationship with remittances is necessary for countries with large remittance inflows in order to react adequately to cyclical fluctuations in output. Pallage and Robe (2001) argue that foreign aid in Africa, a major source of external funding, may have the potential to play a key role in smoothing out output fluctuations. In Mexico, remittances, rather than foreign aid, are a major source of external funding. In such a context, it is important to evaluate the macroeconomic impact of

[1] For expositional purposes the cyclical component in Figure 1 is estimated using the Hodrick-Prescott (1997) filter. The other estimations in the article are conducted using the Baxter-King (1995) filter.

remittances and, in particular, their potential for reducing output volatility. Finding ways of reducing output volatility is essential for developing countries given the longstanding argument that output fluctuations in developing countries are much stronger than in developed countries (Pallage and Robe 2003).

For instance, imagine that remittances are countercyclical (i.e. remittances increase after negative downturns in Mexico's economy). In such a scenario, receiving countries could potentially use remittances as part of their strategy to offset negative cyclical fluctuations in output. As the World Bank suggests:

"Remittances may move countercyclically relative to the economic cycle of the recipient country. Remittances may rise when the recipient economy suffers a downturn in activity or macroeconomic shocks due to financial crisis, natural disaster, or political conflict, because migrants may send more funds during hard times to help their families and friends. Remittances may thus smooth consumption and contribute to the stability of recipient economies" (World Bank 2006).

The idea of remittances being countercyclical is derived, in part, from the evidence suggesting that a large portion of remittance transfers are for altruistic purposes (e.g. Agarwal and Horowitz 2002). If economic conditions in the home

country deteriorate, migrants may remit more to compensate their families for the decrease in income.[2]

But altruism is just one of several potential reasons for remitting. Previous literature has also identified self-interest motives for remitting, such as investment (e.g. Woodruff and Zenteno 2001) and interest in inheriting from the household's assets (e.g. de la Briere et al. 2002). Remittances sent for these purposes may decrease after economic downturns in the home country. For instance, declines in output are likely to be accompanied by a worsening of the investment opportunities in the home country and may also have a negative impact on the inheritable assets of the household. Thus, in this case, remittances may tend to be procyclical. If remittances are procyclical with respect to home country output, then receiving countries cannot use remittances as part of their strategy to offset negative cyclical fluctuations in output. On the contrary, a stop in the inflow of remittances may even accentuate recessions.

The relationship between remittances and the business cycle of the host country is also relevant. If remittances are not responsive to the host country business cycle, then we should not expect drastic decreases in remittances after downturns in the host economy (e.g. US economy). Alternatively, if remittances are strongly correlated with the host country business cycle, remittances can

[2] Home country refers to the remittance-receiving country (e.g. Mexico). Host country refers to the remittance-sending country (e.g. US).

become another channel by which cyclical fluctuations in the host economy can impact the home country.

There is a large body of literature that uses microeconomic data to study the impact and determinants of remittances in Mexico (e.g. Amuedo-Dorantes and Pozo 2006a, 2006b, Borraz 2005, López-Córdova 2005, Woodruff and Zenteno 2001). A smaller, but still considerable in size, literature uses macroeconomic data to study remittances in Mexico (e.g. Balderas and Nath 2008, Vargas-Silva 2008, Vargas-Silva and Huang 2006). Although, these studies have provided valuable information about remittances in Mexico, the business cycle characteristics of remittances to Mexico have remained largely unaddressed.[3] Our goal is to describe the business cycle properties of workers' remittances. We also provide a comparison of the business cycle properties of remittances with the business cycle properties of FDI flows.

We seek answers to the following questions regarding the cyclical properties of remittances. Are fluctuations in remittances impacting cyclical fluctuations in Mexico's output? Or alternatively, are cyclical fluctuations in Mexico's output impacting cyclical fluctuations in remittances? Are Mexican remittance inflows responsive to cyclical fluctuations in the US economy? Is the impact (response) of remittances to the business cycle different from the impact

[3] A recent working paper by Roache and Gradzka (2007) links remittances to *Latin America* with the *US* business cycle. While their approach is different from ours, there is some consistency in the results of both studies.

(response) of other capital inflows, such as FDI? In the remainder of the article we use different methodological approaches to answer these questions.

The article is structured as follows. The next section explains the empirical approach. The third section introduces the data. The fourth section presents the results. Concluding remarks are contained in the last section.

2. Methodology

The empirical approach consists of four steps. First, we use a filter to estimate the cyclical component of remittances, FDI, and the output of Mexico and the US. Second, we estimate the correlation between the cyclical components (including correlations using leads and lags). Third, we estimate impulse response functions and variance decompositions using a structural vector autoregressive (SVAR) model. Finally, we conduct some robustness tests. Next we explain each of these four steps.

2.1. Obtaining the cyclical components

In order to estimate the cyclical fluctuation of a macroeconomic series it is common to use a filter to decompose the series into a slow moving component (or trend) and a cyclical component. Baxter and King (1995) proposed the use of a band-pass filter to obtain the cyclical component of a series. The Baxter-King filter is usually preferred over high pass filters (e.g. Hoddrick and Prescott 1997), because in addition to removing low frequency components it also removes high frequency components (irregular or fast moving components). In order to use the

Baxter-King filter we need to select the duration of the business cycle. We identify the business cycle as fluctuations lasting no less than six quarters and no more than thirty-two quarters. This identification of the business cycle is common in the literature and originated with Burns and Mitchell (1946).[4]

2.2. Correlations

After the cyclical components have been estimated, the next step consists of estimating correlations between the cyclical components. In correlations involving the cyclical component of US output, remittances and FDI are denominated in US dollars. In this case we use the US consumer price index to deflate the variables. In correlations involving the cyclical component of Mexico's output, remittances and FDI are denominated in Mexican pesos, and are deflated using Mexico's consumer price index.

