MPRA

Munich Personal RePEc Archive

Lead-lag relationship between remittance and growth: ARDL approach

Robbana, Aroua and Masih, Mansur

INCEIF, Malaysia, Business School, Universiti Kuala Lumpur, Kuala Lumpur, Malaysia

18 February 2018

Lead-lag relationship between remittance and growth: ARDL approach

Aroua Robbana[1] and Mansur Masih[2]

Abstract

The paper seeks to investigate the lead-lag relationship between remittance and growth for Tunisia. The analysis is based on the autoregressive distributed lag (ARDL) approach to cointegration proposed by (Pesaran, Shin, & Smith, 2001) which has the advantage to provide estimates with desirable properties and to make reliable conclusions. The results indicate cointegrated relationships among the variables. The findings confirm that the Tunisian economic growth, the unemployment and inflation have long term theoretical relationship with remittances. The variance decompositions (VDC) analysis tends to indicate that remittances are driven by economic growth and not the other way around. These results suggest policymakers to significantly take advantage of this lead-lag relationship in order to ensure more remittance inflows into the country.

Keywords; Lead-lag, remittance, growth, ARDL, VECM, VDC, IRF

_____

[1] INCEIF, Lorong Universiti A, 59100 Kuala Lumpur, Malaysia.

2 **Corresponding author**, Senior Professor, UniKL Business School, 50300, Kuala Lumpur, Malaysia.

Email: mansurmasih@unikl.edu.my

Introduction

Immigration has existed during the whole history of humankind. At distant times tribes roamed in search for new pastures for their livestock, new places for hunting and fishery. Later people started to migrate in search for more fertile lands and foundation of new settlements. Today migration still takes place in the world, people are forced to change their places of living due to different natural and man-made calamities.

There are many reasons which make people leave their homes and move to other places. Economic reasons have always been among the main reasons for migration. Life in poverty and despair often forces people to search a better life. The gap between the developed countries and the third world countries increases year by year, as a result people move to industrialized countries in order to have stable earnings, better employment opportunities, higher standards of living and financing their families in their home countries through remittances.

In a demonstration of their economic footprint, international migrants sent $601 billion to their families in their home countries on 2016, with developing countries receiving $441 billion, says the Migration and Remittances Factbook 2016, produced by the World Bank Group's Global Knowledge Partnership on Migration and Development (KNOMAD) initiative.

Compared to the other capital inflows, remittances are considered to be the most stable inflow into any country. The volume of remittances tends of have an increasing rate over the years in developing countries, which we can see obviously in the following table.

Table 1: Remittances

US$ billions	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015f
Inward remittance flows*	25.9	31.4	35.2	33.0	38.9	41.6	48.5	48.8	50.9	51.7
All developing countries	228.6	279.5	324.8	302.9	335.7	377.9	400.7	416.2	431.1	-
World	330.3	398.6	460.2	429.4	463.7	525.9	547.0	572.3	592.9	-
Outward remittance flows*	6.2	5.1	6.7	8.6	7.8	6.2	8.5	9.9	6.4	-
All developing countries	28.7	33.3	40.9	42.2	42.1	45.0	52.2	59.2	58.8	-
World	240.7	294.4	345.9	330.6	334.1	367.1	383.1	422.0	427.8	-

Note: This table reports officially recorded remittances. The true size of remittances, including unrecorded flows through formal and informal channels, is believed to be larger.

Source (World Bank Group, 2015)

One frequent criticism leveled against remittance income is that it is not sustainable because recipient 'squander' these funds on consumption; Rita Ramalho, Acting Director of the World Bank's Global Indicators Group said "Remittances are an important source of income for millions of families in developing countries. As such, a weakening of remittance flows can have a serious impact on the ability of families to get health care, education or proper nutrition," (WB, 2016), which according to some economists won't drive development as these purchases are not proper investments. However, some evidences dispute this view, showing that families spend remittances disproportionally on human capital-building areas, compared to how they spend other forms of income (R. H. Adams & Cuecuecha, 2010). Others believe that funds from abroad help to develop a domestic financial system. Depending on restrictions on the movement of capital around the country, these funds can not only help individuals pay for the consumption of goods and services, but also be used to make loans to businesses (Catrinescu, Leon-Ledesma, Piracha, & Quillin, 2009)

Whether remittances promote economic growth still an important issue of debate amongst economists. Empirical studies present an inconclusive relationship between remittance and economic growth through various direct and indirect transition channel including consumption, investment and trade. Some researchers claim that remittances have significant role in economic development (Ahamada & Coulibaly, 2011) It increases purchasing power hence increase consumption and domestic production which, in turn, increase economic growth. However, some other researchers presented no relationship between remittance and economic growth. (Zhu & Luo, 2008).

