The Determinants of Remittances by Moroccans Resident Abroad: Empirical Study from 1970 to 2006

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Abstract

The impact of migrant remittances on economic development and growth is becoming increasingly influential, and harbours vital benefits for developing countries. In this article, we seek to identify the macroeconomic determinants of migrant remittances in the context of Morocco. Using the technique of co-integration between remittances and other variables (agricultural GDP and exchange rates), our empirical investigation reveals the co-integrating relationships between these variables. The error correction model (ECM) showed us that there is also a stability relationship. Finally, the shock analysis (both short and long-term) exposes the ongoing effect between remittances and changes in agricultural GDP.

Keywords: remittances by Moroccans resident abroad, altruism, agricultural GDP, co-integration, ECM, shocks.

1. Introduction

In view of the scale of international migration flows over the last 10 years due in part to the search for skills and brain-power, the economic contribution by migrants has expanded to significant proportions.

Migrant populations finance development in their home countries. In some cases, their remittances are the principal source of currency reserves and external financing. They form the cornerstone of the banking system, providing a considerable supply of liquidity and serving as a key driver for the development of the financial sector. As C. Vargas-Silva & P. Huang stated, “Remittances are not only used as a mechanism for the survival of the poor in...
developing countries, but also as a risk sharing mechanism, a stable source of investment and for future consumption smoothing”.

Indeed, the phenomenon is no longer solely altruistic or a way to help disadvantaged households. It also leads to investments and development of projects, and that way, migrants are counted as significant participants in the development of their home country.

In developing countries, current workers’ remittances amounted to approximately USD 170 billion in 2006. According to International Financial Statistics (IFS), remittances by Moroccans resident abroad reached about USD 5.5 billion in 2006.

The remainder of our article addresses the following points: We start by focusing on the importance of international remittances for the Moroccan economy. We then present a review of the literature on the determinants of migrant remittances. We continue by conducting the empirical study on the determinants of remittances by Moroccans resident abroad between 1970 and 2006, before ending the article with our conclusions and recommendations regarding migration policy.

2. The Importance of International Remittances for Morocco

Migrant remittances to their home countries have become increasingly important, particularly over the last 10 years. These remittances far exceed development aid flows and are second only to foreign direct investment (FDI) flows. Furthermore, they are growing faster than FDI (see Figures 1 and 2 below).


3. The authors and international organisations have adopted a number of methods for calculating migrant remittances in order to estimate their scale. For example, the OECD has adopted the method already applied by Daianu (2001), which proposes adding together the components ‘compensation of employees’, workers’ remittances’ and ‘other current transfers of other sectors’. Some authors calculate these remittances as the sum of three components: 1. compensation of employees, 2. workers’ remittances (Ratha, 2003). Others (like Taylor (1999)) simply add together net migrant remittances and compensation of employees. We note that whichever method is chosen, it is still not sufficient to describe migrant remittances in a precise manner. According to the majority of economists working in this area, it is still very difficult to obtain exact data on remittances. In response to a request from the G7, the World Bank, the IMF and the UN have commissioned an international working group to improve the statistics on remittances. The aim of this initiative is to review the information used to calculate remittances by including personal remittances and remittances to non-profit institutions serving households (poor people, in particular).
According to estimates made by Dilip Ratha et al. (2007)\(^4\), the official total amount of remittances to developing countries is expected to reach USD 240 billion\(^5\) in 2007.

This improvement has been made possible by a series of factors linked to an increasingly modern and efficient banking and financial infrastructure. Advances in telecommunications, the internet, and network systems\(^6\) have permitted a substantial increase in migrant remittances.

In Morocco’s case, it is clear that these same remittances can now be considered as a vital source of external financing for the national economy. They contribute not only to help families survive and reduce poverty (the altruistic model developed in the 1970s), but also to develop a number of vital economic and social sectors.

In the case of Morocco, private current remittances by migrants are now a strategic challenge for the public authorities and the banking sector. Remittances by Moroccans resident abroad have for several years been the second-largest source of revenue in the balance of payments after merchandise exports. They exceeded MAD 40 billion in 2006.

Remittances have constituted between eight percent and 10 percent of GDP over the last few years, up from just about 5.5 percent in 1994. They account for almost one-third of all commercial bank deposits, with 82 percent emanating from the Euro zone\(^7\). These remittances have increased by 30.7 percent over the last five years.

In growth terms, remittances by Moroccans resident abroad rose by 13.5 percent between 2000 and 2005, compared with 2.5 percent between 1994 and 1999. In addition, they accounted for 22.4 percent of imports of goods and services in 2005, 42.9 percent of exports, and covered 46.8 percent of the trade deficit.

Remittances by Moroccans resident abroad come primarily from Europe, which is home to some two million migrants or 78 percent of all Moroccans resident abroad. Funds come predominantly from France (43 percent), followed by Spain (12.6 percent) and Italy (11.9 percent).

As Figure 1 below shows, remittances are a major source (ranked 10th globally) of financing for the Moroccan economy. According to recent statistics\(^8\), Morocco is now the world’s 11th largest remittance-recipient country after Romania, and the largest in the MENA region.

