Determinants of International Remittances in Mexico: Economic vs. Financial Variables

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Keywords: Remittances, Economic Variables, Financial Variables, VAR, DAG.

Abstract: This work seeks to analyze whether economic or financial variables are more important in determining the remittances sent by Mexican migrants in the United States to their communities of origin. For this, we estimate three models: a linear regression model with all the variables transformed to first differences, to eliminate the possibility of spurious regression; an autoregressive vector (VAR) model that approximates the relationships between variables in the absence of consolidated theories; and Directed Acyclic Graph (DAG) model, which is the most appropriate for estimating causal relationships between variables. The results show that the most important variables in determining the remittances of Mexican migrants in the United States are the economic ones, specifically, the Gross Domestic Product (GDP) of the United States and the Gross Domestic Product (GDP) of Mexico.

1 INTRODUCTION

Remittances are one of the main results of the migration process and constitute an important source of income for millions of Mexican families, as well as an important source of foreign exchange for Mexico.

Remittances sent by Mexican migrants in the United States have shown a growing evolution since their emergence, particularly in the period analyzed in this paper, between the first quarter of 1995 and the second quarter of 2021. In nominal figures, the remittances received during 2020 were 652% higher than in 1995, 397% higher than in 2000, 83% higher than in 2010, and 11% higher than in 2019. For the years 1995, 2000, 2010, 2019, and 2020, remittances amounted 5,667, 8,572, 23,313, 38,457 and 42,624 million dollars (Banxico, 2021). This growing trend has been exposed in different dissertations (Canales, 2006; Islas and Moreno, 2011; Valdivia, et al., 2020).

Regarding the theories that explain the sending of remittances from host countries to migrants' home countries, the theoretical and empirical literature indicate two groups of determinants; the first is grouped within the Endogenous Migration approach, which considers the sending of remittances as an endogenous variable within the migration decision process, together with the length of stay, savings, and others, in addition to assessing family relationships and aspects like the socio-economic situation of migrants. All of them consider altruism as a central source that explains the sending of remittances; while the second is grouped within the Portfolio Optimization approach, which considers that only the self-interest of migrants motivates sending money. Additionally, this decision is independent of their decision to migrate and the conditions of their family (Islas y Moreno, 2011).

The first is clearly dominated by economic determinants while financial variables prevail in the second, there is no consensus in the literature about the predominance of one approach over the other. The objective of this essay is to contribute to the debate on the importance of economic and financial determinants in determining the remittances sent by Mexican migrants to their communities of origin from the United States. We also intend to contribute to the study of public policies of an economic and financial nature to encourage the entry of remittances into Mexico.

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This work consists of an introduction, theoretical and empirical antecedents, methodology, results and discussion, and, finally, conclusions.

2 THEORETICAL AND EMPIRICAL BACKGROUND

There are two main (not necessarily irreconcilable) approaches to modelling remittances from international workers. The first treats international remittances as an endogenous variable in the decision-making process on migration and remittances within the family, while the second treats them as savings transfers from one region to another. In the first, the determinants of international remittances are dominated by family relationships, while in the second, investment portfolio considerations are emphasized (Elbadawi and Rocha, 1992; Islas and Moreno, 2011).

2.1 The Endogenous Migration Approach to International Remittances

In this approach, the ability to remit is directly associated with the salary received in the host country and the saving behaviour of the migrant, both of which suggest a decision process in which the level of savings is determined along with the participation to be remitted to the home country (Elbadawi and Rocha, 1992).

In this model, the migrant is seen as the traditional macroeconomic-maximizing agent of the intertemporal utility function that generates a saving-consumption route, both in the country of origin and in the host country; although in them the migrant savings program is more complex than the standard savings program since they need to know information on relative prices abroad, wage routes and interest rates, as well as the duration of their stay abroad. Djajic (1989) uses this structure to generate the optimal overseas savings rate and leisure and merchandise consumption routes in the context of guest-worker migration[1].