It is possible for the cyclical components of the series to be related in lags or leads. We test this possibility calculating the correlations, contemporaneously and with one of the series shifted backward and forward up to three quarters. The selection of the number of lags and leads to report is ad-hoc, but there are no differences in the main conclusions if estimations with additional lags or additional leads are used.

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[4] Burns and Mitchell define a business cycle as "a type of fluctuation found in the aggregate economic activity of nations that organize their work mainly in business enterprises: a cycle consists of expansions occurring at about the same time in many economic activities, followed by similarly general recessions, contractions and revivals which merge into the expansion phase of the next cycle" (Burns and Mitchell 1946, p. 3).

2.3. Impulse response functions and variance decompositions

While correlations are informative, they have a number of limitations. First, correlations do not provide information about causality among the variables. Second, correlations are simple bi-variate statistics and we may want to control for a number of additional factors. In order to address these limitations we estimate a four variable VAR containing US GDP, FDI, remittances and Mexico's GDP.

In addition to addressing the previous concerns, the use of a VAR addresses the potential endogeneity between the variables. For instance, while it is possible for remittances and FDI to impact Mexico's business cycle, it is also likely that these variables respond to changes in Mexico's business cycle. Once the VAR has been estimated we proceed to estimate impulse response functions and variance decompositions.

Impulse response functions show the predictable response of each variable after a shock to another variable in the system. For example, if the response of remittances after a shock to Mexico's output is positive, then presumably remittances will respond positively to innovations in Mexico's output. Variance decompositions show the portion of the forecast error variance for each variable that is attributable to its own innovations and to innovations from the other variables in the system.

In order to compute variance decompositions and impulse response functions the residuals must be orthogonalized. In this article the Sims-Bernanke structural decomposition is used to produce orthogonal residuals. A structural decomposition is an alternative to the conventional Cholesky decomposition. The Cholesky decomposition is not unique, which means that results for impulse response functions and variance decompositions will depend on the ordering of the variables. A possible solution is to try different orderings and compare the results for each ordering. But this is only valid if the true model is recursive and just the ordering is unknown. Moreover, Bernanke (1986) argues that "if it is not believed that the true economic model is recursive, then the orthogonal 'shock' series obtained by the conventional approach have no particular meaning." We use theoretical considerations to specify the structural model.[5]

The variables included in the estimation are the cyclical components of Mexico's remittance inflows (R), Mexico's inward FDI (F), and the output of Mexico (Y^{M}) and the US (Y^{US}). The specification of the structural model is given in Equations (1) to (4). Equations (1) to (4) give a structure for the VAR contemporaneous innovations, lagged relationships among the variables are not restricted. Lower case letters represent the first stage VAR residuals of the corresponding variables:

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[5] We estimate the structural decomposition using the CVMODEL instruction in the RATS software (version 6). As recommended by the RATS manual, we first used the GENETIC method and then switch to BFGS. See also Enders (2003, p. 75) for more details.

$$y^{US} = u_1, \tag{1}$$

$$y^{M} = a_1 y^{US} + a_2 r + a_3 f + u_2, \tag{2}$$

$$r = a_4 y^{US} + u_3, \tag{3}$$

$$f = a_5 y^{US} + a_6 y^{M} + u_4. \tag{4}$$

Equation (1) is based on the assumption that innovations to the cyclical component of U.S. income are contemporaneously uncorrelated with innovations to other variables. This assumes that shocks to the large economy (US) are contemporaneously exogenous. Equation (2) relates Mexico's business cycle with the US business cycle, remittances and FDI. Remittances and FDI are important flows of money to Mexico, whose cyclical fluctuations may impact Mexico's business cycle contemporaneously. The contemporaneous impact of the US business cycle on Mexico's business cycle is based on the assumption that the large economy (US) impacts the small economy (Mexico) contemporaneously. In fact, the previous literature has identified the US business cycle as having an important impact on Mexico's business cycle. For instance, Torres and Vela (2003) in their conclusion of a study of Mexico and the US business cycles suggest that "fluctuations in U.S. industrial activity affect the demand for Mexican imports and these in turn influence the Mexican business cycle." Other papers, such as Chiquiar and Ramos-Francia (2005) also report business cycle synchronization between the two countries through the trade channel.

In Equation (3), we have that r is a function of y^{US}. The cyclical fluctuations in the home country are likely to affect the migrant's budget constraint, which in most remittance theoretical models encourages the migrant to adjust the amount transferred to family and friends abroad. This argument is also consistent with the evidence that remittances respond in the short-run, mostly to changes in the host country economic conditions. Using data for a group of 5 Latin American countries (including Mexico), Vargas-Silva and Huang (2006) presented evidence that remittances responded mostly to macroeconomic factors of the host country. Also, Ziesemer (2006) using data for 96 countries finds that OECD income has a stronger impact on remittances than domestic variables.

Finally, foreign direct investment depends on economic conditions in both countries (Equation (3)). This allows contemporaneously for the "cheap labour" hypothesis in which a worsening of economic conditions encourages FDI and the "market size" hypothesis in which FDI increases with improvements in economic conditions. Evidence on these two hypothesis has been found on previous studies (see Blonigen (2005) for a review of the literature and Love and Lage-Hidalgo (2000) for a study specific to the case of Mexico).

