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The relationship between Trade, FDI and Economic growth in Tunisia: An application of autoregressive distributed lag model

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Abstract:

This paper examines the dynamic causal relationships between foreign direct investment (FDI), trade and economic growth in Tunisia by applying the bounds testing (ARDL) approach to cointegration for the period from 1970 to 2008. The bounds tests suggest that the variables of interest are bound together in the long-run when foreign direct investment is the dependent variable. The associated equilibrium correction was also significant confirming the existence of long-run relationship. The results indicate also that there is no significant Granger causality from FDI to economic growth, from economic growth to FDI, from trade to economic growth and from economic growth to trade in the short run.

Key words: FDI, trade, economic growth, ARDL cointegration, Tunisia.

JEL classification: C22, F13, F21.

1. Introduction

Trade and FDI inflows are well known as very important factors in the economic growth process. Trade plays the role of upgrading skills through the importation and adoption of superior production technology and innovation. Exporters use innovation and developed production technology either by acting as subcontractors to foreign enterprises or through international markets competition. Producers of import-substitutes face competition from foreign firms. They are pushed to adopt more capital-intensive production facilities to face the hard competition in developing countries where products are usually capital-intensive (Frankel and Romer, 1999). The impact of trade openness on economic growth can be positive and significant due mainly to the accumulation of physical capital and technological transfer.

Inward FDI can play an important role by increasing and augmenting the supply of funds for domestic investment in the host country. This is can be done through production chain when foreign investors buy locally made inputs and sell intermediate inputs to local enterprises. Furthermore, inward FDI can increase the host country's export capacity causing the developing country to increase its foreign exchange earnings. FDI can also encourage the creation of new jobs and enhance technology transfer and boosts overall economic growth in host countries.

The majority of past empirical studies have dealt with either trade and FDI interaction on economic growth (Balasubramanyam et al., 1996; Karbasi et al., 2005), or the relationship between FDI and economic growth (Lipsey, 2000) or the relationship between trade and economic growth (Pahlavani, et al., 2005). All these studies have concluded that both FDI inflows and trade promote economic growth. However, the studies have failed to provide a conclusive result on the relation in general and the direction of the causality in particular in many developing countries. The growth enhancing effects from FDI inflows and trade vary from country to country and overtime. For some countries FDI and trade can even negatively affect the economic growth (Balasubramanyam et al., 1996; Borensztein et al., 1998; Lipsey, 2000; De Mello, 1999; Xu, 2000).

Some past studies on this subject suffer from two limitations. The first limit is that these studies used cointegration techniques based on either the Engle and Granger (1987) cointegration test or the maximum likelihood test based on Johansen (1988) and Johansen and Juselius (1990). Or, these cointegration techniques may not be appropriate when the sample

size is too small (Odhiambo, 2009). Odhiambo (2009) uses the bounds testing cointegration approach developed by Pesaran et al. (2001) which is more robust for the small sample. The second limit is that by using cross-sectional data some studies do not address the country specific issues (Odhiambo, 2009; Ghirmay, 2004; Casselli et al., 1996).

The current study investigates the dynamic causal relationship between trade, FDI and economic growth in Tunisia by implementing the newly developed ARDL-Bounds testing approach to cointegration. Trade and FDI are expressed as a ratio of GDP. The proxy of economic growth is real GDP per capita. Labour and capital investments are also considered in the model. The Granger procedure is used to test the direction of causality within the Vector Error Correction Model (VECM). If a set of variables is cointegrated, they must have an error correction representation wherein an error correction term (ECT) must be incorporated in the model (Engle and Granger, 1987). The advantage of VECM is the reintroduction of the information lost by differencing time series. This step is fundamental to investigate the short-run dynamics and the long run equilibrium.

Despite the abundant literature on FDI, trade and economic growth in many emerging and developing countries, there is little empirical work on this subject in Tunisia. By contrasting the big role of FDI inflows, we can draw important lessons and guidelines for policy makers in their pursuit for a more effective scheme to promote economic growth in Tunisia which is suffering from a huge ratio of unemployment. What role that can play FDI and trade in the New Tunisia to meet the challenges that the revolution spawned? This study will add valuable knowledge to the existing literature in Tunisia. The study is relevant because the twin policy targets of FDI attraction and trade liberalisation have been integral preoccupation of Tunisia since the IMF Structural Adjustment Programme of 1986 and continue to be after the revolution of 14th January 2011.

The rest of the paper is structured as follows: Section 2 presents a brief literature review. Section 3 gives an overview of Tunisian's foreign direct investment and regional trade agreements. Section 4 describes the used data, while section 5 deals with the estimation technique and the empirical analysis of the results. Section 6 concludes the paper.

2. A brief literature review

The literature studying the impacts of FDI and trade on economic growth is very large. The effect of each one of the two variables of FDI and trade on economic growth has generally been studied for many countries using various sample periods and econometric approaches and methods. The results of some papers studying the effects of trade (or exports) and FDI on economic growth in developing countries are promising (Balassa, 1985; Sengupta and Espana, 1996). There is evidence for the export-led growth hypothesis (ELGH) and FDI-led growth hypothesis (FLGH). These hypotheses, which are supported, are based on the idea that exports and FDI variables are the main drivers of economic growth.