An alternative version of this approach treats remittances as an intertemporal contractual agreement between the migrant and his family, in which the family contract is considered as a risk-

sharing agreement between the family and the migrant. That agreement compensates for the prevailing lack of insurance markets in developing countries, especially in rural areas. The benefit for the migrant is guaranteed income during cyclical downturns, while the benefit for the family is a better risk-return frontier so that they can assume riskier investments, such as the mechanization of the countryside (Elbadawi and Rocha, 1992).

2.2 Portfolio Approach to International Remittances

In this approach, remittances are the result of a broader portfolio allocation process by the migrant worker, a process by which the migrant must decide whether to keep their savings in the host country or send them to their country of origin in the form of either real or financial assets. This perspective, therefore, bases the migrant worker's decision to remit on relative rates of return, relative prices, and uncertainty as basic determinants (Elbadawi and Rocha, 1992).

Under this approach, Swamy (1981) includes as determinants of international remittances the following variables: the differential in the interest rates of the country of origin relative to the interest rate of the host country, the difference in the rates of return on real estate in the home country with respect to the similar rate in the host country, the real exchange rate in the country of origin, the stock of migrants and their earnings in the host country.

On their part, Glytsos and Katseli (1986) generate a budgetary restriction for migrants, where the return on the portfolio is a function of their wealth, foreign and domestic interest rates, and the variability of the exchange rate. For them, the budget constraint and the risk-return preferences program jointly determine the part of the migrant's portfolio that will be placed in assets in the country of origin.

2.3 Empirical Background

Among the empirical studies on the determinants of remittances in Mexico, Castillo (2001), who emphasizes the scarcity of studies on the determinants of remittances to Mexico despite its importance as a fundamental income for a large number of families in Mexico, performs a cointegration analysis that establishes a long-term positive relationship between

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[1] The analysis of (Djajic, 1989) is based on the determination of the pattern of leisure and consumption of goods both in the host country and in the country of origin and its comparison with the patterns of leisure and

consumption of goods chosen by the natives of the host country on the one hand and non-migrants in the country of origin on the other.

remittances and the United States GDP, as well as a long-term negative relationship between remittances and Mexico's GDP and between remittances and the real exchange rate.

Another study from our country is the one presented by Salas and Pérez (2006), it analyzes the influence of macroeconomic variables on the sending of remittances from the United States to Mexico and the effect that these have on the distribution of income in Mexico. To do this, they use a short-term econometric model that relates remittances to Mexican monetary policy variables (inflation, interbank interest rate, and exchange rate) as well as economic variables (foreign direct investment, Mexican GDP, and United States GDP). They find that Mexico's GDP and inflation inversely affect remittances sent to the country, while the United States' GDP affects them directly.

Another study, Islas and Moreno (2011), analyzes the macroeconomic variables that determine the flow of family remittances from the United States to Mexico. To do this, it carries out an econometric exercise using Vectors Autoregressive with Error Correction (VAR) to identify, from a synthetic perspective, the long-term determinants of family remittances that arrive in Mexico. Their results show that remittances are the consequence of an investment decision rather than altruism on the part of migrants since the impact of interest rates is clearer than the impact of Gross Domestic Product.

For the case of other countries, Suamy (1981) gathers available data on the remittances of workers from Turkey, Yugoslavia, and Greece and analyzes the regional structure and the growth of these flows; he relates the flow of remittances to the level and fluctuations of economic activity and to inflation in the recipient countries. The results of the analysis show that these last variables, as well as the number of migrants and their wages, significantly affect a large part of the variation in remittance flows; while the relative rates of return on saving both in the host country and in the home country and the incentive schemes in the country of origin, such as the foreign currency deposit scheme and the exchange rate premium, do not seem to have a significant impact on total remittances.

There is also the work of Elbadawi and Rocha (1992), which proposes an empirical model for the determination of remittances, which includes demographic, macroeconomic, and portfolio factors as well as special incentive policies. They use data from 5 labour-exporting countries in North Africa and Europe: Morocco, Portugal, Tunisia, Turkey, and the former Yugoslavia. Their results show that remittances are significantly affected by the economic policies of their country of origin (labour exporting countries) and that special incentive schemes to attract international remittances cannot substitute a stable and credible macroeconomic policy.

