MULTIVARIATE GRANGER CAUSALITY BETWEEN FINANCIAL DEVELOPMENT, INVESTMENT AND ECONOMIC GROWTH: EVIDENCE FROM TUNISIA

HELMI HAMDI[1]
ABDELAZIZ HAKIMI[2]
RASHID SBIA[3]

Abstract

The aim of this paper is to empirically examine the dynamic relationship between financial deepening, investment activities and economic growth for the case of Tunisia during the period 1961-2010. To this end, we use a multivariate framework based on Vector Error Correction Model and Cointegration techniques. The short-run estimation reveals that finance does not led to economic growth in Tunisia while the long-run results show the opposite conclusion. Further, it was shown that investment is the main engine of growth in the short-run and long-run as well. Our findings could be of great interest for Tunisia new government to draw proper policy responses to promote the role of the financial sector in the economy.

Keywords: Financial Deepening, Economic Growth, Tunisia, VECM

JEL Classification: E44, O16, G18

1. Introduction

The debate on finance and growth nexus was initially developed more than hundred years ago by the pioneering works of Schumpeter (1911). Since, this topic has received a great of attention by scholars. Empirical studies investigating the relationship between finance and growth have been conducted for either single country data (Ang and McKibbin 2005, Khan and Qayyum 2006, Mohamed 2008, Odhiambo 2009, among others) or panel of countries or regions (Levine *et al.* 2000, Khan and Senhadji 2000, Abu-Bader and Abu-Qarn 2006, Apergis *et al.* 2007, Bangake and Eggoh 2011,.., etc). Despite the huge literature on the topic, empirical evidences provide conflicting results on the direction of causality between the development of the financial sector and economic growth.

---

[1] Aix-Marseille Université CERGAM-CAE (4225). helmi_aix@yahoo.fr

[2] FSEJG Jendouba and ISG Sousse. abdelazizhakimi@yahoo.fr

[3] DULBEA, Solvay Brussels School of Economics and Management, Belgium. Rashid.Sbia@ulb.ac.be

Generally speaking, literature on finance-growth nexus could be classified into four different hypotheses: "*supply-leading*", "d*emand-following*", "*feedback hypothesis*" and the "*neutral hypothesis*".   The first hypothesis was firstly developed by Goldsmith (1969) who suggested that financial development has a positive impact on economic growth as it may boost the capital accumulation efficiency and or increase the level of saving and thus the level of investment as suggested by McKinnon (1973) and Shaw (1973). In other words, by growth in saving and increase of investment efficiency, financial development may play a key role in growing the economic output (Townsend, 1979; Greenwood and Jovanovic, 1990; Levine, 1997). Moreover, this would create incentives for financial innovations and the implementation of new technology (Abu-Bader and Abu-Qarn, 2008). Empirically, the first hypothesis shows that financial development Granger causes economic growth. In literature, several studies supported the first hypothesis. For example, Ibrahim (2007) investigated the finance and growth relationship in Malaysia during the period 1980-2005. Using a battery of time series econometric techniques including different unit root tests, cointegration test, VEC model, Granger causality, IREF and VCD, he found evidence that financial development encourages economic growth in Malaysia. Jalil and Ma, (2008) observed that financial development adds to output growth by growing capital formation in Pakistan and China over the period 1960-2005. The author conducted the bound testing (ARDL) approach to cointegration. Further, he used deposit liabilities ratio (DLR) and credit to private sector (CPS) as proxies of financial development. However, the results were different for both countries. In Pakistan, both DLR and CPS have significant effect on economic growth while in China only DLR seems to affect economic growth. Coccorese (2008) implemented Sims' causality to test the causality direction between both variables in twenty Italian regions over the period 1991- 2001. The author computed eight-bank loan concentration ration as proxy for financial development and GDP as proxy of economic growth. He stated that output growth is Granger cause of financial development. Masih *et al.* (2011) have used a long-run structural modeling (LRSM), to investigate the causality between financial development and economic growth in Saudi Arabia. The authors have used bank deposit to nominal GDP ratio and bank credit to the private sector to nominal GDP as proxies for financial development. Further, some control variables have been included as export to real GDP and real deposit interest rate. They confirmed the existence of supply-leading hypothesis in the case of Saudi Arabia. Similarly, Kar and Mandal, (2012) study revealed that financial development stimulates economic growth by enhancing capitalization in India. Instead of using the GDP as usual proxy for economic growth, the study used monthly industrial production index as proxy of economic growth. Further, the study distinguished between the banking size and activity as potential proxy for financial development.

The second hypothesis suggests that financial development follows economic growth. Patrick, (1966) indicated that 'demand-following' relationship shows that real economic growth has a positive impact on financial development by creating demand for financial services as economy jumps to another stage of development. Liang and Teng, (2006) explored the relationship between financial development and output growth using VAR approach in case China over the period 1952-2001. The empirical analysis revealed that the variables are cointegrated and economic growth Granger causes financial development. Here also, the study is in a bi-variate framework using GDP as economic growth proxy and Bank credit ratio as proxy of financial development. For robustness check, Deposit liabilities have been considered in the empirical analysis. Fung, (2009) noted that positive effect of economic growth on financial

development is consequence of increasing level of productivity and technological progress. He investigated the convergence between economic growth and financial development in 57 countries over the period 1967-2001. The sample had been divided in sub sample according to the IFS classification. Thirteen of them were classified as industrial countries, twenty as developing countries from Africa, eleven as developing countries from Asia and thirteen as developing from the western hemisphere. The author two measures of financial intermediation namely, credit allocated to the private sector and quasi-money. Chukwu and Agu, (2009) confirmed the demand-leading hypothesis in the case of Nigeria. He adopted multivariate vector error correction model to investigate the causality between financial depth and economic growth from 1971 to 2008. The financial development was proxied by the ratio of bank sector's credit to private sector to GDP, the ratio of broad money to GDP, the ratio of bank deposit liabilities to GDP and the loan deposit ratio. Similarly, *Amarathunga, (2010) got the same result in case of Sri Lanka* by taking into account saving, investment, trade and real interest rate during the period from 1960 to 2008. The authors constructed a single composite index for three financial proxies to represent financial development using Principal Component Analysis. Odhiambo (2010) examined the relationship between financial development and economic growth in South Africa using the ARDL bounds testing and the VECM Granger causality approaches. Distinct from the majority of the previous studies, Odhiambo (2010) included investment in the bivariate model between financial development and economic growth. Thus, he created a simple trivariate causality model. In addition, he used three proxies of financial development, namely M2/GDP, the ratio of private sector credit to GDP and the ratio of liquid liabilities to GDP for robustness check. The empirical analysis revealed that variables are cointegrated and financial development is Granger cause of economic growth. Further, Odhiambo (2011) validated the existence of demand-leading hypothesis in Tanzania using multivariate framework. He included foreign capital inflows as endogenous variable. In a panel framework, Hasan et al. (2011) stated unidirectional causality running from economic growth to financial development in developing economies. To do such they estimate both panel regressions and variance decompositions