Ghirmay et al. (2001) studied the relationship between exports and economic growth in nineteen developing countries. Their results supported a long-run relationship between the two variables only in twelve of the developing countries and the promotion of exports attracted investment and increased GDP in these countries. By using a bivariate technique, Mamun and Nath (2003) found a long-run unidirectional causality from exports to economic growth in Bangladesh. Narayan et al. (2007) examined the export-led growth hypothesis for Fiji and Papua New Guinea. Their results support the ELGH in the long-run for Fiji, while for Papua New Guinea there is evidence of ELGH in the short-run.

Empirical researches, which have studied FLGH, have found that FDI promotion can greatly benefit host countries by the introduction of new technologies and skills, the creation of new jobs, surging domestic competition and expanding access to international marketing networks. According to Blomstrom et al. (1992), FDI promotes economic growth when the host economy is a developed one. The findings of Boyd and Smith (1992) are that FDI may affect negatively growth due to misallocation of resources in the presence of some distortions in pre-existing trade, price and others. Borensztein et al. (1998) studied the effect of FDI on economic growth in a cross-country regression approach. According to their findings, FDI can be an important tool and a channel to the transfer of modern technology, but its effectiveness depends on the stock of human capital in the host country. By referring to Nair-Reichert and Weinhold (2001) findings, the causal relationship between foreign and domestic investment and economic growth in developing countries is heterogeneous. The authors justify these results by the homogeneity of assumptions imposed across countries. By using new statistical

techniques and two new databases to reassess the relationship between economic growth and FDI, Carkovic and Levine (2002) found that there is no evidence of FLGH.

According to Anthukorala (2003), FDI had a positive effect on GDP and a unidirectional causality running from GDP to FDI in Sri Lanka. The finding of Baliamoune-Lutz (2004) is that the impact of FDI on economic growth is positive and there is a bidirectional relationship between exports and FDI in Morocco. This result implies that FDI can also promote exports and vice versa. Also, some authors have studied the relationship between regional integration and FDI. Darrat et al. (2005) investigated the impact of FDI on economic growth in Central and Eastern Europe (CEE) and the Middle East and North Africa (MENA) regions. They found that FDI inflows stimulate economic growth in EU accession countries, while the impact of FDI on economic growth in MENA and in non-EU accession countries is either non-existent or negative. Similar to that of Darrat et al. (2005), Hisarciklilar et al. (2006) don't find causality between FDI and GDP for most of the following Mediterranean countries of Algeria, Cyprus, Egypt, Israel, Jordan, Morocco, Syria, Tunisia and Turkey for the period of 1979-2000. These countries could create an environment that attract FDI and lead to the transfer of technology and skills and increase production, creation of new jobs and exports.

Research examining the impacts of exports and FDI on GDP within the same model has also concluded ambiguous results. For example, by referring to Alia and Dcal (2003), there is evidence of ELGH for Turkey but not FLGH because the spillover effects from FDI to GDP are not present. In the Latin American countries (Argentina, Brazil, and Mexico), Alguacil et al. (2000) found that the FLGH is confirmed but not ELGH. The authors found that FDI promotes economic growth and trade. Dritsaki and Adamopoulos (2004) found a unidirectional causal relationship from FDI to economic growth and a bidirectional causal relationship between exports and economic growth for Greece. According to Yao (2006), there is a strong relationship between exports, FDI and economic growth for China. Rahman (2007) re-examined the effects of exports, FDI and expatriates' remittances on real GDP of some Asian countries (Bangladesh, India, Pakistan and Sri Lanka) using the ARDL technique for cointegration for the period of 1976-2006. The ARDL technique confirmed cointegrating relationship among variables in these three countries. The short-run net effects of exports on real GDP of Bangladesh are more visible than those of FDI. The same apply to India as well with some minor exceptions for relatively stronger short-run effects. In the case of Pakistan, FDI was found to exert net restrictive effects on its real GDP, though not highly significant. For Sri Lanka, FDI was found to have consistently restrictive effects on real GDP.

Alalaya (2008) investigated the relationship between economic growth, trade and FDI for Jordan for the period of (1990 -2008) by applying the ARDL model for cointegration. He found a unidirectional causal effect from trade and FDI to economic growth. It was also found that the speed of adjustment in the model is 0.587 and it seems relatively high and significant.

3. Tunisian's foreign direct investment and regional trade agreements

During the last decades, many measures have been adopted by Tunisian government to attract FDI inflow by the belief that this inflow will introduce modern technology, enhance productivity and stimulate export-led growth. Tunisian's structural adjustment plan was set in 1986. It has led to encourage standard fiscal and monetary policy reforms and liberalization of financial sector. This programme has characterized the moving forward of Tunisia's economic development. A policy of gradual trade liberalization was pursued, first by implementing current account convertibility, followed by accession to the GATT agreements and by a free trade association with the European Union in 1995, which went into effect on January 1, 2008. The objective of the agreement is to eliminate customs tariffs and other trade barriers on a wide range of goods and services. However, the most important aspect of the association agreement may well be that it has served to anchor Tunisia's commitment to reforms.