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5. This amount does not take into account any parallel undeclared remittances. Remittances are defined here as the sum of workers' remittances, compensation of employees, and migrant transfers.
6. Remittance systems use the SWIFT network, which clears payment transactions between national banking systems at remarkable speed.
Table 3. Trend of Migrant Remittances (only workers’ remittances considered) in Developing Countries and Morocco

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<td>Remittances by workers from developing countries in USD millions</td>
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<td>Remittances by Moroccans resident abroad in USD millions</td>
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<td>1969.50</td>
<td>2165.47</td>
<td>1892.81</td>
<td>2010.64</td>
<td>1938.11</td>
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Table 4. Trend of Remittances in Developing Countries and to Morocco (three components)

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<td>100990.00</td>
<td>113136.00</td>
<td>123672.00</td>
<td>132071.00</td>
<td>145239.00</td>
<td>168772.00</td>
<td>86759.40</td>
<td>91672.70</td>
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<td>113136.00</td>
<td>123672.00</td>
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<tr>
<td>Current remittances for Moroccans in USD millions</td>
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<td>2658.83</td>
<td>2285.69</td>
<td>2499.71</td>
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<td>2000.34</td>
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<td>4243.28</td>
<td>5022.28</td>
<td>5533.02</td>
<td>6512.07</td>
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3. Determinants of Migrant Remittances: Review of Recent Literature

As noted by Rapoport and Docquier (2005), theoretical and empirical economic literature on migrant remittances can be divided into two approaches: A microeconomic approach focusing on the determinants of remittances, and a macroeconomic approach focusing on the impact of these remittances on economic growth and development.

Virtually all authors and experts on migration issues agree that there are two main motivating factors behind migrant remittances to their home countries: Altruism and self-interest.
The literature on the determinants of migrant remittances to their home countries seeks to define and analyse the relationship between financial remittances and the factors deemed to be attractive in the context of economic and financial development.

In fact, it is clear that the issue of determinants of migrant remittances, particularly in relation to the socioeconomic impact of remittances on the development of the home country, has been examined at great length over the past 15 years.

One of the first studies to test the determinants of migrant remittances using macroeconomic data was that conducted by Swamy in 1981. Using data on Greece, Turkey, and Yugoslavia, he did not identify any significant impact or causal relationship between the principal macroeconomic variables and remittances in either the host country or the home country.

Following from the ideas set out above, Buch and Kuckulenz (2004) found that economic growth and the level of economic development in the home country have no clear impact on remittance levels.

Similar works (Straubhaar (1986), and Sayan (2004)) have produced virtually identical results9. However, the study by Straubhaar (1986) on remittances by Turkish migrants identified salary levels in the host country (Germany) as a significant variable.

In contrast to these ‘pioneering’ studies, recent econometric analyses have revealed that macroeconomic variables have a positive impact on migrant remittances. For example, we can cite Vargas-Silva C. and Huang P. (2006), pointing to the results indicating that changes in the macroeconomic environment of the host country have a positive influence on remittances.

In the same vein, Aydas et al. (2005) conclude that macroeconomic variables have a significant impact on workers’ remittances to Turkey, demonstrating that the black market premium, interest rate differential, inflation rate, growth in home and host country incomes, and periods of military regime, have significantly affected Turkish remittance flows. In the same paper, they conclude that the governments of home countries can positively influence the migrant remittance inflows by implementing an appropriate macroeconomic policy. Improving financial intermediation policy and preventing exchange rate misalignments can also help boost remittance flows.

Furthermore, El-Sakka and McNabb (1999) note in their study on Egypt that the parallel currency market premium and the interest rate differential are key variables that explain the increase in remittances. By the same token, Elbadawi and Rocha (1992), using data on six countries (Algeria, Morocco, Portugal, Tunisia, Turkey, and Yugoslavia), show that a number of macroeconomic variables play a major role in determining remittances. Elbadawi and Rocha (1992) suggest that a useful empirical model for determining official remittances must include as determinants, the stock of workers (or

9. In Sayan’s 2004 study, exchange rates and interest rates had no positive impact on remittances.
population) abroad, the level of income in the host country, a proxy for the length of stay, inflation in the host country, the exchange rate premium in the parallel market, and the interest rate differential between the host and home country.

In a slightly older study, Katselli and Glytsos (1986) found that remittances might be related to the interest rate in the host country. According to the same authors, however, changes in the macroeconomic environment in the home country do not have any impact on remittances.

In a study covering a sample of seven Eastern European countries (Albania, Bosnia-Herzegovina, Bulgaria, Croatia, Romania, Macedonia, and Turkey), Ioana Schiopu and Nikolaus Siegfried (2006) introduced an innovation compared with earlier studies in that their analysis took bilateral remittance flows into account and incorporated new variables such as income inequality and the share of the informal economy in the home country. They also showed that the impact of the interest rate differential was not significant. The authors interpreted these results as an indication that altruism played a key role in remitting, while the investment motive to remit was fairly weak at best.

Their results also showed that remittances increased with migrants’ qualifications, and that the share of the informal economy fell on average as remittances rose. Lower remittance costs was found to have a positive impact on migrant remittances, particularly where the home country was sufficiently far away.