The third hypothesis shows the "*feedback*" between economic growth and financial development. For example, Ozturk (2007) noted that cointegration exists between the variables of his study and the feedback effect is confirmed in case of South Africa for the period 1970-2003. Using a bivariate framework, Zheng et al. (2010) noted that financial development and economic growth are complementary in case of China during the period 1979-2008. He used VECM approach and Granger causality test. Similarly, Husam-Aldin et al. (2012) study showed the existence of the feedback effect between financial development and economic growth in the case of UAE. The authors used the autoregressive distributed lag (ARDL) approach to co-integration. Further, they employed two indicators to detect the level of financial development. The first one was the financial depth or size of the financial intermediaries sector as measured by the monetization ratio. The second one is the ratio of the credit provided to private sector by commercial banks as a percentage of the GDP. Generalized Least Square (GLS) method with cross-section Seemingly Unrelated Regression (SUR), Eslamloueyan and Sakhaei, (2011) demonstrate the feedback relationship between financial development and economic growth in the Middle East countries

Finally, the fourth hypothesis shows no relationship between finance and growth. For example, Bakhouche (2007) explored the relationship between several indicators of the development of the financial sector and economic growth in Algeria by applying an autoregressive distributed tag (ARDL) model. He stated that financial development does not stimulate economic growth and thus economic growth has no effect on financial development in the case of Algeria during 1979-2004. Ernesto and Dabós, (2012) have also found the same results based on a new, larger dataset in terms of time periods and countries comparing to previous studies. Further, they incorporated additional set of control variables such as institutional quality and the investment rate. They confirmed that financial development and economic growth are independent and thus stated that that the finance–growth relationship is not as strong as described.

It has been observed that the majority of empirical studies have investigated the relationship between financial development-growth nexus focused on the bivariate framework. However, the recent empirical studies showed the limits of bivariate framework and scholars started lately to introduce multivariate framework and our work comes to contribute to the literature in the same way. Therefore, the aim of this paper is to enrich the available literature by studying the Tunisian context. Tunisia is an interesting case study for at least three reasons.

First, during the past three decades, the Tunisian government has implanted several reforms in order to modernize the organization of the financial sector and to give banks more power in the process of economic growth. The government has progressively liberalized the banking sector in 1987 following the adoption of the structural adjustment programs (SAPs).

Second, Tunisia has encouraged foreign banks to do their business in Tunisia in order to facilitate access to finance and to encourage households to be familiarized with banks and the banking system. The central Bank of Tunisia (CBT henceforth) has also encouraged mergers and acquisitions between local and foreign banks to facilitate the transfer of technology and financial engineering to Tunisian financial institutions.

Third, to the best of our knowledge, there is not study that investigated the finance-growth nexus in Tunisia during the past decade. The only available study was conducted by Ghali (1999) in 1999 and his empirical analysis was based on data that covers the period 1963–93. However, following 1993 several reforms were undertaken by the Tunisian government such as trade liberalization (1994), the adhesion to the European Union free trade agreement (1995) and the adhesion to the World Trade Organization (1994), etc. Further, Ghali (1999) have used a tri-variate framework in his empirical model. Therefore, this paper aims at filling the gap and providing new and fresh results of the consequences of the financial deepening in economic growth in Tunisia during the period 1961-2010. Unlike the numerous studies which have used bivariate and tri-variate frameworks to test for causality between financial deepening and economic growth, in this paper we use multivariate procedure within a vector error correction model. The choice of this methodology allow us to obtain consistent results to better study the dynamic linkage between all the variables in short run and long run as well. The overall results reveal that the financial sector is a main driver of economic growth in Tunisia in the long run while in the short run, it needs further reforms. Our results could be of great interests to Tunisia government especially in the current period, in which Tunisia is passing by a severe period of transition.

The rest of the paper is organized as follows: section two describes the methodology and data, section three presents the empirical results and section four concludes.

2. Overview of the Tunisian Banking Sector

Since the 80s, the Tunisian banking sector has undergone various structural reforms initially implanted under the supervision of the International Monetary Funds and the World Bank. These reforms were called the Structural Adjustment Programs (SAPs) which aimed at removing barriers imposed on banks and to liberalize progressively the economy to abroad. The SAPs also aimed at creating a market-based economy in which the private sector should play a crucial role in the local economy. The first step of the SAPs was the restructuring of the commercial banking system in 1987, which was intended to push banks to be more competitive and to permit banks to become more responsible and capable of making their own credit decisions (Moore, 1991). Reforms were projected to mobilize savings and lead to a more efficient allocation of resources (Cook et al. 2001). The second step of the SAPs was the liberalization of interest rate in 1987 which has allowed Banks to have more liberty in granting loans as credit allocation was subject to authorization from the CBT. Banks were also permitted, with certain restrictions, to set their deposits and lending interest rates. The liberalization of credit and interest rates was followed by the suppression of the rediscounting rate in 1996 and a boosting of the money market (Hachicha 2005). Following the implementation of these reforms, the number of commercial banking offices increased rapidly, moving from 128 branches in 1974 to 685 branches in 1995. This has increased competition between financial institutions and banks started adopting a new variety of activities based on financial innovation (ATMs, credit and debit cards, retail banking operations, etc). Later, in 2005, the structure of the Tunisian banking sector has witnessed new events and further steps of modernisation. The first step was the creation of a new bank called "Banks of Financing of Small and medium-sized firms", which aims at financing SMSs with low credit constrains. The second event was the privatization of the "Banque de Sud" which gives the birth of "Attijari Bank" and finally the third event is relative to the change of the statute of some development banks (STUSID, BTL, TQB and BTK) to universal banks (Hakimi *et al.* 2012). In 2007, the Tunisian banking sector was principally made up of 4 mega banks holding more than 55% of the sector's assets, 5 medium-size banks holding 32% of the total assets and finally 11 small banks holding 13% of total assets.

