

# *Are remittances a stabilizing factor in the Mexican economy?*

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- **Abstract:** This paper evaluates whether remittances can function as a countercyclical mechanism for a recessive phase of the business cycle in Mexico. Remittances have resulted from the intense migration of Mexican workers to the USA during the nineties. The flow of remittances in Mexico had an explosive growth until the year 2006; since 2007, a drastic drop in this growth is observed, and in 2008 it became negative. A panel data model was established using information of the GDP and remittances at the state level for the period 2005-2008. This methodology considers the regional effects of remittances on the economic growth of the Mexican economy. The econometric results of the analysis indicated that remittances have a positive coefficient with respect to the position of the business cycle in Mexico. Additionally, the findings weaken the positions of those that consider the strategy of promoting remittances for use as a tool for macroeconomic stabilization of the business cycle.
- **Resumen:** El trabajo evalúa el papel de las remesas como un mecanismo contracíclico para la fase recesiva del ciclo económico en México. Los flujos de remesas derivan de la intensa migración de trabajadores mexicanos hacia los EUA durante la década de los noventa. El flujo de remesas creció explosivamente hasta el 2006, cayendo en el 2007 y convirtiéndose en negativo en 2008. En el artículo se establece un modelo econométrico de panel utilizando el PIB y a las remesas al nivel estatal para el periodo 2005-2008. Los resultados económicos muestran un coeficiente positivo para las remesas con relación al comportamiento del componente cíclico del PIB en México. Dichos resultados debilitan los planteamientos respecto a la consideración de los ingresos por remesas como un instrumento de estabilización macroeconómico en la fase recesiva del ciclo económico.
- **Key words:** remittances, Mexican economy, GDP, economic cycles, economic integration.
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## ■ *Introduction*

The Mexican economy has shown an increasing vulnerability to the recessionary stages of the US business cycle, most recently during the economic recessions of 2001 and 2008. Traditionally, external trade and foreign direct investment are the mechanisms by which an economic downturn in the US affects the economic activity in Mexico. Additionally, as a result of the integration of the US and Mexican economies, and the intense migration of Mexican workers to the USA, during the decade of the nineties, the remittances sent by Mexican workers from the US have increased rapidly, especially during the nineties. Therefore, when the US economy entered a recessionary phase in 2008, those channels of economic integration became a negative influence on the macroeconomic performance of the Mexican economy.

It is important to note that remittances have become an important source of foreign exchange in Mexico, and have played the role of a financing mechanism that has supplemented private foreign financing, with the advantage that these resources do not create debt. Concerning this point, several papers have argued that remittances may function as a countercyclical stabilizer in receiving countries (Frankel, 2009). According to this perspective, remittances can be used for “smoothing” the economic fluctuations of the business cycle by diversifying the financial structure and by generating high return investment opportunities. Also, it has been pointed out that since remittances are determined by decentralized private decisions, as compared to public spending, there are better conditions for determining the best use of remittances. Therefore, remittances could work as a countercyclical tool, which would increase when the receiving country enters a recessionary phase and would decrease when the country is growing above its potential level of income. This aspect is particularly important for implementing public policies looking to organize and make better use of remittances in developing countries.

From this perspective, it has been considered that remittances positively affect economic growth because they can encourage the expansion of the rate of investment and consumption. Within a context of financial constraints, remittances could turn into a mechanism aimed at funding the lack of domestic credit and therefore could further increase consumption and investment.

However, in developing economies with a higher degree of economic integration with respect to developed economies, the synchronization of the two economies limits the possibility that remittances could become a mechanism for “smoothing” the business cycle fluctuations in the short run. In fact, when the countries sending and receiving remittances experience economic integration, such as the case of the US and Mexico, remittances would not necessarily work as a countercyclical mechanism. The high level of synchronization between two countries reduces the flow of remittances when those economies are facing the recessive phase of the business cycle. Because of this, the flow of remittances become procyclical, following the same pattern as exports and FDI.

Considering this fact, the objective of this paper is to evaluate the impact that mac-

roeconomic fluctuations in Mexico have on the flow of remittances, in order to corroborate the capacity of those financial resources to work as a countercyclical mechanism during a recessive phase of the business cycle in Mexico. The article is structured as follows: the following section is a discussion about the effect of remittances on economic growth; the third section is an analysis of the macroeconomic variables, remittances and Mexican migration flows; the fourth section includes the theoretical approach and the methodology of analysis; the fifth section includes the results of the analysis and the last section presents the conclusions of the paper.

### ■ *Mexican migration and macroeconomic behavior*

From a macroeconomic perspective, the important issues regarding remittances are the amount of remittances sent to the recipients in the home country, the income earned and brought back to the sending country by return migrants, the mechanisms for distributing the financial resources between consumption (Rempell y Lodbell, 1978) and investment (Stark, 1978 y 1991), and the short and long term effects on economic growth and income distribution.

