ECONOMIC RESEARCH FORUM

منتدى البحوث الاقتصادية

Working Paper Series

ERF 25TH ANNIVERSARY

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Working Paper No. 1294

February 2019

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First published in 2018 by
The Economic Research Forum (ERF)
21 Al-Sad Al-Aaly Street
Dokki, Giza
Egypt
www.erf.org.eg

Abstract

This paper examines the causality between remittances (REMs) and *financial sector development* (FD) in MENA countries. We seek to fill a gap in the extant literature by exploring the *inward REMs-financial development* nexus across the MENA region via the bootstrap rolling Granger non-causality approach. To identify the changes in the interplay among variables, we apply a series of time-varying rolling window tests based on annual-frequency data from 1980 to 2015. Our findings reveal that any shock (demand, supply, or policy-induced) will have permanent long-run effects on selected indicators. The analysis also points out episodes of directional predictability from FD to REM inflows. However, the results evidenced significant windows of directional predictability from inward REMs to financial development.
Keywords: remittances, financial development, MENA countries, time-varying causality.
JEL Classifications: F24, F41, O16

1. Introduction

Global remittances (REMs) have become a substantial source of external finance for developing nations. The Middle East and North Africa (MENA) accounts for one of the largest REM receving regions, with REMs standing at $73 billion remittances as of 2015 (Hamma, 2016). REMs can facilitate financial development in recepeint countries by increasing the volume of deposits and reducing financing constraints faced by recipient countries by increasing the availablity of credit, and bringing a larger proportion of the country's unbanked population in contact with the formal financial system (IMF 2005, Cooray 2012). Studies emphasize the substitutability between REMs and the financial system in enhancing growth with REMs compensating for inefficient credit markets (inter alia, Calderon et al., 2008; Giuliano and Ruiz-Arranz, 2009; Brajas et al., 2009). Remittances also have the potential for reducing volatility in economic growth, augmenting loanable funds and stabilizing financial shocks. Remittances can thus, enhance financial sector development. On the other hand, because remittances reduce individuals' financing constraints, they could reduce the demand for credit and limit credit market development. If banks hold these remittances without increasing lending, or remittances are channelled into financing government or private consumption, then they may not lead to an increase in financial sector development (Martrinez Peria 2010). For this reason, investigating the relation between REMs and the financial sector is important for policy implementation. Therefore, researchers and policymakers are concerned with the impact of REMs on financial sector development.

Most previous studies have not addressed the issue of reverse causation between remittances and financial development. While the studies of Fromentin, 2015; Giuliano and Ruiz – Arranz, 2009; Mundaca, 2009; Meyer and Shera, 2016, examine causality between remittances and financial sector development, specifically, a question that remains to be answered is one concerning the direction of causality between remittances and financial sector development. For, if financial sector development leads to higher remittance inflows, then it is necessary for a government to develop its financial sector in order to attract more flows. Causality however, varies by country, financial terms and the overall macro environment. Further, various historical episodes affect remittance flows, which provides a starting point for an anlysis of remittances and financial sector development in the MENA region.

We prefer a country-specific time series analysis to a cross-sectional panel study because empirical analyses conducted at the aggregate level are unable to capture and account for the complexity of the economic environment and histories of each individual country. For this reason, we employ annual-frequency data from 1980 to 2015 for the MENA countries. REMS sent by workers to developing nations are the second largest type of flow, after foreign direct investments (Naceur et al., 2014) and enabled the development of the financial systems in many developing states, including the MENA region (Aggarwal et al., 2006). Traditionally, REMs have represented a steady source of inflows to labour-exporting countries, easeing financing constraints and positively reshaping the financial arena. Therefore, this research aims to provide valuable insights into this interplay of these variables across the MENA nations.

A rolling-window bootstrap Granger causality test approach is used for the empirical analysis. Analyses using this methodology seeks to determine if there is predictability between REMs and financial sector development, with regards to specific country data. Zapata and Rambaldi (1997) suggest that the test yields efficient results for both larg and small samples due to its explanatory power properties. Moreover, Mantalos (2000) shows that the bootstrap test exhibits the highest accuracy in estimates, irrespective of the cointegration properties compared to othe methods.

The remainder of this article is organized as follows. Section 2 reviews some major studies on the relationship between remittances and financial development. Section 3 details the econometric methodology underlying our analysis; Section 4 describes the data to be used; Section 5 presents the empirical findings, and Section 6 concludes and provides some policy recommendations.

2. Theoretical Considerations

A number of studies investigate the relation between remittances and financial sector development. A strong financial market can attract more REMs by enabling higher flows, and/or by reducing associated costs (Aggarwal et al., 2011). Inward remittances can have two effects on FD. One is that inward remittances can increase the volume of credit and loans intermediated by the financial sector, leading to financial sector development. Alternatively, REMs can dilute financial sector development by reducing the stringency of financial terms required by banks in receiving countries. The studies of Orozco and Fedewa (2005), Aggarwal et al. (2011), Chami et al. (2003), Gupta et al. (2009), Demirguc-Kunt et al. (2010), find a bidirectional causal link between REMs and financial development.

Many previous studies that examine the interaction between REM and FD at a regional level do not consider country specific factors, but work under the assumption of parameter homogeneity (Gupta et al., 2009; Aggarwal et al., 2011). Furthermore, these studies only explore the causality from REMs to financial development. However, as mentioned by Coulibaly (2015), the homogeneity assumption could lead to false conclusions.

There is a large literature articulating the positive effects of REMs on financial sector development in the home country (e.g. Aggarwal et al., 2011 ; Beck et al., 2007 ; Gupta et al., 2009; Demirguc-Kunt et al., 2010; Ambrosius and Cuecuaha; 2016), but this potential growth-stimulating impact would depend on the state of the domestic financial market. Giuliano and Ruiz-Arranz (2009) argue that REMs could promote financial sector development in financially constrained countries by offering alternative options for financing investment. Hence, inward remittances can promote growth in regions with less developed financial markets. However, the theoretical model of Mundaca (2009) shows that REMs augment economic growth in financially well developed economies, as these countries can direct such flows more effectively. Hence, according to Mundaca (2009), there is complementarity between REMs and financial progress. Based on a panel smooth transition regression model using data for 87 developing states between 1980 and 2008, Ahamada and Coulibaly (2011) argue that the negative effects of REMs can be counteracted by well-functioning financial markets via flows directed to non-receiving agents in need of investment financing. To explore the causality from financial development to REMs, Bettin et al. (2012) forecast a micro-behavioral model of REMs of legal emigrants to Australia for the 1993-1995 time periods and find that FD does not influence the propensity to remit to home countries. Chowdhury (2011) studies the impact of REMs on financial development in Bangladesh, using the single equation approach of Aggarwal et al. (2011) and annual data from 1971 to 2008. Chowdhury (2011) finds that REMs positively influence the local financial market. However, the author does not find any evidence of reverse causation, that is, that the financial system affects inward REMs. By using a sample of six high REM receiving countries (Albania, Bulgaria, Macedonia, Moldova, Romania, and Bosnia Herzegovina), for the period 1999-2013, Meyer and Shera (2016) find a positive impact of remittances on growth, which increases at higher levels of REMs to GDP. Agarwal et al. (2011) use data on REMs to 109 developing states from 1975 to 2007 to explore the relation between REMs and financial sector development, proxied by aggregate deposits and credit intermediated by local banks, and highlight a significant REMs-financial development nexus in the developing countries. Bugamelli and Paternø (2009) confirm the stabilizing effect of REM flows by employing cross-sectional data for approximately 60 developing economies. The authors work with annual variations in rainfall to identify the implications of exogenous income shocks on REMs for a sample of 41 SSA nations between 1970 and 2007, and underline insignificant consequences of average rainfall shocks on REMs. However, the marginal effect is largely declining in the proportion of domestic credit to GDP, hence, at high levels of credit to GDP, these shocks have substantial implications on REM flows, while at low levels, the impact of rainfall on REMs is significant and positive.

Given their role as a reliable source of funds for the developing world, recipient countries have made significant efforts to attract more REMs, particularly via formal channels, which are less risky compared to informal ones. One approach would be to increase financial openness, but this could lead to additional costs driven by macroeconomic volatility. Beine et al. (2012) review the interaction between REMs and financial openness in the context of 66 developing nations for the 1980-2005 period. Based on a dynamic generalized ordered logit framework that addresses financial openness using a two-step model to correct for endogeneity, they find evidence that REMs affect financial openness. Frometin (2017) in a study of the link between REMs and financial development for a sample of emerging and developing states during 1974-2014 via a *pooled mean group* (PNG) approach, find a positive long-run REMs-financial development relation.

Taking a look at region specific studies, a number of studies have been undertaken on the SSA region and the MENA region. Ahamada and Coulibaly (2012) using panel Granger causality and Wald tests with country-specific bootstrap critical values for the 1980-2007 timeframe, show no relation between REMs and growth in Sub-Saharan African countries. Coulibaly (2015) using a similar methodology and liabilities to represent financial market development, observes a positive effect from REMs to financial development only for four countries in the sample, and from FD to remittances, only in the case of Gambia. When credit is used as a proxy for financial development, the results reveal a positive REM effect on FD only in Sudan, and no relation for the rest of the countries in the sample. Therefore, Coulibaly (2015) concludes that there is no causality between REM flows and financial development in the SSA region and that FD is not a driver of REM inflows in SSA countries. Employing panel data for 36 Sub Saharan African states during 1990-2000, Lartey (2013) finds a positive relationship between remittances and growth, as well as a positive interaction effect between remittances and financial depth on economic growth. Bettin and Zazzaro (2011) also obtain a similar result via the estimation of a homogeneous panel with annual data series from 66 developing nations (including 10 SSA countries), for the period 1970–2005. The authors identify a negative (positive) REMs effect on economic progress in beneficiaries with a low (high) degree of financial development. Williams (2009) also focuses on the REMs-financial development nexus in SSA countries and use a 5-year non-overlapping panel data for the 1970-2013 timeframe to investigate the role of democratic institutions in mediating remittance effects on FD. The findings point to a significant positive relation between REMs and FD; specifically, a 10% increase in REMs leads to a 0.43% growth in private credit, with a cumulative impact of approximately 1.84%. Furthermore, there was no substantial role of domestic institutions in mediating the relation between REMs and financial development in the region. Overall, Williams (2009) advocated the importance of REMs in sustaining the smooth-functioning of a financial system.