Pradhan, Upadhyay, & Upadhyaya, 2008, find that remittances have a small, positive impact on growth in a 36-country cross-sectional study using a linear regression model in which remittances form one of five variables, (Taylor, 1992) also find a positive association between remittances and economic growth. (Taylor, 1992) find that every dollar Mexican migrants send back home or bring back home with them increases Mexico's GNP from anywhere between US$2.69 and US$3.17. In contrast, (Spatafora, n.d.) finds that there is no direct link between per capita output growth and remittances. Meanwhile, in one of the larger cross country surveys, Chami et al. (2003) conclude that remittances have a negative effect on economic growth across a sample of 113 countries.

In fact, it is in this perspective that this paper proposes to answer at the following question: What is the impact of remittances on economic growth in Tunisia? The investigation of such impact, in Tunisia is thus interesting because remittances constitute an important source of external finance[1], and according to The World Bank which provides data for Tunisia from 1975 to 2015, the average value for Tunisia during that period was 850.14 million U.S. dollars with a minimum of 142.27 million U.S. dollars in 1975 and a maximum of 1652.66 million U.S. dollars in 2015.

Many factors are behind this increase of the amount of remittances during this period, such as unemployment and institutional and political conditions, migration becomes an important phenomenon in Tunisia. Indeed, with the rapid evolution of illegal migration to Europe and the greatest demand of visa for skilled migration, mainly to Canada, migration has become a solution for individuals as well as for makers. It is true that by the presence of high unemployment rates, migration constitutes a good solution for a great number of unemployed skilled and unskilled workers and an important income source of many families. In fact, according to the World Bank about 300,000 households have benefited by the remittances.

Therefore, in order to explore the impact of foreign remittance on the Tunisian's economic growth., a time-series technique 'ARDL approach' will be used to determine the lead-lag relationship. So, we examine the causal links by distinguishing the impacts of the short-run from those of the long-run since, as we know, the influence of a variable on another over the short-run can be different from that of the long-term. In addition, we check the emergence of the model by

---

[1] Relevant findings from the analysis also help the Tunisian government to make deep decisions and judicious economic policies when it has to understand how remittances impact economic growth and vice versa

testing for cointegration before using it to investigate the causal links between the variables over the short-run and long-run.

This paper contributes to the existing literature from two main points. First, the majority of studies use the remittances' share affected to investment to test their effect on growth. While this paper is using, remittances affected by inflation and unemployment to test the economic growth. Second, we consider Tunisian as the focus country, while all works were mainly directed to USA, China, Bangladesh, India, Sri Lanka and so on, thus, we believe this study will help fill in such a gap.

Therefore, it is important to stress that given the obtained results, the policy implications may be important not only for Tunisia, but also for the other Maghreb countries, especially Algeria and Morocco that are also important sources of expatriate workers to Europe.

The remainder of the paper is organized as follows, section 2 will provide the literature review, Section 3 presents the methodology used to investigate the causality links between the variables, provides an analysis of the data, and discusses the empirical results. Given the obtained results, policy implications are provided in Section 4. Section 5 concludes the paper.

Literature Review

Several theoretical and empirical works have studied remittances effects on macroeconomic variables, such as consumption, investment and growth. In fact, results are varied. Some works showed a positive effect of remittances on growth. Other studies prove that remittances have negative impact on growth and development.

Remittances can improve growth in countries where financial market is not developed, and constitute a fundamental financial source of development (Aggarwal, Demirg????-Kunt, & Per??a, 2011) (S. Adams & Klobodu, 2016) showed in a study which analyzed the impact of remittances on growth through the regime durability, that remittances are significantly correlated to growth when the regime is durable or democrat. Otherwise, their impact is very limited.

On the other hand, (Akobeng, 2016) in a study concerning 41 Sub-Saharan Africa countries gets a positive effect of remittances on poverty reduction. Further, this effect is important when the financial sector is well functioning. This effect varies according to the measure of poverty. The

same idea is confirmed by the study of (Giuliano & Ruiz-arranz, 2005) through which authors showed that remittances enhance growth in the countries where the financial sector is less developed.

(Jouini, 2014) tested the relationship between remittances and economic growth through two channels: investment and financial development for Tunisia. The author concludes that the causality between remittances and growth depends on analysis term. The causality is so bidirectional only in the short-term. In the same sense, (Lim & Simmons, 2015) showed that there is no a long-run relationship between remittances and growth or investment, but this relationship is proved between remittances and consumption.

(Tahir, Khan, & Shah, 2015) analyzed the effect of foreign factors: foreign direct investment (FDI), remittances and imports on growth of Pakistan over the period from 1977 to 2013. The main result showed that remittances and FDI have a significant positive impact on long-run growth. Nevertheless, (Barguellil, Zaiem, & Zmami, 2013) don't get a long-run direct relationship between remittances and growth in the case of Tunisian economy. Authors showed, by against that there is a positive indirect effect of remittances on growth. Indeed, remittances affect growth through education.