With respect to the impact of remittances in the short run, a central aspect of the analysis has to do with the study of remittances as a source of foreign exchange and, therefore, its effect on macroeconomic equilibrium and GDP growth. This approach is based on the Keynesian model in order to capture the effect of remittances on the aggregate demand, by estimating the income multiplier. From this perspective, several studies regarding the effect of remittances on consumption, investment and imports, have concluded that remittances have positively affected GDP and the marginal propensity to import (Glystos, 1999, and El-Sakka and Mcnabb, 1999).

On the other hand, remittances could negatively influence economic growth, through the effect of the “Dutch disease”, which could result from the appreciation of the real exchange rate. With respect to this point, Acosta, Lartey and Mandelman (2007), using a VAR model, found evidence of the “Dutch disease impact”. Additionally, there is a possibility of moral hazard due to asymmetric information generated by the distance between the sending and receiving countries. This situation determines that individuals receiving remittances could have fewer incentives to work or to make high risk investments (Chami, Fullenkamp and Jahjah, 2003), thus affecting the economic growth of the receiving country.

A relevant aspect of the link between remittances and economic growth is related to the business cycle. The World Bank (2006) has found evidence that remittances are positively related to the GDP per capita of the country sending migrants, and thus receiving remittances, and a weak correlation with the GDP per capita of the country receiving migration flows and sending remittances. In addition, Sayan (2006) found that in twelve developing economies there was no evidence of the countercyclical effect of remittances. Furthermore, Lueth y Ruiz-Arranz (2007) estimated a vector correction model in order to determine the macroeconomic impacts of remittances and found that remittances are procyclical, in that they decline when the local currency weakens and increase with oil price

shocks that affect migration flows from the oil producing countries.

The long run effects of remittances are related to their impact on productivity, inequality (Chami, Fullenkamp y Jahjah, 2003), human capital formation (Hanson and Woodruff, 2002), and entrepreneurial activity (Woodruff and Zenteno, 2001).

It is worth mentioning that the possibility that remittances could have a positive impact depends on circumstances such as the mobility of capital, and the perception of a permanent remittances flow. Both factors could reduce the effect of remittances on capital formation in favor of consumption. Another potential impact is related to its role in the development of human capital in the countries receiving remittances (Chami, Barajas, Cosimano, Fullenkamp, Gapen and Montiel, 2008). In this case, the entrepreneurial and labor skills and the level of income of the household members that receive remittances could limit the impact of remittances on human capital formation and consumption.

#### ■ *Stylized facts of the business cycle and remittances in Mexico*

The average annual growth of remittances between 1995 and 2009 was 11.7%. In particular, the annual average growth rate during the period from 1995-2003 was explosive at 15.7% (Table 1). However, after 2007, remittances declined sharply, reaching a negative growth rate in 2008 and 2009 of -3.6% and -15.7%, respectively. Even so, the total amount of remittances increased from \$9,814.45 million dollars in December of 2002 to \$21,181.1 million dollars in 2008 (Table 2). It is worth mentioning that in the period analyzed, the share of remittances as a percentage of GDP increased from 2.3% in 2003 to 2.8% in 2009.

It is worth mentioning the rising trend of remittances was reversed by the international economic recession of 2008, which reduced the migration of Mexican workers to the USA and increased return migration to Mexico. The growing remittance flows experimented during the decade of the nineties and, particularly between 2000 and 2005,

Table 1  
Rate of Growth of remittances 1995-2009

Years	Rate of growth	Years	Rate of growth
1995		2004	21.88%
1996	15.00%	2005	18.32%
1997	15.18%	2006	17.88%
1998	15.66%	2007	1.96%
1999	5.02%	2008	-3.57%
2000	11.22%	2009	-15.74%
2001	35.34%	AAGR 2009-1995	11.68%
2002	10.33%	AAGR1995-2003	15.66%
2003	53.25%	IAAGR 2009-2003	4.89%

Source: Own elaboration with data from El Banco de México (Banxico). TCPA: Annual average growth rate.