Awdeh (2018) demonstrated that in MENA states with less developed financial systems (e.g., Mauritania, Djibouti, and Yemen), REMs behave as a substitute for financial intermediaries by offering altenative ways to secure investment financing and alleviate credit/liquidity constraints. Remittance flows were shown to have a positive impact on growth and household spending. In addition, there is Granger causality between the two variables. Furthermore, the author notes a significant impact of GDP and inflation on remittance inflows and suggested that the wosening of home country conditions increases REM inflows to migrant' families.

Ben Mim and Ben Ali (2012) examine the effects of REMs on economic growth in a number of MENA countries between 1980 and 2009 and find a positive REM impact on growth only when they are invested and that remittances are a growth enabler via human capital accumulation. Marzovilla and Mele (2015) investigate the implications of REMs on the economic growth in Marocco by using a VAR methodology and variance decomposition analysis over the period 1980-2014 and conclude that REMs have been a critical growth driver. Moreover, such REMs have been procyclical. Sabra (2016) explors the nexus between REMs and economic growth, investment and domestic savings in eight MENA labor exporting nations.

3. Data

To perform the empirical analysis, we use annual data from 1980 to 2015 covering the MENA countries. The data corresponding to all selected variables is collected from the World Bank data warehouse (World Development Indicators). The start date of our sample is dictated by data availability. REM flows are described as personal financial resources that include transfers and compensation of employees. Transfers refer to all current cash/similar transactions made or received by resident households to/from non-resident households (e.g. personal transfers might indicate all current releases between resident and non-resident individuals). Employees' compensation is mainly related to income of border, seasonal, and other short-term workers employed in a country that is not their home country, and of residents working for non-resident entities. We use GDP per capita in constant 2000 USD dollars to measure real GDP growth. Financial development is proxied by two indicators, namely, *liabilities,* calibrated by the ratio of money and quasi money (M2) to GDP, and *domestic credit* to the private sector as a share of GDP (Aggarwal et al. 2006). Remittances, M2, and credit variables are all considered as percentages of GDP.

The descriptive statistics of the data series are presented in Table 1. Of the countries in the sample, Oman has the lowest average amount of remittances received by person compared to other MENA countries. For personal remittances received as a percent of GDP, Oman registered the greatest dispersion around the mean, noted by the standard deviation. We note that personal remittances received are less volatile than GDP per capita and FD indicators, which suggests that inward REMs were stable from 1980 to 2015 in MENA countries.

Further, Jordan has the highest average amount of remittances received by a person compared to other MENA countries. Jordan also registers greater dispersion in personal remittances received, albeit small, relative to GDP per capita and FD indicators. Algeria has the lowest domestic credit to private sector as a percent of GDP, although data registers the highest positive skewness. Of the other countries, Israel has the highest GDP per capita and highest amount of broad money, which is negatively skewed.

Economic growth is highly volatile compared to the financial development indicators. The data shows an asymmetric distribution (see Skewness) and the Jarque-Bera statistics reveal a non-normal distribution of the series. Non-normal distribution in economic growth is especially pronounced for Oman despite having the lowest average amount of personal remittances. Israel also registers high dispersion in economic growth and a relatively low average amount of personal remittances, albeit highly skewed. Non-normal distribution in economic growth is also noted in Morocco and Tunisia, evidenced by the higher standard deviation and J-B statistics relative to financial development indicators. Therefore, the results highlight the necessity of relying on an asymmetric approach as we do in the present analysis.

4. Econometric Methodology

We apply *the bootstrap rolling* Granger non-causality test first developed by Balcilar et al. (2010) to explore the time-varying nexus between inward remittances and financial development across the MENA countries. This framework is independent of the level of integration of the variables and can be used to check the stability of both short and long-term parameters. According to Balcilar and Ozdemir (2013a, 2013b), researchers should always consider the potential cointegration among variables when running stability tests. In case of no cointegration, scholars examine only short-term stability and carry out causality verifications supported by standard VAR methodologies. The rolling windows model is based on the lag augmented VAR (LA-VAR) model of Toda and Yamamoto (1995) that considers inferences with trending parameters. The following equation describes the LA-VAR technique:

$$y_t = \Phi_0 + \Phi_1 y_{t-1} + \ldots + \Phi_p y_{t-p} + \varepsilon_t, \qquad t = 1,2,3,\ldots,T$$

where: $\varepsilon_t = (\varepsilon_{1t}, \varepsilon_{2t})'$ is a zero mean independent white noise process with nonsingular covariance matrix $\sum$. We determine the lag length p via the Akaike Information Criterion (AIC). For simplicity purposes, y_t is segmented in two sub vectors, as noted below:

$$\begin{bmatrix} y_{1t} \\ y_{2t} \end{bmatrix} = \begin{bmatrix} \phi_{10} \\ \phi_{20} \end{bmatrix} + \begin{bmatrix} \phi_{11}(L) & \phi_{12}(L) \\ \phi_{21}(L) & \phi_{22}(L) \end{bmatrix} \begin{bmatrix} y_{1t} \\ y_{2t} \end{bmatrix} + \begin{bmatrix} \varepsilon_{1t} \\ \varepsilon_{27} \end{bmatrix}$$

Where y_{1t} and y_{2t} denote the natural logarithms of remittances and financial development variables, respectively. $\phi_{ij}(L) = \sum_{k=1}^{p} \phi_{ij,k} L^k, i, j = 1,2$ and L is the lag operator defined as $L^k x_t = x_{t-k}$. In this setting, the null hypothesis that y_{2t} does not Granger cause y_{1t} can be tested by imposing zero restrictions $\phi_{12,i} = 0$ for $i = 1,2,\ldots,p$. Analogously, the null hypothesis that y_{1t} does not Granger cause y_{2t} can be tested by imposing the restriction $\phi_{21,i} = 0$ for $i = 1,2,\ldots,p$. The Wald statistic, which follows a standard chi-squared distribution (Toda and Yamamoto 1995), is used to test this null hypothesis.

To include the changes in the interplay between selected variables, we apply a series of time-varying Granger causality tests, namely rolling window variations of this approach, due to their superiority in revealing asymptotic distributions (Zapata and Rambaldi; 1997). Hacker and Hatemi-J (2006) worked with Monte Carlo simulations and argued that the modified Wald (MWALD) test with a bootstrap distribution indicates diluted size distortions. Furthermore, this model is less sensitive to sample dimensions, orders of integration, and error term processes such as homoscedasticity or ARCH.

As noted by Granger (1996), structural instability is one of the most challenging issues investigated by the scientific community. Particularly, structural changes could lead to variations in parameters and, thus, reshape causal interactions over time. To analyze the shift in causal connections driven by structural changes we apply a rolling window approach based on the modified bootstrap test.

The rolling window MWALD causality test first estimates the MWALD statistics for a pre-established subsample. The associated estimator relies on subsamples rolled with a fixed window size. Further, we build a VAR model and run a bootstrap Granger causality test. The application of the rolling-window estimator helps us determine the appropriate window size. Nevertheless, there is no clear criterion researchers could use to decide on the number of windows. Larger sizes could mean more accurate parameters, but fail to address heterogeneity. By contrast, a small window size may increase the variance levels of our estimations. Pesaran and Timmermann (2005) use a Monte Carlo simulation to identify the optimal window size under structural changes in terms of the root square error, and suggest that the bias in autoregressive (AR) parameters are minimized with window sizes around 10–20 in case of repeated breaks.

To address any potential change in the causality interactions, we model the bootstrap *p*-value of observed LR-statistics rolling over the whole sample. We estimate the bootstrap *p*-values of the null hypothesis that remittances (REM) do not Granger cause the financial development variable (FD) by imposing $\phi_{12,i} = 0$ for $i = 1,2, \ldots, p$ and that the residential property prices do not Granger cause the oil price by imposing $\phi_{21,i} = 0$ for $i = 1,2, \ldots, p$ by applying the residual-based bootstrap method (Balcilar *et al.*, 2010). Furthermore, we explore the magnitude of REMs-FD variable nexus. The cumulative effects of REM flows on financial development is captured by the mean of all bootstrap estimates, that is $\phi_{12}^{*} = N_b^{-1} \sum_{k=1}^{p} \phi_{12,k}^{*}$, where N_b^{-1} equals the number of bootstrap repetitions and $\phi_{12,k}^{*}$ equal the bootstrap estimates from the VAR model. Likewise, the cumulative effect of REM on FD variable is added by $\phi_{21}^{*} = N_b^{-1} \sum_{k=1}^{p} \phi_{21,k}^{*}$. We calculate the 95-percent confidence interval, and the corresponding lower and upper limits as 2.5 and 97.5 quantiles of each of $\phi_{12,k}^{*}$ and $\phi_{21,k}^{*}$, respectively.

5. Empirical Findings

5.1. Unit Root testing

We start by checking for unit roots in each of the selected macroeconomic series based on Perron's (1997) unit root approach with a break in both the intercept and trend. We endogenously determine the break date via the computation of the unit root test statistic for all identified break points and choose the break date that minimizes these statistics. In the case of macroeconomic time series data, structural changes can be caused by many factors, *inter alia,* economic tensions, policy shifts or regime changes. Perron (1989) highlights that unit root issues in time series could generate structural changes and that traditional tests might offer biased results. The unit root framework that allows for the possible presence of structural breaks has two major advantages (Perron, 1989). First, it avoids biased results towards non-rejection; second, it helps one identify possible structural breaks, and offers important insights on the link between structural breaks of certain variables and a particular government measure, economic crises, social upheaval, regime shifts, etc. The empirical findings returned by Perron's (1997) unit root tests indicate non-stationarity for most MENA states in the context of structural breaks identified on different dates according to the variable and the country (see table 2). Therefore, any shock (demand, supply, or policy-induced) will have a permanent long-run impact on selected variables. After differencing once, the variables are found to be stationary. The results of the unit root tests also show that most of the structural breaks of personal remittances received occurred during two periods 1984-1994 and 1995-2005. The former corresponds to macroeconomic reforms in these countries; however, the latter is associated with financial reform, particularly in Jordan and Tunisia.

5.2. Analysis of the results

Panel A of Table 3 reports results for Granger causality tests between remittances and financial development for the full sample. The null hypothesis of no causality between remittances and financial development is rejected at the 1% level for Oman. Egypt and Malta which display causality form remittances to domestic credit. Panel B indicates that causality runs from money supply to remittances in Jordan, Oman and Tunisia. There is causality from remittances to money supply in Egypt and Tunisia.