3. Data

3.1. The Importance of Remittances to Mexico

Mexico received more than 23 billion US dollars in remittances during 2006. This represents the largest volume of remittances received by any single country in Latin America. In that same year, remittances accounted for about 2.9 % of Mexican GDP (International Fund for Agricultural Development 2007). As mentioned in the introduction, remittances are the equivalent of one third of wage earnings in the formal sector of the Mexican economy and have exceeded formal wage earnings in some Mexican states (Banco de Mexico 2006). Moreover, remittances surpass FDI and tourism receipts to become the second source of external finance in Mexico, just after oil exports (Hernández-Coss 2005). Hence, while remittances account for just about 3 % percent of Mexico's GDP, these flows represent one of the most important sources of foreign currency and external finance in the country.

Table 1 reports the dollar amount of remittances received by Mexico since 1997. It seems that remittances have been increasing constantly over that period, registering an average annual growth rate of about 19 percent. However, it is estimated that remittances may grow as little as 5 percent during 2007 due to tougher migration controls and an economic slowdown in the United States. US federal immigration authorities are making it harder for would-be illegal workers to get across the border and those already on the U.S. are suffering from the slowdown in the US economy, especially in the construction sector (Lopez and Phillips 2007; Minton 2007).

3.2. Data Description

There are various issues concerning macroeconomic remittances data. First, there is no single definition of the term "remittances." Second, there may be a large portion of remittances that are sent through informal channels, making it more difficult for the government to track these flows. In order to address these issues, we use two alternative measures of remittance flows to Mexico. First, we use Total Family Inward Remittances to Mexico as reported by the Mexican Central Bank. To check for robustness we also conduct the estimations using the US net remittance transfer with the rest of the world as a measure of US outward remittances. This article is only concerned with remittances to Mexico, but Mexico is the main recipient of remittances from the US. We use net remittances and not remittance outflows to represent US outward remittances because US remittance outflows are not published in quarterly frequency.

Output is measured as seasonally adjusted real GDP for both, the US and Mexico. US output is obtained from the website of the Federal Reserve Bank of St. Louis (FRED), while Mexican output is obtained from the website of the Mexican Central Bank.[6] FDI is obtained from International Financial Statistics and US outward remittances are obtained from the US Bureau of Economic Analysis. The sample covers the period from the first quarter of 1981 to the

[6] Please visit http://research.stlouisfed.org/fred2/ for the database of the Federal Reserve Bank of St. Louis and http://www.banxico.org.mx/index.html for the database of the Mexican Central Bank.

second quarter of 2006. All variables are expressed in logarithms and are used in real terms. The results of these robustness checks are reported in Section 5.

4. Empirical Results

4.1. Correlations

The correlations between the cyclical components are displayed in Table 2. Panel A reports the correlations of the cyclical component of Mexico's output with the cyclical component of Mexico's inward remittances, FDI and US output. Column (1) reports the correlations when the series on the left column is shifted backward three periods (e.g. correlation of $remittances_{t-3}$ and Mexico's $output_t$), while column (7) reports the correlations when that series is shifted forward three periods (e.g. correlation of $remittances_{t+3}$ and Mexico's $output_t$).

We find that remittances are associated negatively and significantly with Mexico's output. The contemporaneous correlation coefficient between remittances and Mexico's output is -.75. Moreover, the relationship between remittances and Mexico's business cycle does not seem to be sensitive to the use of leads or lags.

On the other hand, the correlation between the cyclical component of FDI and the cyclical component of Mexico's output is positive. Thus, while remittances seem to be countercyclical with respect to Mexico's business cycle, FDI seems to be procyclical with respect to Mexico's business cycle. There are numerous theories of FDI that support a positive link between FDI and the

destination country output. For instance, it may be possible that FDI into Mexico is market seeking, and, as a consequence, better economic conditions in Mexico attract more investment.

Panel B reports the correlations of the cyclical components of remittances, FDI and Mexico's output with the cyclical component of US output. Lags of remittances seem to be procyclical with respect to the US business cycle, however, we are not able to find much significance. Likewise, there is not a strong correlation between FDI and US output. It seems that FDI flows to Mexico are mainly driven by economic conditions in Mexico and not by the state of the US economy. Alternatively, it is possible that FDI has a stronger relationship with other measures of economic conditions in the US, such as stock market indices, than with GDP.

Finally, it is also interesting to notice that there is a positive and significant correlation between the cyclical component of US output and the cyclical component of Mexico's output. This positive correlation has been documented in previous studies (e.g. Torres and Vela, 2003). While Mexico's output and US output have a strong positive correlation, US output does not seem to have a strong correlation with remittances. After an improvement in the US economy, migrants are more capable of sending money home, encouraging transfers, but the positive correlation between the US business cycle and Mexico's business cycle suggests that economic conditions in Mexico may also have

improved, discouraging transfers. Hence, we have two conflicting impacts. A second possibility, rest with the concentration of Mexican workers in certain areas of the US economy. For instance, it is possible that remittances have a stronger correlation with other measures of economic activity in the US, such as those related to the construction sector.

In the next section we account for both the US business cycle and Mexico's business cycle in the estimation and may able to clarify some of these impacts.

4.2. Impulse response functions and variance decompositions

One of the main purposes of this article is to study the relationship between remittances and Mexico's business cycle. The results of the previous section indicate that the cyclical component of Mexico's output has a negative correlation with the cyclical component of remittances. Therefore, we may be tempted to conclude that improvements in Mexico's economy impact remittances negatively. That is, remittances are countercyclical with respect to Mexico's business cycle.

Can we make such a strong statement? Not really. There are various limitations in the previous analysis. An important limitation lies in the difference between correlations and causality. Correlations, while informative, do not provide information about causality (including those with leads and lags). Moreover, correlations are simple bi-variate statistics; by adding more variables to the analysis we are able to control for additional factors. Hence, the fact that

remittances are negatively correlated with Mexico's GDP, does not necessarily implies that remittances increase after downfalls in Mexico's economy.