Table 2  
Evolution of the flow of remittances and FDI in Mexico (current dollars)

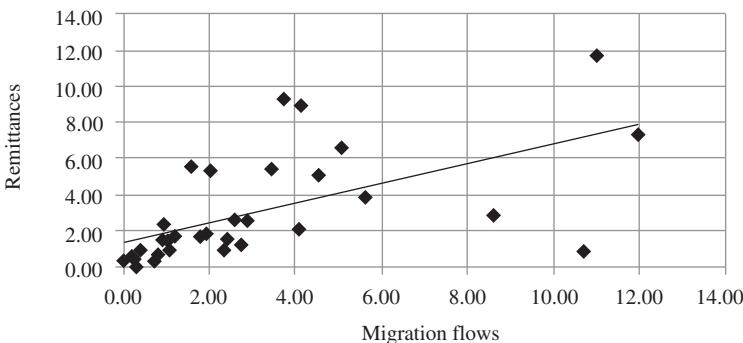
	Remittances (A)	GDP (B)	A/B	Foreign Direct Investment (C)	A/C
2003	15,040,730,000	663,751,644,242	2.27%	17,387,878,400	86.50%
2004	18,331,310,000	723,934,708,060	2.53%	26,828,800,400	68.33%
2005	21,688,700,000	810,421,268,067	2.68%	28,461,645,000	76.20%
2006	25,566,830,000	911,928,299,700	2.80%	25,378,658,500	100.74%
2007	26,068,680,000	993,291,243,154	2.62%	36,034,696,100	72.34%
2008	25,137,370,000	1,062,681,813,970	2.37%	26,747,246,800	93.98%
2009	21,181,140,000	ND	ND	21,663,000,000	97.78%
2010-	10,035,000,000	ND	ND	20,400,171,600	49.19%

Source: Own elaboration with data from the Balanced of Payments Statistics Banxico.

are directly related to the intense migratory activity for the same period. According to this fact, Figure 1 shows a positive trend between the migratory flows of the Mexican workers and growth of remittances at the state level. However, the economic recession of 2008 marked a change in the trend of both the migratory flows and remittances, with both trends becoming negative.

The growth of remittances brought about an expansion of foreign exchange in the Mexican economy, turning remittances into an important source of financial resources, comparable with other sources such as direct foreign investment (FDI) and exports. In fact, the share of remittances compared to FDI represented 86.5% in 2003 and increased to 100.7% in 2006. From peak of that year, the participation of remittances

Figure 1  
Relation between migration flows and remittances at the state level (2003) (%)



Source: Balance of Payments Statistics. Bank of Mexico (BANXICO) and populations projections of the National Council of Population (CONAPO).

declined to 72.2% in 2007. In the first six months of 2010 remittances only represented 49.2% of FDI (Table 2). This recent trend demonstrates that, in the recessive phase of the business cycle, remittances follow the same negative trend as other macroeconomic variables, thus decreasing in importance as an external source of financing.

In general, one of the main sources of foreign exchange for the Mexican economy since the liberalization strategy started has been the export sector, particularly manufacturing and oil exports. During the period of 2003-2008, the share of remittances as compared with exports corresponded to 9.3% of total exports, 63.4% of the oil exports and 11.4% of the manufacturing exports (Table 3). Therefore, it is evident that remittances have become an important source of foreign income even when compared with

Table 3  
Remittances and exports in Mexico  
(Thousands of dollars)

	Remittances (A)	Total exports (B)	Oil exports (C)	Manufacturing exports (D)	A/B	A/C	A/D
2003	15,040,730	164,766,436	18,597,225	140,650,306	9.13%	80.88%	10.69%
2004	18,331,310	187,998,555	23,663,079	157,768,214	8.00%	63.56%	9.53%
2005	21,688,700	214,232,956	31,888,572	175,195,588	7.02%	47.17%	8.59%
2006	25,566,830	249,925,144	39,016,849	202,751,837	6.02%	38.55%	7.42%
2007	26,068,680	271,875,312	43,013,838	219,709,422	5.53%	34.97%	6.85%
2008	25,137,370	291,342,595	50,635,372	230,881,575	5.16%	29.70%	6.51%
2009	21,181,140	229,783,026	30,910,823	189,698,395	6.55%	48.66%	7.93%
2010-06	10,035,000	141,262,022	19,381,992	115,733,427	10.65%	77.60%	13.00%
Average	163,049,760	1,751,186,046	257,107,750	1,432,388,764	9.31%	63.42%	11.38%
2003-2010							

Source: Own elaboration with data from the Balance of Payments Statistics from Banxico and the Economic Information Bank from INEGI.

the traditional sources of foreign exchange for the Mexican economy.