Methodology and empirical results:

Our methodology consists in applying the ARDL approach proposed by (Pesaran et al., 2001), which is commonly used to investigate the long-run links between variables.

In this paper, we attempt to investigate the dynamic relationship between Gross Domestic Product per capita (GDP per capita, proxy for economic growth), remittances (REM) as share of GDP, inflation measured through consumer price index (CPI), and unemployment (UNE), for Tunisia over the period 1975–2015 based on annual data obtained from the World Development Indicators database. The descriptive statistics gives the qualitative information with regards to the location, dispersion of the variables. The following table shows the summary of the variables:

Table 2: Summary statistics and empirical correlations between series

LEVEL	LRM	LGDPPC	LCPI	LUNE
Mean	1.3980	7.5368	4.9446	3.8402
Std. deviation	.14778	.95447	.33495	0.21895
Maximum	1.6154	8.93548	5.5960	3.8836
Minimum	1.1086	5.7377	4.5517	3.8111
First differences	DRM	DGDPPC	DCPI	DUNE
Mean	.10328	.079943	-.024857	-.7838E-3
Std. deviation	.10204	.037375	.049950	.0051472
Maximum	.27287	.17138	.050100	.012632
Minimum	-.17609	-.011446	-.23613	-.0084034
Correlation	LRM	LGDPPC	LCPI	LUNE
LRM	1.0000	.53317	-.53916	-.052714
LGDPPC		1.0000	-.93940	-.49437
LCPI			1.0000	.62774
LUNE				1.0000

Initial assessment from the summary statistics presented in the table, that for level (first difference) series, the variables vary in average from the minimum of 1.1086 for remittances (RM) and the maximum of 8.93548 for GDP per capita (GDPPC). The average of RM received by Tunisia in last 40 years, is $1.3980 million. The Standard Deviation of remittance shows very low dispersion over the years (0.14778).

If one variable is excessively linearly correlated with another, then it will be impossible to determine their separate influences. The table shows that the variables are not highly correlated with each other and there is no perfect-collinearity. Also, it shows that RM and GDPPC are positively correlated. As a result, higher increases in each variable lead to higher values of the other variables, which is logic as it has been found that remittances help promote growth in less financially developed countries. However, the correlation between RM, inflation (measured by CPI) and the unemployment is negative.

Remittances can be spent partly on consumption and partly on investment, Thus, the negative correlation between remittances and unemployment can be explained by the fact that having access to credit can help increase investment opportunities in areas of developing countries which will in

turn reduce the unemployment. As for, the negative correlation between remittances and inflation, it can be explained by, when inflation increase the local currency value will decrease, and foreigners can remit lower amount of currency to equate how much they send before the depreciation that occur due to inflation. Add to that, the table shows that GDPPC, inflation and unemployment are negatively correlated which can be also explained by,

growth in aggregate demand and aggregate supply (productive capacity). In particular, the growth needs to be sustainable and avoid a boom and bust cycle, this will lead to an economic growth and a lower inflation and lower unemployment.

In short, in the absent other considerations, faster economic growth is, lower will be the unemployment and inflation rates.

This correlation analysis just allows providing a preliminary idea about the nature of the relationship among the variables of interest, but cannot be determinative of the presence of causal links between series.

The objective of this paper is to determine leads-lag relationship between remittance and economic growth. Before conducting tests for cointegration among variables, we test for unit root using first the ADF (Said & Dickey, 1984) and KPSS (Kwiatkowski, Phillips, Schmidt, & Shin, 1992) tests10 in order to ensure that the considered series are not integrated of order two or more because in this case the (Pesaran et al., 2001) cointegration test statistic used in this paper is not valid.

The variables have been transformed into logarithmic form using natural log for greater uniformity. It is well established that most economic time series are nonstationary 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.

Table 3: ADF test at level form for unit root test

Variable	ADF	Value	T-stat	C.V	Result
LRM	ADF (1) = AIC	29.7742	-2.5979	-3.5664	Non-stationary
	ADF (1) = SBC	27.4411	-2.5979	-3.5664	Non-stationary
LGDPPC	ADF (1) = AIC	69.8986	-2.0918	-3.6865	Non-stationary
	ADF (1) = SBC	67.3807	-1.9584	-3.5664	Non-stationary
LCPI	ADF (1) = AIC	63.0468	-1.6091	-3.4778	Non-stationary
	ADF (1) = SBC	59.1662	-2.4836	-3.6865	Non-stationary
LUNE	ADF (1) = AIC	136.8993	-1.3259	-3.6865	Non-stationary
	ADF (1) = SBC	133.7886	-1.3259	-3.6865	Non-stationary

The ADF tests show that all variables are non-stationary. However, ADF test only correct possible serial correlation in the error terms by adding the lagged difference terms of the regressors. Therefore, (Phillips & Perron, 1988) suggested another way of testing unit root by using nonparametric statistical methods to take care of the serial correlation in the error terms without adding lagged difference terms. This also correct the Heteroskedasticity issue.