According to some authors (Agarwal and Horowitz (2002), and Gubert (2002)), remittances tend to increase if domestic production (particularly agricultural) in the home country remains volatile or suffers climatic or other shocks. Macroeconomic studies have underlined determinants such as the level of economic activity in the host and home country, wage rates, inflation, interest rate, and exchange rate differentials and the efficiency of the banking system (Russell (1986)).

According to these and other studies (Swamy (1981), Straubhaar (1986), Elbadawi and Rocha (1992), El-Sakka and McNabb (1999), and Chami et al. (2005)), real gains and the total number of migrants in the host country have a significant positive impact on remittance flows.


According to Buch and Kuckulenz (2004), home countries with a large share of female employment, a high ratio of older (inactive) citizens, and the lowest illiteracy rates, receive more remittances than other countries at the same level of development.
There have been only a limited number of studies on the relationship between remittances and financial development. As Aggarwal et al. (2006) note, apart from descriptive studies on the efforts made by financial institutions on behalf of remitting migrants (Orozco and Fedewa 2005), the question of whether migrant remittances can promote financial development in the recipient countries has curiously attracted little attention. However, there have been three studies in this niche of the literature on migrant remittances. Indeed, we refer in this review, to an interesting study conducted by Paola Giuliano and Marta Ruiz-Arranz, which uses cross-country data sets on remittances covering a broad sample of developing countries (100 countries over the 1975 to 2003 period). In this study, the authors attempt to clarify the nature of the relationship between remittances and financial development, and the impact it may have on growth. They also showed that since financial intermediation is weak and cannot finance the economies of developing countries due to a lack of resources and under-developed banking and financial infrastructure, migrant remittances may act as a substitute. They can, in fact, replace the lack of financial development, thereby promoting economic growth. Their empirical analysis shows that remittances can promote growth in less financially developed countries. They argue that the increase in remittances can be considered as a lifeline to compensate for liquidity restrictions brought about by the weakness of financial development.

A second study in this area, conducted by Mundaca in 2005, analysed the impact of remittances on growth in Central America, Mexico, and the Dominican Republic, based on panel data for the 1970 to 2003 period. Mundaca finds that control in the context of financial development strengthens the positive impact of remittances on growth. She concludes that financial development potentially leads to better use of migrant remittances, thus boosting growth. A similar study comes up with equally interesting findings. Aggarwal et al. (2006) examine whether migrant remittances influence financial development by looking at the impact of remittances on bank deposits and on the amount of credit extended to the private sector. Using data on migrant remittance flows received by 99 developing countries between 1975 and

10. Since King and Levine (1993) and Levine et al. (1998), the issue of the relevance of financial development in promoting growth has been crucial. A well-developed banking and financial infrastructure made up of banks, finance companies, microfinance, and factoring institutions, and modern, liquid capital markets enhanced by good governance and strict controls, plays a key role in financing growth and reducing poverty.

11. Expanding Paola Giuliano and Marta Ruiz-Arranz’s idea, we can say in this context that the flourishing and even the essence and continued existence of parallel markets (informal currency exchange and financing markets) are driven by remittances. Going even further, we can say that the existence of parallel markets brings about growth in migrant remittances to countries where the financial markets are not very well developed.

12. This study is considered to be the first in the literature to examine the impact of remittances on bank deposits and credit.
2003, the authors conclude that remittances have a positive and significant impact on financial development in developing countries.

Among the studies on remittances by Moroccans resident abroad and their impact on growth and economic development, very few are devoted to this topic. Despite the key role played by remittances by Moroccans abroad in the activities of banks and all credit establishments in Morocco\textsuperscript{13}, to our knowledge, there has never been an individual econometric study (using time series data\textsuperscript{14}) on the impact of these remittances on financial development (banking intermediation and the development of capital markets).

In his paper on the theory of workers’ remittances with an application to Morocco, Jacques Bouhga-Hagbe\textsuperscript{15} shows that altruism, attachment to the home country (primarily investment in real estate), portfolio diversification opportunities, and the interest rate differential may be factors behind the increase in remittances by Moroccans living abroad. Using co-integration techniques, the author concludes that apart from the portfolio diversification factor, there is a stable relationship between remittances and their determinants. Portfolio diversification motives may not be significant in the decision by Moroccans resident abroad to remit funds to their home country.

4. Econometric Study

Clearly, the majority of studies, particularly those conducted in the 1980s and 1990s, have a number of handicaps linked to the lack of statistical data over long periods and the limited number of macroeconomic and financial variables recorded\textsuperscript{16}. These studies produce more of contradictory results. The conclusions of empirical investigations on the majority of macroecono-

\textsuperscript{13} For example, the Groupe Banques Populaires has attracted 66 percent of all remittances by Moroccans resident abroad made via the banking sector (Amin and Freund (2005), cited in Global Economic Prospects, Economic Implications of Remittances and Migration, World Bank, 2006). The Moroccan government, in partnership with host countries, has allowed a number of banks to open branches and representative offices abroad. These banks offer banking services (current accounts in dirham, convertible dirham and foreign currencies, tax exemption, etc.) to Moroccans resident abroad at increasingly competitive prices.

