Does remittance lead or lag exchange rate? evidence from Morocco

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Does remittance lead or lag exchange rate? evidence from Morocco

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Abstract

Studying the relationship between remittance and exchange rate is not a new trend in the empirical literature, however, most of these studies were conducted using classical regression and correlation and very few studies used the time series techniques to address the lead-lag relationship between remittance and exchange rate. We use Morocco as a case study. The findings confirm that the remittance has a long term theoretical relationship with the exchange rate and that remittance leads the exchange rate rather than the other way around. This conclusion implies that the role of remittances in the Moroccan economic development must be ever present in economic policy decisions and, especially, in the exchange rate policy going forward.

Keywords: Remittance, exchange rate, lead-lag, VECM, VDC, Morocco

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Introduction

The inflow of remittances has become an important source of external financing in developing countries, overcoming other conventional sources of capital, in particular aid and portfolio investment. It is estimated that remittances to the MENA will grow by 2.9 percent in 2018. (migration and remittances, 2017). Although it is generally accepted that remittances are an important means of improving the living conditions of families of the poorest countries in the world, there is a disagreement on the evaluation of their macroeconomic effects. Besides, remittances have welfare and growth effect. There is a concern whether remittances result in an appreciation of the real exchange rate (RER), which could cause Dutch disease. The massive inflow of remittances could be associated with real exchange rate appreciation and loss of international competitiveness (Barrett 2013).

The role of remittances is well recognized and there is an increasing volume of research in that regard. Not only is this recognized at the research level, the issue of remittances as a developmental tool, as well as its potential negative consequences, has engaged policy makers and the attention of major financial institutions such as the World Bank and IMF (see for instance IMF's World Economic Outlook 2005 and the World Bank's Global Economic Prospects 2006).

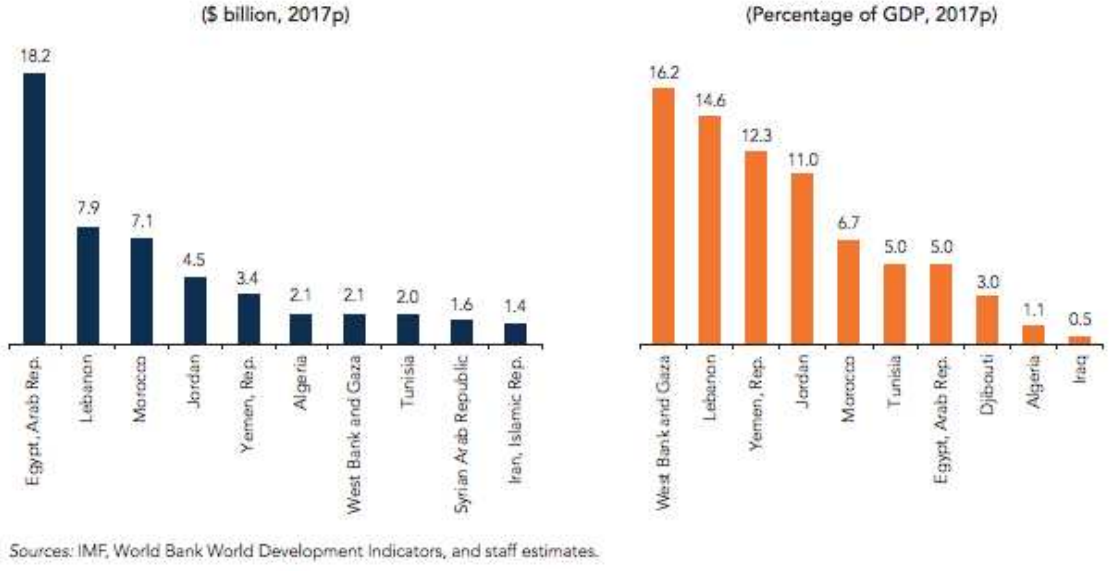
Several empirical studies have been conducted to study the relationship between remittances and economic growth. However, only a few studied the relationship between remittances and exchange rate, and almost no study has looked so far at this kind of Granger-causal relationship for the remittances and exchange rate in Morocco. The effects of remittances on the exchange rate raise an important area for research and the exploration of the relationship between remittances and the real exchange rate more closely, and that was the main motivation behind writing this research especially in a Moroccan context.