The PP tests tend to be more powerful but, also subject to more severe size distortions. The actual size is larger than the nominal one when autocorrelations of at are negative. Moreover, it is more sensitive to model misspecification (the order of autoregressive and moving average components). Therefore, (Kwiatkowski et al., 1992) proposed another stationarity test (known as KPSS) unlike ADF and PP test (as those are unit root test). KPSS is used for testing a null hypothesis that an observable time series is stationary around a deterministic trend (i.e. trend-stationary) against the alternative of a unit root. PP and KPSS tests have also been used to test stationarity of the series which are shown below:

Table 4: PP and KPSS test at level form for unit root test

PP	T-stat	C.V	Result	KPSS	T-stat	C.V	Result
LRM	-2.6655	-3.4523	Non-stationary	LRM	.10418	.17634	Non-stationary
LGDPPC	-1.1771	-3.4523	Non-stationary	LGDPPC	.15900	.17634	Non-stationary
LCPI	-.81735	-3.4523	Non-stationary	LCPI	.13322	.17634	Non-stationary
LUNE	-.66790	-3.4523	Non-stationary	LUNE	.14307	.17634	Non-stationary

Both tests suggest that all variables are not stationary at its level form hence have unit root. If a time series has a unit root, the first differences are generally stationary. Therefore, the first differences have been taken of each series for stationarity. The ADF and PP test have been used to test unit root and KPSS has been used for testing stationarity. The following table shows the results of these tests.

Table 5: ADF test at first differenced form for unit root test

Variable	ADF	Value	T-stat	C.V	Result
DRM	ADF (1) = AIC	29.1082	-5.3543	-2.8472	Stationary
	ADF (1) = SBC	26.0555	-5.3543	-2.8472	Stationary
DGDPPC	ADF (1) = AIC	66.2002	-4.4780	-2.8811	Stationary
	ADF (1) = SBC	64.6738	-4.4780	-2.8811	Stationary
DCPI	ADF (1) = AIC	60.2178	-3.5104	-2.9215	Stationary
	ADF (1) = SBC	57.9283	-3.5104	-2.9215	Stationary
DUNE	ADF (1) = AIC	132.4397	-3.3804	-2.8811	Stationary
	ADF (1) = SBC	130.9133	-3.3804	-2.8811	Stationary

Table 6: PP and KPSS test at first differenced form for unit root test

PP	T-stat	C.V	Result		KPSS	T-stat	C.V	Result
DRM	-6.2229	-2.9181	stationary		LRM	.16993	.38183	stationary
DGDPPC	-3.7947	-2.9181	stationary		LGDPPC	.42512	.38183	Non-stationary
DCPI	-2.3415	-2.9181	Non-stationary		LCPI	.28653	.38183	stationary
DUNE	-3.5919	-2.9181	stationary		LUNE	.33941	.38183	stationary

As it can be seen that all variables becomes stationary after the first differenced in the ADF test, while all variables become stationary except CPI in PP test and GDPPC in KPSS test remain non-stationary. For this reason, this study will continue with the ARDL model where it estimate model irrespective of whether the regressors are I (0) or I(1).

Var order

In order to conduct the cointegration test, the lag length of VAR (Vector Autoregressive) model needs to be determined. Most VAR models are estimated using symmetric lags. The AIC (Akaike information criterion) and SBC (Schawarz Bayesian Criterion) have been used in determining the lag length which is shown below:

Table 7: Var order

Order	LL	AIC	SBC	LR test	LR adjusted
1	342.1001	322.1001	305.7243	CHSQ(16)= 24.9186[.071]	CHSQ(16)= 19.0168[.268]
0	315.9750	311.9750	308.6998	CHSQ(32)= 77.1690[.000]	CHSQ(32)= 58.8921[.003]

The highest value of AIC and SBC suggest 1 lag length for our VAR models which may be due to the limited size and short duration of data available.

Now we move to the next stage, the following table reports the results of the Pesaran's ARDL bounds tests. We use both the critical values for determining the long-run forcing variable, found in (Pesaran et al., 2001), and modified by (Narayan, 2005) for small samples. The deterministic term included in the model is an unrestricted intercept. Using the critical values, we reject the null hypothesis of no cointegration at the 10% level of significance when RM and CPI are the dependent variable. When we conducted the bounds, tests specifying GDPPC and UNE individually as the dependent variable, we fail to reject the null hypothesis of no cointegration. Thus, from the results presented, we statistically confirm that there is a long-run relationship among RM, GDPPC, CPI and UNE.