"Tunisia provided a wide range of incentives such as a tax relief up to 35 percent on reinvested revenues and profits (30 percent starting from 2007), exemptions from customs duties and a 10 percent reduction of VAT for imported capital goods having no Tunisian manufacturing equivalent, a suspension of VAT and sales tax on locally produced equipment at company start-up and an optional depreciation scheduling for capital equipment older than seven years. Additional incentives are provided to off-shore industries or totally exporting industries such as full exemption on corporate profits earned on export for the first ten years and 50 percent reduction thereafter (granted also to partially exporting firms), full tax exemption on reinvested profits and income, total exemption from customs duties on imported capital goods, raw materials, semi finished goods and services necessary for business" (Ghali and Rezgui, 2007).

According to Ghali and Rezgui (2007), the net FDI flows to GDP attained 2.2% in 1990. About 80 percent of FDI was mainly oriented to the petroleum and gas sector until the first half of the 1990's. Due to the privatization program, the share of total FDI in the petroleum

and gas sector decreased and attained 58 percent in 1998. There is an FDI shift to manufacturing sector.

The largest foreign investor in Tunisia is the European Union (EU). Its FDI is mainly oriented to the development of the infrastructure network and the textiles and clothing sectors.

Trade openness is important as a vehicle for technological spillovers. In order to benefit from trade openness, Tunisia needs to have trade partners that are capable to provide it with technology embodied in products, machines and equipments in which the country is in short supply. So, by importing capital equipment and intermediate products from developed countries that have a larger stock of knowledge, Tunisia can improve its own stock of knowledge.

Tunisia has been a member of the WTO since March 1995. In order to benefit from trade openness, Tunisia signed a Euro-Mediterranean Association Agreement (AA) with the European Union in July 1995. It was the first country to sign an AA with the EU among the South Mediterranean countries which are engaged in the Barcelona Process. However, this agreement was ratified and entered into force in March 1998. The main objective of the AA is liberalisation and facilitation of the exchange of goods, services and capital. Already, Tunisia finished the tariffs dismantling for industrial products in 2008.

The first trading partner of Tunisia is the EU. The main exports of Tunisia to the EU are manufactured products, raw energy and phosphate, and agricultural products. It accounted for about 80% of its exports in 2008 and experienced a growth rate of more than 9% from 2003 to 2008. The main imports of Tunisia from the EU are machinery and transport equipment, textiles, chemicals and refined energy. These imports accounted for near 65% of Tunisian's needs in goods from EU countries and grew at an estimated average annual rate of 7.2% (Boughzala, 2010).

On the other side Tunisia has some international trade relations with some Arabic countries. Tunisia signed a bilateral agreement with Libya which entered into force in 2002. It signed the Agadir agreement with Morocco, Egypt and Jordan in 25 February 2004. This committed all partners to removing substantially all tariffs on trade between them and to harmonizing their legislation with regard to standards and customs procedures. Even this agreement entered into force in July 2006, its effective implementation did start only in April 2007. Tunisia signed also a free trade agreement with a Middle East country which is Turkey in November 2004. This agreement replaced the old one, which was signed in 1992, and entered into force in July 2005.

The Tunisia's Euro-Med agreement with the EU can increase the openness of the Tunisian economy and hence increase FDI inflows to Tunisia. The aim of Mediterranean countries was to create an environment which can attract FDI that could lead to the transfer of technology and increase production, creation of new jobs and exports. This objective is our main motivation to investigate FDI-economic growth relationship in Tunisia. In this study we try to see if FDI shift has beneficial effects for employment, trade, and economic growth in Tunisia.

4. Data sources and description of variables

Annual time series data on economic growth, FDI, trade, labour and capital stock, which cover the 1970-2008 period, have been used in this study. The data has been obtained from different sources, including Tunisia Central Bank annual reports, quarterly bulletins, etc. In addition, different volumes of the International Financial Statistics (IFS) Yearbook, published by the International Monetary Fund, and World Development Indicators 2009 edition published online by the World Bank have been used to supplement the local data.

The economic growth variable, which is measured by real GDP per capita, is noted by Y. FDI is the value of real gross foreign direct investment inflows to GDP ratio; Trade openness is the total sum of exports and imports divided by GDP; L is measured as the volume of the total labour force; capital stock (K) is measured by the real value of gross fixed capital formation (GFCF).

5. Econometric methodology and empirical results

5.1. Unit roots tests

In time series analysis, before running the causality test the variables must be tested for stationarity. For this purpose, in this current study we use the conventional ADF tests, the Phillips-Perron test following Phillips and Perron (1988) and the Dickey-Fuller generalised least square (DF-GLS) de-trending test proposed by Elliot et al. (1996).

The ARDL bounds test is based on the assumption that the variables are I(0) or I(1). So, before applying this test, we determine the order of integration of all variables using the unit root tests. The objective is to ensure that the variables are not I(2) so as to avoid spurious results. In the presence of variables integrated of order two, we cannot interpret the values of F statistics provided by Pesaran et al. (2001).