Various studies have reported mixed effects of remittances on the real exchange rate. For instance, Amuedo-Dorantes and Pozo (2004), Molina and Bussolo (2007), Acosta, Lartey and Mandelman (2008), Acosta, Baerg and Mandelman (2009), Barajas et al. (2010), Combes, Kinda and Plane (2011), Lartey, Mandelman and Acosta (2012), and Hassan and Holmes (2012) discovered that huge remittances led to appreciation of Tajikistan's real exchange rate whereas

Barrett (2014) and Izquierdo and Montiel (2006)on the contrary found that remittances depreciate the Jamaica's real exchange rate. (Rahman and Mustafa, 2010) found that exchange rate and remittances seem correlated with no causal connection.

Ball et al. (2013) analyze the short-run dynamics triggered by an increase in remittances under different exchange rate regimes, with a focus on the monetary nature of remittances. The theoretical predictions indicate that under a fixed exchange rate regime, a rise in remittances leads to an increase in GDP, increase in the rate of inflation and an appreciation of the real exchange rate, while under a flexible exchange rate regime they generate an increase in GDP, an appreciation of the real exchange rate, but a decrease in inflation rate.

Morocco is the third largest remittances receiver in the MENA region and due to robust growth in the euro area, we also expect remittances to Maghreb countries, which receive the bulk of their remittances from Europe. In Morocco, the dollar value of remittances declined by 11 percent in the first three quarters of 2015, whereas remittances grew by 4.5 percent in Moroccan dirham (world Bank 2017). At the same time, arrivals in Spain coming from Morocco through August 2017 have tripled compared to the same period last year, according to the International Organization for Migration (IOM) (world Bank 2017).



According to the central bank, Morocco will move toward greater exchange rate flexibility in 2017. This should strengthen the economy's ability to adjust to external shocks while remaining

consistent with the country's strategy to position itself as a trade and financial hub. The reform has been widely expected, but the process will remain gradual to leave the economy enough time to prepare. It is thus likely that greater volatility of the MAD will be allowed through a widening of the current band. The introduction of a flexible exchange rate regime in Morocco will encourage sending remittances and due to robust growth in the euro area, we also expect remittances to Maghreb countries, which receive the bulk of their remittances from Europe, to remain stable or grow modestly.

Consequently, the key research questions answered in this study are: Is there any long-run relationship between remittances inflow, exchange rate? Do remittances lead exchange rate or vice versa? Therefore, this paper aims to explore whether foreign remittance has any significant impact on the exchange rate the Moroccan economy. Standard time-series techniques will be used to determine the lead-lag relationship. The remainder of the paper is structured as follows. Section 2 will provide the theoretical relationship between remittance and exchange rate. Section 3 will review the empirical studies to date. It is followed by the statistical methodology and discussion on result in section 4. Finally, the concluding remark will be made.

Literature Review

The literature has documented both desirable and undesirable consequences of remittances in recipient economies. Most of these empirical studies and their findings suggest that remittances inflow leads to the appreciation of the recipient. Amuedo-Dorantes and Pozo (2004), Molina and Bussolo (2007), Acosta, Lartey and Mandelman (2008), Acosta, Baerg and Mandelman (2009),

Barajas et al. (2010), Combes, Kinda and Plane (2011), Lartey, Mandelman and Acosta (2012), and Hassan and Holmes (2012) all conclude that remittances inflow appreciates real exchange rate.

Amuedo-Dorantes and Pozo (2004) test the impact of worker's remittances on the real exchange rate on 13 Latin America and Caribbean economies using fixed-effect OLS taking into consideration the use of instrumental variables to account for the possibility of endogeneity and found that remittances appreciate real exchange rate over the time period 1979 – 98. The result was confirmed by Lopez, Molina and Bussolo (2007) who investigated this issue further by analyzing the effects of remittances on the exchange rate using panel of 20 countries (some of which are Latin American) over the time period 1990-2003. They found the same result which is remittances appreciates real exchange rate.