In other words, we found that when remittances are the dependent variable, the calculated F-statistic F (RM/RM, GDPPC, CPI, UNE) = 4.4488, is more than upper bound of the critical value obtained from (Pesaran et al., 2001) indicating there is significant evidence for co-integration between remittances and its independents in Tunisia for the study period.

These results reveal that a long-run level relationship exists between remittances, economic growth, inflation and unemployment and they are co-integrated, which means there is a theoretical relationship existing between the variables. The process has been repeated for the other variables and result shows that for inflation (CPI) is also highly cointegrated with its determinants. Unemployment doesn't seem to be cointegrated with its determinants. However, unemployment is considered one of the main causes of transferring money to the foreign workers' families.

Table 8: F-stat for testing the long run relationship

	Computed F-stat	Decision
F (RM/RM, GDPPC, CPI, UNE)	4.4488	Cointegration
F (GDPPC/RM, GDPPC, CPI, UNE)	1.4335	No-cointegration
F (CPI/RM, GDPPC, CPI, UNE)	6.1486	Cointegration
F (UNE/RM, GDPPC, CPI, UNE)	.91282	No-cointegration
F critical value at 10% sign level	3.063 - 4.084	

After finding the F-test significant, the next step involves estimating (1) to (3) using appropriate lag-length selection criteria based on the Akaike Information Criterion (AIC) and SBC. Both of the estimations are summarized in the following tables.

Table 9: Long-run ARDL Model Estimation using SBC

	Model 1 LGDPPC	Model 2 LRM	Model 3 LCPI	Model 4 LUNE
C	-.20511 [1.2598]	-4.9992 [3.2288]	-.56166 [1.2719]	.31443* [.16656]
LRM	.074028** [.053420]	----	-.40467 [.39646]	1.2921 [.99403]
LGDPPC	-----	.96228*** [.017448]	-.27540** [.11692]	.19060 [.38294]
LCPI	-.51106*** [.17228]	.019138 [.059298]	-----	.42955 [.37889]
LUNE	.0039083 [.0023391]	.010980 [.0063065]	.013266 [.0072963]	------

Firstly, in the first cointegration relationship, only the remittances and inflation have a long run impact on economic growth. It has been found that remittances is positively and statistically significant with the economic growth with a correlation coefficient of (.074) which means that they positively impact each others in the long run, while the inflation is negatively statistically significant with economic growth with a correlation coefficient of (-.51106) which is relatively high comparing to others and which reflect the strong impact of it on the economic growth.

While in the second and third model only economic growth (GDPPC) has an influence on the remittances and inflation over the long-run with a high correlation coefficient of (.96228) with remittances and relatively negative lower one (-.27540) with inflation (CPI).

Error correction models

The second stage in this study involves estimating the short run model by estimating an Error Correction Model (ECM) using the long-run estimates. This enables the speed of adjustment of the dependent variable to independent variables to be estimated. This procedure allows drawing conclusions about the dynamic adjustments of short-run deviations of the variables from their long-term state. This procedure allows drawing conclusions about the dynamic adjustments of short-run deviations of the variables from their long-term state. If the ECM is significant, it entailed that

the dependent variable in the model is an endogenous variable, and if the ECM is insignificant, it implies that the dependent variable of the model is an exogenous variable.

In the following table, the ECM's representation for the ARDL model is selected with AIC Criterion.

Table 10: Error correction model of ARDL

Variables	Coefficient	Standard error	T-ratio [prob]	Implication
ecm(-1) dlRM	-.40999	.12090	-3.3911[.002]	Endogenous
Ecm(-1) dlGDPPC	-.035439	.017622	-2.0111[.052]	Exogenous
Ecm(-1) CPI	-.12891	.074697	-1.7257[.093]	Exogenous
Emc(-1) UNE	-.087804	.049012	-1.7915[.082]	Exogenous

Our results show that remittances (RM), is an endogenous variable, while the other variables, namely economic growth (GDPPC), inflation(CPI), and unemployment (UE) are exogenous variable. The exogenous variables are the leaders and endogenous variables are the followers. From these results, we can conclude that remittances follow the movement of the exogenous variables. The coefficient of error correction term indicates the speed of adjustment of disequilibrium in the model, and the higher the magnitude of the coefficient means the better the speed of adjustment.

The negative sign in the coefficient confirmed the existence of cointegration. For the detected cointegrating relationships, the results reported in show evidence of a certain return to the long-run equilibrium for all the specifications since the corresponding error correction terms are significantly negative.