In order to overcome the concerns discussed above we estimate a structural VAR that includes: US output, FDI, remittances and Mexico's output. We start by checking our variables for stationarity. We conduct a series of Dickey and Fuller (1979) stationarity tests for all the variables in levels. The results indicate that all the variables have one unit root. Next, we use the Baxter-King (1995) filter to obtain the cyclical component of each series and conduct unit root tests on the cyclical components. The cyclical components of all the series are stationary. Thus, while the series are non-stationary in levels, their respective cyclical components are stationary. The SVAR is estimated using the cyclical components, hence, all the variables included in the estimation are stationary. We include 4 lags (the equivalent of one year) of each variable in each equation of the VAR. Q-statistics indicate an absence of serial correlation in each equation of the VAR, indicating that the lag length is adequate.

Columns 1 to 3 in Table 3 report the portion of the forecast error variance in the cyclical component of Mexico's output that is attributable to innovations in the cyclical components of US output, remittances and FDI. Turning first to the relationship between US output and Mexico's output we see that US output accounts for 7 to 17 percent of the variation in Mexico's output. Remittances account for about 9 to 14 percent of the variation in Mexico's output. However,

FDI seems to be the principal driving factor explaining up to 68 percent of the variation. Moreover, only for the case of FDI are the point estimates at least twice as large as the standard errors.

The responses of Mexico's output after shocks to the other variables in the system are shown in Figure 2. In Figure 2 and in the figures that follow, the upper and lower bounds represent a two-standard deviation confidence interval. The confidence intervals are computed via Monte Carlo simulation with 2,000 draws. It seems that shocks to the cyclical component of US output have an initial positive effect on the cyclical component of Mexico's output. This suggests some positive association between the business cycle of both countries. However, the response is not significant. There is evidence that shocks to FDI impact the cyclical component of Mexico's output negatively. However, the response of Mexico's output to shocks in FDI is significant in only one period and after seven periods dies out and remains very close to the zero line. Finally, it seems that shocks to remittances have a positive impact on Mexico's output. The response is positive for fourteen periods and dies out afterwards.

In the introduction we argued that while remittances (and FDI) may impact the cyclical component of Mexico's output, it is also likely that remittances (and FDI) are affected by Mexico's output cyclical component. If migrants are remitting for altruistic or investment purposes they may adjust the amount of their transfers due to cyclical fluctuations in Mexico's economy.

Hence, it is also important to look at the impact of the cyclical component of Mexico's output on remittances and FDI.

As we did for Mexico's output we begin the analysis by looking at the percentage of the forecast error variance in remittances and FDI that is attributable to the cyclical components of Mexico's and US output. These percentages are reported in columns 4 and 5 of Table 3 for remittances and in columns 6 and 7 for FDI. The cyclical component of US output accounts for about 4 to 16 percent of the variation in the cyclical component of remittances. However, the percentage of the variation explain by Mexico's output is much higher, reaching up to 26 percent and is significant at most horizons. Therefore, in terms of the variance decompositions it seems that cyclical fluctuations in Mexico's output are having greater effects on the cyclical fluctuation of remittances.

The percentages of the forecast error variance in the cyclical component of FDI that are attributable to innovations in the cyclical component of Mexico's and US output are presented in columns 6 and 7 of Table 3. As was the case with remittances it seems that Mexico's output explains a bigger share of the variance in FDI than US output. In specific, innovations to US output explain up to 12 percent of the variation, while Mexico's output explains up to 74 percent of the variation.

The responses of the cyclical components of remittances and FDI after a shock to Mexico's and US output are reported in Figure 3. The cyclical component of FDI responds positively to shocks to the cyclical component of Mexico's output. However, the response is significant for only one period. The initial response of the cyclical component of remittances to a shock to the cyclical component of Mexico's output is negative before turning positive, however, the confidence band always includes zero and thus, we fail to find significance.

Panel B of Figure 3 shows the response of the cyclical components of remittances and FDI after a shock to the cyclical component of US output. It seems that remittances respond negatively to shocks in US output. On the other hand, FDI responds negatively at first, but it then turns positive with some significance after 7 periods. In both cases we get significance in only one period.

In sum, the results suggest that there is a strong negative correlation between remittances and Mexico's business cycle. Furthermore, the variance decompositions indicate that Mexico's output has an important role in explaining the forecast error variance of remittances. On the other hand, there is no evidence that cyclical fluctuations in remittances explain the forecast error variance of the cyclical component of Mexico's output. Results also suggest that the cyclical component of remittances has a weak relationship with the cyclical component of US output.

5. ROBUSTNESS

As we mentioned above, there are various issues concerning the accuracy of macroeconomic remittances data. To check for robustness of our previous results we repeated the estimations using a measure of US outward remittances. Table 4 reports the correlations of US outward remittances with US output and Mexico's output. As was the case for Mexico's inward remittances, it seems that remittances have a strong correlation with the cyclical component of Mexico's output and a weak correlation with the cyclical component of US output. In this case the contemporaneous correlation between remittances and Mexico's output is -.58.

The portion of the forecast error variance of Mexico's output explained by innovations in US output, US outward remittances and FDI is presented in columns 1 to 3 of Table 5. Contrary to the for Mexico's inward remittances, now it seems that remittances explain an important share of the variation in Mexico's output. The response of Mexico's output after a shock to US outward remittances is presented in Figure 4. While for the case of Mexico's inward remittances the response was positive, in this case the initial response is negative and turns positive only after eight periods.