The study by El-Sakka and McNabb (1999) considers the macroeconomic determinants of remittances from migrants to their home countries. In the case of Egypt, they find, in contrast to other studies, that both the real exchange rate and the differential in interest rates are important for attracting remittances through official channels.

On one hand, Tuncan, Neyapti, and Metin-Ozca (2005) point out that the flows of workers' remittances in Turkey have increased since the 1960s, and they continue to be a significant proportion of imports. They presented empirical evidence that the premium of the black market, interest rate differential, inflation rate, economic growth, income from both home and host countries, and periods of military rule have significantly affected remittance flows to Turkey. Among them, the negatively significant effects of the black-market premium, inflation, and the military regime dummy indicate the importance of sound exchange rate policies and economic and political stability for attracting remittance flows; likewise, there are reasons for both consumption and investment smoothing, although the latter seems more prevalent after the 1980s.

On the other hand, the article by Rapoport and Docquier (2005) reviews the recent theoretical and empirical economic literature on migrant remittances in a microeconomic section on the determinants of remittances and a macroeconomic section on their effects on growth. At the micro level, they present in a completely harmonized framework the various motivations to refer described in the literature. The results of empirical studies show that a mixture of individualistic and family motives explains the probability and size of remittances. At the macro level, they briefly review the standard (Keynesian) literature and trade theory on the short-term impact of remittances. They then use an endogenous growth framework to describe the growth potential of remittances and present the evidence for different growth channels.

Also, Vargas-Silva and Huang (2005) examine the determinants of workers' remittances. They use variance decompositions, impulse response functions, and Granger causality tests derived from an error correction vector, to test whether remittances are affected by macroeconomic conditions in the host country (sending remittances) or the home country (remittance recipient). The data used correspond to

Brazil, Colombia, the Dominican Republic, El Salvador, Mexico, and the United States. The results indicate that remittances respond more to changes in the macroeconomic conditions of the host country than to changes in the macroeconomic conditions of the home country.

3 METHODOLOGY

To explain remittances from Mexican migrants in the United States to Mexican communities, in the present work we estimate the relationship between remittances (REM_t) and endogenous and portfolio migration factors, in coincidence with the models proposed by Islas and Moreno (2011) and El-Sakka and Mc Nabb (1999), as follows:

$$REM_t = f\ (GDP_{USA_t}, GDP_{MX_t}, I_{USA_t}, I_{MX_t}, E_t, INFLA_t) \tag{1}$$

where GDP_USA is the Gross Domestic Product of the United States, GDP_MX is the Gross Domestic Product of Mexico, I_USA is the US interest rate, I_MX is the interest rate of Mexico, E is the real exchange rate Mexico-United States, $INFLA$ is the inflation rate in Mexico. As it can be seen, the first two variables are economic, while the remaining four are financial.

According to the Endogenous Migration theory, a positive relationship between remittances would be expected with the variable GDP_USA, since as the economy of the United States (the host country) grows, remittances to Mexico will grow; while a negative relationship of remittances with the variable GDP_MX would be expected, since as the economy of Mexico (the home country) grows, the economic situation in it would improve and thus remittances to Mexico would be reduced.

On the other hand, according to the Portfolio theory, a positive relationship between remittances would be expected with any of the variables with the highest value, I_USA o I_MX. This would indicate that the migrant would invest their savings either in the host country or by sending it as remittances to the country of origin, depending on whether the interest rate is higher in the United States or Mexico. We would also expect a positive relationship of remittances with the variable E, since an increase in the real exchange rate of Mexico, that is, a depreciation of it, would lead to an increase in remittances, due to the increase in Mexican currency that the migrant would receive for each dollar. Likewise, we would expect a negative relationship of

remittances with the variable $INFLA$, since the increase in inflation in the home country, Mexico, would lead to an increase in remittances, due to the loss of the purchasing power of money in the home country.