In line with the earlier research, Acosta, Lartey and Mandelman (2008) for panel of 109 developing and transitional countries for the period 1990-2003 using an OLS country fixed-effects model and generalized method of moments (GMM) revealed that GDP per capita, the terms of trade index, and GDP growth resulted in real exchange rate appreciation and they are statistically significant at the 10% level. In a similar study, Acosta, Baerg and Mandelman (2009) confirm that remittances lead to real exchange rate appreciation. Using the same data, they also postulate that if depreciation occurs, the amount by which the currency depreciates depends on the ability of the domestic economy to channel remittances towards investment. Barajas et al. (2010), also found that countries of the Middle-East and North Africa are most likely to experience real exchange rate appreciation due to increases in remittances inflow employing a panel co-integrating methodology.

Using a panel co-integration approach, Hassan and Holmes (2012) tested the long-run relationship between the real exchange rate and remittances for less developed economies. The results showed that remittances lead to real exchange rate appreciation and there is causality from remittances to the real exchange rate in the short run. The same technique was applied by Combes, Kinda and Plane (2011) in an analysis of the implications of capital flows and exchange rate flexibility on the real exchange rate in developing economies where the results show that public and private flows are associated with a real exchange rate appreciation. Finally, Lartey, Mandelman and Acosta (2012) also found that remittances cause real exchange rate appreciation and resource movement effects that favor the non-tradable sector at the expense of tradable good

production (together, known as “Dutch Disease”) in a comprehensive sample of 109 countries over the time period 1992 – 2003.

In contrast, Barret (2014) supports the adverse influence of remittances inflows on the real exchange rate in case of Jamaica as it depreciates real exchange rate. Similarly, Izquierdo and Montiel (2006) argued that remittances cause exchange rate depreciation.

Some other researchers showed no significant relationship (Özcan (2011). Izquierdo and Montiel (2006) focused on six economies from Central America and the Caribbean for the period 1985-2004. Contrary to most findings, it revealed that for Honduras, Jamaica and Nicaragua, remittances have no effects on the real exchange rate. (Rahman et al, 2010) found that exchange rate and remittances seem correlated with no causal connection.

Data & Methodology:

The objective of this paper is to empirically analyze the relationship between remittance and exchange rate in Morocco covering a period of 41 years starting from 1976. The data have been collected from Thomson Reuters DataStream. The exchange rate and remittance are two main variables in this paper. One of the major shortcomings of traditional regression analysis to determine lead-lag relationship is that it cannot capture the dynamics of the variables. It assumes that parameters across units/countries remain constant which is not realistic in practice. Moreover, traditional regression presumes theoretical relationship between variables. Furthermore, it presets the causality direction without testing. Therefore, the time-series analysis is more appropriate to test the temporal or lead-lag relationship between variables (Masih et al. 2009).

Our model depends on data of remittance (**RM**) and exchange rate (**EX**) in Morocco beside two macroeconomic control variables which are inflation (**INF**) and foreign direct investment (**FDI**).

1-Testing for stationarity/non-stationarity of the variables

The variables have been transformed into logarithmic form using natural log for greater uniformity. It is well established that most economic time series are non-stationary in their original ‘‘level’’ form (Yule 1926). If the variables are nonstationary, the conventional statistical

tests (such as R2, t, etc.) are not valid. Therefore, mean variance and covariance of each variables need to be constant to ensure stationarity.

The non-stationarity of the data means that there is a unit root among different variables and that requires conducting certain test. ADF (Augmented Dickey Fuller) Test has been used to test stationarity. This is developed by Dickey and Fuller which is conducted by "augmenting" the preceding three equations by adding the lagged values of the dependent variable (Gujarati and Porter, 2009). It includes an intercept and a linear trend for the level form of the variables and an intercept but not a trend for a differenced form of the variables. The ADF regression order is selected based on the highest computed values for Akaike Information Criterion (AIC) and Schwarz Bayesian Criterion (SBC). The null hypothesis of the subsequent variable to be non-stationary is tested.