The results of the stationarity tests show that all variables are non-stationary at level. These results are given in Table 1. The ADF, the Phillips-Perron and DF-GLS tests applied to the

first difference of the data series reject the null hypothesis of nonstationarity for all the variables used in this study (Table 2). It is, therefore, worth concluding that all the variables are integrated of order one.

Table 1. ADF and DF-GLS unit root tests on log levels of variables

| Variables | ADF test | | | DFGLS test | | | PP test | |
	SIC lag	t-Stat	Critical value at 5%	SIC lag	t-Stat	Critical value at 5%	t-Stat	Critical value at 5%
Ln(Y)	0	-2.40***	-3.53	0	-1.75***	-3.19	-2.55***	-3.53
Ln(K)	1	-3.14***	-3.53	1	-2.52***	-3.19	-2.01**	-2.94
Ln(L)	0	-2.18**	-2.94	0	-0.92***	-3.19	-2.20**	-2.94
Ln(F)	0	-2.79**	-2.94	0	-2.73**	-1.95	-2.76**	-2.94
Ln(T)	1	-3.17***	-3.53	1	-2.58***	-3.19	-2.53***	-3.53

*model without constant and trend, **model without trend, ***model with constant and trend

Table 2. ADF and DF-GLS unit root tests on first differences of log levels of variables

| Variables | ADF test | | | DFGLS | | | PP test | |
	SIC lag	t-Stat	Critical value at 5%	SIC lag	t-Stat	Critical value at 5%	t-Stat	Critical value at 5%
Ln(Y)	0	-6.21**	-2.94	1	-3.07**	-1.95	-6.26**	-2.94
Ln(K)	0	-3.73**	-2.94	0	-3.62**	-1.95	-3.24*	-1.95
Ln(L)	0	-5.58**	-2.94	0	-5.62**	-1.95	-5.59**	-2.94
Ln(F)	0	-7.82*	-1.95	0	-7.66**	-1.95	-10.80*	-1.95
Ln(T)	0	-4.87**	-2.94	0	-4.89**	-1.95	-4.47*	-1.95

*model without constant and trend, **model without trend, ***model with constant and trend

5.2.   ARDL Bounds tests for cointegration

In order to empirically analyse the long-run relationships and short run dynamic interactions among the variables of interest (trade, FDI, labour, capital investment and economic growth), we apply the autoregressive distributed lag (ARDL) cointegration technique as a general

vector autoregressive (VAR) model of order p, in Z_t, where Z_t is a column vector composed of the five variables: $Z_t = (Y_t \; K_t \; L_t \; F_t \; T_t)'$. The ARDL cointegration approach was developed by Pesaran and Shin (1999) and Pesaran et al. (2001). It has three advantages in comparison with other previous and traditional cointegration methods. The first one is that the ARDL does not need that all the variables under study must be integrated of the same order and it can be applied when the under-lying variables are integrated of order one, order zero or fractionally integrated. The second advantage is that the ARDL test is relatively more efficient in the case of small and finite sample data sizes. The last and third advantage is that by applying the ARDL technique we obtain unbiased estimates of the long-run model (Harris and Sollis, 2003). The ARDL model used in this study is expressed as follows:

$$D(\ln(Y_t)) = a_{01} + b_{11}\ln(Y_{t-1}) + b_{21}\ln(K_{t-1}) + b_{31}\ln(L_{t-1}) + b_{41}\ln(F_{t-1}) + b_{51}\ln(T_{t-1}) + \sum_{i=1}^{p} a_{1i}D(\ln(Y_{t-i}))$$

$$+ \sum_{i=1}^{q} a_{2i}D(\ln(K_{t-i})) + \sum_{i=1}^{q} a_{3i}D(\ln(L_{t-i})) + \sum_{i=1}^{q} a_{4i}D(\ln(F_{t-i})) + \sum_{i=1}^{q} a_{5i}D(\ln(T_{t-i})) + \varepsilon_{1t} \qquad (1)$$

$$D(\ln(K_t)) = a_{02} + b_{12}\ln(Y_{t-1}) + b_{22}\ln(K_{t-1}) + b_{32}\ln(L_{t-1}) + b_{42}\ln(F_{t-1}) + b_{52}\ln(T_{t-1}) + \sum_{i=1}^{p} a_{1i}D(\ln(K_{t-i}))$$

$$+ \sum_{i=1}^{q} a_{2i}D(\ln(Y_{t-i})) + \sum_{i=1}^{q} a_{3i}D(\ln(L_{t-i})) + \sum_{i=1}^{q} a_{4i}D(\ln(F_{t-i})) + \sum_{i=1}^{q} a_{5i}D(\ln(T_{t-i})) + \varepsilon_{2t} \qquad (2)$$

$$D(\ln(L_t)) = a_{03} + b_{13}\ln(Y_{t-1}) + b_{23}\ln(K_{t-1}) + b_{33}\ln(L_{t-1}) + b_{43}\ln(F_{t-1}) + b_{53}\ln(T_{t-1}) + \sum_{i=1}^{p} a_{1i}D(\ln(L_{t-i}))$$