The portion of the forecast error variance of remittances for which innovations in US output and Mexico's output account is reported in columns 4 and 5 of Table 5. The results seem to be consistent with the previous estimation, in which Mexico's output explained a larger share of the variation than US output.

In this case Mexico's output explains up to 41 percent of the variation, while US output explains up to 12 percent of the variation. The response of remittances after a shock to Mexico's output is shown in Figure 5. It seems that remittances respond negatively and significantly to shocks in Mexico's output. The response is significant for about six periods. This suggests that remittances are countercyclical with respect to Mexico's business cycle. Finally, Figure 5 also reports the response of remittances after a shock to US output. The response looks similar to the case of Mexico's inward remittances. Remittances seem to respond negatively to a shock in the cyclical component of US output. However, as was the case for Mexico's inward remittances, the response is significant in only one period.

In general, results seem to be consistent across specifications. However, there are some differences, especially when it comes to the impact of cyclical fluctuations in remittances on Mexico's business cycle.

6. Concluding Remarks

The aim of this article was to document the business cycle properties of remittance flows to Mexico. We focused on the relationship between remittances and the business cycle of the US and Mexico. Moreover, we discussed key differences between the cyclical properties of remittances and cyclical properties of FDI flows. In spite of the abundant literature about remittances in Mexico, little is known about their business cycle characteristics.

Using simple correlations we find that the cyclical component of remittances is negatively correlated with Mexico's business cycle. This suggests that remittances are countercyclical with respect to Mexico's business cycle. On the other hand, we fail to find a strong correlation between the cyclical component of US output and remittances to Mexico. These results were consistent for alternative measures of remittances.

Using variance decompositions we showed that cyclical fluctuations in Mexico's output explain a significant portion of the forecast error variance in the cyclical component of remittances. Again there was a lack of explaining power on the part of the US business cycle. These results were also consistent for the alternative measures of remittances.

Finally, impulse response functions indicated that Mexico's business cycle responds positively to shocks to remittances. However, this result was not robust to the use of different measures of remittances. Other results that were not robust include the large portion of the variation in Mexico's output explained by remittances when US outward remittances were used as the measure of remittances. Hence, for some of the results different measures of remittances provide different conclusions. Future improvements in remittances data (including an agreed upon definition of the term "remittances" and better collection of data) could help resolve these ambiguities.

We were able to find a response of the cyclical component of remittances to the cyclical component of Mexico's output that suggest that remittances are countercyclical with respect to Mexico's business cycle. While this invites to the use of remittances as a buffer against cyclical fluctuations in output, we have to point out that the result was not robust, indicating that the use of remittances to smooth cyclical fluctuations in Mexico's output may not be a straightforward strategy. On the other hand, it seems that remittances are not that responsive to cyclical fluctuations in US output, indicating that remittances should not be a factor by which cyclical fluctuations in US output are transmitted to Mexico. However, this last result should also be viewed with caution, as some may argue that remittances to Mexico have a stronger correlation with cyclical fluctuations in other measures of economic activity in the US, such as those related to the construction sector where Mexican workers are concentrated.

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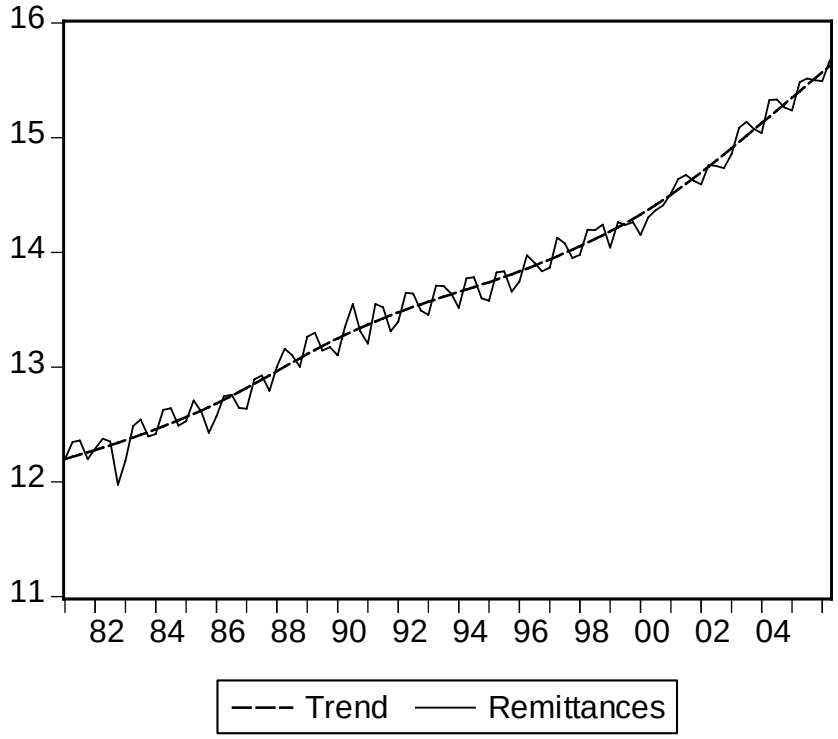
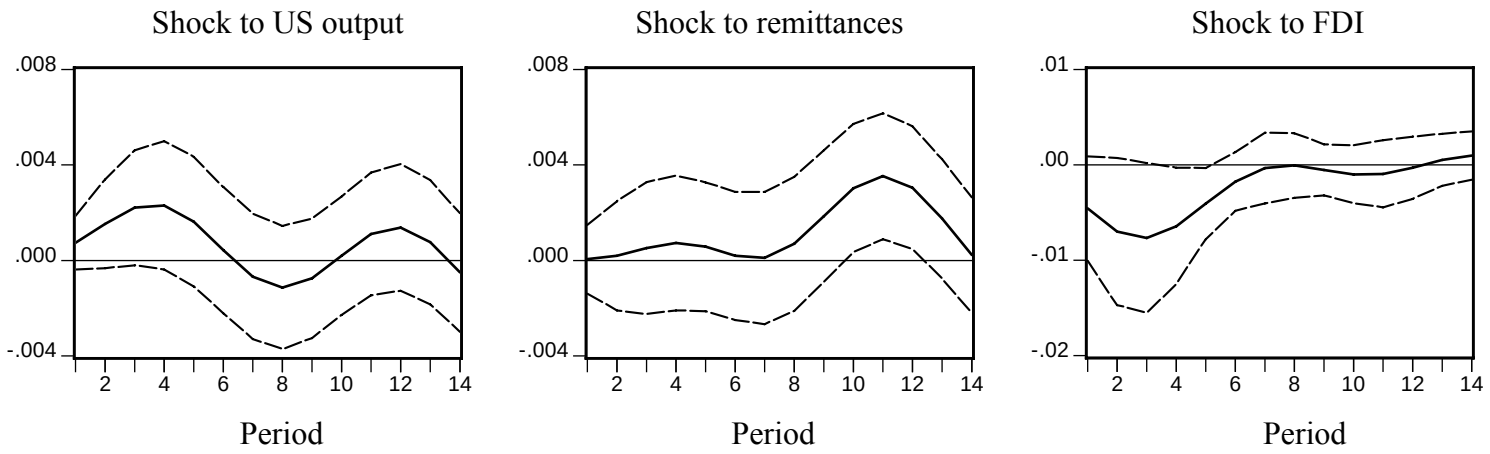
Figure 1: Remittances across Time