The data used in this work correspond to the period between the first quarter of 1995 and the second quarter of 2021. The remittance figures were obtained from quarterly data on remittances sent by Mexican migrants in the United States reported by Banco de México in millions of dollars from 1984. The figures of the Gross Domestic Product of the United States were procured from the database of the Bureau of Economic Analysis in billions of dollars of the year 2012. The figures for the Gross Domestic Product of Mexico were collected from INEGI in millions of pesos at 2013 prices. The United States interest rate was attained from the nominal interest rate of government instruments at one month in that country, reported by the Department of the Treasury of the United States. The Mexican interest rate was recovered from the 28-day nominal interest rate of Cetes, reported by Banco de México. The figures for the real exchange rate were obtained from the series of the Banco de México's Economic Information System of the nominal exchange rate converted to the real exchange rate based on 1984. The figures for the inflation rate for Mexico were also acquired from the database of the annual underlying inflation rate of Mexico reported by Banco de México.

Table 1 shows the quarterly descriptive statistics of the variables used in this work, which shows the contrasting values between the variables of the migrant's home country (GDP_MX, I_MX, E and INFLA) and those of the host country of the migrants (GDP_USA and I_USA).

Table 1: Quarterly descriptive statistics of the variables, period 1995: Q1 - 2021: Q2.

Variable	Mean	Std. Dev..	Units
REM	5,016.48	2,770.46	Mill. dll.
GDP_MX	14,706,695.49	2,442,205.06	Mill. Pesos 2013
I_MX	10.75	10.66	%
E	67.26	21.68	Pesos/ dll. 1984
INFLA	7.94	9.37	%
GDP_USA	15,200.23	2,415.97	Bill. dll. 2012
I_USA	2.36	2.25	%

Source: Indicated in the text.

The main objective of this work is to test whether financial or economic variables are the most important in determining remittances sent by Mexican migrants who are in the United States.

To do this, we estimate three models: a) a regression model considering remittances as the dependent variable, but transforming all variables into first differences due to the time-series nature of the variables, in which all variables were subjected to the Augmented Dickey-Fuller stationarity test, which aims to avoid the possibility of spurious regression; b) a Vector Autoregressive model that approximates the relationships between variables in the absence of consolidated theories; and c) a Directed Acyclic Graph model, which is considered the most appropriate to estimate causal relationships between variables.

4 RESULTS AND DISCUSSION

4.1 Regression Model

As we mentioned earlier, all the variables of the regression model are estimated in first differences, the results of which show, as can be seen in table 2, that the main variables to explain remittances are the US GDP, the Mexican GDP, and the real exchange rate Mexico-United States, if we consider the p-value less than 0.05 as the level of significance.

Table 2: OLS regression with variables converted into first differences.

Variable	Coefficient	p-value
C	-1.183056	0.3127
	(1.16584)	
GDP_USA1	-0.022008***	0.0007
	(0.006246)	
GDP_MX1	0.0000146***	0.0000
	(0.000002)	
I_USA	2.220863	0.3969
	(2.609809)	
I_MX1	-0.358285	0.2605
	(0.316538)	
E1	-0.802523***	0.0051
	(0.280313)	
INFLA1	0.48507	0.2631
	(0.430914)	

1 Means first differences. *** Significance at 1%.
Source: Own elaboration.

However, the results of table 2 show that the GDP of the United States, the GDP of Mexico, and the real exchange rate Mexico-United States, present signs contrary to those indicated by the theory, since the first presents a negative sign instead of positive and the second has a positive sign instead of negative, while the third has a negative sign instead of positive. Therefore, we resort to two additional econometric models.