Following the adoption of all these reforms, credit conditions improved considerably as competition between banks intensified. This in turn has boosted investment activities and credit to private sector as part of Gross Domestic Product (GDP henceforth) moved from 21% in 1961 to 59.9% in 2000 and 68.75% in 2010 (see the figures below). This environment has encouraged national and international investors to do business in Tunisia (Hamdi et al, 2013).
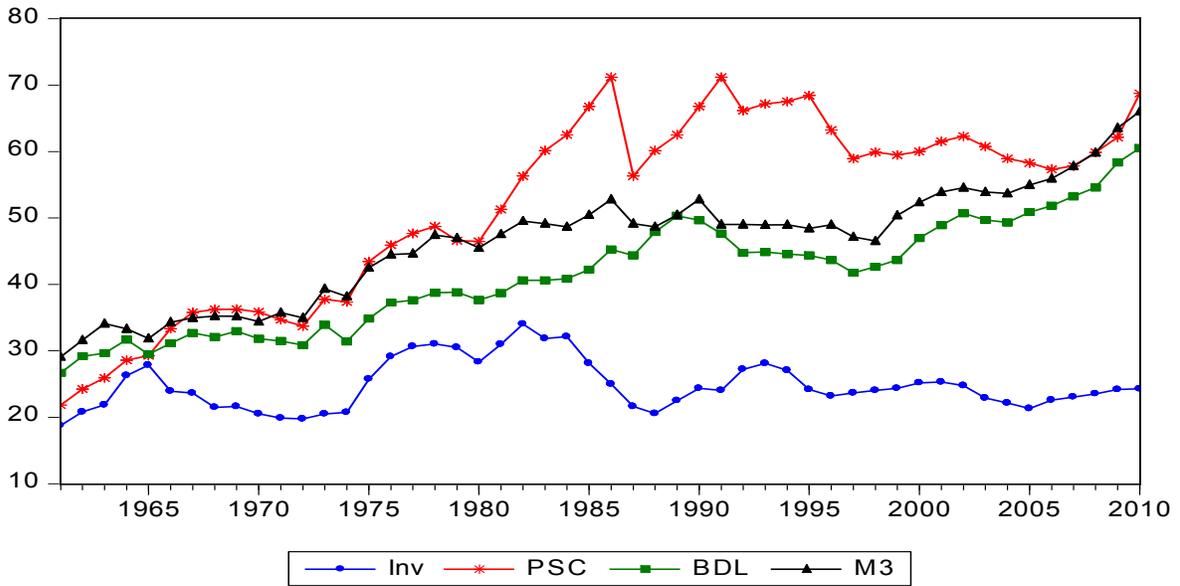
Figure 1. Evolution of the financial development indicators in Tunisia since 1961
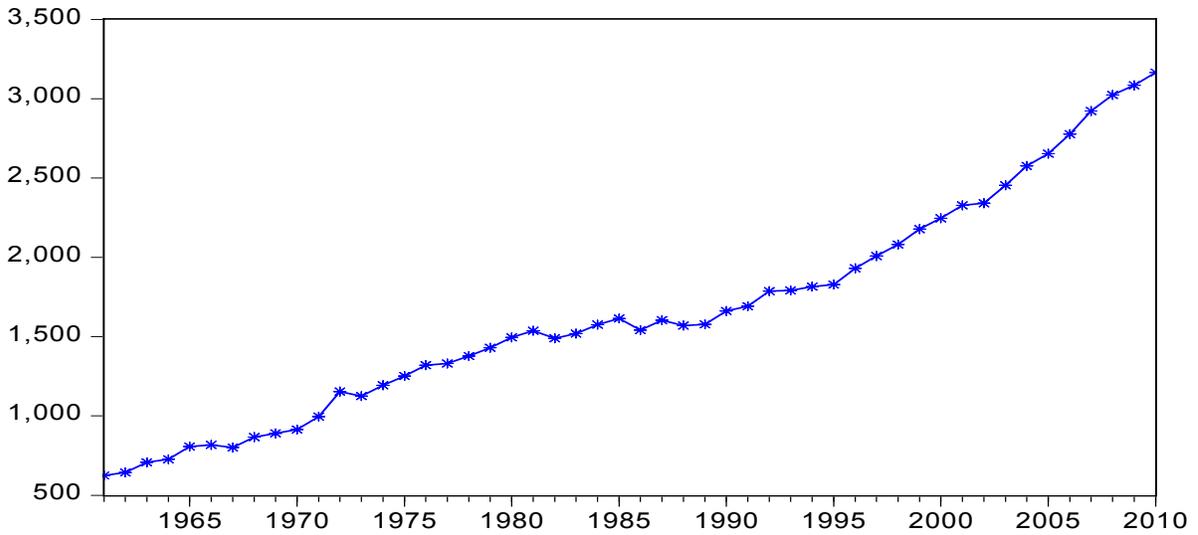
Source: IFS and WDI (2012)

Figure 2. Evolution of the Tunisia GDP per capita since 1961 (US Dollar constant 2000)

        According to Figures 1 and 2, it seems that the several undertaken reforms have improved the Tunisian economic growth. In this paper we will study the consequences of the developments of these financial indicators on economic growth, notably on GDP per capita. To

this end, we use Vector Error Correction Model (VECM henceforth) to test the cointegration between variables of financial deepening, investment activities and economic growth.

3. Methodology

3.1 Data

In modern literature, financial development is proxied by various indictors. First, the ratio of broad Money (M2) to GDP which indicates the overall size of the financial intermediary of a country (Levine, 1997, Calderon and Liu, 2003, King and Levine, 1993, Khan and Senhadji, 2000). A higher ratio of M2 to GDP indicates a larger financial sector and a larger financial intermediation. However, for the case of Tunisia, M2 to GDP ratio could not automatically reveals a greater financial performance as money is used as a store of value in the absence of other more attractive alternatives.[4] To avoid this problem, we use in this paper an alternative measure which is the ratio of banking deposit liabilities to GDP (BDL).[5] We expect that an increase in BDL would have a positive impact on economic growth. The second ratio is the broad Money (M3) to GDP ratio which reflects the change in liquidity of the banking sector during the time. Because of the upward trend in financial innovation in the different financial systems we use a broader measure of money stock (M3) to capture the extent of intermediation in the Tunisia (Ghali 1999). The ratio of M3 to GDP is assumed to be in line with the inside money model of McKinnon (1973) where the accumulation of real money balances is a necessary for investment activities. A rise in M3 to GDP could be considered as a progress in the financial sector in the economy. The third ratio is the private sector credits to GDP (PSC), which is considered as one of the relevant indicators of the magnitude and the extent of financial intermediation. Therefore, it is our main indicator of financial deepening and we expect a positive impact of PSC on economic growth. We also use gross fixed capital formation to GDP ratio, which captures the evolution of investment activities during the time (Inv). Broadly, a well-developed financial system boosts investment activities; hence we expect a positive impact of investment on economic growth. Finally, the variable, which indicates the economic growth, is measured by per capita real output measured as the ratio of real Gross Domestic Product (GDP) to total population (GDPpc). All the variables are expressed in logarithm form.

It is worth important to notice that there are several controversies relating to each of these proxies as measures of financial development (Wolde-Rufael 2009). Thus there is no single aggregate measure that would be sufficient to capture most aspects of financial development (Ang, 2008). The data are obtained from the International Financial Statistics (IFS) CD-ROM and the World Bank Development Indicators (2012). The sample ranges from 1961 to 2010, for a total of 49 observations.

---

[4] Khan and Senhadji, (2000) argued that some countries may have a high ratio of money to GDP but their financial system is underdeveloped.

[5] This ratio is calculated by subtracting currency in circulation from M2 and dividing by nominal GDP

3.2 Econometric Approach

Our investigation is to test whether the development of the financial sector led to an improvement of the GDP per capita in Tunisia. The basic empirical investigation has two purposes. The first one is to examine the long-run relationship between financial deepening and economic growth while the second is to examine the short-run dynamic causal relationship between the different variables. The basic testing procedure requires three steps. The first step is to test whether the variables contain a unit root to confirm the stationarity of each variable. This is done by using the Augmented Dickey–Fuller tests (F-ADF) and Philips–Perron (PP) tests. For a robustness check, we also use the Clemente-Montanes-Reyes (1998) unit root test with double unknown structural breaks. In the second step we test for the existence of a long-run cointegrating relationship between the variables. This is done by the use of the Johansen-Fisher methods. Finally, the last step, if all variables are integrated of order one I(1) and cointegrated short-run elasticities can be computed using the vector error correction model (VECM) method suggested by Engle and Granger (1987).