In this situation, the error correction term coefficient of ECM of remittances is (-.40999) implies a fast speed of adjustment compare to other variables. It can be possibly explained by; even though workers will not be able to send remittances for certain period for different reasons, they quickly go back and send in order to help their families. On the other hand, the coefficient of ECM of economic growth is (-.035439). It indicates a very slow speed of adjustment to any disequilibrium in the model. This possible because this variable is affected by other variables, hence if there is

any disequilibrium in the model, it might take sometimes for this variable to get back to equilibrium

Also, the fact that all error correction term coefficients are between 0 and 1 signifies that the relationships are characterized by high predictability and that the spread movement is mean-reverting.

VDC

However, from the ARDL result, we could not determine the relative exogeneity and endogeneity of each variable in our sample. Therefore, we decided to conduct the additional steps which are VDC and IRF simulation to see the relative exogeneity and endogeneity, and to see how long it takes for the variables to go back to equilibrium if there is a shock in one of the variables.

Whilst we have established that economic growth (GDPPC), inflation (CPI) and unemployment (UE) are exogenous, and remittances (RM) is endogenous, but we have not been able to say anything about the relative endogeneity and exogeneity of the remaining variables. The relative exogeneity or endogeneity of a variable is determined by the proportion of the variance explained by its own past (Domingos, 2000) The variable that is explained mostly by its own shocks (and not by others) is deemed to be the most exogenous of all. We started out applying generalized VDCs and obtained the following results.

Table 11: generalized VDC

	Horizon	DRM	DGDPPC	DCPI	DUNE	total
RM	5	77%	8%	12%	3%	100%
GDPPC	5	3%	90%	3%	4%	100%
CPI	5	6%	11%	75%	8%	100%
UNE	5	2%	11%	21%	67%	100%
	Horizon	DRM	DGDPPC	DCPI	DUNE	total
RM	25	77%	8%	12%	3%	100%
GDPPC	25	3%	90%	3%	4%	100%
CPI	25	6%	11%	75%	8%	100%
UNE	25	2%	11%	21%	66%	100%
	Horizon	DRM	DGDPPC	DCPI	DUNE	total
RM	40	77%	8%	12%	3%	100%
GDPPC	40	3%	90%	3%	4%	100%
CPI	40	6%	11%	75%	8%	100%
UNE	40	2%	11%	21%	66%	100%

From the table above, it can be seen that at the 40 years' horizon, economic growth (GDPPC) is the most exogenous while UNE is the least exogenous, while remittances is endogenous with highly percentage. In other words, leader remained leader and follower remained follower.

The interesting result is that remittances is shown as the highly endogenous variable within the sample, which indicates that government will take more time to adjust the crime for any shock movement in the others.

Impulse-response

Impulse response (IR) analysis is based on VAR model. For the advantages of IR analysis, it provides policy makers with additional information that which variable is the most exogenous and relative exogeneity/endogeneity. Therefore, policy makers would shock on one variable which is the most exogenous to achieve the economic target. Moreover, the impulse response functions (IRFs) essentially produce the same information as the VDCs, except that they can be presented in graphical form. If any specific one variable was shocked, we will see the immediate effect on others.

We investigate the short-run dynamics of the variables. We consider by using the generalized impulse response functions that assess the response of our focus variables to shock in other control variables at some time horizons. The first that is shocked is the remittances. Since this variable is the only endogenous between our main variables. The figures show that the back to the line off for remittances is fast, as well as all other exogenous variables, and that the reaction to shock disappears from almost the 4th years for remittances while it takes more time when we chock the exogenous variables which can take more than 8 years.