$$+ \sum_{i=1}^{q} a_{2i}D(\ln(K_{t-i})) + \sum_{i=1}^{q} a_{3i}D(\ln(Y_{t-i})) + \sum_{i=1}^{q} a_{4i}D(\ln(F_{t-i})) + \sum_{i=1}^{q} a_{5i}D(\ln(T_{t-i})) + \varepsilon_{3t} \qquad (3)$$

$$D(\ln(F_t)) = a_{04} + b_{14}\ln(Y_{t-1}) + b_{24}\ln(K_{t-1}) + b_{34}\ln(L_{t-1}) + b_{44}\ln(F_{t-1}) + b_{54}\ln(T_{t-1}) + \sum_{i=1}^{p} a_{1i}D(\ln(F_{t-i}))$$

$$+ \sum_{i=1}^{q} a_{2i}D(\ln(K_{t-i})) + \sum_{i=1}^{q} a_{3i}D(\ln(L_{t-i})) + \sum_{i=1}^{q} a_{4i}D(\ln(Y_{t-i})) + \sum_{i=1}^{q} a_{5i}D(\ln(T_{t-i})) + \varepsilon_{4t} \qquad (4)$$

$$D(\ln(T_t)) = a_0 + b_{15}\ln(Y_{t-1}) + b_{25}\ln(K_{t-1}) + b_{35}\ln(L_{t-1}) + b_{45}\ln(F_{t-1}) + b_{55}\ln(T_{t-1}) + \sum_{i=1}^{p} a_{1i} D(\ln(T_{t-i}))$$

$$+ \sum_{i=1}^{q} a_{2i} D(\ln(K_{t-i})) + \sum_{i=1}^{q} a_{3i} D(\ln(L_{t-i})) + \sum_{i=1}^{q} a_{4i} D(\ln(F_{t-i})) + \sum_{i=1}^{q} a_{5i} D(\ln(Y_{t-i})) + \varepsilon_{5t} \qquad (5)$$

Where all variables are as previously defined in section 4, ln(.) is the logarithm operator, D is the first difference, and ε_t are the error terms.

The bounds test is mainly based on the joint F-statistic which its asymptotic distribution is non-standard under the null hypothesis of no cointegration. The first step in the ARDL bounds approach is to estimate the five equations (1, 2, 3, 4 and 5) by ordinary least squares (OLS). The estimation of the five equations tests for the existence of a long-run relationship among the variables by conducting an F-test for the joint significance of the coefficients of the lagged levels of the variables, i.e., : H_0: $b_{1i} = b_{2i} = b_{3i} = b_{4i} = b_{5i} = 0$ against the alternative one : H_1: $b_{1i} \neq b_{2i} \neq b_{3i} \neq b_{4i} \neq b_{5i} \neq 0$ for i= 1, 2, 3, 4, 5. We denote the F-statistic of the test which normalize on Y by F_Y $(Y\backslash K, L, F, T)$. Two sets of critical values for a given significance level can be determined (Pesaran et al., 2001). The first level is calculated on the assumption that all variables included in the ARDL model are integrated of order zero, while the second one is calculated on the assumption that the variables are integrated of order one. The null hypothesis of no cointegration is rejected when the value of the test statistic exceeds the upper critical bounds value, while it is accepted if the F-statistic is lower than the lower bounds value. Other ways, the cointegration test is inconclusive.

The use of this approach is guided by the short data span. We choose a maximum lag order of 2 for the conditional ARDL vector error correction model by using the Akaike information criteria (AIC). The calculated F-statistics are reported in Table 3 when each variable is considered as a dependent variable (normalized) in the ARDL-OLS regressions. Their values are: for equation (1), F_Y $(Y \backslash L, K, F, T) = 1.992$; for equation (2), F_L $(L \backslash Y, K, F, T) = 0.762$; for equation (3), F_T $(T\backslash Y, K, F, L) = 2.736$; for equation (4), F_K $(K\backslash Y, L, F, T) = 2.552$; and for equation (5), $F \backslash Y, K, L, T) = 6.701$. From these results, it is clear that there is a long run relationship amongst the variables when FDI is the dependent variable because its F-statistic (6.701) is higher than the upper-bound critical value (4.15) at the 5% level. This implies that the null hypothesis of no cointegration among the variables in equation (5) is rejected. However, for the other equations (1) - (4), the null hypothesis of no cointegration is accepted.

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Table 3: Results from bound tests

Dependant variable	AIC lags	F-statistic	Decision
F_F *(F\Y, K, L, T)*	2	6.701	Cointegration
F_Y (Y\L, K, F, T)	2	2.365	No cointegration
F_L *(L\Y, K, F, T)*	1	0.762	No cointegration
F_T *(T\Y, K, F, L)*	1	2.736	No cointegration
F_K *(K\Y, L, F, T)*	1	2.552	No cointegration
Lower-bound critical value at 1%	3.06		
Upper-bound critical value at 1%	4.15		

Lower and Upper-bound critical values are taken from Pesaran et al. (2001), Table CI(ii) Case II.