4. Results

4.1 Unit Root Tests

First, we use the Augmented Dickey–Fuller (F-ADF) unit root tests to test the non-stationarity in our data series. Considering the low power of the ADF test we also use the Phillips-Perron (PP) test (1988), which takes account of the serial correlation and heteroscedasticity, as an alternative test. The results are displayed in Table 2.

The test statistics for the log levels of GDPpc, LBDL, LM3, Linv and LPSC are statistically insignificant. When we apply the unit root tests to the first difference of all variables, both tests reject the joint null hypothesis for each variable at the 1 per cent level. Thus, from all of the tests, the unit roots tests indicate that each variable is integrated of order one.

Table 2. Unit root tests

	ADF		PP		Order of Integration
	Level	1st diff,	Level	1st diff,	
LGDPpc	-1.528	-7.4207***	-1.6281	-7.4037***	I(1)
LBDL	-2.511	-7.6203***	-2.7071	-7.6034***	I(1)
LM3	-2.3578	-7.5444***	-2.3501	-7.5444***	I(1)
Linv	-3.0564	-4.6615***	-2.7928*	-4.7039***	I(1)
LPSC	-2.2681	-6.3764***	-2.2723	-6.3600***	I(1)

Note: The regressions in first difference include intercept.
*** Denotes the rejection of the null hypothesis at 1%level of significance

Based on our discussion in the second section, it was shown that the Tunisian economy has been subject to extensive economic reforms during the period 1980-2005, indicating that macroeconomic variables are likely to have been subject to a number of structural breaks, such as that from the structural adjustment programs in 1987. In this case, the basic ADF and PP tests could not provide reliable results. In fact, the ADF and PP unit root tests are known to suffer

potentially severe size distortions in finite samples when errors are serially correlated, especially when the errors are of the moving average type with a root approaching minus one (Haldrup and Jansson, 2005). To overcome these problems many economists[6] require the necessity of including unknown breakpoint that can be determined endogenously from the data. To get consistent results, we use in this paper the Clemente-Montanes-Reyes (1998) unit root test that allows for two unknown structural breaks.

Table-3 reports the results of Clemente et al. (1998) unit root test. The results from the Additive Outlier (AO) model clearly show that the null of at least one unit root cannot be rejected for all of the series under study. The AO approach reveals that all the variables have quite diverse structural breaks that depend on key policy changes. The results reveal that all the variables have unit root at level but to found to be stationary at 1st difference in the presence of various structural breaks.

Table 3. Clemente-Montanes-Reyes Structural Break Unit Root Test

	Innovative Outliers			Additive Outlier		
	t-statistic	TB1	TB2	t-statistic	TB1	TB2
LGDPpc	-3.995 (4)	1972	1986	-9.442 (3)*	1974	1992
LBDL	-4.766 (3)	1988	1995	-7.314 (6)*	1989	1997
LM3	-4.408 (3)	1994	1998	-7.108 (2)**	1990	1999
LINV	-4.113 (3)	1992	2000	-8.213 (4)*	1988	1994
LPSC	-3.958 (4)	1987	1996	-6.927 (2)*	1988	1995

* Denotes the rejection of the null hypothesis at 10%level of significance

Changes in Innovational Outlier model occur progressively over the time, allowing for a break in both the intercept and slope while changes Additive Outlier models occur suddenly allowing for a break in the mean (the crash model).

After checking the integration of our four variables at order one, I(1), we selected the optimal lag length of underlying Vector Auto Regression (VAR henceforth) using the conventional model selection criteria. These criteria established that the optimal lag length is two.

4.2 Cointegration : Long Run and Short Run

The cointegration tests based on multivariate Johansen approach (1988) which uses two statistic tests namely: Trace test and Max-Eigen value. The likelihood Ratio (LR) test is based on the trace statistics (λ trace) which tests the H_0: $r \leq q$ against H_1: $q = r$ is calculated thus:

$$\lambda_{trace}(r) = -T\sum_{l+1}^{p}\ln(1 - \hat{\lambda}i)$$ where $\lambda r + i \dots \lambda n$, are the least value of eigenvectors $(p - r)$.   The

second test is the maximal eigenvalue test (λ_{max}) which tests the H_0: there are r cointegrating vectors against the H_1: there are $r + 1$ cointegrating vectors and is calculated as follows:

---

6   Zivot and Andrews (1992), Perron and Vogelsang (1992) and Perron (1997).

$\lambda_{max}(r, r+1) = -T\ln(1 - \hat{\lambda}r + 1)$. Results of the Johanson cointegration tests are displayed in Table 3 below. The Trace test and Max-Eigen value) suggest the existence of one cointegrating vectors at 1% of significance.

Table 3. Results for Trace and Max-Eigen Statistics

Hypothesized	Trace Statistic	Max-Eigen Statistic
None *	97.47573	43.87435
At most 1 *	53.60138	30.15570
At most 2	23.44568	15.58192
At most 3	7.863758	7.377939
At most 4	0.485819	0.485819

Trace test and Max-eigen statistics indicate 1 cointegrating eqn(s) at the 0.05 level

* denotes rejection of the hypothesis at the 0.05 level

**MacKinnon-Haug-Michelis (1999) p-values

The existence of cointegration signifies that there is at least one long-run equilibrium relationship among the variables. In this case, Granger causality exists among these variables in at least one way (Engle and Granger, 1987). The VECM is used to correct the disequilibrium in the cointegration relationship, as well as to test for long and short-run causality among cointegrated variables. The correction of the disequilibrium is done by the mean of the Error correction term (ECT).

While most of papers have used bivariate and trivariate frameworks to test for causality between financial deepening and economic growth, in this paper we use multivariate procedure by the mean of a VECM which is specified as follows:

$$\Delta LGDPpc_t = \alpha_1 + \sum_{i=1}^{p}\beta_{1i}\Delta LGDPpc_{t-i} + \sum_{i=1}^{q}\beta_{1i}\Delta LBDL_{t-i} + \sum_{i=1}^{r}\beta_{1i}\Delta LM3._{t-i} + \sum_{i=1}^{s}\beta_{1i}\Delta LInvY_{t-i} +$$
$$\sum_{i=1}^{t}\beta_{1i}\Delta LPSC_{t-i} + \theta_1 ect_{t-1} + \varepsilon_{1t} \qquad \text{... (1)}$$

$$\Delta LBDL_t = \alpha_2 + \sum_{i=1}^{q}\beta_{1i}\Delta LBDL_{t-i} + \sum_{i=1}^{p}\beta_{1i}\Delta LGDPpc_{t-i} + \sum_{i=1}^{r}\beta_{1i}\Delta LM3._{t-i} + \sum_{i=1}^{s}\beta_{1i}\Delta LInvY_{t-i} +$$
$$\sum_{i=1}^{t}\beta_{1i}\Delta LPSC_{t-i} + \theta_2 ect_{t-1} + \varepsilon_{21t} \qquad \text{... (2)}$$