Note: The vertical axis reports the logarithm of remittances, while the horizontal axis reports the year. We use quarterly data on remittances from Mexico's Central Bank. Please refer to the main body of the paper for more information on sources of data and series definitions.

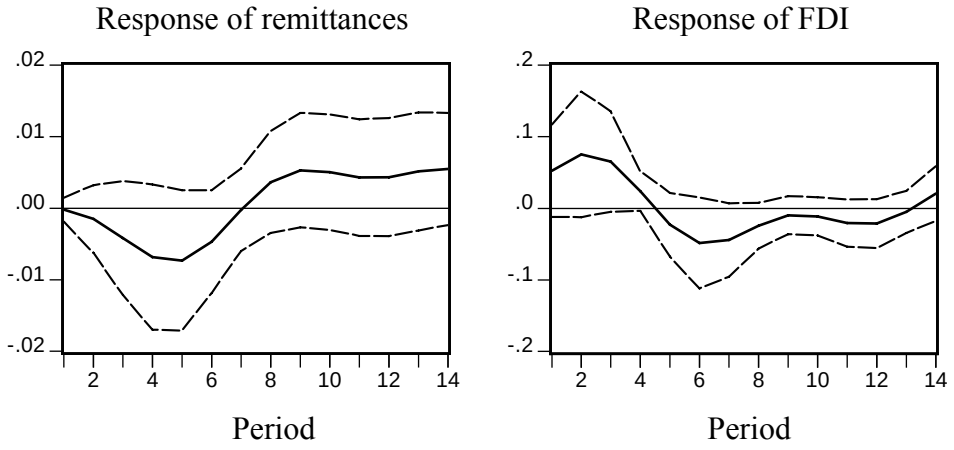
Figure 2: Response of Mexico's Output to Shocks in Other Variables



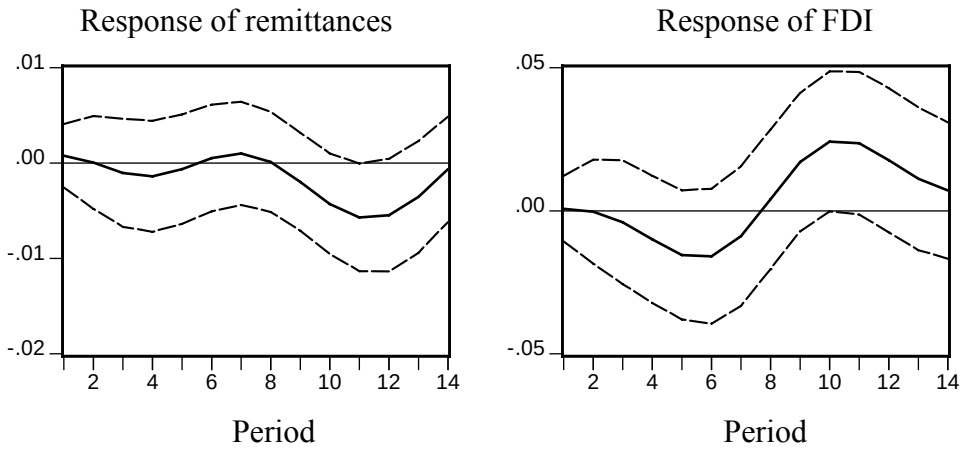
Note: The VAR is estimated using the cyclical components of the respective variables. The cyclical components are estimated using the Baxter and King (1995) filter. We include four lags of each variable as well as a constant in each equation of the VAR. The Sims-Bernanke structural decomposition is used to produce orthogonal residuals. Please refer to the main body of the paper for more details about the decomposition. Ranges indicated represent two-standard deviation confidence intervals.