The result of ADF test is shown below in the **Table 1 & 2.**

		ADF		
	Variable	T-Stat.	CV	Result
	LRM	-3.4858	-3.5426	NS
	LEX	-3.4547	-3.5426	NS
	LINF	-2.0517	-3.5426	NS
Level form	LFDI	-2.1337	-3.5426	NS
	DRM	5.7977	-2.9499	S
	DEX	-3.6222	-2.9499	S
	DINF	-4.4925	-2.9499	S
Diff. form	DFDI	-7.0575	-2.9499	S

Table 1

	Variable	T-Stat.	PP CV	Result
Level form	LRM	-7.7819	-3.3410	**S**
	LEX	-2.2398	-3.3410	NS
	LINF	-2.3275	-3.3410	NS
	LFDI	-1.8232	-3.3410	NS
Diff. form	DRM	-20.6011	-2.9016	S
	DEX	-11.1123	-2.9016	S
	DINF	-8.2057	-2.9016	S
	DFDI	-7.0015	-2.9016	S

Table 2

There is other test Phillips-Perron (PP) for the determination of the stationarity/non-stationarity of variables but it relies on an asymptotic theory (it only performs well in the large data samples) while the number of observations in this study might not be determined as big (Mahadeva, 2004). However, we will depend on ADF test results as it's more suitable for time series data and, more consistent with the objectives of this paper. ADF test showed non-stationarity for all variables in the level form, and stationarity in the differenced form. Thus, the variables can be generally categorized as I (1) type which allows the further analysis in chosen methodology to be performed.

2- Determination of the order of the VAR model.

In order to conduct the cointegration test, the lag length of VAR (Vector Autoregressive) model needs to be determined.

Order	LL	AIC	SBC
0	-49.01	-53.01	-56.06
1	-23.51	-43.51	-58.77
2	-9.74	-45.74	-73.21
3	1.42	-50.57	-90.26
4	21.11	-46.88	-98.78
5	47.88	-36.11	-100.22
6	**74.96**	**-25.03**	**-101.35**

Table 3

AIC selects the maximum lag (selects higher order), whereas SBC selects the minimum lag (selects lower order). Depending on the results we will take 6 lag order.

3- Testing cointegration

The following step is to see if the variables are cointegrated and if there is theoretical relationship among the variables and if they are in the equilibrium in the long run. The Engle-Granger (E-G) determined the presence of cointegrating vector for the variables. However, E-G test is that it can identify the presence of cointegration but unable to specify the number of cointegrating vectors. The results Johansen test are the following Table 4

Cointegration LR Test Based on Maximal Eigenvalue of the Stochastic Matrix				
Null	**Alternative**	**Statistic**	**95% Critical Value**	**Result**
r = 0	r = 1	87.45	31.79	3 cointegrations
r<= 1	r = 2	28.41	25.42	
r<= 2	r = 3	19.8	19.22	
r<= 3	**r = 4**	**4.73**	**12.39**	

Cointegration LR Test Based on Trace of the Stochastic Matrix				
Null	**Alternative**	**Statistic**	**95% Critical Value**	**Result**
r = 0	r>= 1	140.50	63.00	2 cointegrations
r<= 1	r>= 2	53.04	42.34	
r<= 2	**r>= 3**	**24.63**	**25.77**	

Table 4: Johansen test

According to Johansen cointegration test performed, there are two cointegrating vectors representing the theoretical relationship among the variables in the long run (both Maximal Eigenvalue and Trace tests give this result). It can be seen from the Table 3 that the tested null hypothesis of "no cointegration" is rejected on the both initial levels of the steps (first hypothesis pair r=0 and r=1 as alternative hypothesis for the Maximal Eigenvalue statistics and r=0 and r>=1 for the Trace statistics) with 95% of confidence level based on the comparison of Computed statistic and critical value of the tests. The null hypothesis of r<=1is also rejected. Both of Johansen tests claim the presence of two cointegrating vectors, which describe the co-movement of the variables.

4- Long Run Structural Modelling (LRSM)

LRSM aims to estimate theoretically meaningful long-run relations by imposing identifying and over-identifying restrictions on the relations between variables based on theoretical and economic overview (Table 5). The exact identifying restriction is imposed in Panel A – the variable GNN is normalized (as the Gini coefficient is the focus variable in the study). The rest of the Panels (B, C, D) represent the over-identifying restrictions on corresponding variables' coefficients: LCPI, LRIR,

LTRD. The details of the results are in the appendix. LRSM allows testing if the estimated relations and variables brought into consideration in the study complies to the 1. Expectations of the theoretical background 2. Statistical significance 3. Logic and common sense (the pioneers of time series technique are blamed to be mechanical in their approach by those who are called "regression econometricians", so this stage is to help time series professionals to connect the outcome of data and time-series technique results to the theoretical framework and economic knowledge).