Table 4 reports the outcome of these tests of parameter constancy for financial development and the remittances equations along with the associated p-values. The Sup-LR, Mean-LR, and Exp-LR tests necessitate trimming at the ends of the sample. Following Andrews (1993), Balcilar and Ozdemir (2013a; 2013b) and Balcilar, Ozdemir and Arslanturk (2010), among others, we trim 15% from both ends and compute these test statistics for the fraction of the sample in [0.15, 0.85]. To sum up, in all the evidence from the parameter stability tests proposes that the estimated VAR models do not have constant long-run and short-run parameters, highlighting the existence of structural changes. Therefore, any statistical inference based on the assumption of parameter constancy is expected to be invalid. Accordingly, we can conclude that the Granger causality results between financial development and remittances are not reliable for the whole sample. The same conclusion can be retained for the Granger causality between M2 and remittances (table-5).

Figures 1-8, illustrate the time-varying Wald test statistic sequences and their corresponding 5% critical values for the bootstrap rolling procedure in panel (A) assuming homoskedasticity and panel (B), assuming heteroskedasticity. The results given in panels A and B show detected episodes of directional predictability from financial development indicators to inward remittances. In general, the findings under the homoscedasticity and heteroscedasticity assumptions are dissimilar. Thus, it seems judicious to conclude that more attention should be paid to the heteroskedastic-consistent tests in interpreting the results. For example, in the case of Jordan (see figure 4), the directional predictability from remittances to FD indicators cannot be identified by the homoscedastic version that lies below its critical value; however, the heteroscedasticity-consistent version depicts significant directional dependence during the 1990-1998. This period was characterized by a decline in remittance inflows into Jordan during the first and second Gulf wars. Likewise, for the case of Egypt (figure 2), where the maintained assumption is that of either homoskedasticity or heteroskedasticity, we detect no causality from domestic credit to REMs over the entire period. Nevertheless, for the same country, the results under the heteroscedasticity assumptions show major episodes of directional predictability from REMs to domestic credit to private sector running from 1992 to 1996 and 2009. Between 1991 and 1994, workers' remittances in Egypt increased significantly when the Persian Gulf states decided, after the first Gulf war, to replace large numbers of Jordanians, Palestinians, Sudanese, and Yemeni workers with Egyptian labor. While in 2009, despite the global financial crise, workers' remittances continue to be vital to the Egyptian private sector and for the whole economy. Similarly, the hypothesis of no Granger causality from remittances to domestic credit is rejected. The finding, in the context of heteroskedasticity show a number of shorter bursts of causality during 2006-2009. Overall, in the case of Egypt, inward REMs cause financial development. The main window of predictability detected by these test is 2009. Considering *liabilities* as an indicator of financial development, the interplay between M2 and remittances show evidence of causality in some isolated instances for the 1996-1998 and 2000-2002 periods.

Our results for Israel, Jordan and Morocco (figures 3, 4, 6) indicate that the hypothesis of no Granger causality from the FD variable to remittances cannot be rejected, except for some shorter duration episodes. However, for these same countries, the findings highlight significant timeframes of directional predictability from REMs to financial development. However, for Oman (figure 7), the heteroscedasticity version shows a very different picture from an unequivocal failure to reject the null hypothesis of no predictability. Therefore, the heteroscedasticity version fails to identify directional predictability running from remittances to FD. Instead, in the oil producer countries, the increase in oil price explains the financial development variable, whereas inward REMs are not significant. In the case of Jordan, the heteroscedasticity assumption returned no significant episodes of directional predictability flows from remittances to FD. This result is contrary to our expectations and to all existing evidence of the usefulness of REMs in boosting financial development in this country.

The outcomes of our analysis also emphasize that the directional predictability from FD to remittances depends on the indicator of financial development. Domestic credit as a proxy of FD indicates no evidence of directional predictability in Egypt and Israel, with the exception of Morocco, implying that domestic credit, as a proxy of FD, provides no evidence of causality from financial development to REM inflows. The use of *liabilities* as proxy of financial development under the heteroscedastic assumption identifies directional predictability from FD to remittances in all countries, except for Jordan and Morocco.

In the case of Algeria and Tunisia (figure 1 and 8), we find some prolonged episodes, namely 1990-1996 and 2003-2014, of significant directional predictability from REMs to financial development. In Malta, inward remittances cause financial development in different periods: 1991, 1995, 1998-2000 and 2010-2012. For these countries, the heteroscedasticity version identifies significant directional predictability running from financial development to remittances. Overall, REMs play an important role and represent a major source of external financing.

Consequently, our results provide some important information on the directional predictability between remittances and financial development. First, if we use the same proxy for financial development, the causality among remittances and FD varies across MENA states. If we consider domestic credit as proxy for FD, the findings indicate significant directional predictability from financial development to inward REMs only in five countries (Algeria, Jordan, Malta, Oman, and Tunisia). If we treat liabilities as proxy for FD, the time-varying Wald test statistics for causal effects running from financial development to REM flows provide evidence of causality in all countries, with the exception of Jordan and Morocco. However, the heteroscedasticity version depicts substantial directional predictability from remittances to FD in different periods, except for Jordan and Oman, which means that the REMs to these two countries do not influence financial development.

6. Conclusion and Policy implications

This paper seeks to fill a gap in the extant literature by exploring the causal interactions between *inward remittances* and *financial development* across MENA states. To identify the changes in the interplay among selected variables, we apply a series of time-varying Granger causality tests, namely rolling window variations of this approach, due to their superiority in revealing asymptotic distributions. We apply a bootstrap rolling Granger non-causality test first to investigate REMs-FD nexus based on annual-frequency data from 1980 to 2015. We use *liabilities* and *domestic credit* to private sector as proxies for financial development.

Our findings highlight that Oman has the lowest average amount of inward REMs of all MENA countries. Furthermore, these inflows are less volatile than GDP per capita and FD indicators, which suggests that inward remittances were stable during 1980-2015 in the MENA region. Economic growth is highly volatile compared to financial development variables.

The empirical outcomes obtained by applying Perron's (1997) unit root tests reveal non-stationarity for most MENA members in the context of structural breaks identified at various moments. Thus, any shock (demand, supply, or policy-induced) will have permanent long-run effects on selected variables. The results of the unit root tests also showed that most of the structural breaks of inward REMs occurred during two periods, namely, 1984-1994 and 1995-2005. The former correspond to macroeconomic reforms in MENA countries; however, the latter is associated with financial reforms, particularly in Jordan and Tunisia.

Our analysis also pointed out episodes of directional predictability from FD indicators to REM inflows. For example, in Jordan, the directional predictability from remittances to FD indicators cannot be identified under the homoscedasticity assumption; however, the heteroscedasticity-consistent version shows significant directional dependence during 1990-1998, a period marked by a decline in inward REMs. Our findings indicate that causality runs from money supply to remittances in Jordan, Oman and Tunisia.

Similarly, in Egypt, we detect no causality from domestic credit to REMs at all over the entire timeframe. Overall, inward REMs cause the financial development variable in this country. Egypt and Malta display causality form remittances to domestic credit. There is causality from remittances to money supply in Egypt and Tunisia.

The results also show that the hypothesis of no Granger causality from FD to remittance inflows cannot be rejected in the case of Israel, Jordan and Morocco, except for some shorter duration episodes. However, the findings highlight significant windows of directional predictability from REMs to financial development.

We note evidence contrary to our expectations in the case of Jordan, where the heteroscedasticity assumption returned no significant episodes of directional predictability flows from remittances to FD.

Our analysis suggests that directional predictability from FD to remittances depends on the indicator of financial development. Domestic credit as a proxy of FD indicates no signs of directional predictability in Egypt and Israel, with the exception of Morocco, implying that domestic credit, as proxy of FD, provides no evidence of causality from financial development to REM inflows. The use of *liabilities* as proxy of financial development, under the heteroscedastic assumption identifies directional predictability from FD to remittances in all countries, except for Jordan and Morocco.

To summarize, this research shows a link between inward REMs and financial development. Given the role of remittances as essential source of external financing for the developing world, this research provides valuable insights into REMs-growth nexus during the process of financial development. Our work suggests that policy-makers in recipient MENA states should be more focused on supporting the financial system so they can fully benefit from the positive REM inflows to promote growth as inward flows can help relax the financing constraints of individuals.

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Table 1: Country-wise descriptive statistics of the variables

	Mean	Std. Dev.	Skewness	Kurtosis	J-B	Probability
a). Personal remittances, received (% of GDP)						
Algeria	1.148	1.022	0.621	2.000	3.816	[0.148]
Egypt	7.137	3.233	0.639	2.328	3.124	[0.210]
Israel	0.822	0.690	0.713	2.023	4.481	[0.106]
Jordan	18.515	4.059	-0.199	1.957	1.869	[0.393]
Malta	2.090	1.237	0.106	2.378	0.647	[0.724]
Morocco	6.305	1.076	0.055	2.015	1.475	[0.478]
Oman	0.271	0.177	0.350	1.855	2.699	[0.259]
Tunisia	4.181	0.548	-0.458	2.150	2.343	[0.310]
b). Domestic credit to private sector (% of GDP)						
Algeria	27.586	24.846	0.727	1.745	5.534	[0.063]
Egypt	35.082	11.588	0.464	1.998	2.800	[0.247]
Israel	67.064	7.184	-0.024	2.352	0.634	[0.728]
Jordan	67.943	10.651	0.215	3.145	0.308	[0.857]
Malta	84.214	27.548	-0.647	2.312	3.224	[0.200]
Morocco	37.536	19.647	0.389	1.723	3.353	[0.187]
Oman	31.385	11.969	0.537	2.992	1.733	[0.420]
Tunisia	60.897	14.043	-0.335	2.171	1.706	[0.426]
c). Broad money (% of GDP)						
Algeria	84.141	8.437	-0.186	2.634	0.408	[0.815]
Egypt	95.466	32.932	0.652	2.835	2.590	[0.274]
Israel	113.895	17.164	-0.267	1.892	2.268	[0.322]
Jordan	--	--	--	--	--	--
Malta	70.915	30.382	0.398	1.599	3.896	[0.143]
Morocco	32.084	7.477	0.610	4.841	7.316	[0.026]
Oman	62.566	8.069	0.449	2.680	1.365	[0.505]
Tunisia	52.015	8.358	0.848	2.523	4.657	[0.097]
d). GDP per capita (constant 2010 US$)						
Algeria	3860.067	471.888	0.386	1.874	2.799	[0.247]
Egypt	1883.395	465.463	0.364	1.820	2.883	[0.237]
Israel	24572.740	5053.661	0.141	1.768	2.398	[0.301]
Jordan	3081.826	397.231	0.050	2.004	1.504	[0.471]
Malta	15915.260	4970.251	0.047	1.735	2.414	[0.299]
Morocco	2076.092	572.859	0.532	2.069	3.002	[0.223]
Oman	16390.060	2391.199	-0.987	3.431	6.120	[0.047]
Tunisia	2938.422	808.742	0.423	1.638	3.856	[0.145]