Figure 3: Response of Remittances and FDI to Shocks in US and Mexico's Output

(A) Response of Remittances and FDI to a Shock in Mexico's Output

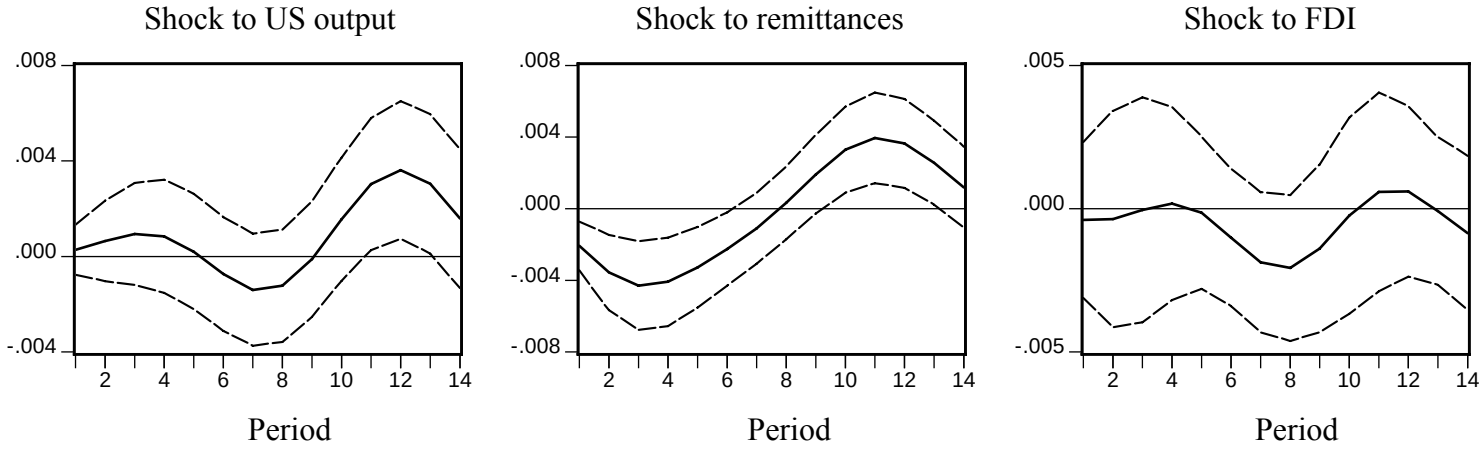


(B) Response of Remittances and FDI to a Shock in US Output



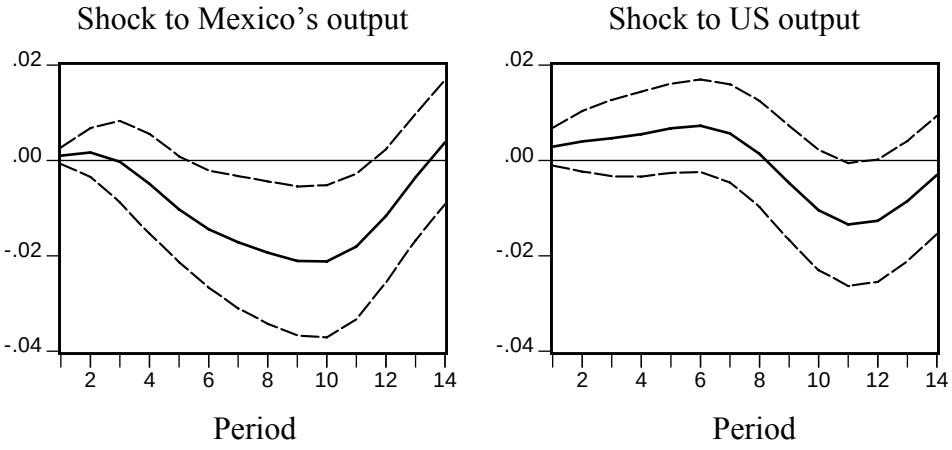
Note: The VAR is estimated using the cyclical components of the respective variables. The cyclical components are estimated using the Baxter and King (1995) filter. We include four lags of each variable as well as a constant in each equation of the VAR. The Sims-Bernanke structural decomposition is used to produce orthogonal residuals. Please refer to the main body of the paper for more details about the decomposition. Panel (A) reports the response of the cyclical components of remittances and FDI to a shock to the cyclical component of Mexico's output, while Panel (B) reports the response of the cyclical components of remittances and FDI to a shock to the cyclical component of US output. Ranges indicated represent two-standard deviation confidence intervals.

Figure 4: Response of Mexico's Output to Shocks in Other Variables Using Alternative Measure of Remittances



Note: The VAR is estimated using the cyclical components of the respective variables. The cyclical components are estimated using the Baxter and King (1995) filter. We include four lags of each variable as well as a constant in each equation of the VAR. The Sims-Bernanke structural decomposition is used to produce orthogonal residuals. Please refer to the main body of the paper for more details about the decomposition. Ranges indicated represent two-standard deviation confidence intervals.

Figure 5: Response of Remittances to Shocks in US and Mexico's Output Using Alternative Measure of Remittances



Note: The VAR is estimated using the cyclical components of the respective variables. The cyclical components are estimated using the Baxter and King (1995) filter. We include four lags of each variable as well as a constant in each equation of the VAR. The Sims-Bernanke structural decomposition is used to produce orthogonal residuals. Please refer to the main body of the paper for more details about the decomposition. Ranges indicated represent two-standard deviation confidence intervals.

Table 1: Remittances to Mexico in Billions of US Dollars

Year	Remittances	Growth Rate (%)
	(1)	(2)
1997	4.9	15.2
1998	5.6	15.7
1999	5.9	5.0
2000	6.6	11.2
2001	8.9	35.3
2002	9.8	10.3
2003	13.7	39.1
2004	16.7	22.6
2005	19.9	19.2
2006	23.7	-
Average	11.6	19.3

Note: These numbers were calculated by the authors using the information published by Mexico's Central Bank. Please refer to the main body of the paper for more information on sources of data and series definitions.