Table 5 *Long Run Structural Modelling (LRSM) results*

VARIABLE	**PANEL A**
LRM	1.0000
	(*NONE*)
LEXR	-61.3564
	(20.1243)
LINF	-.59220
	(6.0008)
LFDI	.82371
	(.62174)
Trend	.82294
	(.44756)
CHSQ(1)	NONE

Standard errors in parentheses, p-values in brackets.

Panel A represents the result of exact identifying restriction imposed on the relations among the variables in the study. Testing the significance of the variables by comparing t-statistics with critical value for 95% confidence level allows stating that the coefficients of LEX is significant. However, the other variables are statistically insignificant. thus, we will use it as there is a theoretical relationship between the variables.

5- Vector Error Correction Model (VECM)

Cointegration, however, it does not tell which variables are leading and following (Davidson et al. 1990). Therefore, Vector Error Correction Model (VECM) has been applied which can indicate the direction of Granger causality in short and long run and determine the leader and follower (exogenous and endogenous) among variables (Engle and Granger 1987).

Table 6 *Vector Error Correction Model*

ECM(-1)	**dLRM**	**dLEXR**	**dINF**	**dFDI**
Coefficient	- .050101	.081341	.11901	.24763
(St. error)	.030011	.0098963	.11182	.31383
T-ratio	-1.6694	8.2193	1.0642	.78904
(Prob)	[.119]	[.000]	[.307]	[.444]
Result	**Exogenous**	Endogenous	**Exogenous**	**Exogenous**

*Notes: Standard errors in parentheses, p-values in brackets. *Indicates significance at the 5% level or less.*

Inspecting the significance or otherwise of the error-correction coefficients, the LEXR variable is found to be endogenous but the rest of the variables are exogenous (if based on p-value it is statistically significant to reject the null hypothesis of "exogenous"). That means that the LEXR variable depends on the deviations of the rest of the variables

6- Variance Decompositions (VDCs)

The VECM (previous step) aims to indicate the endogeneity/erogeneity of the inspected variables, but if there is a need to identify relative endogeneity/erogeneity of the variables-the Variance Decomposition technique is applied. The relative exogeneity or endogeneity of a variable can be determined by the proportion of the variance explained by its own past. The variable that is explained mostly by its own shocks (and not by others) is deemed to be the most exogenous, while the least self-explanatory stands to be least exogenous. (Masih et al. 2009). However, VDC and VECM have some limitations too. Both models are based on the estimates of the cointegrating vectors which are 'atheoretical' in nature (Masih et al. 2010).

Two approaches are used within VDC: Orthogonalized (Table 7) and Generalized (Table 8). There are differences between them, which make preference to the Generalized approach, so the main interpretation of the results is focused on the Generalized VDC. Firstly, the order of variable influence the result in Orthogonalized approach but not in the generalized approach (which is not the case for the generalized approach – it is order indifferent). Secondly, in case of shock to a variable, the Orthogonalized approach assume the rest of the variables are "switched off", however, Generalized approach allows them to change. There are two types of VDC, namely Generalized and Orthogonalized which are presented below.

Table 7 Orthogonalized approach to VDC

	Horizon	LRM	LEX	LINF	FDI	Ranking
LRM	10	43.09%	16.07%	11.96%	28.88%	2
LEX	10	30.48%	30.06%	22.04%	17.42%	3
LINF	10	5.51%	60.82%	27.48%	6.19%	4
LFDI	10	1.68%	4.46%	1.97%	91.89%	1

	Horizon	LRM	LEX	LINF	FDI	Ranking
LRM	20	43.30%	14.65%	12.48%	29.57%	2
LEX	20	42.45%	20.36%	19.76%	17.44%	4
LINF	20	4.52%	65.40%	24.31%	5.77%	3
LFDI	20	1.53%	3.26%	1.48%	93.73%	1