5.3. Granger short run and long run causality tests

Once cointegration is established, the conditional ARDL (*p, q₁, q₂, q₃, q₄)* long-run model for *ln(Fₜ)* can be estimated as:

$$\ln(F_t) = a_0 + \sum_{i=1}^{p} a_{1i} \ln(F_{t-i}) + \sum_{i=0}^{q_1} a_{2i} \ln(K_{t-i}) + \sum_{i=0}^{q_2} a_{3i} \ln(L_{t-i}) +$$

$$\sum_{i=0}^{q_3} a_{4i} \ln(Y_{t-i}) + \sum_{i=0}^{q_4} a_{5i} \ln(T_{t-i}) + \varepsilon_t \qquad (6)$$

Where, all variables are as previously defined. The orders of the ARDL (p, q₁, q₂, q₃, q₄) model in the five variables are selected by using AIC. Equation (6) is estimated using the following ARDL (1, 0, 0, 0, 0) specification. The results obtained by normalizing on FDI, in the long run are reported in Table 4.

Table 4. Estimated long run coefficients using the ARDL approach

Variable	Coefficient	t-statistic	Probability
C	-14.57	-1.44	0.15
Ln(Y)	0.93	0.89	0.37
Ln(L)	-1.82	-2.45	0.01
Ln(K)	1.87	2.50	0.01
Ln(T)	-1.17	-1.26	0.21

The estimated coefficients of the long-run relationship are significant for capital and labour but not significant for trade and economic growth. Capital investment has a positive significant impact on FDI at the 5% level. The labour force variable is negatively signed and significant at the 5% level. This is indicative of the growing unemployment problem and the low productivity of labour in Tunisia. Considering the impact of trade openness, it is insignificant at 5% probability and has a negative impact on FDI. Economic growth is also insignificant at 5% level and has a positive impact on FDI.

Following the research papers of Odhiambo (2009) and Narayan and Smyth (2008), we obtain the short-run dynamic parameters by estimating an error correction model associated with the long-run estimates. The long-run relationship between the variables indicates that there is Granger-causality in at least one direction which is determined by the F-statistic and the lagged error-correction term. The short-run causal effect and is represented by the F-statistic on the explanatory variables while the t-statistic on the coefficient of the lagged error-correction term represents the long-run causal relationship (Odhiambo, 2009; Narayan and Smyth, 2006). The equation where the null hypothesis of no cointegration is rejected is estimated with an error-correction term (Narayan and Smyth, 2006; Morley, 2006).

The vector error correction model is specified as follows:

$$D(\ln(F_t)) = a_0 + \sum_{i=1}^{P} a_{1i} D(\ln(F_{t-i})) + \sum_{i=1}^{q} a_{2i} D(\ln(K_{t-i})) + \sum_{i=1}^{q} a_{3i} D(\ln(L_{t-i})) +$$

$$\sum_{i=1}^{q} a_{4i} D(\ln(Y_{t-i})) + \sum_{i=1}^{q} a_{5i} D(\ln(T_{t-i})) + \alpha\ ECT_{t-1} + \varepsilon_t \qquad (7)$$

$$D(\ln(Y_t)) = a_0 + \sum_{i=1}^{P} a_{1i} D(\ln(Y_{t-i})) + \sum_{i=1}^{q} a_{2i} D(\ln(K_{t-i})) + \sum_{i=1}^{q} a_{3i} D(\ln(L_{t-i})) +$$

$$\sum_{i=1}^{q} a_{4i} D(\ln(F_{t-i})) + \sum_{i=1}^{q} a_{5i} D(\ln(T_{t-i})) + \varepsilon_t \qquad (8)$$

$$D(\ln(K_t)) = a_0 + \sum_{i=1}^{P} a_{1i} D(\ln(K_{t-i})) + \sum_{i=1}^{q} a_{2i} D(\ln(Y_{t-i})) + \sum_{i=1}^{q} a_{3i} D(\ln(L_{t-i})) +$$

$$\sum_{i=1}^{q} a_{4i} D(\ln(F_{t-i})) + \sum_{i=1}^{q} a_{5i} D(\ln(T_{t-i})) + \varepsilon_t \qquad (9)$$

$$D(\ln(L_t)) = a_0 + \sum_{i=1}^{P} a_{1i} D(\ln(Y_{t-i})) + \sum_{i=1}^{q} a_{2i} D(\ln(L_{t-i})) + \sum_{i=1}^{q} a_{3i} D(\ln(K_{t-i})) +$$

$$\sum_{i=1}^{q} a_{4i} D(\ln(F_{t-i})) + \sum_{i=1}^{q} a_{5i} D(\ln(T_{t-i})) + \varepsilon_t \qquad (10)$$

$$D(\ln(T_t)) = a_0 + \sum_{i=1}^{P} a_{1i} D(\ln(T_{t-i})) + \sum_{i=1}^{q} a_{2i} D(\ln(K_{t-i})) + \sum_{i=1}^{q} a_{3i} D(\ln(L_{t-i})) +$$

$$\sum_{i=1}^{q} a_{4i} D(\ln(F_{t-i})) + \sum_{i=1}^{q} a_{5i} D(\ln(Y_{t-i})) + \varepsilon_t \qquad (11)$$

Where a_{1i}, a_{2i}, a_{3i}, a_{4i} and a_{5i} are the short-run dynamic coefficients of the model's convergence to equilibrium and α is the speed of adjustment.