Note: This table reports the descriptive statistics of the data from 1980 until 2015. J-B stands for Jarque-bera test of normality. P-values are in big brackets

Table 2: Results of unit root test with break - Perron (1997)

	Level		First difference	
	Test statistics	Break date	Test statistics	Break date
a). Personal remittances, received (% of GDP)				
Algeria	-3.817	2004	-7.388***	2005
Egypt	-5.357***	1992	-6.073***	1994
Israel	-6.389***	1994	-7.887***	1984
Jordan	-4.011	2007	-5.549***	1992
Malta	-2.969	2003	-12.77***	2004
Morocco	-4.407	1999	-8.166***	2001
Oman	-2.646	1986	-7.355***	1990
Tunisia	-4.301*	2009	-5.671***	1987
b). Domestic credit to private sector (% of GDP)				
Algeria	-11.13***	1991	-11.31***	1992
Egypt	-5.080***	1992	-5.423***	2007
Israel	-3.277	1997	-7.535***	1985
Jordan	-3.822	1992	-7.471***	2005
Malta	-4.173	1995	-6.111***	2011
Morocco	-2.391	1996	-5.104***	2012
Oman	-1.334	2014	-5.144***	2014
Tunisia	-1.780	2009	-5.621***	2000
c). Broad money (% of GDP)				
Algeria	-3.937	1995	-5.585***	2003
Egypt	-5.324***	2006	-7.851***	2013
Israel	-3.436	2002	-6.965***	1989
Jordan				
Malta	-2.363	1996	-6.221***	2007
Morocco	-2.581	2014	-7.085***	2014
Oman	-3.937	2011	-7.143***	1987
Tunisia	-2.440	2006	-4.092***	1998
d). GDP per capita (constant 2010 US$)				
Algeria	-2.340	2001	-4.151***	1994
Egypt	-1.725	2005	-3.886***	2003
Israel	-1.129	2004	-5.655***	2002
Jordan	-4.088	2003	-5.680***	1989
Malta	-1.942	2014	-5.134***	2013
Morocco	-1.527	2002	-13.58***	2001
Oman	-3.530	1995	-5.300***	1985
Tunisia	-1.792	1995	-6.038***	1989

Note: *** and ** and denote significance at 1%, 5% and 10% level, respectively. The null hypothesis of Perron (1997) is that a series has a unit root with a break in both the intercept and trend.

Table 3: Full-sample Granger causality tests between remittances and financial development.

Panel A: Financial development through domestic credit (DC)

Country	k	$\boldsymbol{H_0}: DC_t -/\rightarrow REM_t$	$\boldsymbol{H_0}: REM_t -/\rightarrow DC_t$
Algeria	1	0.018 [0.847]	1.445 [0.187]
Egypt	1	1.889 [0.587]	7.427** [0.057]
Israel	2	6.291** [0.043]	1.411 [0.574]
Jordan	2	6.271** [0.041]	1.159 [0.687]
Malta	2	3.903 [0.185]	9.159** [0.011]
Morocco	1	1.809 [0.462]	2.139 [0.433]
Oman	1	17.619*** [0.007]	3.571 [0.552]
Tunisia	1	8.033** [0.027]	4.467 [0.109]

Panel B: Financial development through money supply (M2)

Country	k	$\boldsymbol{H_0}: M2_t -/\rightarrow REM_t$	$\boldsymbol{H_0}: REM_t -/\rightarrow M2_t$
Algeria	1	0.000 [0.827]	2.008 [0.121]
Egypt	2	2.390 [0.308]	8.654** [0.041]
Israel	2	3.202 [0.265]	0.891 [0.745]
Jordan	1	7.320** [0.039]	1.350 [0.685]
Malta	2	-	-
Morocco	1	0.936 [0.777]	0.985 [0.810]
Oman	1	14.401** [0.041]	1.769 [0.890]
Tunisia	1	10.656** [0.013]	9.184** [0.014]

Note: The optimal lag order (k) of the VAR model is determined by the AIC. The *p*-values are based on 2,000 bootstrap replicates. As usual, ***, and ** indicate rejection of null hypothesis of no causality at the 1%, and 5% significance level, respectively.

Table 4: Parameter stability test results for domestic credit and remittance

	Financial development equation		Remittance equation	
	Statistics	p-values	Statistics	p-values
1). Algeria				
Sup-LR	13.8348**	[0.0380]	20.4996**	[0.0090]
Exp-LR	4.3960**	[0.0310]	6.9195**	[0.0320]
Mean-LR	5.7375**	[0.0190]	1.7120	[0.4100]
OLS-CUSUM	1.5716***	[0.0000]	1.2203***	[0.0000]
2). Egypt				
Sup-LR	9.7637**	[0.0120]	4.0533	[0.3470]
Exp-LR	3.7001***	[0.0040]	0.7433	[0.5640]
Mean-LR	6.8199***	[0.0000]	1.2302	[0.6190]
OLS-CUSUM	1.8921***	[0.0000]	1.639***	[0.0015]
3). Israel				
Sup-LR	11.0445***	[0.0050]	7.2543	[0.1120]
Exp-LR	2.3713**	[0.0130]	1.2952	[0.2050]
Mean-LR	1.0370	[0.6060]	1.6289	[0.3070]
OLS-CUSUM	1.5482**	[0.0119]	1.1762	[0.2871]
4). Jordan				
Sup-LR	2.4554	[0.8030]	4.6342	[0.2690]
Exp-LR	0.3456	[0.9440]	0.6403	[0.6840]
Mean-LR	0.6090	[0.9470]	0.9139	[0.8190]
OLS-CUSUM	0.8719	[0.3621]	0.9652	[0.2861]
5). Malta				
Sup-LR	5.2808	[0.1020]	32.0834***	[0.0060]
Exp-LR	1.3097	[0.1110]	12.7093**	[0.0260]
Mean-LR	1.7415	[0.2290]	2.1259	[0.2250]
OLS-CUSUM	0.6281	[0.3872]	0.9963	[0.1872]
6). Morocco				
Sup-LR	3.1091	[0.8020]	9.3738***	[0.0030]
Exp-LR	0.6207	[0.7570]	7.8800**	[0.0260]
Mean-LR	1.1034	[0.6630]	4.2262**	[0.0182]
OLS-CUSUM	1.0063	[0.4892]	1.9282***	[0.0028]
7). Oman				
Sup-LR	2.7453	[0.8290]	4.2456	[0.3890]
Exp-LR	0.6308	[0.7170]	0.9354	[0.3730]
Mean-LR	1.0782	[0.7000]	1.4164	[0.4470]
OLS-CUSUM	1.0972	[0.1729]	1.0382	[0.1143]
8). Tunisia				
Sup-LR	14.4504***	[0.0003]	3.7472	[0.3450]
Exp-LR	6.4838***	[0.0010]	0.6240	[0.5780]
Mean-LR	4.7010***	[0.0053]	1.1048	[0.5670]
OLS-CUSUM	1.8929***	[0.0012]	1.1723	[0.1072]

Note: The null hypothesis for all tests is that the estimated parameters are constant. The *p*-values for the long-run and short-run parameter stability tests are calculated using 2000 bootstrap repetitions. As usual, ***, ** and * indicate rejection of null hypothesis of no causality at the 1%, 5% and 10% significance level, respectively.

Table 5: Parameter stability test results for domestic credit and remittance

	M2 equation		**Remittance equation**	
	Statistics	p-values	Statistics	p-values
1). Algeria				
Sup-LR	3.5225	[0.5280]	19.6956***	[0.0230]
Exp-LR	0.5460	[0.7440]	6.5191**	[0.0150]
Mean-LR	0.9070	[0.7610]	1.9006	[0.3130]
OLS-CUSUM	0.9827	[0.3621]	1.9862***	[0.0017]
2). Egypt				
Sup-LR	8.4189**	[0.0140]	3.5052	[0.4790]
Exp-LR	3.0728***	[0.0020]	0.7163	[0.5630]
Mean-LR	5.1255***	[0.0010]	1.2255	[0.5810]
OLS-CUSUM	1.9961	[0.0001]	1.0072	[0.2982]
3). Israel				
Sup-LR	12.3769***	[0.0040]	8.5551	[0.1190]
Exp-LR	3.8650***	[0.0020]	1.7066	[0.1630]
Mean-LR	5.0370***	[0.0000]	1.7727	[0.2760]
OLS-CUSUM	1.8992	[0.0082]	1.7392	[0.1763]
4). Jordan				
Sup-LR	2.5908	[0.7510]	4.5699	[0.2310]
Exp-LR	0.6171	[0.6610]	0.6241	[0.6100]
Mean-LR	1.1147	[0.6310]	0.9564	[0.7090]
OLS-CUSUM	0.9762	[0.3751]	1.1872	[0.1872]
5). Morocco				
Sup-LR	3.4235	[0.4020]	15.5346***	[0.0010]
Exp-LR	0.9777	[0.1960]	6.8891***	[0.0040]
Mean-LR	1.8340	[0.1390]	3.1983**	[0.0192]
OLS-CUSUM	1.0042	[0.3826]	1.8628**	[0.0488]
6). Oman				
Sup-LR	10.5229**	[0.0476]	5.6961	[0.1320]
Exp-LR	3.6863*	[0.0515]	1.1574	[0.1980]
Mean-LR	4.0931*	[0.0583]	1.5652	[0.3030]
OLS-CUSUM	1.9982***	[0.0001]	1.5638	[0.2812]
7). Tunisia				
Sup-LR	4.9572	[0.1970]	3.0027	[0.5420]
Exp-LR	0.9399	[0.3360]	0.4839	[0.7620]
Mean-LR	1.6053	[0.3140]	0.8400	[0.7590]
OLS-CUSUM	0.9761	[0.2763]	1.7622	[0.1422]

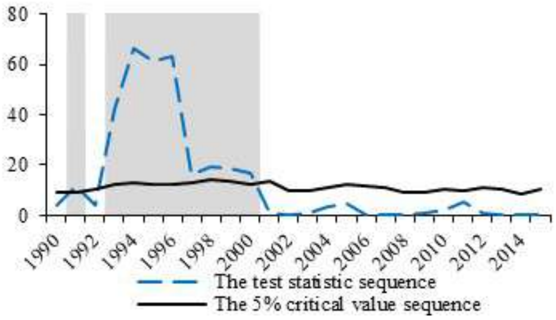
Note: See notes to previous table.