The evolution of remittances at the state level illustrate that states with high migratory intensity also have a high participation of remittances in the state GDP. Such is the case of the states of Michoacan and Zacatecas, where remittances represented 10.7% and 8.1% of each state's respective GDP in 2003. In addition, there are states that received a high level of remittances, even though their share of remittances to GDP is lower due to a high level of economic activity. The states of Veracruz, Puebla, State of Mexico and the Federal District fall into this category and, in 2008, remittance flows are of \$1,620, \$1,568, \$1,942 and \$1,105 million dollars received, respectively. However, in those states, remittances only represented 3.3%, 4.4%, 2.1% and 0.6% of GDP (Table 4). Finally, it is worth mentioning the accelerated rate of growth of remittances in the states with extensive migration of Mexican workers to the USA, such as Chiapas, Oaxaca, Veracruz and Hidalgo. Therefore, the empirical analysis of the stylized facts

Table 4  
Remittances and GDP In Mexico, 2006-2008

	Remittances (Millions of dollars)		GDP (%)	
	2003	2008	2003	2008
Total	15,040.7	25,137	2.27	2.37
Aguascalientes	260.9	\$332	3.66	3.04
Baja California	144.4	\$342	0.72	1.15
Baja California Sur	19.4	\$36	0.55	0.59
Campeche	52.5	\$74	0.16	0.10
Coahuila de Zaragoza	142.2	300	0.65	0.90
Colima	105.2	198	2.82	3.62
Chiapas	439.3	800	3.34	4.16
Chihuahua	240.5	475	1.09	1.43
Distrito Federal	826.8	1,105	0.67	0.61
Durango	265.3	450	3.03	3.55
Guanajuato	1,112.1	2,096	4.14	5.33
Guerrero	1,403.2	2,325	13.01	15.42
Hidalgo	845.5	1,402	8.96	8.12
Jalisco	589.1	\$940	1.32	1.44
México	1,345.4	1,942	2.25	2.08
Michoacán de Ocampo	1,778.9	2,457	10.73	9.52
Morelos	368.5	621	4.40	5.74
Nayarit	229.6	384	5.95	6.13
Nuevo León	193.3	331	0.40	0.41
Oaxaca	770.8	1,457	7.31	8.73
Puebla	804.9	1,568	3.55	4.43
Querétaro	283.2	442	2.59	2.30
Quintana Roo	53.7	100	0.59	0.66
San Luis Potosí	397.7	758	3.34	3.86
Sinaloa	319.4	\$489	2.36	2.27
Sonora	130.5	\$318	0.83	1.23
Tabasco	87.3	\$159	0.55	0.41
Tamaulipas	238.1	\$511	1.05	1.40
Tlaxcala	143.1	\$299	3.68	5.43
Veracruz de Ignacio de la Llave	989.6	1,620	3.41	3.32
Yucatán	59.5	\$129	0.67	0.90
Zacatecas	400.5	\$678	8.09	8.28
Standar deviation	453	700	3.22	3.44
Average	470	786	3.31	3.64

Source: Own elaboration based on the statistics of the National Accounting System from INEGI and Banxico.

of remittances behavior with respect to the macroeconomic variables in the Mexican economy reveals that, for the period 2003-2008, remittances have followed the trend of the expansive and recessive phases of the major macroeconomic variables.

With the objective of understanding the role of remittances as a source of financial funds that affect the behavior of the business cycle, this paper estimates the correlation of the cyclical components of the GDP and remittances for the period from January 1995 to February 2010. For that purpose, the Hodrick-Prescott filter (HP) was used to separate the cyclical component and the trend of economic time series. The Hodrick-Prescott method is a straightforward technique where the outcome of the estimation does not require fine tuning.

However, this method has been criticized because of several underlying limitations such as the discretionary choice of the smoothing parameter  $\lambda$ . In addition, any trend estimation procedure is confronted with the problem that the trend of a macroeconomic time series is not observable. This makes it difficult to directly assess the quality of a specific estimate of the trend component. In order to offset that uncertainty, the decomposition of a time series into a trend and a cyclical component requires the identification of assumptions regarding the functional form and stochastic properties of the trend component.

There are other procedures such as the band pass filter, developed by Baxter and King (1995). However, it has similar properties to the HP filter, such that this filter is also symmetric, the filter weights are fixed and the resulting moving average filter is of infinite order. Therefore, so far, there is not an ideal filter to calculate business cycles.

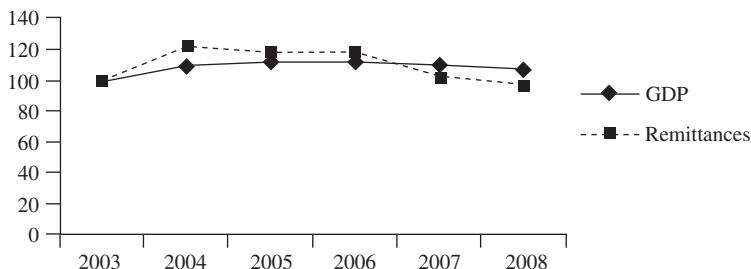
The Hodrick-Prescott method considers that a series  $Y_t$  consists of a cyclical component ( $C$ ) and a trend ( $Y_t = T_t + C_t$ ). By applying the HP filter it is possible to determine the conditions of the times series; the first term follows a smooth trend and the second one follows the short term movements of the original series. The trend is estimated with a process of optimization.<sup>2</sup> The way to control between the sensitivity and the smoothness is by using a parameter  $\lambda > \infty$ , which defines one of the two conditions. For high values, the smoothness condition predominates and for low values, the adjustment condition takes over.