	Horizon	LRM	LEX	LINF	FDI	Ranking
LRM	30	43.83%	13.51%	12.65%	30.01%	2
LEX	30	48.41%	16.02%	19.06%	16.51%	4
LINF	30	3.51%	68.33%	23.37%	4.78%	3
LFDI	30	1.34%	2.63%	1.23%	94.79%	1

	Horizon	LRM	LEX	LINF	FDI	Ranking
LRM	40	43.97%	12.75%	12.67%	30.60%	2
LEX	40	51.77%	13.45%	18.70%	16.08%	4
LINF	40	2.87%	70.19%	22.81%	4.13%	3
LFDI	40	1.22%	2.20%	1.08%	95.50%	1

	Horizon	LRM	LEX	LINF	FDI	Ranking
LRM	50	44.23%	12.28%	12.73%	30.77%	2
LEX	50	53.92%	11.79%	18.49%	15.81%	4
LINF	50	2.43%	71.48%	22.41%	3.68%	3
LFDI	50	1.14%	1.91%	0.98%	95.97%	1

Table 8 Generalized approach to VDC

	Horizon	LRM	LEX	LINF	FDI	Ranking
LRM	10	32.51%	18.34%	26.96%	22.19%	3
LEX	10	25.43%	25.69%	35.79%	13.09%	4
LINF	10	3.47%	39.50%	52.87%	4.15%	2
LFDI	10	1.63%	4.27%	4.82%	89.28%	1

	Horizon	LRM	LEX	LINF	FDI	Ranking
LRM	20	32.08%	17.81%	27.42%	22.69%	3
LEX	20	34.39%	20.28%	32.74%	12.60%	4
LINF	20	2.85%	41.30%	51.86%	3.98%	2
LFDI	20	1.51%	3.12%	3.37%	92.00%	1

	Horizon	LRM	LEX	LINF	FDI	Ranking
LRM	30	32.24%	17.27%	27.42%	23.07%	3
LEX	30	38.84%	17.90%	31.54%	11.72%	4
LINF	30	2.21%	42.37%	52.02%	3.40%	2
LFDI	30	1.34%	2.49%	2.62%	93.55%	1

	Horizon	LRM	LEX	LINF	FDI	Ranking
LRM	40	32.28%	16.86%	27.28%	23.58%	3
LEX	40	41.34%	16.50%	30.86%	11.30%	4
LINF	40	1.81%	43.03%	52.13%	3.04%	2
LFDI	40	1.22%	2.05%	2.12%	94.61%	1

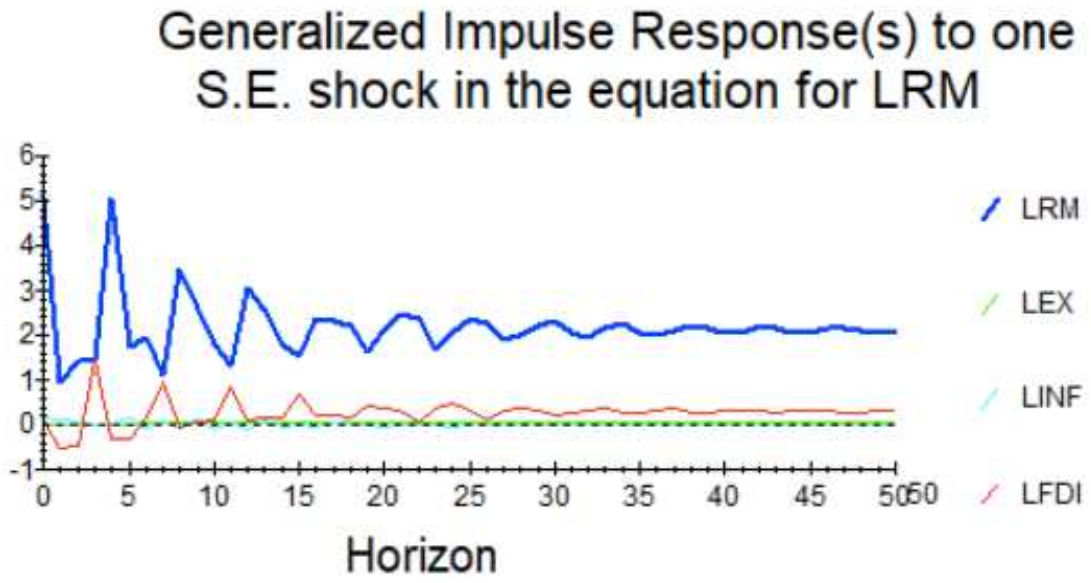
	Horizon	LRM	LEX	LINF	FDI	Ranking
LRM	50	32.38%	16.63%	27.25%	23.73%	3
LEX	50	42.91%	15.61%	30.45%	11.03%	4
LINF	50	1.53%	43.48%	52.20%	2.79%	2
LFDI	50	1.15%	1.75%	1.78%	95.33%	1