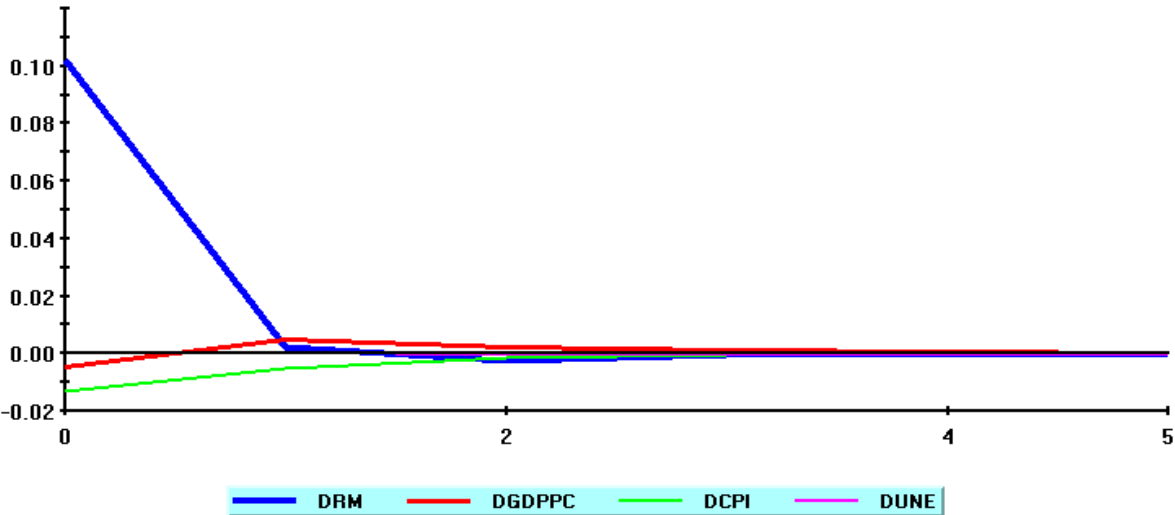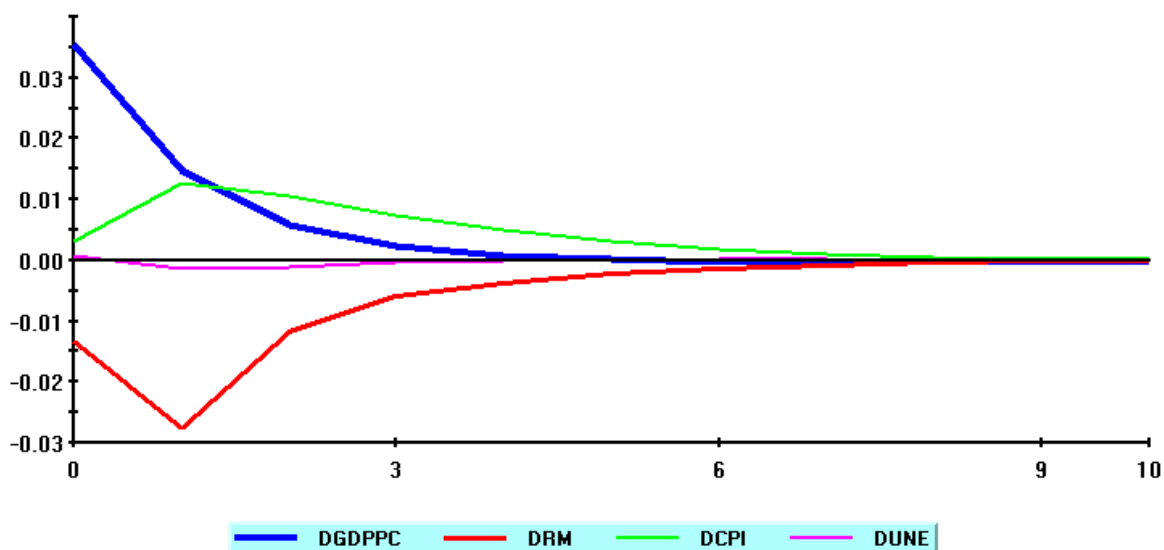Figure 1: Generalized impulse response to one SE shock in the equation for DRM

Figure 2: Generalized impulse response to one shock in the equation for DGDPPC

Also, when one of the exogenous variables are shocked, the RM is the most affected and it took relatively more time to back to equilibrium which emphasize our previous results.

In the second graph, when we shocked the GDPPC, we found that the less affected one is the UNE which is according to our previous results in VDC show that it is the less exogenous the second less affected one is inflation (CPI) while our main endogenous variable is highly affected which is in line with our findings in VDC as it can explain itself by 75%.

VDC and Impulse response analysis and findings

From the analysis of VDC and impulse response (IR), it appears that economic growth (GDPPC) and inflation (CPI) dominate the system to some extent as their forecast errors are largely attributable to their own innovations: about 90% and 75% respectively of the forecast error variance are explained by their own innovations at 40 years' period. When we shocked each variable to see its effect on other ones we found that economic growth and inflation (CPI) response largely than other variables. Here we can argue that when economic growth, inflation and unemployment, increase or decrease it shakes the flow of remittances into Tunisia which oppose the analysis of most authors (Jouini, 2014)

Policy implications

In the last decades, many empirical research studies attempt to investigate how external financial flows exert an impact on economic growth directly or indirectly through some channels. Our findings indicate that the application of the ARDL approach enhances the understanding of the causal links between remittances and economic growth for Tunisia, and support the view that these links are of great interest for economic policy makers. Indeed, the significant relationship between the variables we consider can help the Tunisian government to make deep economic policies over the short run and long-run depending on the causality direction and its magnitude, and on whether the impact of each variable on the others is positive or negative.

The government should adopt a clear definition of remittances, which helps to implement the appropriate international, regional and individual policy in financial market in order to be more competitive since the existence of competitors' financial institute can pay and canalize transfers in remote areas.