Figure 2 shows the cyclical component and the trend for both the remittances and the GDP series. It stands out that the peaks of expansion and the downturns of both series exhibit similar movements, visually supporting the assumption of a positive correlation. Moreover, it can also be deduced from the graph that there is a higher volatility in the cyclical component of remittances as compared to that of the GDP.

The analysis of the times series with the trend shows that there is a positive correlation between the two series and, therefore, the flow of remittances is procyclical with respect to the movement of the GDP with three quarterly lags. This correlation gives evidence that, in a context of economic integration between the USA and Mexico, Mexican remittances are characterized by a positive movement with respect to the be-

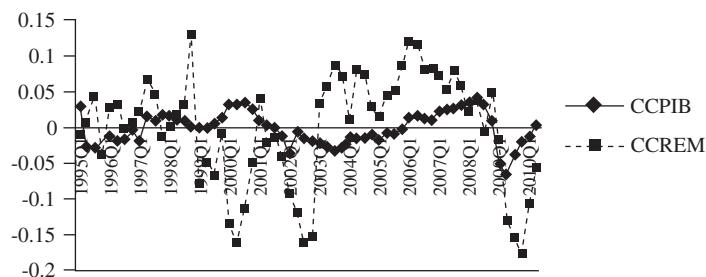
<sup>2</sup> 
$$\min T_t \left[ \sum_{i=3}^T (Y_t - T_t)^2 \lambda \sum_{i=1}^T [(T_t - T_{t-1}) - (T_{t-1} - T_{t-2})]^2 \right]$$
 subject to  $Y_t = T_t + C_t$ , where the first term related the accuracy of the trend with the original series and the second one the degree of smoothness of the trend.

Figure 2  
Mexico: index of growth of remittances and GDP (Dollars)



Source: Balance of Payments Statistics. Banco de México.

Figure 3  
Cyclical component of the GDP and remittances series: 2005-2010



Source: Own elaboration based on the statistics of the National Accounting System from INEGI and BANXICO.

Table 5  
Estimation of correlation and volatility of quarterly series of GDP and Remittances,  
1993-01-2010-12

Correlation (1)	0.169
Correlation (2)	0.222
Correlation (3)	0.06
Autocorrelation (1)	0.765
Autocorrelation (2)	0.535
Autocorrelation (3)	0.289
SD PIB	0.023
SD REM	0.078
Volatility	3.36

Source: Own estimations with data from Banxico and INEGI. SD= Standard deviation

havior of the Mexican GDP (Table 5). Another aspect that stands out regarding these two variables has to do with the high level of volatility of the cyclical component of remittances when compared to that of the GDP, as indicated by a volatility index of 3.36, far above the unity.

■ *Theoretical and methodological*

*Theoretical approach*

The approach to understanding the relationship between remittances and the GDP is derived from a production function:

$$Y_t = AK_t^\alpha L_t^\beta, \quad 0 < \alpha < 1, \quad \beta = 1 - \alpha$$

Where  $A$  is the technology,  $K$  and  $L$  are capital and labor,  $\alpha$  is the income share of capital and  $\beta$  is the share of labor in the period  $t$ .

The economy functions with income generated in the domestic economy and with the income from remittances, according to the following identity:

$$(1) \quad C + I + G = Y + R$$

Where  $C$  is the value of aggregate consumed goods,  $I$  is the level of aggregate investment,  $G$  is government spending,  $Y$  is the national income and  $R$  are remittances. In other words, income and remittances could be used for consumption and investment in the economy. This model assumes that there are linear functions for consumption and investment, the government spending ( $G$ ) is an exogenous variable, imports ( $M$ ) depend on disposable income and exports ( $X$ ) depend on the disposable income in the US. The functions that show the behavior of these variables are:

$$(2) \quad C = \alpha + \beta(Y_{dmx}) + \delta(R)$$

$$(3) \quad I = I(r, \eta)$$

$$(4) \quad M = M_0 + \gamma(R)$$

$$(5) \quad X = X_0 + \gamma(Y_{deua})$$

Where  $\alpha, M_0$  y  $X_0$  are autonomous parameters, and  $\delta$  and  $\gamma$  are parameters showing the effect of remittances on consumption and imports, all of them are positive and between 0 and 1;  $r$  and  $\eta$  are the interest and the investor confidence parameters. Therefore, remittances are incorporated in the theoretical analysis of the GDP determination as a variable that impacts the patterns of consumption and imports.