4.2 Autoregressive Vector Model (VAR)

This model approximates the relationships between variables in the absence of consolidated theories since its starting point is an atheoretical approach in which endogenous variables (those that can be determined within the VAR System) and exogenous variables (those that cannot be determined within the VAR System), can be separated. The variables that can be considered endogenous in our study are the economic and financial variables that can be determined in Mexico (the GDP of Mexico, the interest rate of Mexico, the real exchange rate Mexico-United States and the inflation rate of Mexico), while those that can be considered exogenous are the economic and financial variables that cannot be determined in Mexico (the GDP of the United States and the interest rate of the United States).

In this result, we have a consistency in the variables that we can consider relevant to explain remittances, but the sign of the coefficient is different. This model implies that the variables to be considered to explain the behaviour of remittances in Mexico are remittances with a lag, the GDP of Mexico, also lagged, and the GDP of the United States, which was considered as an exogenous variable. It is important to mention that in this model the coefficient of GDP in Mexico is negative, so we can conclude that if the Mexican economy is decreasing, this would generate a positive impact on remittances as we might expect; Furthermore, if the Mexican economy is growing, this would reduce the number of dollars that families from the United States send to Mexico (see table 3).

Table 3: Autoregressive Vector Model[2].

	REM	GDP_MX
REM (-1)	0.789223*** (-0.11654) [6.77220]	-7328.068 (-5310.1) [-1.38003]
REM (-2)	-0.010786 (-0.10752) [-0.10032]	-8195.205 (-4899.06) [-1.67281]
GDP_MX(-1)	-8.36E-06*** (-1.70E-06) [-4.92485]	0.077423 (-0.07731) [1.00143]
GDP_MX(-2)	1.46E-06 (-1.70E-06) [0.85425]	0.283554*** (-0.07787) [3.64127]
I_MX(-1)	0.193817 (-0.327) [0.59271]	-7784.688 (-14899.9) [-0.52247]
I_MX(-2)	-0.298265 (-0.27623) [-1.07978]	-21240.35 (-12586.3) [-1.68757]
E(-1)	-0.046661 (-0.22199) [-0.21019]	-36398.56*** (-10115.1) [-3.59843]
E(-2)	-0.070827 (-0.25307) [-0.27987]	5487.444 (-11531.1) [0.47588]
INFLA(-1)	-0.211047 (-0.55685) [-0.37900]	31892.12 (-25373.1) [1.25693]
INFLA(-2)	0.118928 (-0.38656) [0.30766]	4977.638 (-17613.6) [0.28260]
C	-23.77136 (-16.9567) [-1.40189]	-3574679*** (-772634) [-4.62661]
GDP_USA	0.009775*** (-0.0031) [3.15548]	1056.643*** (-141.153) [7.48579]
I_USA	0.919247 (-0.59854) [1.53581]	47418.13 (-27272.6) [1.73868]

	REM	GDP_MX
R-squared	0.932731	0.981124
Adj. R-squared	0.923861	0.978635

Standard errors in ( ) and t-statistics in [ ].*** Significance at 1%.
(-1) and (-2) means first and second lags.
Source: Own elaboration.

4.3 Directed Acyclic Graph (DAG)

This methodology is based on the concept of conditional correlation, to estimate the causality among variables. Towards estimating the causality, it is possible to use a computer algorithm called Tetrad 6, the result of which is a graph that represents the analyzed variables and the vectors with direction between these variables, which represent causality. Likewise, it is possible to establish restrictions at different levels; For example, for the variables used we establish as level 1 the variables exogenous to the model, which are the GDP and interest rate variables for the US economy. In the second level, we have the endogenous variables to the model, which are the GDP, the interest rate, the real exchange rate, and the inflation rate for the Mexican economy, and the last level is the variable that we want to explain: the remittances. For a more detailed explanation of the process see Vera (2021) and for recent references on this methodology see Dutta and Saha (2021), Moon and Seok (2021), and Wang et al., (2021).