Table 2: Correlations of the Cyclical Components

Variable	*t-3*	*t-2*	*t-1*	*t*	*t+1*	*t+2*	*t+3*
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
(A) Correlation with Mexico's output							
Mexico's inward remittances	-.45*	-.68*	-.78*	-.75*	-.61*	-.41*	-.23*
FDI	.03	.26*	.42*	.48*	.49*	.47*	.45*
US Output	.04	.17	.30*	.34*	.31*	.22*	.10
(B) Correlation with US output							
Mexico's inward remittances	.23*	.16	.09	.01	-.05	-.09	-.14
FDI	-.20	-.11	-.04	.01	.07	.14	.20
Mexico's Output	.10	.22*	.31*	.34*	.30*	.18	.02

Note: Panel (A) reports the correlations of the cyclical component of Mexico's output with the cyclical component of Mexico's inward remittances, FDI and US output, while Panel (B) reports the correlations of the cyclical components of remittances, FDI and Mexico's output with the cyclical component of US output. The cyclical components are estimated using the Baxter and King (1995) filter. *t-i* indicates a correlation using *i* lags of the variable in the left column, while *t+i* indicates a correlation using *i* leads of that variable. For instance, column (1) reports the correlations when the series on the left column is shifted backward three periods, while column (7) reports the correlations when that series is shifted forward three periods. A * means statistically significant at the $P \leq 0.05$ level.

Table 3: Forecast Error Variance Decomposition

	Percentage of the variation in Mexico's output explained by			Percentage of the variation in remittances explained by		Percentage of the variation in FDI explained by	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Horizon	US output	Remittances	FDI	US Output	Mexico's output	US output	Mexico's output
12	6.84	9.35	67.96*	4.01	15.06	8.05	74.32*
18	12.09	12.51	57.99*	7.63	18.48	8.08	72.41*
24	13.54	12.89	56.68*	9.03	25.10*	11.02	65.25*
30	14.83	14.11	54.54*	11.68	26.34*	11.64	63.80*
36	15.77	14.49	53.52*	13.85	25.69*	11.54	62.56*
42	16.01	14.35	53.19*	14.93	25.00*	11.58	62.49*
48	16.52	14.18	52.56*	15.53	24.71*	11.66	62.27*

Note: We include four lags of each variable as well as a constant in each equation of the VAR. The Sims-Bernanke structural decomposition is used to produce orthogonal residuals. Please refer to the main body of the paper for more details about the decomposition. Columns 1 to 3 report the portion of the forecast error variance in the cyclical component of Mexico's output that is attributable to innovations in the cyclical components of US output, remittances and FDI. Columns 4 and 5 (6 and 7) report the portion of the forecast error variance in the cyclical component of remittances (FDI) that is attributable to the cyclical components of Mexico's and US output. The cyclical components are estimated using the Baxter and King (1995) filter. These numbers are point estimates. A * indicates that the point estimate is at least twice as large as its standard error.

Table 4: Correlations of Remittances with US and Mexico's Output Using Alternative Measure of Remittances

	t-3	*t-2*	*t-1*	*t*	*t+1*	*t+2*	*t+3*
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
(A) Correlation with Mexico's output							
US outward remittances	-.48*	-.67*	-.70*	-.58*	-.34*	-.09	.09
(B) Correlation with US output							
US outward remittances	.04	-.03	-.08	-.06	.001	.10	.17

Note: Panel (A) reports the correlation of the cyclical component of Mexico's output with the cyclical component of US outward remittances, while Panel (B) reports the correlation of the cyclical components of US outward remittances with the cyclical component of US output. The cyclical components are estimated using the Baxter and King (1995) filter. *t-i* indicates a correlation using *i* lags of remittances, while *t+i* indicates a correlation using *i* leads of remittances. For instance, column (1) reports the correlation when remittances are shifted backward three periods, while column (7) reports the correlations when remittances are shifted forward three periods. A * means statistically significant at the $P \leq 0.05$ level.

Table 5: Forecast Error Variance Decomposition Using Alternative Measure of Remittances

	Percentage of the variation in Mexico's output explained by			Percentage of the variation in remittances explained by		Percentage of the variation in FDI explained by	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Horizon	US output	Remittances	FDI	US output	Mexico's output	US output	Mexico's output
12	5.81	32.71*	3.77	8.48	36.15*	14.64	16.27
18	12.05	31.55*	3.68	10.93	38.23*	16.73	18.80
24	11.38	28.75*	5.17	10.64	41.06*	15.71	29.11*
30	11.78	27.72*	5.23	11.70	40.27*	16.46	29.07*
36	11.75	27.85*	5.20	11.66	41.11*	16.78	30.01*
42	12.45	27.66*	5.20	12.11	40.97*	17.33	29.85*
48	12.45	27.56*	5.32	12.23	40.80*	17.56	29.97*

Note: We include four lags of each variable as well as a constant in each equation of the VAR. The Sims-Bernanke structural decomposition is used to produce orthogonal residuals. Please refer to the main body of the paper for more details about the decomposition. Columns 1 to 3 report the portion of the forecast error variance in the cyclical component of Mexico's output that is attributable to innovations in the cyclical components of US output, remittances and FDI. Columns 4 and 5 (6 and 7) report the portion of the forecast error variance in the cyclical component of remittances (FDI) that is attributable to the cyclical components of Mexico's and US output. The cyclical components are estimated using the Baxter and King (1995) filter. These numbers are point estimates. A * indicates that the point estimate is at least twice as large as its standard error.