Additionally, it is assumed that remittances are procyclical in regards to the GDP:

$$(6) \quad R_t = \phi \left( \frac{Y_t}{\bar{Y}} \right)^\lambda$$

Where  $Y_t$  is the actual GDP growth,  $\bar{Y}$  is the potential growth of GDP, and  $\phi$  y  $\lambda$  are positive and constant parameters.

Taking the logs of equation (6) we obtain:

$$(7) \quad \ln R_t = \phi^+ \lambda \ln \left( \frac{Y_t}{\bar{Y}} \right)$$

Equation 7 is the basis of the econometric estimation of the effect of the movements of GDP on the remittance flows to Mexico. Hence, changes in the proportion between actual and potential GDP could show a positive or negative correlation with respect to the movements of remittances. The flow of remittances adds a new macroeconomic mechanism, which may have the potential to work as an automatic stabilizer. Some authors have founded that remittances are relatively stable when compared with financial flows (Chami, Hakura and Montiel, 2009), and therefore providing a basis for assuming that remittances could work as a countercyclical mechanism. However, this assumption depends on the effect of the reduction of the GDP and income on the labor markets. Hence, the final effect of remittances on the macroeconomic stabilization is ambiguous, depending on the economic conditions of the receiving country, and making it relevant to estimate whether or not remittances are procyclical or countercyclical for the case of the Mexican economy in the context of its economic integration with the U.S. economy.

#### ■ *Methodological aspects*

In order to analyze the relationship between remittances and the GDP at the state level, a panel data model was established using state GDP and remittances data for the period 2005-2008. This methodology is utilized because its approach allows taking into consideration the regional effects of remittances on the economic growth of the Mexican economy.

The objective of the paper is to corroborate the existence of the correlation of the cyclical component of the GDP and the flows of remittances at the Mexican state level. The methodology consists of a regression model that includes as a potential shock variable, the cyclical component of the Mexican GDP (macroeconomic determinant) and the cyclical component of the U.S. GDP (GDP of the host country). The stock of migrants by state is included as a control variable, since the cyclical behavior of remittances is probably related to the stock of migrants (Frankel, 2009). Additionally, income per capita by states in Mexico is incorporated as a variable representing the effect of regional purchasing power and consumption disparities on the decisions that determine the regional flows of remittances. According to Ramírez and Sharma (2008), the economic impact of remittances tends to be higher in the regions and groups with higher income. Finally, remittances behave differently than private capital flows and apparently are less volatile than FDI (Fullenkamp, Gapen and Montiel, 2008). Therefore, FDI is included in the model to corroborate whether or not there is a correlation

between remittances and foreign exchange flows.

Thus, based on equation (7), the econometric equation of the empirical research is constructed as follows:

$$R_{it} = (\beta_0 + \lambda_i) + \beta_1 M_{1it} + \beta_2 GDPpc_{2it} + \beta_3 \ln\left(\frac{GDP}{CC_{it}}\right) + \beta_4 FDI_{4it} + \nu_{it}$$

$i = 1 \dots 32, t = 4$

Where:

$\lambda_i$  = individual effect of the error term ( $\varepsilon_{it} = \lambda_i + \nu_{it}$ )

$GDP_{it}/GDPtrend_{it}$  = GDP of state  $i$  divided by trend component of the GDP at the state level (cyclical position of the GDP of state  $i$  at time  $t$ ),

$M$  = stock of Mexican migrants in the USA,

$GDPpc$  = GDP per capita,

$R$  = Remittances at the state level,

$FDI$  = Foreign direct investment divided by GDP at the state level

This type of methodology allows the estimation of either a model of fixed effects or a model of random effects, according to the results of the Hausman and Breuch-Pagan tests. The data base used in the econometric estimation consists of an annual panel data set for 31 states and the Federal District of Mexico for the period 2005-2008. For the remittances variable the information was obtained from the Balance of Payments Statistics published by the Bank of Mexico, to calculate the proxy of the stock of Mexican migrants by state, information from the Survey of Migration of the Northern Border (EMIF) was used, for the GDP at the state level the National Accounts Statistics published by the National Institute of Statistics, Geography and Informatics (INEGI) was consulted, the GDP per capita at the state level was constructed using the population projections of the National Council of Population (CONAPO) and the national account data from INEGI. Finally, the information on foreign direct investment was obtained from INEGI.

#### ■ *Analysis of results*

The purpose of the panel data model was to determine whether or not remittances from Mexican migrants are procyclical. That is, whether remittance flows increase or decrease in the same direction as the GDP or if they exhibit a movement in the opposite direction with respect to the business cycle.