$$\Delta LM3_t = \alpha_3 + \sum_{i=1}^{r}\beta_{1i}\Delta LM3._{t-i} + \sum_{i=1}^{p}\beta_{1i}\Delta LGDPpc_{t-i} + \sum_{i=1}^{q}\beta_{1i}\Delta LBDL_{t-i} + +\sum_{i=1}^{s}\beta_{1i}\Delta LInvY_{t-i} +$$
$$\sum_{i=1}^{t}\beta_{1i}\Delta LPSC_{t-i} + \theta_3 ect_{t-1} + \varepsilon_{31t} \qquad \text{... (3)}$$

$$\Delta LINV_t = \alpha_1 + \sum_{i=1}^{p}\beta_{1i}\Delta LGDPpc_{t-i} + \sum_{i=1}^{q}\beta_{1i}\Delta LBDL_{t-i} + \sum_{i=1}^{r}\beta_{1i}\Delta LM3._{t-i} + \sum_{i=1}^{s}\beta_{1i}\Delta LInvY_{t-i} +$$
$$\sum_{i=1}^{t}\beta_{1i}\Delta LPSC_{t-i} + \theta_4 ect_{t-1} + \varepsilon_{4t} \qquad \text{... (4)}$$

$$\Delta LPSC_t = \alpha_5 + \sum_{i=1}^{t} \beta_{1i} \Delta LPSC_{t-i} + \sum_{i=1}^{p} \beta_{1i} \Delta LGDPpc_{t-i} + \sum_{i=1}^{q} \beta_{1i} \Delta LBDL_{t-i} + \sum_{i=1}^{r} \beta_{1i} \Delta LM3._{t-i} +$$

$$\sum_{i=1}^{s} \beta_{1i} \Delta LInvY_{t-i} + \theta_5 ect_{t-1} + \varepsilon_{5t}$$

... (5)

where ε_{it} are the serially uncorrelated random error terms. The ect_{t-1} is the cointegrating vectors and θ_i is the adjustment coefficient indicating the weight of adjusted disequilibrium in the past. To get a long-run relationship among the variables the coefficient of θ_i should be statistically significant.

The results of the long-run equilibrium relationship are presented in Table 4 below. They show that the coefficient of LBDL is 2.39, which is positive and significant at 5% level of significance. This means that a 1% increase in BDL will increase LGDP per capita by 2.39% in the long-run. In this sense, money supply plays a significant role in promoting economic growth in Tunisia. PSC is also positive and significant at a level of 10% . This conclusion indicates that credit to private sector is also a main engine of economic growth. Facilitating credit conditions, by reducing for example constraints to access to finance, would improve the well-being of Tunisian households. When the cost of credits becomes affordable, enterprises would borrow at a lower cost and therefore, they would increase their output. As a result, they would recruit further and they will open the opportunity to unemployed people to find a job.

The ratio of investment to GDP is positive and significant at the 10 percent level. The magnitude of the coefficient implies that a 1 percent increase in investment to GDP ratio increases real GDP by 1.17 percent. This shows that reducing the cost of credits would improve the capacity of banks to borrow and this will boosts economic growth through increasing investment. Our result is in line with the findings by Sanusi and Salleh (2007) for Malaysia and Kargbo and Adamu (2009) for Sierra Leone. LM3 is found to be negative and significant at the level of 10%. This means that liquidity indicators may affect negatively the growth in the long run. This results joint the one found by Mohamed (2008) for the case of Sudan.

To summarize, the overall results reveal evidence of finance-led-growth in Tunisia in the long-run.

Table 4. Long-run elasticities

Dependent Variable: LGDPpc

Regressors	coefficients	t-value
LBDL	2.39878	-3.11503**
LM3	-1.301150	1.45086*
LPSC	0.94465	-3.38274*
LINV	1.17588	-3.27431*
C	-4.066623	

*. ** and *** Denotes the rejection of the null hypothesis at 10%, 5%, 1% level of significance respectively.

Table 5 illustrates the results only in which LGDPpc is the dependent variable. Since the optimal lag length was two, the short-run results are also presented for two lags of each variable.

The coefficient of the lagged error correction term (-0.77) is negative and statistically significant at the 1 percent level. This indicates that deviations from the short run to the long run are corrected by 77 per cent per year. The negative and significant coefficient is an indication of cointegrating relationship among LGDPpc, LM3, LCPS and LBDL investment. The results of the short-run seem interesting in the sense that only the coefficient of investment (LINV) is statistically significant at 10% level of significance. This means that in short-run, only one of these variables contribute significantly to per capita GDP, and thus to economic growth.   However, the other variables do not have any significant impact on economic growth. In this case, finance does not led to growth in the short run in Tunisia. This finding joint the one found by Chistopoulos and Tsionas (2004) for a panel of 10 developing countries and the study of Khan et al (2005) for Pakistan

**Table 5. ECM results based on Johansen cointegration**

Regressor	Coefficient	t-value
ΔLBDL (1)	-0.057	-0.23571
ΔLBDL (2)	-0.235	-0.99611
ΔLM 3 (1)	-0.1729	-0.79733
ΔLM3 (2)	0.098	0.48
ΔLINV (1)	0.14	2.0193**
ΔLINV (2)	-0.026	-0.29
ΔLPSC (1)	0.075	0.64
ΔLPSC (2)	0.07	0.63
ECM	-0.77	-2.55076**
C	0.06	4.21561***
Diagnostic tests	**t-stats**	**p-value**
White Test	0.7581	0.6772
Normality	0.4936	0.7812
Serial Correlation	1.1822	0.3191
ARCH	0.3063	0.7378
R2	0.781	

Note: ***, **and * indicate the rejection of null-hypothesis at 1%, 5% and10% significance levels, respectively.