\textsuperscript{14} All previous economic studies on Morocco have used panel data.


\textsuperscript{16} In line with a number of authors (Ioana Schiopu and Nikolaus Siegfried (2006), Bhupal Singh (2006)), we can argue that collecting accurate data on remittances is considered to be an extremely difficult task. In reality, the data underestimate true remittance flows. One of the reasons for this phenomenon is that official remittance statistics do not capture amounts sent outside the banking system. In the Euro zone, for example, only amounts above a threshold of EUR 12,500 per remittance are recorded. Similarly, a significant portion of migrant funds is remitted in the form of goods and is generally not recorded if it does not have to be declared to customs authorities. According to Ratha et al. in Migration and Development, Development Prospects Group, Migration and Remittances Team (World Bank 2007), a recent IFAD report suggests that remittance flows to developing countries were about USD 300 billion in 2006. This figure is broadly consistent with the World Bank’s earlier estimate of USD 208 billion (the current estimate is USD 221 billion) of recorded flows in 2006, plus an additional amount in the form of unrecorded remittances. Below the headline total, however, there are differences between the two datasets. The IFAD report appears to include retail payments for trade
mic determinants of remittances are mixed. In most cases, few conclusions can be drawn about the impact of the interest rate differential, the parallel market exchange rate premium, and inflation or the level of economic and financial development in the home country, on the magnitude of remittances.

Furthermore, model estimation is usually based on level-type variables, whereas these same variables may contain non-stationary and seasonal phenomena, thereby distorting the quality of the regressions.

All these factors lead us to doubt the reliability of the general conclusions drawn from the literature on the empirical determinants of migrant remittances.

We will begin our empirical study by formulating the model to be tested. We will then select the variables and analyse their statistical properties. Thirdly, we will specify the VAR (Vector autoregression) system to be retained for our model. The fourth section will address the co-integration test and present its results, then carry out a VECM (Vector error correction) estimation. Finally, we will analyse the variance decomposition and response to shocks.

4.1. Formulation of the Model to be Tested

For this econometric study, we have adopted the model developed by Bouhga-Hagbe J. (2004, 2006), which provides a model on how attachment to the home country (altruism) and portfolio diversification may act as potential motives for remittances by Moroccans resident abroad. The aim of this model is to demonstrate and explain in empirical terms, how the level of remittances by Moroccans resident abroad depends partly on the degree of attachment to the home country and partly on the interest rate differential between the migrant’s home country and host country, if portfolio diversification motives are significant in the decision to remit.

The model in no way seeks to identify the theoretical underpinnings of the determinants of migrant remittances to their home country. Its explanations remain practical and exploratory, which is why we found it interesting to apply it to developing countries, such as Morocco. The approach involves retaining a set of fundamental (from the real economy) and financial variables that may influence remittances by Moroccans resident abroad. Using this model, we will search for co-integrating relationships between remittances, agricultural GDP and exchange rates within the context of the specification below:

\[ \text{Remittances}_t = \alpha \text{Agricultural GDP}_t + \beta \text{Exchange rate}_t + \text{Trend}_t + \epsilon_t \]  

and investment purposes in some cases. According to the authors, this report “generally estimates remittances by multiplying migrant stocks obtained from a bilateral migration database constructed for general equilibrium modelling with average remittances obtained from small-scale surveys, which may not have been nationally representative. These differences once again highlight the great need for improving the data on remittances”.


In this specification:

- **Remittances** denotes remittances by migrants resident abroad;
- **Agricultural GDP** stands for real agricultural GDP;
- **Exchange rate** is the US$ exchange rate against the local currency;
- **Trend** represents time; and
- \( \varepsilon \) is a Gaussian error term with zero mean and finite variance.

It should also be noted that according to Bouhga-Hagbe (2004, 2006), real agricultural GDP is used as an indicator of ‘hardship’ for a country that receives remittances from migrants resident abroad. In other words, a fall in real agricultural GDP may be interpreted as an increase in ‘hardship’. From a theoretical point of view, when agricultural GDP falls, the prices of agricultural products rise.

The inclusion of the exchange rate is justified by the fact that it could influence the level of migrant remittances. However, Bouhga-Hagbe (2004, 2006) underlines that the effect of this variable is not always clear a priori. It can have opposite effects on the level of remittances (i.e. the exchange rate can have both a positive and a negative effect on the level of migrant remittances). According to the author, the reason for this situation is that an increase in the price of goods and services following a depreciation of the home country’s currency could, on the one hand, cause migrants resident abroad to reduce their remittances. On the other hand, migrants may see the devaluation of the exchange rate as an opportunity to increase their purchasing power and attempt to remit more funds in order to invest in real estate, as is the case withMoroccans living abroad.