The panel data model was analyzed with both fixed and random effects. Both the level and the cyclical component of remittances were used as dependent variables with the aim of capturing a better estimate of the synchronization of that variable to the Mexican GDP cyclical component. A set of estimations was conducted by combining the cyclical component of the Mexican GDP variable with a group of control variables.

In order to determine a more suitable econometric estimation regarding the possibil-

ity of non-observable heterogeneity of the regional sample that could affect the econometric results, a Hausman test was performed to corroborate the possible inconsistency of the results of the random effects model. Finally, the results of the Breusch-Pagan test rejected the null hypothesis for the migration stock variable in the model that includes remittances in levels as the dependent variable. In the case of the model that includes the cyclical component of remittances as the dependent variable, three estimations rejected the null hypothesis.

From the results of the estimation of the fixed effects model, the following aspects stand out: the coefficient of the cyclical component of the GDP showed a positive correlation with the coefficient of remittances and was statistically significant when it was estimated with migration and the Mexican per capita GDP (Table 6). This panel data by states estimation corroborates the results of the analysis of the cyclical component estimated by applying the Hodrick-Prescott filter to remittances and GDP at the national level.

When substituting the cyclical component of remittances as a dependent variable and including the stocks of Mexican migrants in the USA, the cyclical component of the Mexican GDP showed a positive and statistically significant coefficient. It is worth mentioning that neither the cyclical component of the U.S. GDP and the FDI exhibited a statistically significant coefficient although they were both positive.

Although the estimation with remittances in levels as the dependent variable did not reject the Breach Pagan test, a random effect model was estimated for all the models including control variables (Table 7). The estimations showed positive and statistically significant coefficients for the cyclical component of the Mexican GDP at the 5% and 10% confidence level. However, for the case of the cyclical component of remittances as the dependent variable, the coefficients were statistically insignificant. However, the control variable of the U.S. component cycle presented a positive and statistically significant coefficient. Since there is evidence of the synchronization of the GDP cyclical components between the U.S. and Mexico; this result further supports the evidence of a pro-cyclical relationship between remittances and the economic activity in Mexico.

With regard to the other control variables of the model, the estimation displayed the coefficient of the GDP per capita with a positive sign and it was statistically significant for the case of remittances as the independent variable in fixed and random effects models, but when using the cyclical component of remittances, the results were not statistically significant. Therefore, the results are not conclusive.

Finally, the coefficient of the IED was positive, although its magnitude was rather small and was not statically significant, suggesting the possibility that both remittances and IED have been impacted in the same fashion by the increasing economic integration between Mexico and the USA. This trend reveals a positive relationship between financial flows and the GDP movement.

Therefore, the results provide empirical evidence that does not support the results presented by Frenkel (2009), which sustained the hypothesis that remittances could be considered as an instrument for smoothing the movements of the business cycle. On the contrary, the results suggest that there is an inverse correlation between the state with lower per capita income and the remittances flows received in Mexico at the state

Table 6  
Fixed effects panel model (2005-2008)  
32 cross sections and 4 times series

	Dependent variable: remittances at the state level				Dependent variable: cyclical component of remittances at the state level			
Constant	6.196*** (6.79)	6.195*** (540.00)	-9.043*** (-2.383)	-11.05* (-1.827)	-11.058 (156.72)	0.037*** (17.43)	12.671*** (3.27)	-0.354 -(0.167)
CCPIBMX	1.621** (3.51)	1.523*** (3.16)	0.286 (0.41)	0.047 (0.05)	0.036 (0.32)	0.541* (1.89)	0.184 (0.50)	1.21* -(1.83)
Mig	0.001 (1.52)	0.002*** (3.01)	0.002*** (3.10)	0.002*** (3.08)	0.002*** (3.03)	0.004*** (2.83)	0.002*** (2.83)	-0.355 -(0.167)
PIBpc		1.370*** (4.02)	1.551*** (2.85)	1.551*** (2.82)		-1.137 -(3.262)	0.033 -(0.17)	0.988 (11.39)
CCPIBUS			0.523 (0.72)	0.519 (0.72)		3.39*** (11.32)	0.000 -(0.06)	0.000 0.03
FDI			0	(1.25)				
R <sup>2</sup>	0.992	0.98	0.984	0.994	0.973	0.975	0.985	0.991
Adjusted R <sup>2</sup>	0.981	0.99	0.982	0.992	0.992	0.964	0.966	0.988
Schwarz Criterion	-97.284	-0.93	-126.273	-123.047	-118.297	-107.828	-112.93	-137.737
Akaike Criterion	-191.401	-190.10	-226.094	-225.722	-223.823	-201.945	-209.93	-237.558
Hanna-Quinn	-153.151	-150.666	-185.536	-184.005	-180.947	-163.705	-170.53	-197.001
							-305.555	-302.397

CCGDP= cyclical component of GDP M=migrants flow from USA, FDI=Foreign direct investment. \*\*\* significant at 1%, \*\* significant at 5%, t ratios in parenthesis.