The stability of the ECM model was checked by various diagnostic tests. The results are reported in the lower part of Table 5, which confirm that the model has the aspiration econometric properties: it has a correct functional form and the model's residuals are serially uncorrelated, normally distributed and homoskedastic. Moreover, R2 shows that the model is a relatively good fit. Hence, the results reported are valid for reliable interpretation. Finally, the stability of model is also checked by applying Cumulative Sum of Recursive Residual (CUSUM) and Cumulative Sum of Squares of Recursive Residual (CUSUMQ) techniques based on equation (4) of the error correction model and they also show that the model is stable
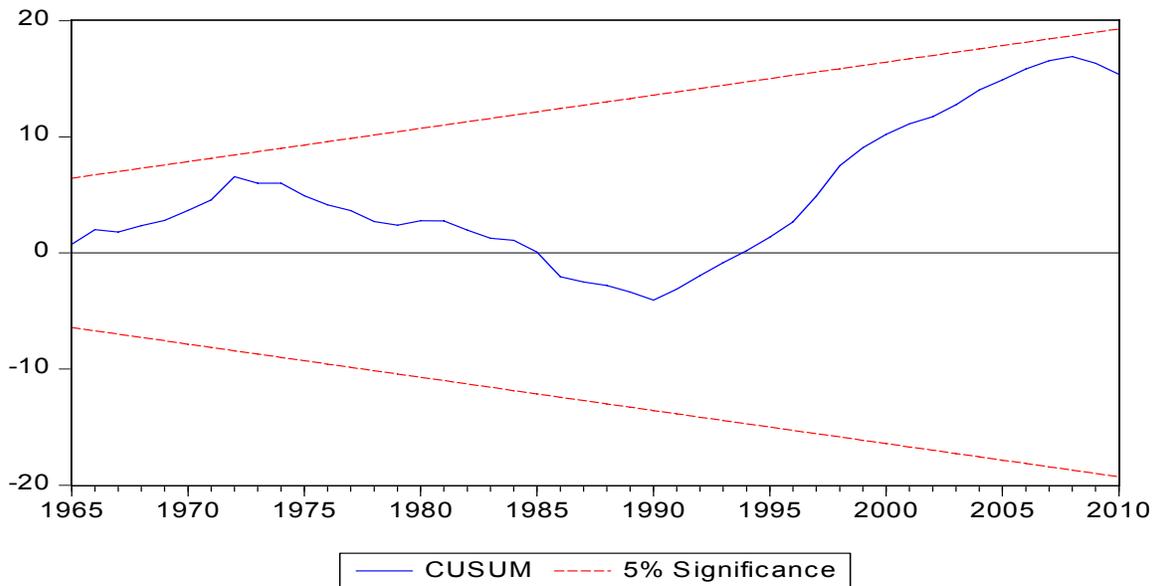
Figure 3. Plot of Cumulative Sum of Recursive Residuals
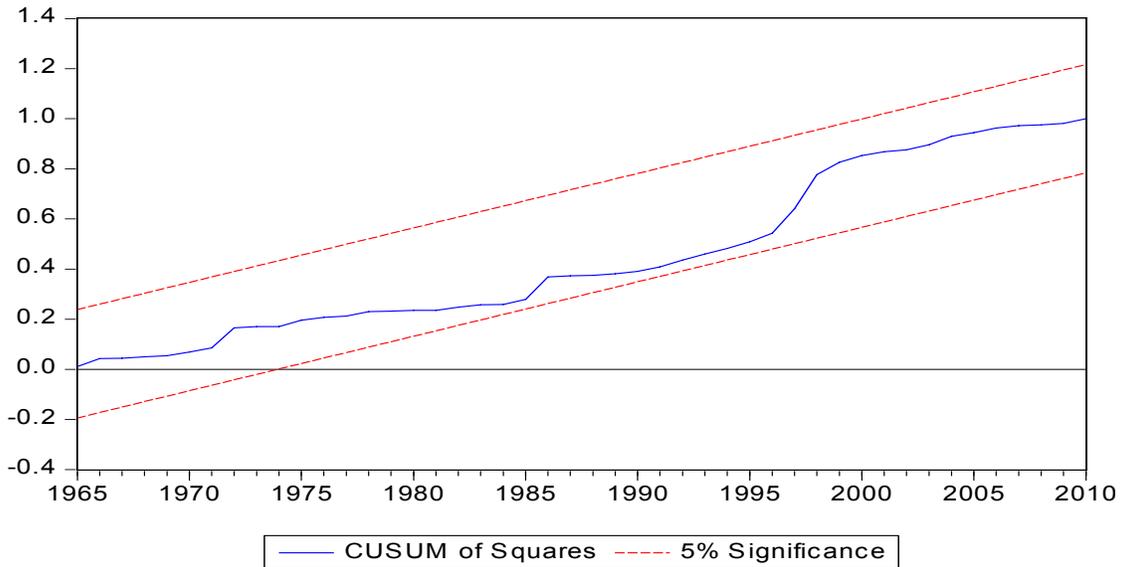
Figure 4. Plot of Cumulative Sum of Squares of Recursive Residuals

In the next step of analysis, we will inspect the direction of causality between the different variables of the model. The basic methodology requires conducting three Granger causality tests: short-run causality long-run causality and the joint short and long run. The first test reveals the significance of the sum of lagged terms of each explanatory variable by the mean of joint Fisher

test; the second test indicates the significance of the error correction term by the mean of the t-test and finally the third test is the short-run adjustment to restore the long-run equilibrium. Table 6 illustrates the results of the all these causality tests.

Table 6. Results of the causality tests for Tunisia

Variable	Short run (F-stats)					ECT (t-stat)	Joint short and long run (F-stats)				
	ΔLGDPpc	ΔLPSC	ΔLBDL	ΔLM3	ΔLINV		ΔLGDPcc & ECT	ΔLPSC & ECT	ΔLBDL& ECT	ΔLM3 & ECT	ΔLINV & ECT
ΔLGDPpc	-	0.345	0.632	0.921	2.403*	-2.55**	-	2.77**	2.129*	2.391*	2.941**
ΔPSC	1.682	-	0.494	0.534	1.432	-1.73*	2.1628*	-	0.632	0.381	0.9621
ΔLBDL	3.86**	0.424	-	0.088	0.660	-1.67	1.684	0.885	-	0.365	0.755
ΔLM3	0.975	1.102	0.523	-	0.606	-3.17***	2.562*	1.112	1.179	-	0.824
ΔLINV	2.721*	2.493*	0.819	1.415	-	-2.08**	5.292***	7.801***	5.31***	6.41***	-

*, **, *** Denote the rejection of the null hypothesis at 10%, 5%, 1% level of significance, respectively.

The F-statistics for the short-run dynamic reveals a bi-directional causality between investment and GDPpc. This means that there exists a dynamic liaison between the two variables. Otherwise, investment activities lead to growth and growth increase the incitation for investing. The adoption of the Structural Adjustment Programs proposed by the IMF in 1987 and the adoption of several structural reforms in all the banking and financial sectors have motivated investors to invest. The Tunisian government has also implemented attractive economic environment and improved some regulatory conditions for foreign direct investment to attract international companies and to encourage doing business in Tunisia. This conclusion confirms our results found in table 5 in which investment led to economic growth in the short-run. Results of Table 6 also show evidence of a unidirectional causality running from LBDL to LGPDpc which reflects the positive and significant impacts of bank deposit liabilities in promoting economic growth. The table 6 also reveals a unidirectional Granger causality running from LINV to LPSC. This means that the dynamic of investment activities encourage banks to allocate credits. As we mentioned in the theoretical background section, capital inflows and the boom of investments in Tunisia were associated with an increase in credits distribution by banks. This environment has promoted the role of banks in Tunisian economy and gave them more power.

Regarding error correction results, it is found to be negative and significant for all the VECMs except in LBDL equation. In this context, LBDL appears to be weakly exogenous. Turning now to the right side of table 6, Results of the significance of interactive terms of change in all the variables along with the ECT in the GDP equation are consistent with the presence of Granger-causality running from LPSC, LINV, LBDL and LM3 to GDP per capita. This means that all the variables have positive and significant long-run impacts on the level of GDP per capita in the Tunisian context. Similar results were found in the LINV equation. This finding reveals the existence of a bidirectional relationship between investment and economic growth. We also confirm the presence of double bidirectional Granger causality in the long-run: the first one running from LPSC to GDP while the second is running from M3 to GDP. To conclude, overall empirical results reveal the positive relationship between the financial development, investment activities and economic growth for the Tunisian context.

4.3 Impulse Response Functions

In order to capture the responsiveness of a series in the presence of a shock in one of the variable beyond the selected time period, we use the generalized impulse response analysis using vector autoregressive (VAR). This generalized impulse response analysis was proposed by Pesaran and Shin, (1998). Several economists stated that with VAR framework, generalized impulse response analysis provides better results compared to other traditional approach (Engle and Granger, 1987). We can mention two raisons, which make this approach superior when compared to orthogonalized impulse response analysis. First raison, the variable ordering does not affect the results because ordering of the variables is determined only by VAR systems. Second raison, is that the generalized impulse response analysis computes the simultaneous shock effects.