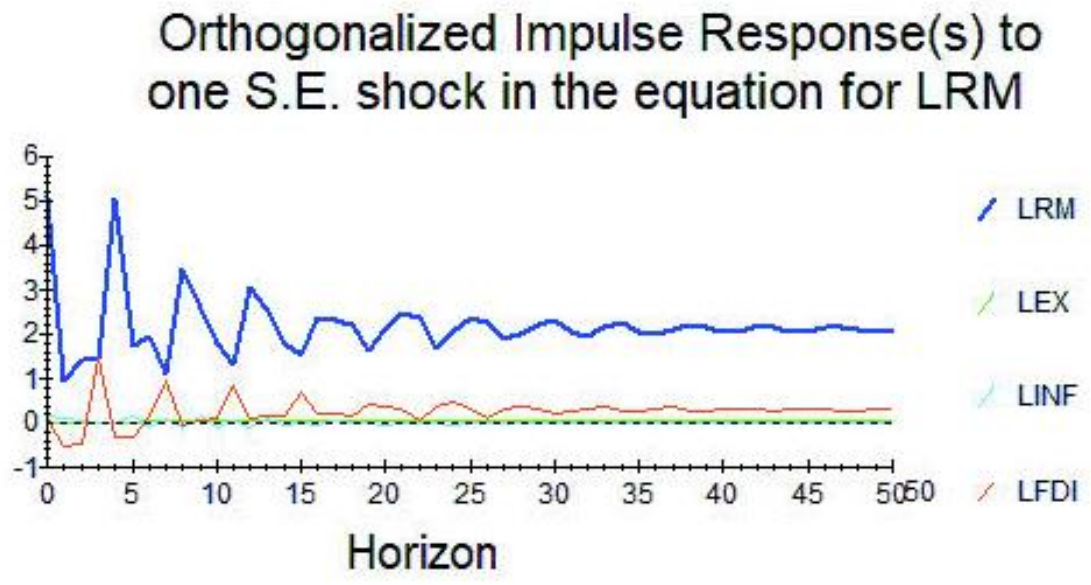
Generalized VDC is more appropriate than Orthogonalized for various reason. Orthogonalized is generally biased towards the first variable. It also assumes that the effects of other variables are switched off when any variable is shocked.

The results tend to indicate that LFDI variable is shown to be most exogenous and LEX to be most endogenous for all the time periods. Approximately 32% variation of remittances can be explained by its own past shocks. However, in Generalized VDC table, approximately 43% of LRM can be explained by its own shock hence secured the 2nd position in ranking. LEX can only be explained by its own past shocks by only approximately 20%. Thus, This can be a tool for the policy makers-if they want to affect exchange rate they need to take measures towards directing the level of remittances in the country and controlling the inflation rates. The results are correspondent to the VECM results.

7- Impulse Response Functions (IRFs)

The Impulse Response Function (IRF) will, then, be used which indicates the dynamic response path of a variable due to a one-period SD shock to another variable. This is a graphical presentation of exposing the relative erogeneity or endogeneity of a variable which are shown below.