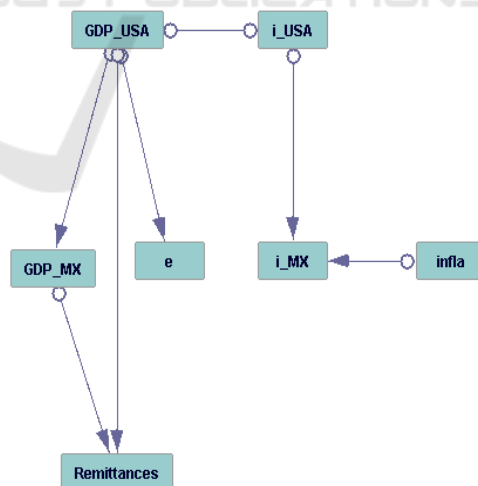Using the data proposed by DAG we estimate the graph in figure 1.

Figure 1: Directed Acyclic Graph (DAG).

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[2] In Table 3 of the VAR model, due to lack of space, only the variable Remittances, which is the variable of interest in our study, as well as one of the endogenous variables, which is the GDP of Mexico, are included on the

horizontal axis. leaving out the rest of endogenous variables (the interest rate in Mexico, the real exchange rate Mexico-United States and the inflation rate in Mexico.

The latter implies that the only variables that we can consider a true cause of remittances in Mexico are GDP in the USA and GDP in Mexico, so from here we can make a regression to estimate the signs and parameters of this relationship, being our final result the one shown in table 4.

Table 4: Main causes of Remittances.

Variable	Coefficient	p-value
C	-67.67461*** (10.58002)	0.000
GDP_USA	0.026082*** (0.003526)	0.000
GDP_MX	0.0000175*** (0.00000346)	0.000

*** Significance at 1%.
Fuente: Own elaboration.

The signs of the variables are as we expected, if the Mexican economy is declining, migrants are willing to send more remittances. Also, if the US economy is growing, migrants send more remittances.

4.4 Discussion of Results

Regarding the studies carried out for Mexico, it should be noted that our results agree with those obtained by Castillo (2001) and Salas and Pérez (2006), regarding the positive relationship between remittances and the GDP of the United States, and negative between the remittances and Mexico's GDP, and with Castillo (2001) regarding the negative relationship between remittances and the real exchange rate. However, our results do not agree with the results of Islas and Moreno (2011), who find that remittances are the consequence of an investment decision rather than altruism on the part of migrants, since the impact of interest rates is clearer than that of Gross Domestic Product.

Also, regarding the studies carried out for other countries, our results agree with those obtained by Suamy (1981) for Turkey, Yugoslavia, and Greece, by Elbadawi and Rocha (1992) for Morocco, Portugal, Tunisia, Turkey, and the former Yugoslavia., Sakka and McNabb (1999) for Egypt, who found that economic activity in remittance recipient countries significantly and positively affects remittance flows; Likewise, they agree with those obtained by Tuncan, Neyapti, and Metin-Ozca (2005) for Turkey, regarding the positive impact of income in the host country on remittances and the negative impact of income from the country of origin on remittances.

However, our results do not agree with those obtained by Vargas-Silva and Huang (2005) in that remittances respond more to changes in the macroeconomic conditions of the host country (income, etc.) than to changes in the macroeconomic conditions of the home country (income, etc.), since our results show that the macroeconomic conditions of both the host country and the country of origin of the migrants affect remittances.

5 CONCLUSIONS

The results of our study agree with those obtained in most of the existing studies on the positive impact of the Gross Domestic Product of the migrant host country on remittances and the negative impact of the Gross Domestic Product of the migrants' home country on the remittances, so we can conclude that remittances are considerably related to the economic variables of the host countries and the origin of the migrants.

However, our results differ from those found in other studies, regarding the importance of financial variables in determining remittances, since we have found that the variables that really have a causal relationship with remittances are the economic variables, such as Gross Domestic Product and not the variables of the financial sector such as the interest rate and the real exchange rate in addition to the inflation rate. We can imply that since the amounts earned by migrants are just enough to survive in many cases, financial decisions like investments or interest rate opportunities are not considered in their decision process.

Finally, we recognize the limitations of our study, since we have not considered in our models other variables that are related to remittances, in some cases due to lack of information.

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