The equations (7) – (11) are estimated by OLS regression separately. The results of the short-run dynamic coefficients associated with the long-run relationships obtained from the equation (7) are given in Table 5. Beginning with the results for the long-run, the coefficient on the lagged error-correction term is significant at 1% level with the expected sign, which confirms the result of the bounds test for cointegration. Its value is estimated to -0.69 which implies that the speed of adjustment to equilibrium after a shock is high. Approximately 69% of disequilibria from the previous year's shock converge back to the long-run equilibrium in the current year. In the long run real GDP per capita, labour, capital and trade Granger cause FDI. This result implies that causality runs interactively through the error-correction term from real GDP per capita, labour, capital and trade to FDI. In the short run, only capital investment is significant at 5% level and has an important impact on FDI. Economic growth and trade have a negative impact but not significant. The impact of labour is positive but not significant.

The regression for the underlying ARDL equation (7) fits very well and the model is globally significant at 1% level. It also passes all the diagnostic tests against serial correlation (Durbin Watson test and Breusch-Godfrey test), heteroscedasticity (White Heteroskedasticity Test), and normality of errors (Jarque-Bera test). The Ramsey RESET test also suggests that the model is well specified. All the results of these tests are shown in Table 6.

The stability of the long-run coefficient is tested by the short-run dynamics. Once the ECM model given by equation (7) has been estimated, the cumulative sum of recursive residuals (CUSUM) and the CUSUM of square (CUSUMSQ) tests are applied to assess the parameter stability (Pesaran and Pesaran (1997)). Graphs 1 and 2 plot the results for CUSUM and

CUSUMSQ tests. The results indicate the absence of any instability of the coefficients because the plot of the CUSUM and CUSUMSQ statistic fall inside the critical bands of the 5% confidence interval of parameter stability.

The Chow Breakpoint and Chow Forecast tests are used to examine significant structural break in the data in 1995 and over the post-Barcelona period of 1995- 2008. The pre-Barcelona period is 1970-1995. We choose 1995 as a breakpoint because in July 1995, Tunisia signed an association agreement with the EU among the South Mediterranean countries engaged in the Barcelona Process. The F-statistics and the Log likelihood ratios do not indicate any structural break (Table 7).

Table 5. Results of equation (7), ARDL (1, 0, 0, 0, 0) selected based on AIC

Variable	coefficient	t-statistic	probability
C	-0.05	-0.48	0.63
D(Ln(Y))	-0.14	-0.05	0.95
D(Ln(T))	-1.47	-1.31	0.19
D(Ln(L))	0.92	0.41	0.68
D(Ln(K))	2.60	2.32	0.02
ECT(-1)	-0.69	-4.09	0.0003
R-squared	0.43		
F-statistic	4.98		0.001
DW-statistic	1.98		

Table 6. Results of diagnostic tests

|	χ^2 statistic	Probability
Breusch-Godfrey Serial Correlation test	0.04	0.82
White Heteroskedasticity test	7.86	0.64
Jarque-Bera test	1.06	0.58
Ramsey RESET Test (log likelihood ratio)	15.49	0.11

Table 7. Statistical output for stability tests

	Forecast period, Breakpoint	F-statistic	Probability of F-statistic	Log likelihood ratio	Probability of Log likelihood ratio
Chow Forecast Test	1995 – 2008	0.87	0.59	19.68	0.14
Chow Breakpoint Test	1995	0.76	0.60	6.20	0.40