The Generalized impulse response functions (GIFRs) is presented in Fig. 5. The chart illustrates the response of each variable of the VAR and the impact of other variables. The GIRFs provided the support of causality status between financial development, investment and economic growth in the VECM system.

5. Conclusion

The purpose of this study is to investigate whether the development of the Tunisian financial sector promoted economic growth during the period 1961-2010. The empirical analysis was conducted through an econometric model based on Error Correction Model and cointegration to detect long run and short run causality between variables of our study. The basic unit root tests (ADF and PP) as well as the structural breaks unit root test based on Clemente-Montanes-Reyes (1988) have been conducted to test the integrating order of all the variables. The results of the short-run causality is found from investment to GDP, and the vice versa. Hence, there is an evidence of bidirectional Granger causality which explains the dynamic liaison between the two variables. This result is in line with the findings by Sanusi and Salleh (2007) for Malaysia, Krgbo and Adamu (2009) Sierra Leone and Odhiambo (2009) for the case of South Africa. Regarding the other variables, they did not affect economic growth. In this sense, financial sector development does not contribute to economic growth in the short-run and show that the Tunisian banking sector needs further structural reforms and the implementation of new policy measures to facilitate the development of the sector for economic growth. Several empirical studies have found similar results such as the of paper Chistopoulos and Tsionas (2004) for the case of 10 developing countries and the study of Khan *et al* (2005) for the case of Pakistan.

Regarding the long run estimation, we found evidence of finance-led-growth in Tunisia as LCPS and LBDL impact positively and significant economic growth. The positive and statistically significant effect of financial development is supportive of the supply-leading hypothesis in accordance with the predictions by McKinnon (1973) and Shaw (1973). However, LM3 is found to be negatively and significantly associated to economic growth. This results finding joint the one found by Mohamed (2008) for the case of Sudan. It appears from the long-run estimation that credit to private sector is a main engine of economic growth. This shows that facilitating credit conditions, by reducing for example constraints to access to finance, would improve the well-being of Tunisian households. In fact, when the cost of credits became affordable, enterprises

would borrow at a lower cost and therefore, they would increase their output. As a result, they would recruit further and they will open the opportunity to unemployed people to find a job.

Response to Generalized One S.D. Innovations ± 2 S.E.
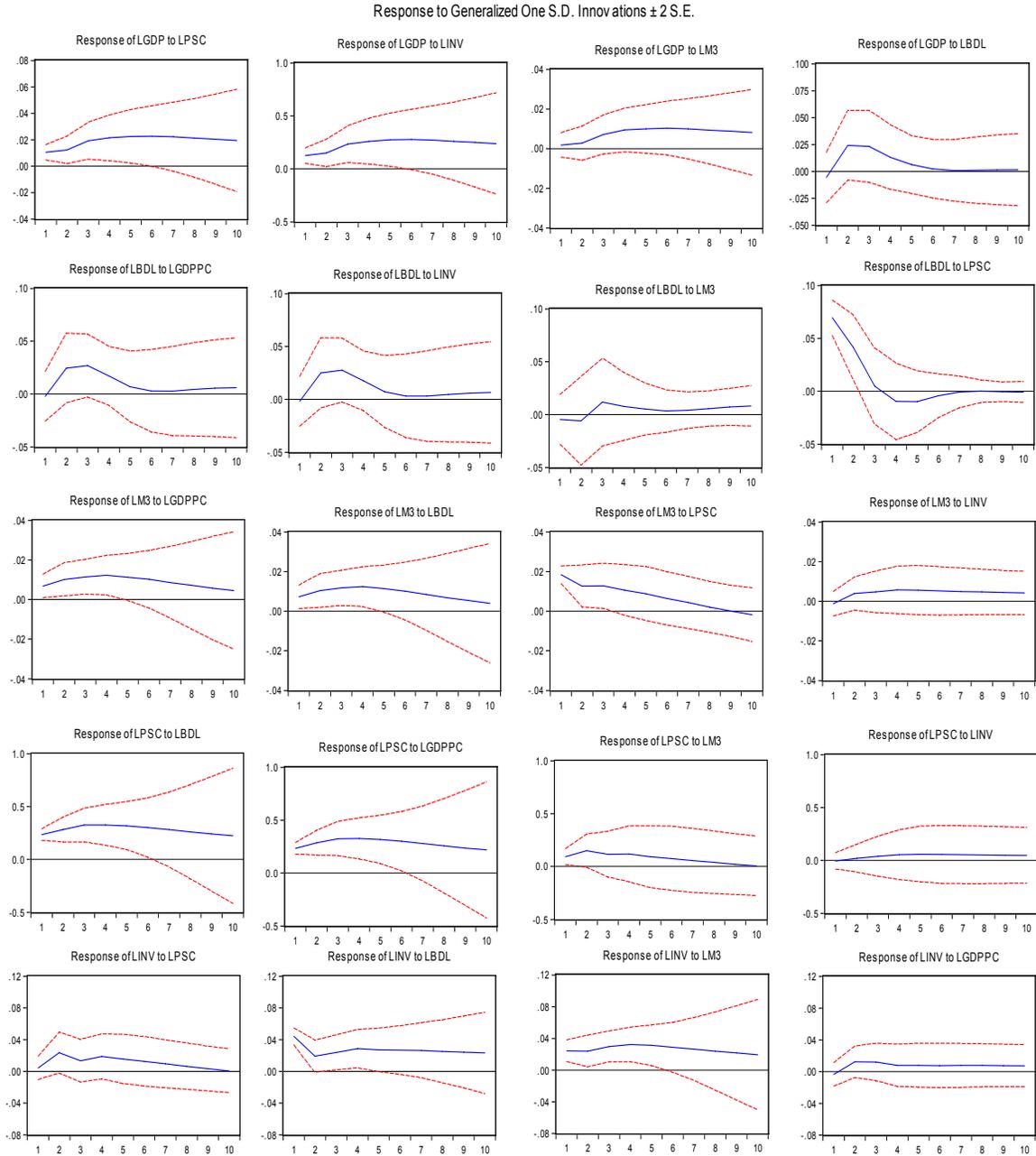
Figure 5.The impulse response functions (IFRs)

Turning now to the Granger causality analysis, one of the most important conclusions is the existence of bidirectional causality between investment and GDP. This relationship shows the crucial role of investment activities in economic growth. However, without a proper credit conditions, investment activities could be easily affected. In this condition, our results could be of great interest for Tunisian policymakers to encourage productive investment and promoting foreign direct investment, which may play a major role in the post jasmine-revolution's period where unemployment rate reached a record of 19.5%. Tunisian government with the collaboration of the central bank of Tunisia have to adopt policy mechanisms that facilitate doing business in the country and attract international investors. The non-significant relationship between finance and growth in the short-run could seriously affect the long-run economic development. Therefore, implementing effective reforms and proper strategies are necessary in the current transitional period.