According to the specification given by Bouhga-Hagbe (2004, 2006), the model to be estimated in this study is drawn from the autoregressive distributed lags equation below:

\[
\Delta \text{Remittances}_t = \sum_{i=1}^{k} a_i \Delta \text{Remittances}_{t-i} + \sum_{j=1}^{k} B_j \Delta \text{F}_{t-j} + \mu \text{EC}_{t-1} + \varepsilon_t \tag{2}
\]

\[
\Delta \text{Remittances}_t = \sum_{i=1}^{n} a_i \Delta \text{Remittances}_{t-i} + \sum_{j=1}^{k} \begin{bmatrix} b_{1j} \\ \vdots \\ b_{nj} \end{bmatrix} \begin{bmatrix} \Delta \text{F}_{t-j} + \mu \text{EC}_{t-1} + \varepsilon_t \end{bmatrix} \tag{3}
\]

Converted into natural logarithms, the equation is formulated as follows:

\[
\Delta \text{LnRemittances}_t = \eta_0 + \sum_{i=1}^{n} \eta_i \Delta \text{Remittances}_{t-i} + \sum_{j=1}^{k} \begin{bmatrix} h_{1j} \\ \vdots \\ h_{nj} \end{bmatrix} \begin{bmatrix} \Delta \text{LnF}_{t-j} + \mu \text{EC}_{t-1} + \varepsilon_t \end{bmatrix} + \Delta \text{LnEC}_{t-1} + \varepsilon_t \tag{4}
\]
4.2. Selection of Variables and Analysis of Statistical Properties of the Series

The series used in this study are year-on-year changes. The main sources for the data are:
- The IMF’s Balance of Payments Statistics Yearbook (BOPSY) and IFS;
- The CHELEM database constructed by the CEPII;
- WDI, the World Bank;
- Various reports by Bank Al-Maghrib.

The study covers the 1970 to 2006 period.

All the original series have been converted into natural logarithms. This allows us to verify the model’s short and long-term partial elasticities on the assumption that remittances are exponentially related to agricultural GDP and the exchange rate.

The purpose at this stage of the analysis is to solve an important problem in analysing the determinants of remittances and the selection to be made among the different explanatory variables of remittances to Morocco, and to study their statistical properties.

4.2.1. Selection of Variables

To estimate the determinants of remittances from Moroccans resident abroad, we selected three variables, namely transfers, agricultural GDP, and the exchange rate.

As in most theoretical and empirical studies, the need arises to be more precise about how to measure remittances from residents abroad. We have taken the definition provided by Giuliano Poala and Ruiz-Arranz Marta (2005), which states that remittances are the sum of the following three elements: Workers’ remittances (part of current transfers in the current account), compensation of employees (part of the income component in the current account), and migrant transfers (part of the capital account).

4.2.2. Description of Data

The symbols used for the different data used in this study are as follows:
- \( L\text{Remittances} \) is the logarithm of remittances;
- \( L\text{AgriculturalGDP} \) is the logarithm of agricultural GDP;
- \( L\text{Exchangerate} \) is the logarithm of the dollar/dirham exchange rate.

Figure 1 shows the trend of all these variables.

4.2.3. Analysis of the Statistical Properties of the Series

The purpose of this level of the analysis is to see how we can transform our original series to make them stationary. The stationarity analysis is carried
out on the basis of three approaches: ‘Dickey – Fuller (DF)’\textsuperscript{17}, ‘Augmented Dicky – Fuller (ADF)’\textsuperscript{18} and ‘Phillips Perron (PP)’\textsuperscript{19}. Tables 5, 6 and 7 below summarise the main test statistics obtained for the determinant variables of the equation for remittances to Morocco, as absolute levels and in first order differentials with a maximum lag of three periods.

The tables show that the results of the stationarity analysis performed on the series do not allow us to reject the hypothesis of a unit root for all the variables used in this study. We can therefore conclude from the characterisation of the series summarised in the tables (the column headed “Decision”) that, according to the DF and PP tests, remittances are integrated of order 1 plus a constant ($\mu$), while under the ADF test the series is I(1). The other variables are I(1) for all three tests.

These results mean we can test the number of co-integration relations in the equation for remittances to Morocco, since all the variables have the same order of integration. They are integrated of the order one I(1).


4.3. Specification of the VAR System

The purpose of this level of the analysis is to precisely specify the model to be tested before applying the estimated equation for remittances to Morocco. We shall first seek to determine the maximum number of lags in the VAR representation, then to test the appropriate determinant trend and finally to analyse the normality of residuals.

4.3.1. Determining the Maximum Number of Lags in the VAR Representation

Our system estimation is obtained by first seeking an optimal lag among variables. For this, we shall take the criteria of Akaike (AIC), Hannan-Quinn

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20. Trend doubtful.
We therefore need to estimate four different models and retain the one where the AIC, HQ and SC criteria are lowest. For each criterion, we obtained the structure of lags summarised in Table 8 below.

Based on the minimum criteria of AIC, HQ, and Schwarz, the results of the analysis of the maximum number of lags in the VAR representation contained in the table show the optimal lag is three.

Having determined the optimal lag in the VAR system for each criterion, we shall now proceed to carry out tests on the selection of the appropriate polynomial lag in a VAR representation.

4.3.2. Testing the Polynomial Trend

The purpose of this level of the analysis is to set restrictions on the constant \( \mu_0 \) and the trend \( \mu_1 \) in a VAR representation. Table 9 below summarises the results of the polynomial trend tests.