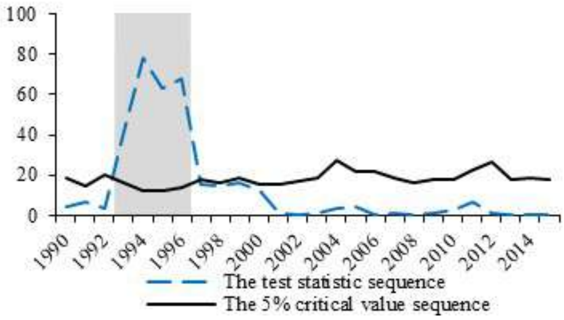
Appendix

Figure 1: The Granger causality results for Algeria

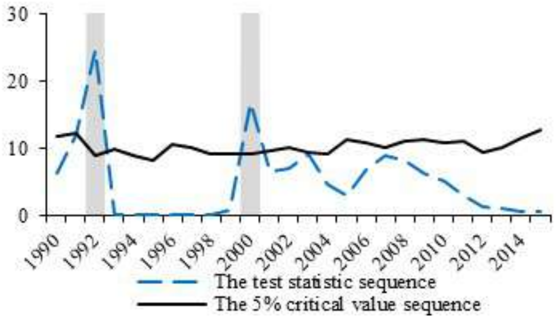
Panel A: Rolling - Homoscedasticity **Panel B:** Rolling -heteroscedasticity

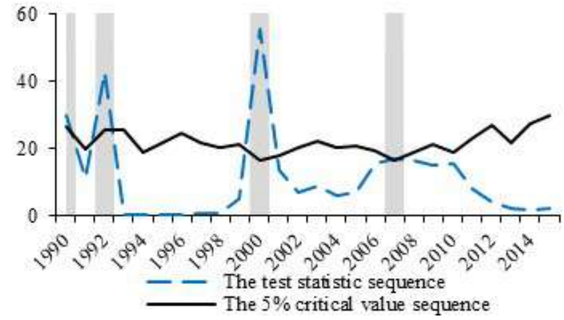
***a*).** $DC_t -/\rightarrow REM_t$



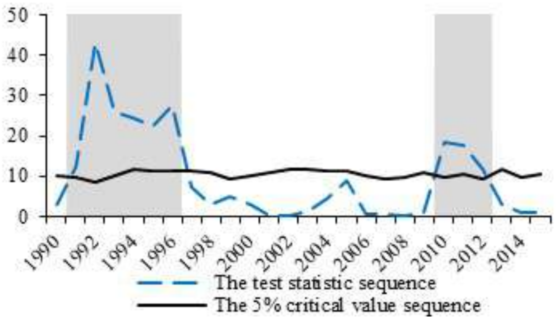


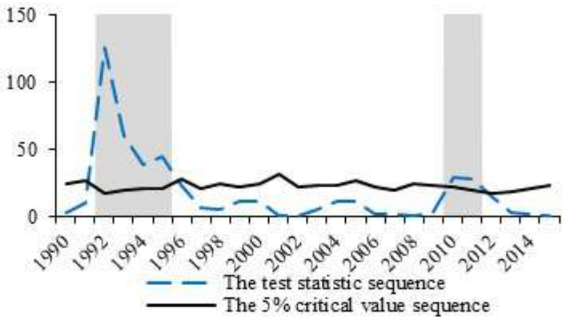
***b*).** $REM_t -/\rightarrow DC_t$



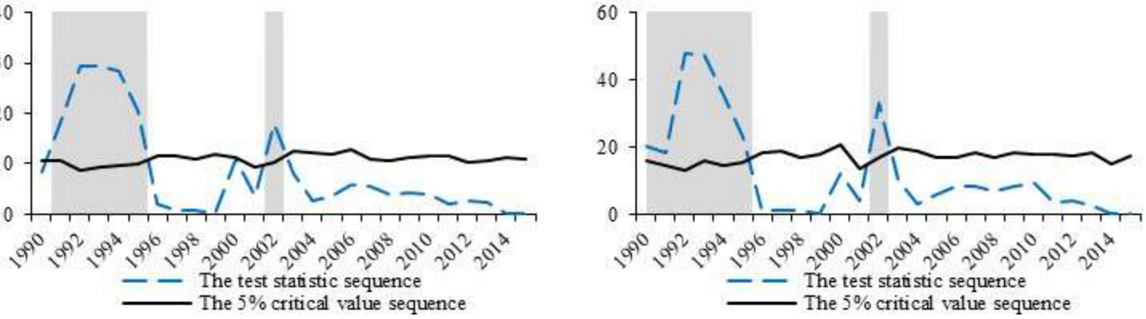


***c*).** $M2_t -/\rightarrow REM_t$





***d*). $REM_t -/\rightarrow M2_t$**

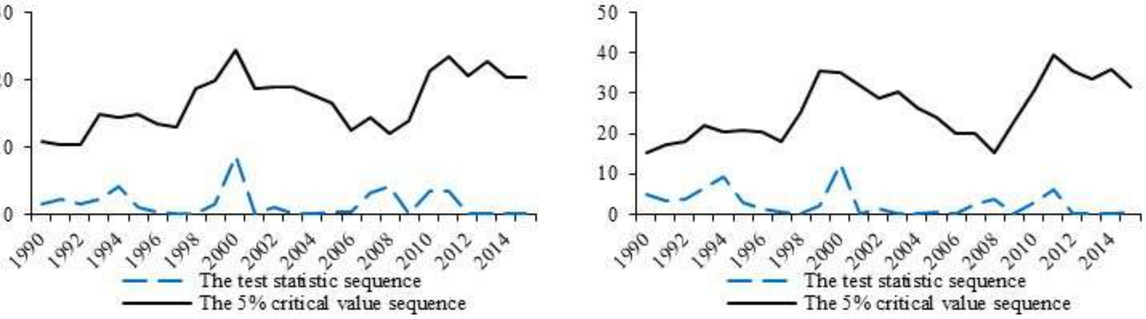


Notes: These figures represent the test statistic sequence (on y-axis) of the rolling window-based bootstrapped Wald tests and the corresponding 5% critical values. The time period is on x-axis. Panel A shows the homoscedastic version of Granger-causality $x_t -/\rightarrow y_t$spreads, whereas Panel B carries the heteroscedasticity-consistent version of the tests.

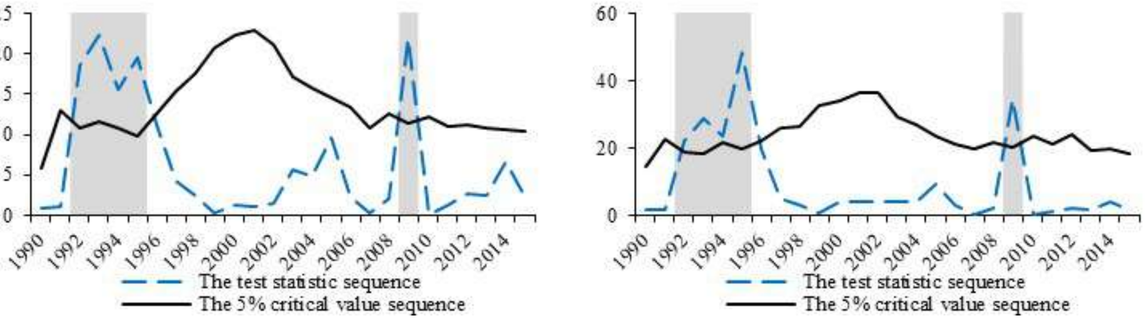
Figure 2: The Granger causality results for Egypt

Panel A: Rolling - Homoscedasticity **Panel B:** Rolling -heteroscedasticity

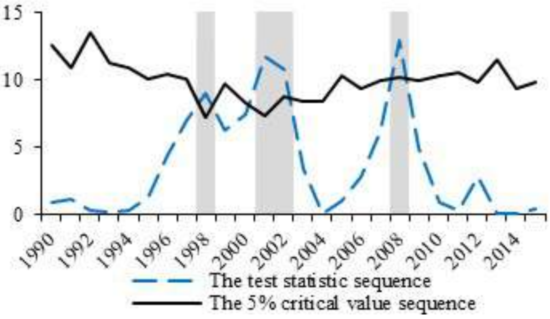
***a*). $DC_t -/\rightarrow REM_t$**

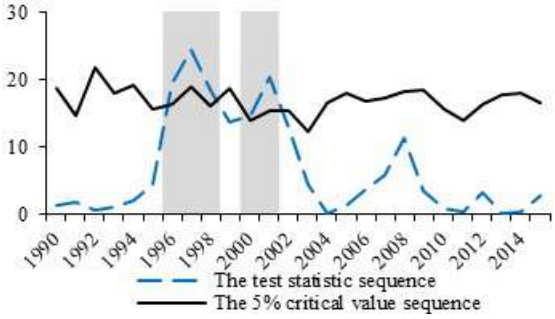


***b*). $REM_t -/\rightarrow DC_t$**

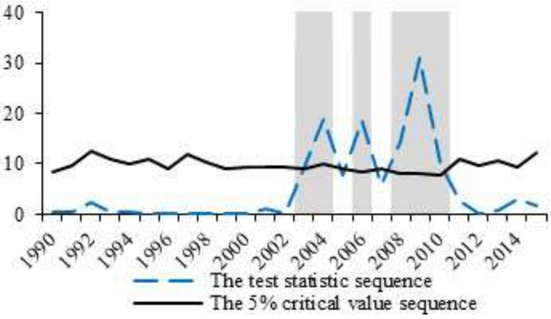


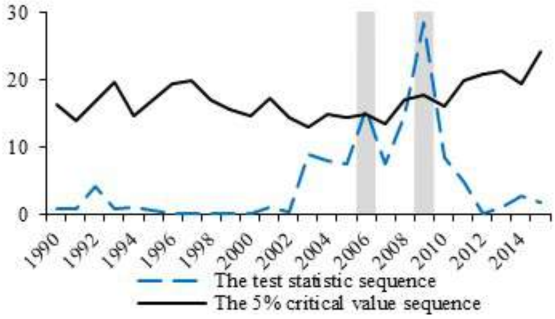
***c*).** $M2_t -/\rightarrow REM_t$





***d*).** $REM_t -/\rightarrow M2_t$



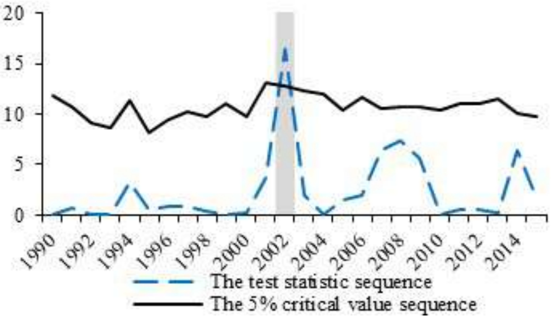


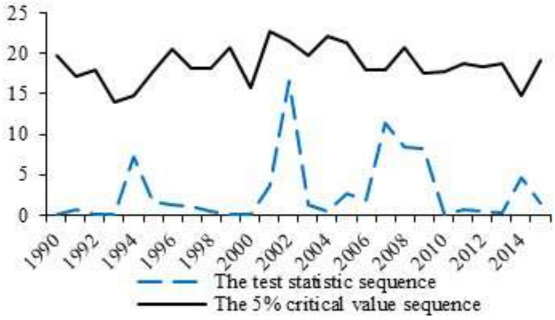
Notes: These figures represent the test statistic sequence (on y-axis) of the rolling window-based bootstrapped Wald tests and the corresponding 5% critical values. The time period is on x-axis. Panel A shows the homoscedastic version of Granger-causality $x_t -/\rightarrow y_t$spreads, whereas Panel B carries the heteroscedasticity-consistent version of the tests.