Source: Own elaboration based on the statistics of the National Accounting System from INEGI and Banxico.

Table 7  
Random effects panel model (2005-2008)  
32 cross sections and 4 times series

		Dependent variable: remittances at the state level				Dependent variable: cyclical component of remittances at the state level					
		Constant	6.196***	6.193***	2.83	2.677	0.037***	0.03	3.896***	0.449	0.447
CCPIBMX	0.723***	(32.18)	(34.42)	-0.836	-1.19	(1.118)	(0.80)	(0.32)	(2.657)	(0.364)	(0.357)
Mig	0.002	(2.30)	(2.06)	0.491*	0.557*	(1.69)	0.553*	0.082	0.032	0.128	-0.88
PIBpc	0.391*	(1.19)	(1.26)	0.002**	0.003	(1.488)	(0.45)	(0.18)	(0.654)	(0.515)	(-0.517)
CCPIBUS	0.555	(1.98)	(1.98)	-0	-1.42	(1.475)	(1.492)	0.005***	0.005***	0.002*	0.002*
FDI								(2.98)	(3.107)	1.774	(1.769)
Schwarz Criterion	391.839	394.45	-126.273	428.263	434.265	206.927	210.438	232.258	218.917	223.796	(0.024)
Akaike Criterion	386.135	385.894	-226.094	414.004	417.153	201.541	201.882	220.85	204.657	206.684	
Hannan-Quinn	388.452	389.371	-185.53	419.795	424.106	203.541	205.359	225.485	210.45	213.637	
Breusch-Pagan test:	187.966	0	147.906	181.925	181.937	178.473	179.243	179.434	187.262	186.799	
Chi-square(1)											
p-value =P(31, 156)	0	6.02	0	0	0	0	0	0	0	0	0
Hausman test: Chi-square(4)	5.579	0.04	17.724	48.415	47.969	1.127	0.235	17.724	1.007	1.129	
p-value	0	0.74	0	0	0	0	0.885	0	0.908	0.951	

CCCGDP= cyclical component of GDP, M=migrants flow from USA, FDI=Foreign direct investment. \*\*\* significant at 1%, \*\* significant at 5%, \* significant at 10%.

level. This finding is probably related to the positive sign of the coefficient of the stock of migrants, which is the same as the coefficient found by Frankel (2009) and Freund and Spatafora (2005).

#### ■ *Concluding remarks*

The remittance flows are an expression of the intense migration of Mexican workers to the USA in particular during the decade of the nineties. For that reason, during that decade, the flow of remittances to Mexico exhibited explosive growth until the year 2006. However, since 2007, a drastic fall on its growth is observed, and in 2008, the trend of remittances became negative. It is worth mentioning that the growth of remittances caused its share to GDP to reach 2.8% in 2006, although it fell to 2.3% in 2008.

The reduction of remittances and migration flows since 2007 has been related to the US economic recession. Therefore, the behavior of remittances and migration is another expression of the economic integration between Mexico and the USA, and both tend to decrease with the synchronized recessive phase of the business cycles experienced in those countries.

In particular, the econometric analysis used for estimating the correlation between the GDP and remittances at the state level and cyclical component of remittances, based on a panel model for the period 2005-2008, suggests that remittances have a positive coefficient with respect to the position of the business cycle in Mexico. Other interesting conclusions that can be derived from the econometric results are the following:

- The international economic recession, within a context of increasing economic integration, has become an important limitation for the effectiveness of the flow of remittances as a countercyclical tool.
- Increases in the migration of Mexican workers are directly and positively correlated to the expansion of remittances.
- The policies to control migration of Mexican workers to the US have also become a limitation for the remittances to work as a countercyclical tool, particularly in the long run.

Therefore, the results of the econometric model estimated in this paper, based on a data set at the state level for a period that encompasses a recessive phase of the business cycle in Mexico, does not corroborate previous papers that have estimated a countercyclical relationship between remittances and the cyclical component (Frankel, 2009). On the contrary, the results showed a procyclical position for the case of the Mexican economy. Such findings weaken the positions that consider the strategy of promoting remittances in order to create conditions to use them as a tool for macroeconomic stabilization of the business cycle, particularly in developing economies that are linked to developed economies not only in terms of migration flows, but also in terms of macroeconomic variables such as exports, FDI and financial flows.

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