Looking at the results of the polynomial trend test, we can retain a VAR model with a constant and no trend because the hypothesis that the trend coefficient is zero is accepted in polynomial trend models one and three.

Having selected the appropriate polynomial trend for the VAR system, the next stage is to specify the residuals.

21. We should note that other methods can be used to determine the optimal lag. These include the likelihood ratio (LR) and the Godfrey-Portmanteau test (GP). For more details of these methods, see Hamilton James D. (1994), *Times Series Analysis*, Princeton University Press, Princeton NJ, pp. 296-98 and pp. 429-30.

The functions \( \text{AIC}(p) \) and \( \text{SC}(p) \) are calculated as follows:

\[
\text{AIC}(p) = -2 \ln(L) + 2p \quad \text{and} \quad \text{SC}(p) = -2 \ln(L) + \frac{2p \ln(n)}{n}
\]

K is the number of variables in the system; n the number of observations; p the number of lags; and S the variance-covariance matrix of the residues of VAR(p).

For more details, see also:

22. We should point out that the selection of a lag of three was also confirmed by the likelihood ratio (LR) and Godfrey Portmanteau tests. The latter justifies the choice by accepting the null hypothesis that the vector of the residuals is white noise for a lag greater than three.

<table>
<thead>
<tr>
<th>Lag</th>
<th>Criterion</th>
<th>Akaike AIC(p)</th>
<th>Hannan – Quinn HQ(p)</th>
<th>Schwarz SC(p)</th>
</tr>
</thead>
<tbody>
<tr>
<td>P = 1</td>
<td>-12.078</td>
<td>-11.895</td>
<td>-11.534</td>
<td></td>
</tr>
<tr>
<td>P = 2</td>
<td>-11.938</td>
<td>-11.617</td>
<td>-10.985</td>
<td></td>
</tr>
<tr>
<td>P = 3</td>
<td>-12.762</td>
<td>-12.304</td>
<td>-11.602</td>
<td></td>
</tr>
<tr>
<td>P = 4</td>
<td>-11.560</td>
<td>-11.965</td>
<td>-9.791</td>
<td></td>
</tr>
<tr>
<td>Optimal lag</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td></td>
</tr>
</tbody>
</table>
4.3.3. Normality Test on System Residuals

The tests for the specification of residues relate to one major property, namely the normality of residuals as measured by the Jarque-Bera statistic. The test was conducted on the residuals of each equation in the VAR system and the residual of the whole VAR system (all equations). The test also allows us to verify the skewness and kurtosis hypotheses, both jointly and separately. Table 10 below summarises the results of the Jarque-Bera normality tests.

Table 10. Results of the Jarque – Bera Normality Test for the Equation for Remittances to Morocco.

<table>
<thead>
<tr>
<th>Polynomial trend models</th>
<th>Hypotheses to be tested</th>
<th>$c^2$ Calculated</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>$H_0$</td>
<td>$H_1$</td>
</tr>
<tr>
<td></td>
<td>Constant $m_0$</td>
<td>Trend $m_1$</td>
</tr>
<tr>
<td>1</td>
<td>$m_0 = m_0$</td>
<td>$m_1 = 0$</td>
</tr>
<tr>
<td>2</td>
<td>$m_0 = 0$</td>
<td>$m_1 = 0$</td>
</tr>
<tr>
<td>3</td>
<td>$m_0 = 0$</td>
<td>$m_1 = 0$</td>
</tr>
</tbody>
</table>

We observe that the specification chosen gives good normal residuals for the hypotheses of skewness and kurtosis for the equations with the variables remittances, agricultural GDP, and exchange rate. Under the hypotheses of skewness and kurtosis taken separately, normality is accepted for all three equations.

Univariate analysis of all the series together shows that the determinants of remittances to Morocco are all of the same order of integration (I(1)). We can therefore test the number of co-integrating vectors used in the VECM. This will be done in the next section.

23. (*) Indicates hypothesis of normality rejected with a significance above 5%.
4.4. Results of the Estimation

4.4.1. Results of the Tests of Co-integration and of the Polynomial Trend selected

The purpose of this level of the analysis is to determine the number of relationships of co-integration and the polynomial trend for the model for remittances to Morocco. In order to test the number of co-integrating relationships in the three-variable VAR system, we chose to adopt the procedure of Johansen and Juselius (1988, 1990)\(^24\) using the trace test. This was selected because it was more powerful than the maximum eigenvector test (also known as \(\lambda_{\text{max}}\)).

For the choice of the appropriate polynomial trend in the co-integration relationship, we refer to the procedure developed by Johansen (1992)\(^25\) and reconsidered by Mosconi Rocco (1999)\(^26\). For the purposes of the procedure, we assumed that the relationship of co-integration among the three variables for the VAR system can be characterised by the presence of a constant \((\mu_0=\alpha_0)\). In fact, we reject the presence of a deterministic trend and accept the presence of a constant \((\alpha_0)\) in the co-integration relationship for our VAR system.

The results of the trace test among the three variables examined are shown in Table 11.

Table 11. Results of the Co-integration Rank (\(r\)) Test for the Equation for Remittances to Morocco.