Figure 3: The Granger causality results for Israel

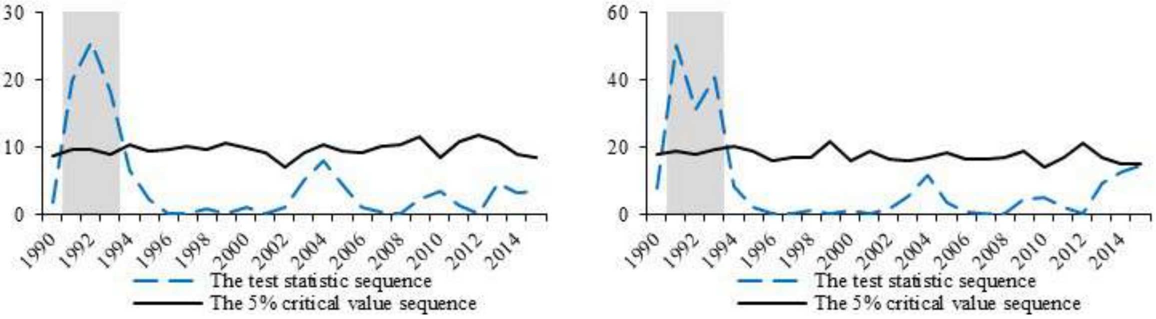
Panel A: Rolling - Homoscedasticity **Panel B:** Rolling -heteroscedasticity

***a*).** $DC_t -/\rightarrow REM_t$

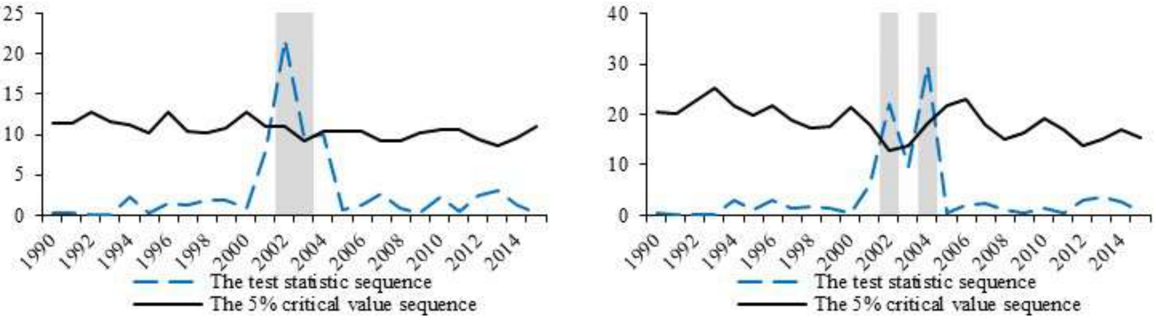




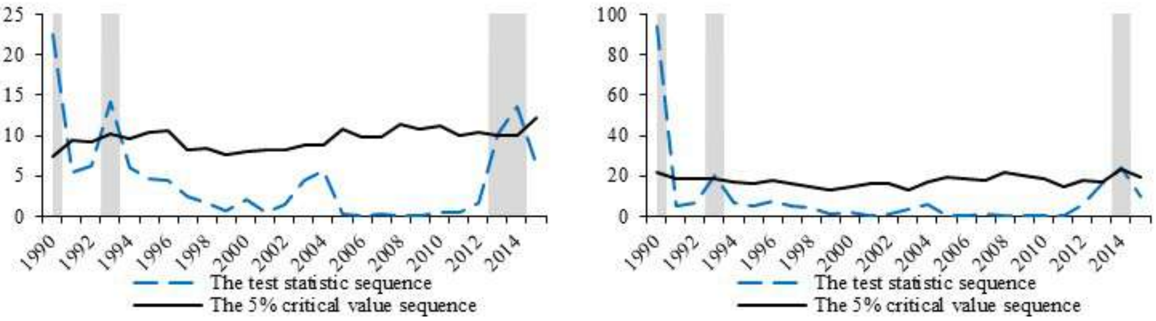
***b*). $REM_t -/\rightarrow DC_t$**



***c*). $M2_t -/\rightarrow REM_t$**



***d*). $REM_t -/\rightarrow M2_t$**

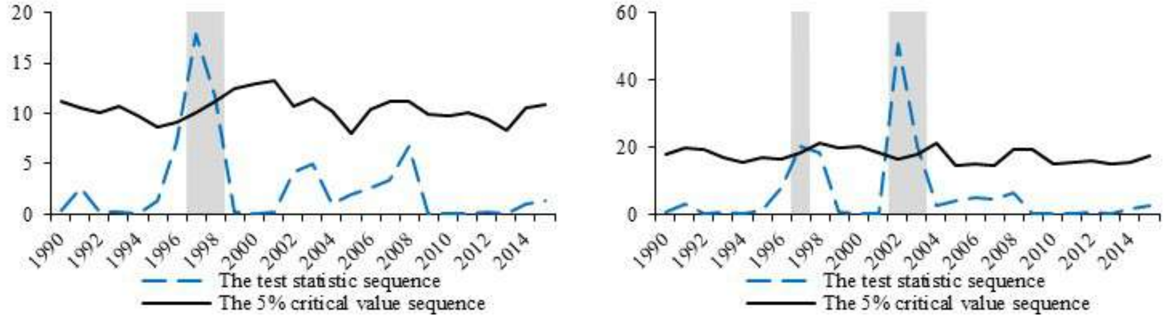


Notes: These figures represent the test statistic sequence (on y-axis) of the rolling window-based bootstrapped Wald tests and the corresponding 5% critical values. The time period is on x-axis. Panel A shows the homoscedastic version of Granger-causality $x_t -/\rightarrow y_t$spreads, whereas Panel B carries the heteroscedasticity-consistent version of the tests.

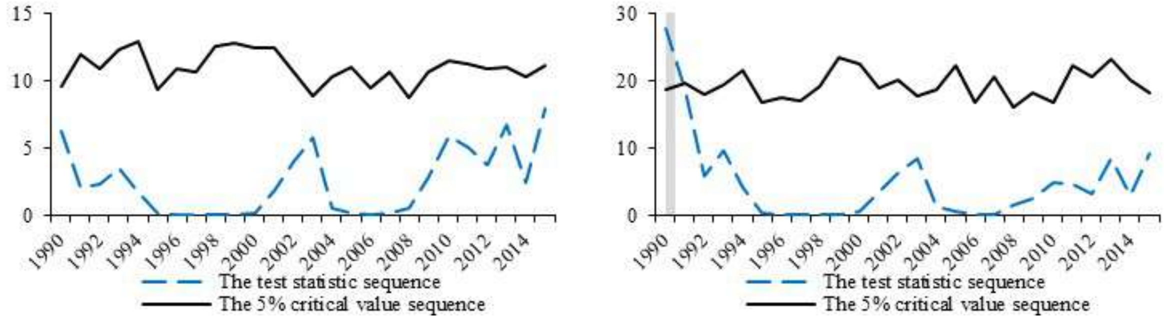
Figure 4: The Granger causality results for Jordan