Also, the government should have the policy scheme to reduce the informal remittances and increase the formal international transfers through ensuring reliable, rapid, safe and cost-effective official transfer mechanisms. The authorities should move to this approach even in rural areas to improve remittances, thus enhancing economic growth in these areas. The authorities should also create favorable conditions to orientate remittances to productive investment, thus creating employment and economic growth opportunities.

Conclusions:

In this paper, the causal relationship between remittances and economic growth for Tunisia has been meticulously investigated based on the ARDL bounds testing approach and by including two control variables which are inflation and unemployment through which the impact is examined. Our analysis shows evidence of significant long-run cointegrating relationships between the variables and they are in equilibrium in the long run.

ECM demonstrate in short and long run that remittance is endogenous while economic growth, inflation and unemployment are exogenous. GDP is exogenous as VDC has been used to know the relative endogeneity and erogeneity. This shows that economic growth is the most exogenous

variable and can be mostly explained by its past own shock (90%), inflation (CPI) is the second exogenous variable in ranking (75%) followed by unemployment (66%). The remittance is driven by economic growth. This result is constant throughout different horizon period.

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.

While this work attempts to study the causal link between remittances and economic growth by including inflation and unemployment as controlled variables, future empirical research works could introduce governance, and skilled and unskilled human capital indicators to explain and to distinguish the causal impact. In this context, it is also important to understand how policy makers could address this issue.

References

Adams, R. H., & Cuecuecha, A. (2010). Remittances, household expenditure and investment in guatemala. *World Development*, *38*(11), 1626–1641.

Adams, S., & Klobodu, E. K. M. (2016). Remittances, regime durability and economic growth in Sub-Saharan Africa (SSA). *Economic Analysis and Policy*, *50*, 1–8.

Aggarwal, R., Demirg-Kunt, A., & Peria, M. S. M. (2011). Do remittances promote financial development? *Journal of Development Economics*, *96*(2), 255–264.

Ahamada, I., & Coulibaly, D. (2011). How does financial development influence the impact of remittances on growth volatility? *Economic Modelling*, *28*(6), 2748–2760.

Akobeng, E. (2016). Out of inequality and poverty: Evidence for the effectiveness of remittances in Sub-Saharan Africa. *Quarterly Review of Economics and Finance*, *60*, 207–223.

Barguellil, A., Zaiem, M. H., & Zmami, M. (2013). Remittances , Education and Economic Growth A Panel Data Analysis. *Journal of Business Studies Quarterly*, *4*(3), 1–11.

Catrinescu, N., Leon-Ledesma, M., Piracha, M., & Quillin, B. (2009). Remittances, Institutions, and Economic Growth. *World Development*, *37*(1), 81–92.

Giuliano, P., & Ruiz-arranz, M. (2006). Remittances , Financial Development , and Growth, IZA Discussion Papers 2160, Institute of Labour Economics (IZA), Bonn.

Jouini, J. (2014). Economic growth and remittances in Tunisia: Bi-directional causal links. *Journal of Policy Modeling*, *37*(2), 355–373.

Kwiatkowski, D., Phillips, P. C. B., Schmidt, P., & Shin, Y. (1992). Testing the null hypothesis of stationarity against the alternative of a unit root. *Journal of Econometrics*, *54*(1–3), 159–178.

Lim, S., & Simmons, W. O. (2015). Do remittances promote economic growth in the Caribbean Community and Common Market? *Journal of Economics and Business*, *77*, 42–59.

Narayan, P. K. (2005). The saving and investment nexus for China: evidence from cointegration tests. *Applied Economics*, *37*(17), 1979–1990.

Pesaran, M. H., Shin, Y., & Smith, R. J. (2001). Bounds testing approaches to the analysis of level relationships. *Journal of Applied Econometrics*, *16*(3), 289–326.

Phillips, P. C. B., & Perron, P. (1988). Testing for a unit root in time series regression. *Biometrika*, 75(2), 335 -346

Pradhan, G., Upadhyay, M., & Upadhyaya, K. (2008). Remittances and economic growth in developing countries. *The European Journal of Development Research*, *20*(3), 497–506.

Tahir, M., Khan, I., & Shah, A. M. (2015). Foreign Remittances, Foreign Direct Investment, Foreign Imports and Economic Growth in Pakistan: A Time Series Analysis. *Arab Economic and Business Journal*, *10*(2), 82–89.

Taylor, J. E. (1992). Remittances and inequality reconsidered: Direct, indirect, and intertemporal effects. *Journal of Policy Modeling*, *14*(2), 187–208.

Yule, U. (1926). Why do we Sometimes get Nonsense-Correlations between Time-Series?--A Study in Sampling and the Nature of Time-Series. *Journal of the Royal Statistical Society Journal of the Royal Statistical Society*, *89*(1), 1–63.