<table>
<thead>
<tr>
<th>Co-integrating vectors ((r))</th>
<th>Constant ((m_0))</th>
<th>Trend ((m_1))</th>
<th>Trace test ((\tilde{\lambda}, \text{Trace}))(^27)</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>(\alpha_0)(^a)</td>
<td>0</td>
<td>39.17</td>
</tr>
<tr>
<td>1</td>
<td>(\alpha_0)(^a)</td>
<td>0</td>
<td>15.90*</td>
</tr>
<tr>
<td>2</td>
<td>(\alpha_0)(^a)</td>
<td>0</td>
<td>5.58</td>
</tr>
</tbody>
</table>

\(^{24}\) For more details, see:


\(^{27}\) For the purposes of this study, we compare the values obtained with the critical values (not shown here). An asterisk indicates that the hypothesis \(r=1\) is not rejected at the 95% threshold.
We can conclude from the trace test that there is a single relationship of co-integration between the series. This result brings us to the next stage in estimating long and short-term solutions for remittances to Morocco in a VECM.

4.4.2. VECM Estimation: Results and Stability

This is one of the most important stages and allows us to both estimate long-term solutions and verify the stability of these results. For these three variables, the VECM estimation allows us to determine remittances to Morocco in a steady state, using the following equation:

\[ \text{LRemittances}_{t-1} = -1.29 \text{LExchangerate}_{t-1} + 4.33 \text{LAgriculturalGDP}_{t-1} \]

The short-term changes with an optimal lag of three months are shown in Table 12.

As the table shows, we can conclude from the estimation of the VECM model for the remittances equation that:

- In a steady state regime, remittances to Morocco (LRemittances) are mainly driven by the exchange rate (LExchangerate) and agricultural GDP (LAgriculturalGDP). In general, the coefficients of the determinant variables for remittances to Morocco do indeed have the expected sign, as noted earlier, i.e. negative for the exchange rate and positive for agricultural GDP; and

- In the short-term, changes in remittances to Morocco are not chiefly determined by past trends (ΔLRemittances), whatever period is selected. Beyond the steady state, changes in agricultural GDP (ΔLAgriculturalGDP) and the exchange rate (ΔLExchangerate) are significant determinants of remittances to Morocco. This can be clearly seen in the Student t-value.

<table>
<thead>
<tr>
<th>State</th>
<th>Variables</th>
<th>LRemittances</th>
<th>LExchange-rate</th>
<th>LAgriculturalGDP</th>
<th>Constant</th>
</tr>
</thead>
<tbody>
<tr>
<td>Steady state</td>
<td>Coefficients</td>
<td>-0.1962</td>
<td>-0.2544</td>
<td>0.8491</td>
<td>-6.2374</td>
</tr>
<tr>
<td></td>
<td>T statistic</td>
<td>-3.1835</td>
<td>-3.1835</td>
<td>3.1835</td>
<td>-3.167</td>
</tr>
<tr>
<td>Short-term</td>
<td>One period</td>
<td>Coefficients</td>
<td>0.1127</td>
<td>0.2113</td>
<td>-0.4182</td>
</tr>
<tr>
<td></td>
<td>T statistic</td>
<td>0.6870</td>
<td>0.5163</td>
<td>-1.8403</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Two periods</td>
<td>Coefficients</td>
<td>0.0823</td>
<td>0.7355</td>
<td>-0.0214</td>
</tr>
<tr>
<td></td>
<td>T statistic</td>
<td>0.5403</td>
<td>1.9339</td>
<td>-0.1265</td>
<td></td>
</tr>
</tbody>
</table>


28. (:): Values of standard deviations.
4.4.3. VECM Estimation: Results and Stability

The analysis of the stability of the coefficients of the VECM model of the equation for remittances to Morocco must be carried out both by using the Z model for short-term coefficients to analyse co-integration-rank stability and the R model to analyse the stability of the coefficients in steady state (b).

Figure 2 shows the co-integration-rank stability analysis performed on the equation for remittances to Morocco in accordance with the R model. The length of the first sub-sample was set at 20 observations. The total number of observations in the study was 37. The upper line represents the stability test for the hypothesis $r = 0$, which is clearly rejected at a level of over 95 percent significance for the entire period. The critical value for the test is greater than one. The other lines represent the stability tests for the hypotheses $r = 1$ and $r = 2$ respectively. Note that the hypothesis $r = 1$ corresponds to the true co-integration rank, since figure 2 clearly demonstrates that the co-integration-rank stability hypothesis is not rejected for this hypothesis, as it less than one.

The stability of the coefficients in steady state (b) is shown in figure 3:

Figure 3 shows that the normalised test is well below one for both the R and Z models over the entire period. This leads us to the conclusion that the two models are convergent and the estimated parameters are stable, despite the instability in the Z model resulting from estimating the short-term trend.

4.5. Variance Decomposition and Response to Shocks

The purpose of this level of the analysis is to examine the respective contributions for the different shock models between short and long-term fluctuations in remittances (LRemittances) and the explanatory variables (LEXchangerate and L AgriculturalGDP). In order to highlight the internal dynamics of this three-variable system, we conducted a decomposition variance analysis of forecasting errors and considered the response functions of the variables to different shocks.