Panel A: Rolling - Homoscedasticity **Panel B:** Rolling -heteroscedasticity

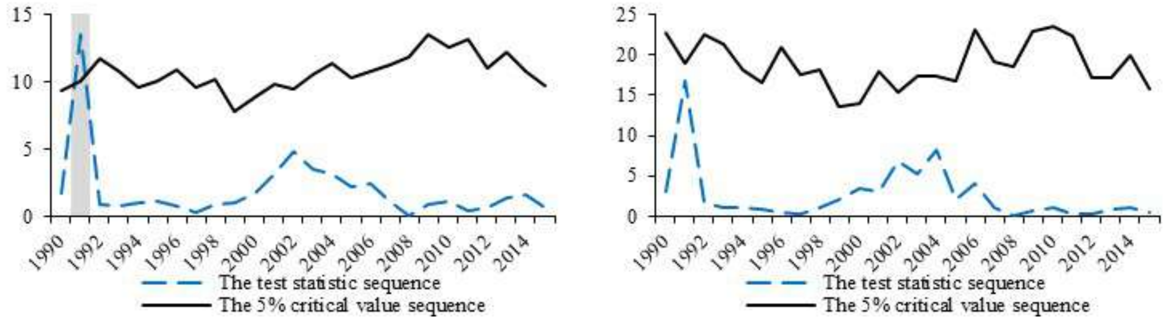
***a*).** $DC_t -/\rightarrow REM_t$



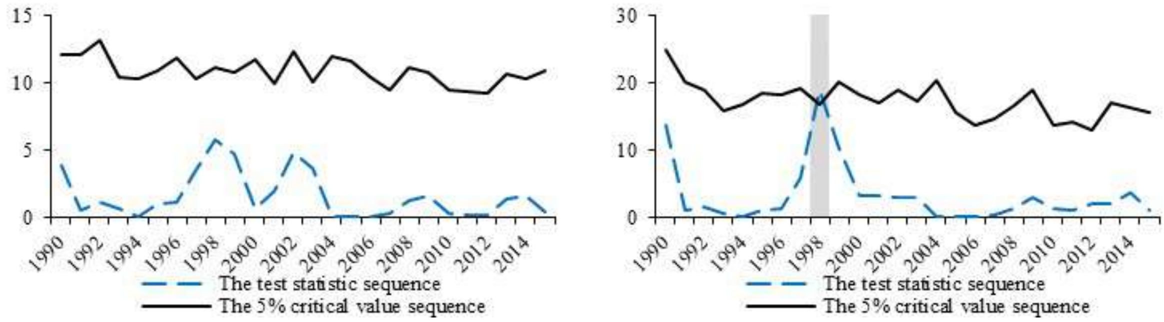
***b*).** $REM_t -/\rightarrow DC_t$



***c*).** $M2_t -/\rightarrow REM_t$



***d*).** $REM_t -/\rightarrow M2_t$

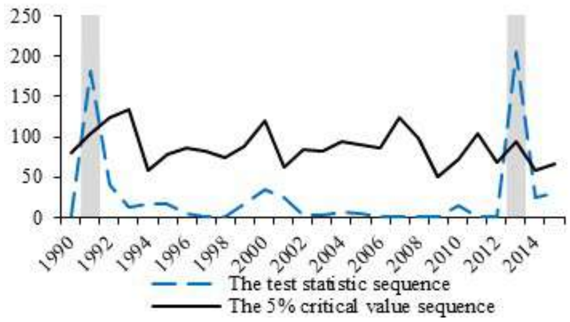


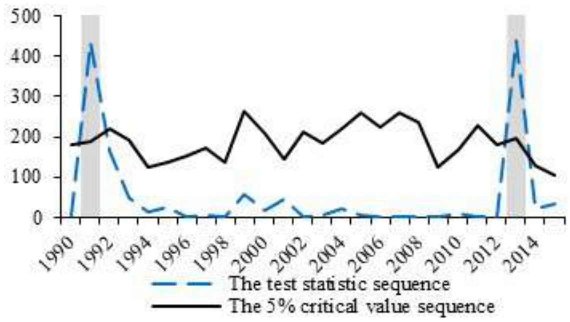
Notes: These figures represent the test statistic sequence (on y-axis) of the rolling window-based bootstrapped Wald tests and the corresponding 5% critical values. The time period is on x-axis. Panel A shows the homoscedastic version of Granger-causality $x_t -/\rightarrow y_t$spreads, whereas Panel B carries the heteroscedasticity-consistent version of the tests.

Figure 5: The Granger causality results for Malta

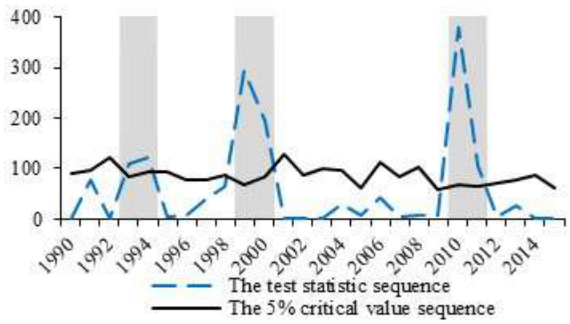
Panel A: Rolling - Homoscedasticity **Panel B:** Rolling -heteroscedasticity

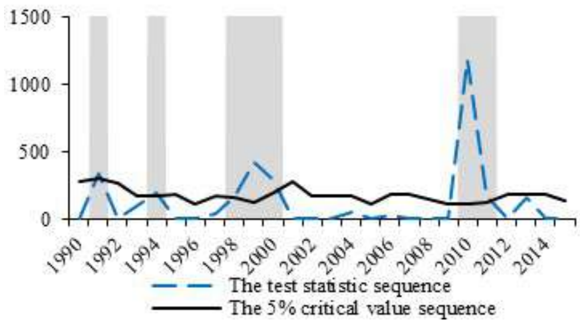
***a*). $DC_t -/\rightarrow REM_t$**





***b*). $REM_t -/\rightarrow DC_t$**



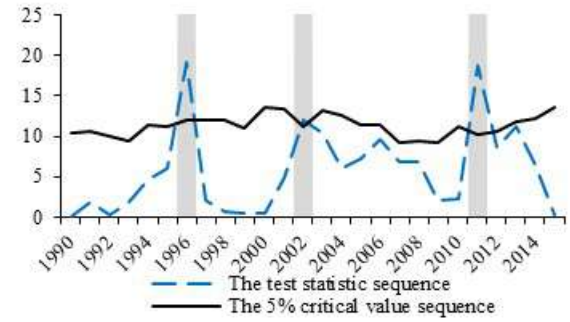


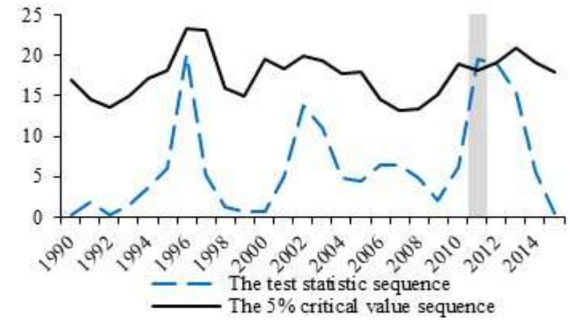
Notes: These figures represent the test statistic sequence (on y-axis) of the rolling window-based bootstrapped Wald tests and the corresponding 5% critical values. The time period is on x-axis. Panel A shows the homoscedastic version of Granger-causality $x_t -/\rightarrow y_t$spreads, whereas Panel B carries the heteroscedasticity-consistent version of the tests.

Figure 6: The Granger causality results for Morocco

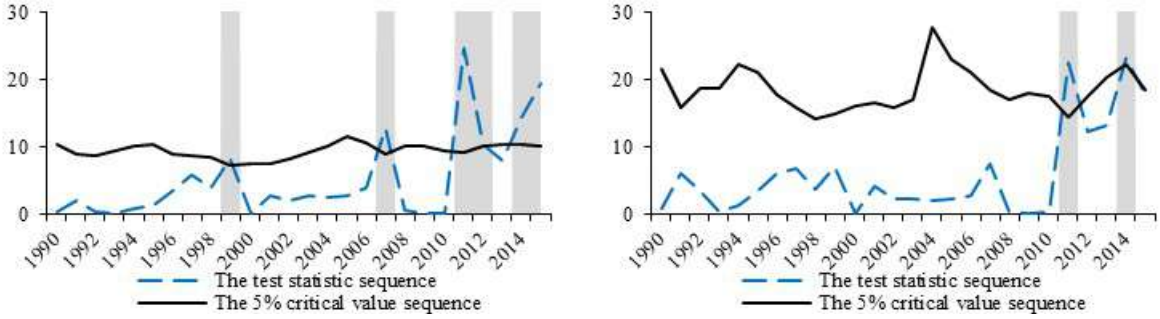
Panel A: Rolling - Homoscedasticity **Panel B:** Rolling -heteroscedasticity

***a*). $DC_t -/\rightarrow REM_t$**

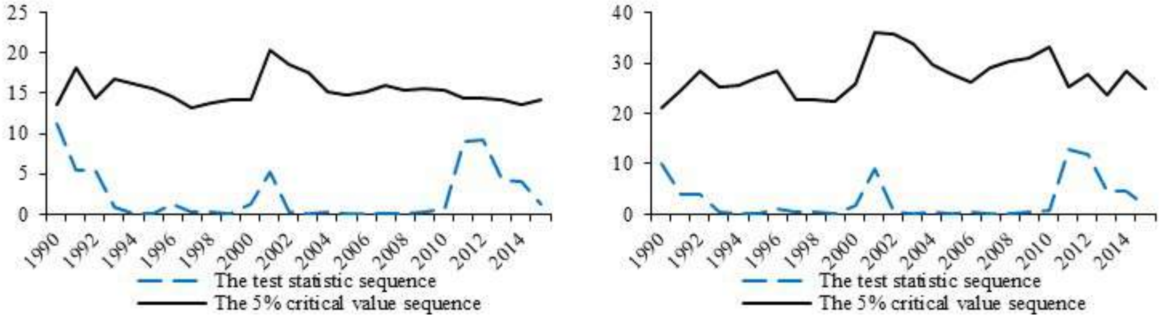




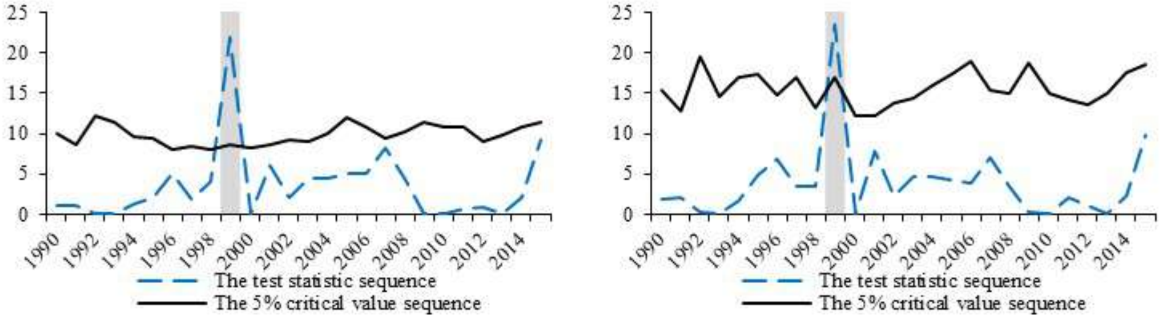
***b*). $REM_t -/\rightarrow DC_t$**



***c*). $M2_t -/\rightarrow REM_t$**



***d*). $REM_t -/\rightarrow M2_t$**

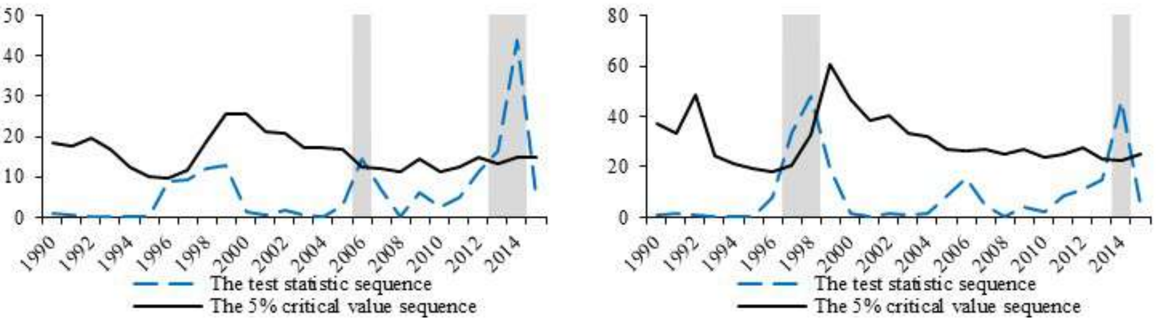


Notes: These figures represent the test statistic sequence (on y-axis) of the rolling window-based bootstrapped Wald tests and the corresponding 5% critical values. The time period is on x-axis. Panel A shows the homoscedastic version of Granger-causality $x_t -/\rightarrow y_t$spreads, whereas Panel B carries the heteroscedasticity-consistent version of the tests.