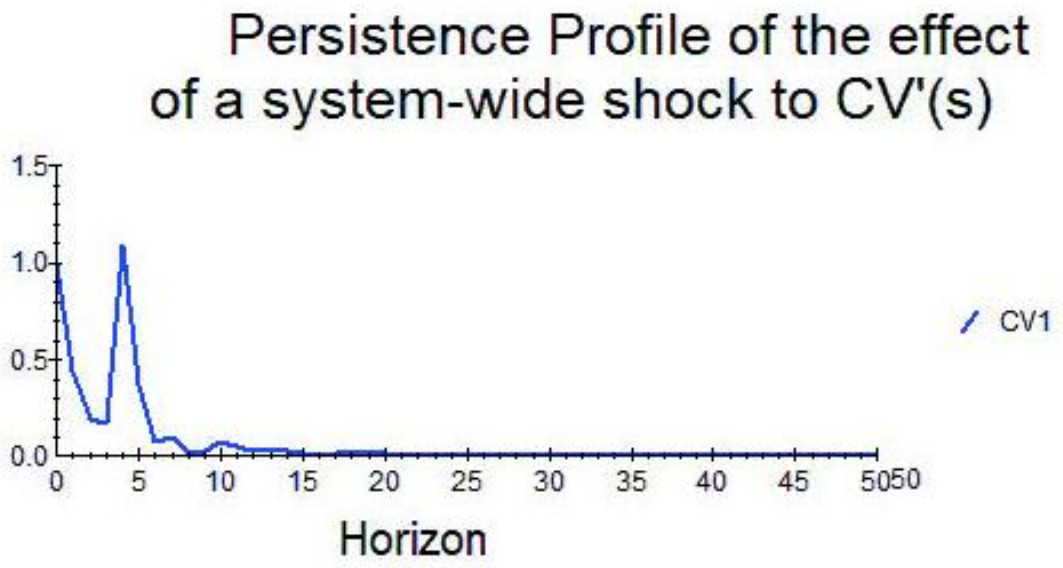




Judging by the graph, it is quite evident that all the variables seem to take about 15-20 years in order to normalize after a 'shock'. It is interesting to note that the shock of remittances greatly affects LFDI which is the most exogenous based on VECM and VDCs. In other words, when there is a shock, the endogenous variables are more affected while the exogenous variables are less effected. However, LEX and LINF weren't effected as LFDI which is not consistent with the earlier result. The inflation is also affected when the remittances is shocked but it's small effect. Reducing LRM and LFDI which will, certainly, have an impact on the inflation and exchange rate.

8.Persistence Profile (PP)

The Persistence Profile (PP) has been applied to estimate the speed at which the variables reach to an equilibrium when there is a system-wide shock. This is opposite of IR function which shows the effects of a variable-specific shock on the long-run relationship (Masih et al. 2009) which is shown below.



The Persistence Profile indicates that if the whole cointegrating relationship is shocked, it will take approximately 8 years for the equilibrium to be restored.

Conclusion and policy recommendation

This paper investigated the relationship between the remittances and exchange rate as well as inflation and foreign direct investment (FDI) using annual time series data covering the period of 41 years starting from 1976 in the context of Morocco.

Cointegration tests showed cointegration which indicates that there is a theoretical relationship among the variables and they are in equilibrium in the long run. LRSM test has been applied to make the coefficients of the cointegrating vector consistent with the theoretical and a priori information of the economy.

VECM demonstrated the direction of Granger causality in short and long run by showing RM relatively exogenous and exchange rate relatively endogenous variable. VDCs has been used to know the relative endogeneity and exogeneity. Exchange rate is the most endogenous variable. The Impulse Response Function (IRF), then, has been used which indicates the dynamic response path of a variable due to a one-period SD shock to another variable. The IRF demonstrated the findings from VDC graphically. Finally, the Persistence Profile (PP) has been applied to estimate the speed at which the variables reach an equilibrium when there is a system-wide shock. This indicates that it will take approximately 8 years to reach an equilibrium if there is a system-wide shock.

Our findings argue that Remittances influence exchange rate. However, foreign direct investment has a bigger influence. The results are similar to most findings by other researches which found strong correlation in the long run between remittance sand exchange rate, although these studies didn't specify the lead-lag relationship (i.e., who leads whom).

This is an important conclusion because it implies that the role of remittances in the growth process must be ever present in the taking economic policy decisions of Morocco. This also applies to the exchange rate policy. In fact, given the close relations existing between remittances and exchange rates, decisions relating to the latter may have important consequences on the dynamics of the economic system.

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