4.5.1. Variance Decomposition

The forecasting error variance decomposition exercises were carried out on different models of innovation so as to establish the relative importance of shocks in the variables (LEXchangerate and L AgriculturalGDP) for remittances (LRemittances). The adoption of a forecasting error decomposition variance approach coupled with alternative orthogonalisations of the residuals of the VAR model of the variables (LRemittances, LEXchangerate and L AgriculturalGDP) then clarifies links of causality or non-causality as defined by Sims (1972)29.

In this connection, we refer to the Choleski method (Doan, 1992) to calculate the forecasting error decomposition variance associated with the alternative orthogonalisations of the residuals from the VAR model. The results of the forecasting error decomposition variance carried out on the VAR process are summarised in figures 4, 5 and 6. The order of the vector of the variables is $L_{\text{Remittances}}$, $L_{\text{Exchangerate}}$ and $L_{\text{AgriculturalGDP}}$, but the results obtained from a permutation of the variables are similar, so we do not show them here.

In general, looking at the results of the forecasting error variance decomposition shown in the figures below (4, 5 and 6) for the model considered in this study, we see that the variance of the change in remittances (LRemittances) is almost 4/5ths comprised of its own innovations and 1/5th by agricultural GDP innovations (LAgriculturalGDP). For the exchange rate (LExchangerate), it is comprised almost 3/5ths of its own innovations and nearly 2/5ths of remittance innovations. For agricultural GDP the variance of its innovations is 2/3rds from its own innovations, nearly 1/4 from remittance innovations and five percent from exchange rate innovations.
4.5.2. Response to a Single Shock

In terms of shocks, we proceed according to a method based on the Cholesky decomposition, whereby reduced-form errors, $e_t$, are linked to structural-form errors, $\eta_t$, as follows: $Ae_t = Be_t$.

Figure 7 shows the shock analysis in more detail. The response functions shown indicate that the response of remittances to a shock in remittances is zero. In other words, it has no effect on itself. By contrast, the response to a
shock in the exchange rate is negative and permanent, but of low magnitude, while the response to a shock in agricultural GDP is positive and permanent, but of low magnitude. We also note that remittances respond to a permanent shock from a combination of the exchange rate and agricultural GDP of the same magnitude but in opposite directions, forming a mirror effect.

We further observe from the figures that shocks to the exchange rate are transitory in nature and consist of a linear combination of the exchange rate, remittances, and agricultural GDP. The impact of the exchange rate and remittances has a positive sign, whereas the effect of agricultural GDP has a negative sign. The response of agricultural GDP to a shock is comprised of a combination of transfers, the exchange rate, and agricultural GDP. The effect of this shock is transitory, with changes in this combination appearing with the same sign.

5. Conclusions

In conclusion, this study shows that remittances are largely explained by the variables we specified, i.e. agricultural GDP and the exchange rate. Indeed, under the co-integration hypothesis, we also noted a co-integration relationship. The long-term relationship therefore appears to be clear and stable.

As to the level of the data, over a long period, remittances have no effect on themselves. Nonetheless, the exchange rate has a negative effect on remittances, while agricultural GDP has a positive influence. These results suggest that exchange rate policy (devaluations, changes in parity or the parity premium, etc.) does not have a positive impact on remittances by Moroccans resident abroad.

Over the long term, Moroccans living abroad are more or less insensitive to what happens to the currency. This result has been confirmed by most studies about what drives remittances. In the case of Morocco, we are led to the conclusion that the strongest factors governing remittances from Moroccans resident abroad are attachment to the country, family and social solidarity, and altruism. On the other hand, a change in agricultural GDP results in a change in remittances in the same direction. When agricultural GDP rises, remittances rise. This is because the conditions in terms of investment are dependent on significant assistance from Moroccans resident abroad, who support agricultural households in the country. When the opposite happens, the effect remains positive if agricultural GDP falls. This confirms the point about solidarity and the altruism displayed by Moroccans living overseas.

For the short-term trend under the ECM, the exchange rate has a positive effect on remittances. Remittances have no effect on themselves, but they have a permanent negative shock on the exchange rate over a period of one to three years. They have a permanent positive effect on GDP over a period of two to three years.
The exchange rate has a provisional or transitory shock effect on itself. It also has a transitory shock effect on remittances and GDP. GDP has a transitory shock effect on itself and on the other variables (remittances and the exchange rate).

Based on the results we have achieved, the most plausible explanation for remittances from Moroccans resident abroad remains altruism and solidarity. To put it another way, Moroccans living overseas will continue to send money to their families whatever the conditions in the home country.

Nevertheless, remittances cannot grow in perpetuity. The authorities will need to make efforts to persuade Moroccans resident abroad to remit more. This will require:
- Developing a financial and banking infrastructure that is solid, innovative, and with affordable client services;
- Cutting delays in terms of administrative procedures, customs formalities, etc.;
- Launching and developing the tourism, social, hospitality, and health infrastructure needed to persuade Moroccans living abroad to send more money and to return home; and
- Helping the non-migrant families of Moroccans resident abroad to improve their daily living conditions (electrification of villages, drinking water, roads, bridges, schools, hospitals, etc.).

References