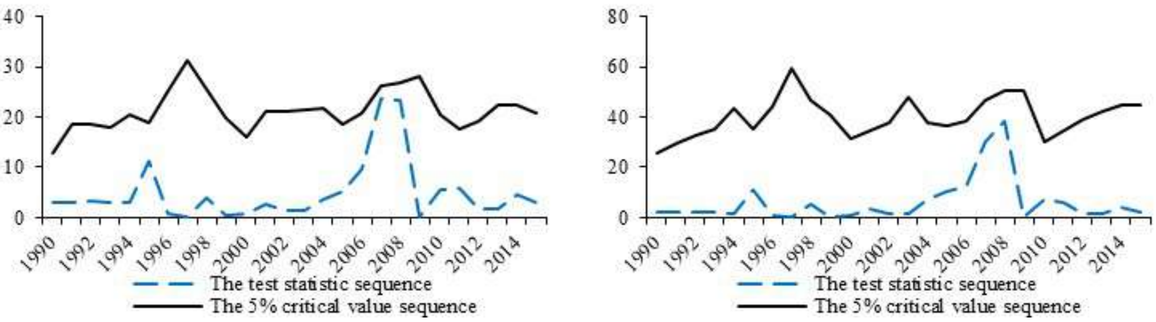
Figure 7: The Granger causality results for Oman

Panel A: Rolling - Homoscedasticity **Panel B:** Rolling -heteroscedasticity

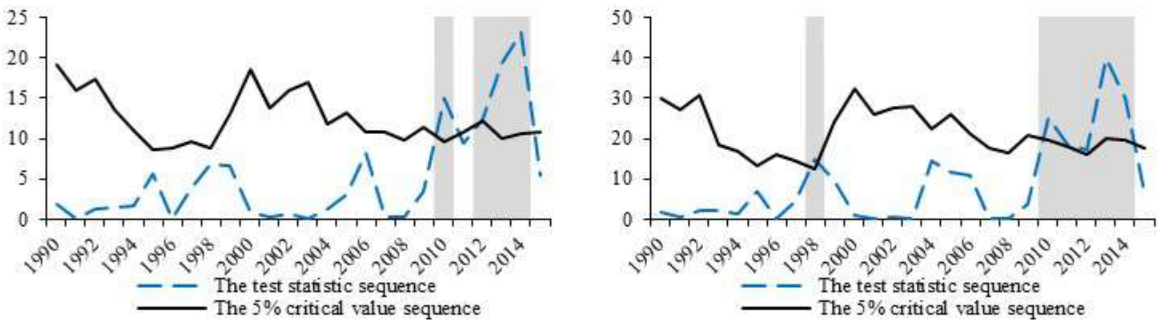
***a*).** $DC_t \;-/\!\!\rightarrow REM_t$



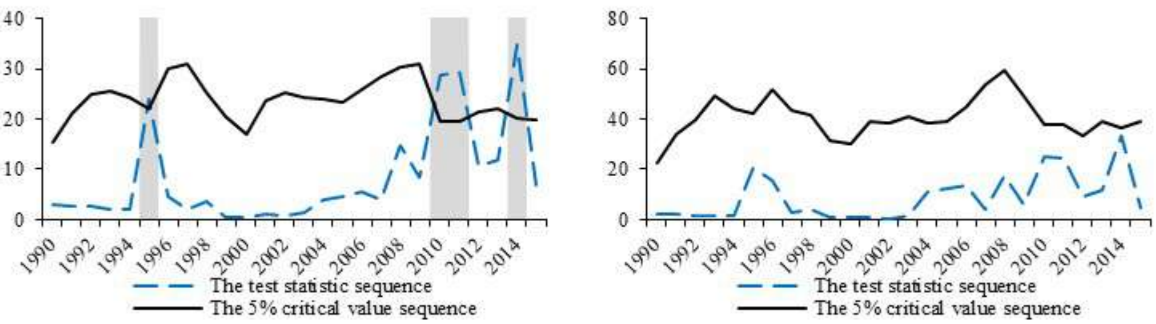
***b*).** $REM_t \;-/\!\!\rightarrow DC_t$



***c*).** $M2_t \;-/\!\!\rightarrow REM_t$



***d*).** $REM_t \;-/\!\!\rightarrow M2_t$

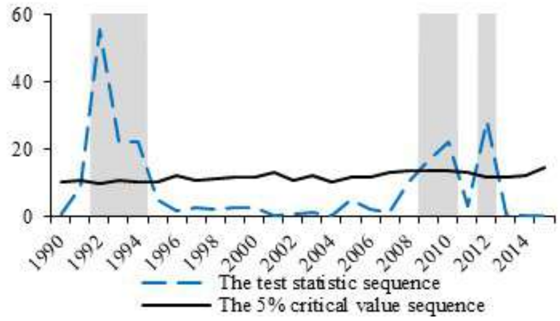


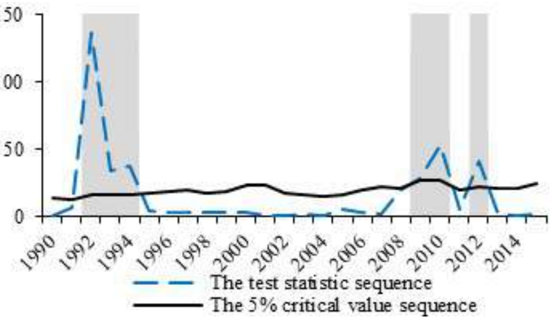
Notes: These figures represent the test statistic sequence (on y-axis) of the rolling window-based bootstrapped Wald tests and the corresponding 5% critical values. The time period is on x-axis. Panel A shows the homoscedastic version of Granger-causality $x_t -/\rightarrow y_t$spreads, whereas Panel B carries the heteroscedasticity-consistent version of the tests.

Figure 8: The Granger causality results for Tunisia

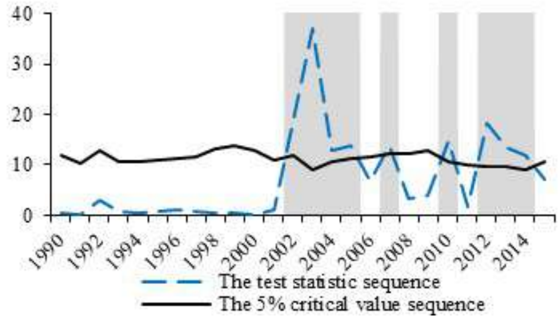
Panel A: Rolling - Homoscedasticity **Panel B:** Rolling -heteroscedasticity

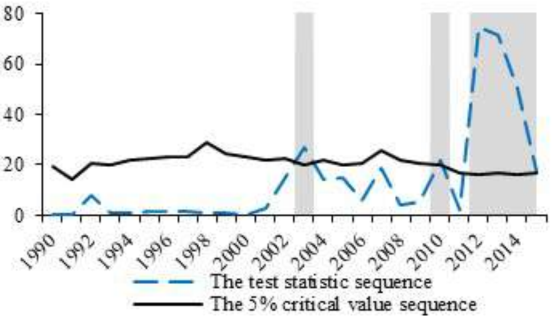
***a*).** $DC_t -/\rightarrow REM_t$



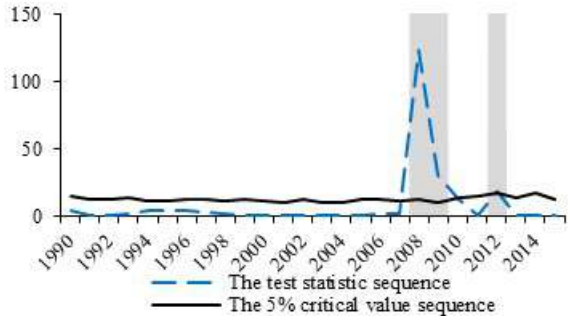


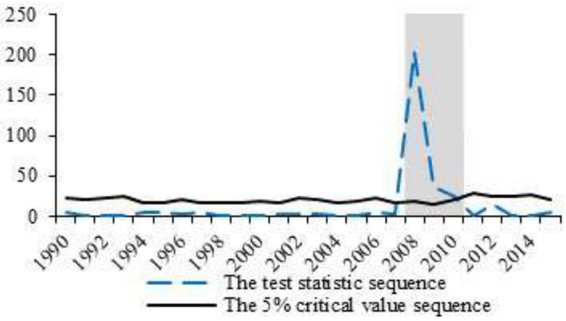
***b*).** $REM_t -/\rightarrow DC_t$



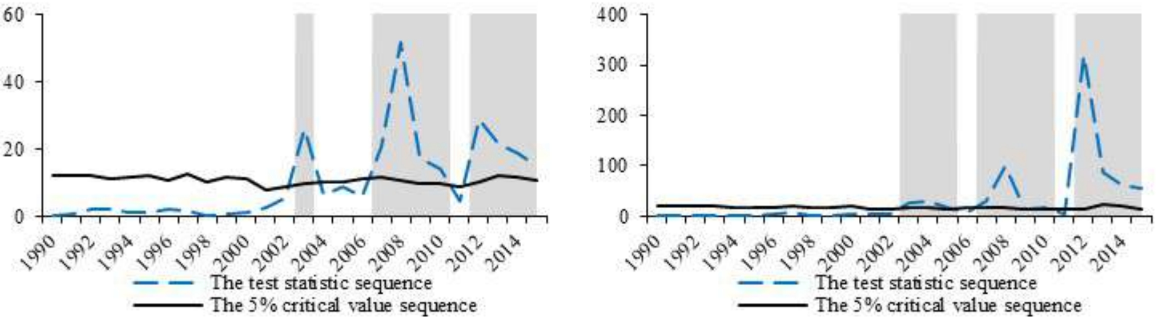


***c*).** $M2_t -/\rightarrow REM_t$





***d*).** $REM_t -/\rightarrow M2_t$



Notes: These figures represent the test statistic sequence (on y-axis) of the rolling window-based bootstrapped Wald tests and the corresponding 5% critical values. The time period is on x-axis. Panel A shows the homoscedastic version of Granger-causality $x_t -/\rightarrow y_t$spreads, whereas Panel B carries the heteroscedasticity-consistent version of the tests.