References

Ang, J.B. and McKibbin, W. J. (2005), "Financial liberalization, financial sector development and growth: Evidence from Malaysia", Centre for Applied Macroeconomic Analysis (CAMA) *Working Paper 5,* Australian National University.

Arestis, P. and P. Demetriades (1997), "Financial Development and Economic Growth, Assessing the Evidence", *Economic Journal*, 107(442), 783-799.

Bangake C and Eggoh JC (2011), "Further evidence on finance-growth causality: A panel data analysis", *Economic Systems* 35 (2011) 176–188

Beck T, Levine R, Loayza N (2000), "Finance and the sources of growth", *Journal of Financial Economics 58 (2000).*

Cook, W. D, Hababou M and Roberts G (2000), Financial Liberalization and Efficiency in Tunisian Banking Industry: DEA Tests. WP Schulich School of Business York University.

Demetriades, P. and K. Hussein (1996), "Does Financial Development cause Economic Growth? Time Series Evidence from 16 countries", *Journal of Development Economics,* 51, 387-411.

Demirgüç-Kunt, A., Levine, R., (2008), Finance, financial sector policies, and long-run growth. Policy Research, *Working Paper 4469*, The World Bank Development Research Group, Finance and Private Sector Team. January.

Dickey, D.A. and W.A. Fuller (1981), "Likelihood Ratio Statistics for Autoregressive Time Series with a Unit Root", *Econometrika*, 49 (4), 1057 – 1072.

Christopoulos, D. K. and Tsionas, E. G. (2004), "Financial development and economic growth: Evidence from panel unit root and cointegration tests", *Journal of Development Economics,* 73, 55-74.

Ghali K. H (1999), "Financial Development and Economic Growth: The Tunisian Experience", *Review of Development Economics, 3(3), 310–322, 1999.*

Goldsmith R.W. (1969), *Financial Structure and Development*, Yale Univ. Press, New Haven.

Gurley, J.G. and E.S. Shaw (1955), *Money in a Theory of Finance*, Washington, D.C: The Brookings Institution.

Gurley, J. and E. Shaw (1967), "Financial Structure and Economic Development", *Economic Development and Cultural Chang*e, 34(2), 333-346.

Johansen, S. (1988), "Statistical Analysis of Cointegrating Vectors", *Journal of Economic Dynamics and Control,* 12, 231-254.

Esso L J (2010), "Re-Examining The Finance-Growth Nexus:Structural Break, Threshold Cointegration and Causality Evidence from the Ecowas", *Journal of Economic Development* 57 Volume 35, Number 3, September 2010

Johansen, S. (1992), "Testing Weak Exogeneity and Order of Cointegration in UK Money Demand Data", *Journal of Policy Modeling,* 14, 313-334.

Johansen, S. and K. Juselius (1990), "Maximum Likelihood Estimation and Inference on Cointegration with Applications to Demand for Money." *Oxford Bulletin of Economics and Statistics*, Vol.52, May, pp. 169 – 210.

Jung, W.S. (1986), "Financial Development and Economic Growth: International Evidence", *Economic Development and Cultural Change,* 34(2), 333-346.

Haldrup, N and Jansson, M (2005), Improving Size and Power in the Unit Root Testing. *Aarhus University Economics Paper* No. 2005-02.

Hakimi A, Hamdi H and Djelassi M (2012), "Modelling non-interest income at Tunisian banks", *Asian Economic and Financial Review*, 2(1),pp.88-99.

Hamdi H, Sbia R, Hakimi A and Hakimi A (2013), "Multivariate Granger causality between FDI and Economic Growth in Tunisia", *Economics Bulletin,* Vol. 33 No. 2 pp. 1193-1203.

Kar, M. and E.J. Pentecost (2000), "Financial Development and Economic Growth in Turkey: Further Evidence on Causality Issue", Department of Economics, *Economic Research Paper*, No. 00/27, University of Loughborough.

Kargbo S M And Adamu P A (2009), "Financial Development and Economic Growth in Sierra Leone", *Journal of Monetary and Economic Integration.* Volume 9, Issues 2-3, December 2009, Pages 30-67.

Khan, S. M. and Senhadji, S. (2002), "Financial Development and Economic Growth: An Overview", IMF Working Paper wp/ 00/209. International Monetary Fund.

King R.G. and R. Levine (1993a), "Finance and Growth: Schumpeter Might Be Right", *Quarterly Journal of Economics*, 108 (3) 717-737.

King R.G. and R. Levine (1993b), "Finance, Entrepreneurship and Growth: Theory and Evidence", Journal of Monetary Economics, 32, 513-542. *European Journal of Social Sciences – Volume 7, Number 2 (2008)* 183

Levine, R., Loayza N. and Beck, T. (2000), "Financial Intermediation and Growth: Causality and Causes", *Journal of Monetary Economics,* 46, 31-77.

Levine, R. and S. Zervos (1996), "Stock Market Development and Long-Run Growth", *The World Bank Economic Review* 10, 323-339.

Levine, R. and S. Zervos (1998), "Stock Markets, Banks and Economic Growth", *American Economic Review* 88, 537-558.

Levine, R., N. Loayza and T. Beck (1999), *Financial Intermediation and Growth: Causality and Cause*s, www.worldbank.org/research.

Liang, Q. and Teng, J.Z. (2006), "Financial development and economic growth: Evidence from China", *China Economic Review*, 17, pp. 395-411.

Luintel, K. B. and M. Khan (1999), "A Quantitative Reassessment of the Finance-Growth Nexus: Evidence from a Multivariate VAR", *Journal of Development Economics*, Vol. 60, pp. 381-405.

McKinnon, R.I. (1973), *Money and Capital in Economic Development*, The Brookings Institution, Washington D.C.

Mohamed, S. E. (2008), "Financial-growth nexus in Sudan: empirical assessment based on an autoregressive distributed lag (ARDL) model", Arab Planning Institute *Working Paper Series* 0803,

Moore C. H. (1991), "Tunisian Banking: Politics of Adjustment and the Adjustments of Politics", In *Tunisia, The Political Economy of Reform*, edited by I. William Zartman, Lynne Rienneer Publishers.

Odhiambo, NM (2011), "Financial Deepening, Capital Inflows and Economic Growth Nexus in Tanzania: A Multivariate Model", *Journal of Social Sciences,* Vol. 28, Number 1.

Odhiambo, N.M. (2010), "Finance-Investment-Growth Nexus in South Africa: An ARDL-bounds Testing Approach", *Economic Change and Restructuring* Vol. 43.

Phillips, P.C.B. and P. Perron (1988), "Testing for a Unit Root in Time Series Regression", *Biometrika* 75 (2) 336-346.

Sanusi, N. A and Sallah, N. H. M. (2007), "Financial development and economic growth in Malaysia: An application of ARDL approach', [Online], available: http://www.ibacnet.org/bai2007/proceedings/Papers/2007bai7443.doc

Schumpeter, J.A. (1911), *The Theory of Economic Development*, Harvard University Press.

Wolde-Rufael Y (2009), "Re-examining the financial development and economic growth nexus in Kenya", *Economic Modelling* 26 (2009) 1140–1146

World Bank (2012), *World Development Report*, New York: Oxford University Press.

◆ ◆ ◆