Graph 1. Plot of CUSUM Test for equation (7)
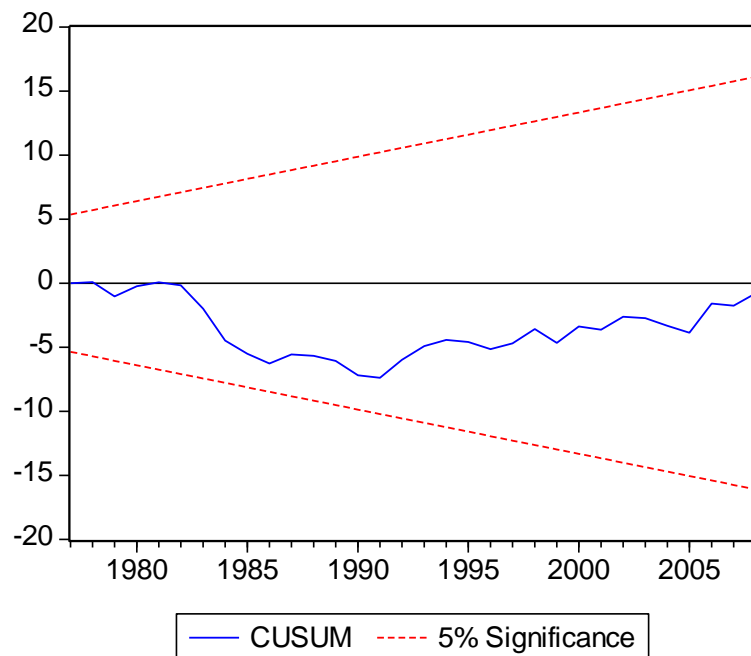
Graph 2. Plot of CUSUMSQ Test for equation (7)
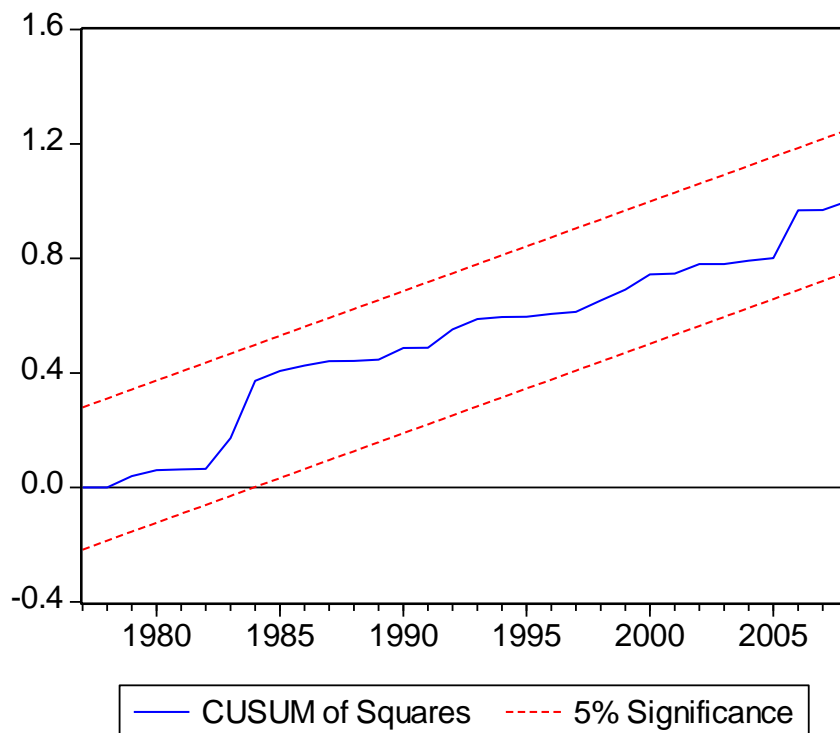
Results of short run Granger causality tests are shown in Table 8. In the short-run, the F-statistics on the explanatory variables suggest that at the 10% level or better there is bi-directional Granger causality between capital investment and economic growth and between capital investment and trade, unidirectional Granger causality running from capital investment to FDI and from FDI to trade. There is no Granger causality from trade to FDI. Hisarciklilar et al. (2006) found that there is no Granger causality from FDI to trade or from trade to FDI for Tunisia. The Granger causality test results for the relationship between FDI and real GDP per capita are interesting. These results indicate that there is no significant Granger causality from FDI to GDP or from GDP to FDI and they are consistent with those of Hisarciklilar et al. (2006). Turning to the Granger causality test results for real GDP per capita and trade openness, there is also no significant Granger causality from trade to real GDP per capita or from real GDP per capita to trade. Hisarciklilar et al. (2006) found that the direction of causality is from economic growth to trade. Our results support the idea that FDI will only be growth enhancing if it affects technology permanently and positively.

We can conclude that domestic investment which promotes trade, FDI and economic growth in the short-run for Tunisia. Domestic investment is the main catalyser of economic growth in Tunisia.

Table 8. Results of short run Granger causality

Dependent variable	F statistics					Direction of causality
	D(Ln(Y))	D(Ln(T))	D(Ln(L))	D(Ln(K))	D(Ln(F))	
D(Ln(Y))	-	0.36	1.05	3.89*	1.88	K → Y
D(Ln(T))	0.40	-	0.98	4.76*	2.81**	K → T; F→ T
D(Ln(L))	0.39	0.67	-	0.009	0.92	-
D(Ln(K))	4.99*	5.19*	0.19	-	0.90	Y → K; T → K
D(Ln(F))	0.002	1.72	0.16	5.39*	-	K → F

(*) and (**) denote statistical significance at the 5% and 10% levels respectively.

6. Conclusion

The paper examines the dynamic causal relationship among the series of economic growth, foreign direct investment, trade, labour and capital investment for Tunisia for the period of 1970-2008. It implements ARDL model to cointegration to investigate the existence of a long run relation among the above noted series; and the Granger causality within VECM to test the direction of causality between the variables. The topic merits special importance due to the possible interrelations among the series with implications for economic growth. The results show that there is cointegration among the variables specified in the model when FDI is the dependent variable. Trade openness and economic growth promote foreign direct investment in Tunisia in the long run. The results indicate that there is no significant Granger causality from FDI to economic growth or from economic growth to FDI in the short run. Turning to the Granger causality test results for economic growth and trade openness, there is also no significant Granger causality from trade to economic growth or from economic growth to trade in the short run.

Domestic capital investment is the catalyser of economic growth in Tunisia. This finding generates important implications and recommendations for policy makers in Tunisia. The results suggest that for FDI to bring in the anticipated positive impacts on economic growth,

Tunisian government will undertake serious reforms with clear objectives and strong commitments.

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