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Multivariate Granger causality between foreign direct investment and economic growth in Tunisia

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Abstract

The aim of this paper is to empirically examine the dynamic relationship between foreign direct investment and economic growth in Tunisia within a multivariate framework. We use annual data for the period 1976-2010 and we perform an econometric model based on cointegration and error correction modeling techniques. The empirical results show that foreign direct investments did not have significant impacts on Tunisian economy; however exports are the main engine for growth.

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1. Introduction

A growing number of studies have been carried out to examine the nature of the relationship between Foreign Direct Investment (FDI henceforth) and economic growth. This question has been examined scrupulously either at the microeconomic level[1] or at macroeconomic level[2]. Nevertheless, the empirical studies reveal conflicting results in both levels. For example, numerous studies found that FDI can promote economic growth in the host country through capital accumulation, productivity efficiency, the diffusion of technologies and the introduction of new methods and procedures (Caves (1996), Borensztein *et al* (1998), Bende-Nabende *et al*. (2003)). These studies showed that FDI promotes economic growth indirectly through the direct diffusion of technology, which in turn augments the stock of knowledge in the host country through labor training and skill acquisition, new management practices and organizational arrangements (De Mello, 1999). In contrast, several other studies did not find evidence of FDI-led-growth. For example, Saltz (1992) empirically examined the FDI-growth nexus for a panel of 75 developing countries during the period 1970-1980, found a negative relationship between the level of FDI and growth. Lyroudi *et al* (2004) found that FDI inflows did not have any significant impacts on economic growth in transition countries. The empirical investigation of Carkovic and Levine (2002) examining the FDI inflows-growth nexus for a panel of 72 countries during the period 1960-1995 revealed that FDI inflows did impact economic growth for both developed and developing economies.

Based on these mixed theoretical views and the ambiguity of the findings, we focused on this subject in our present paper to examine the consequences of FDI on Tunisia's economic growth within a multivariate framework. Tunisia is an interesting case study for several reasons. First, Tunisia was among the first Middle East and North African countries that increased its orientation toward an open-ended economy. Second, Tunisia is endowed with an outstanding socioeconomic and demographic environment as well as having highly qualified human capital. Third, the government of Tunisia implemented several structural reforms to boost economic development by raising private investment rates; strengthening local technological capacities and skills. Since the 80's Tunisia government has implemented various policy reforms to encourage exports activities. The first step was through the implementation of the Structural Adjustment Programs (SAPs) in 1987. The SAPs progressively liberalized the economy and eased doing business in the country. Precisely, the aim of the SAPs is to achieve sustainable economic growth, improve the competitiveness and encourage the development of private sector, which in turn will create employment opportunities (Hamdi *et al* 2013b). The second step consisted of the adhesion of Tunisia to the General Agreement on Tariffs and Trade (GATT) in 1989. The third step was its adhesion to the World Trade Organization (WTO) in 1994.

In the mid-nineties, Tunisia adopted new measures aimed at attracting foreign capital and encouraging foreign investment by offering good infrastructure, qualified human capital, tax incentives and even eliminations of some import fees and customs tariffs for foreign companies. Consequently, the openness was accelerated with the signature of multiple accords with the European Union in 1995 and European Union has become its major trading partner.

[1] Ragazzi (1973), Doukas and Travlos (1988), Rivoli and Salorio (1996), Borensztein *et al* (1998), Gorg and Greenwood (2002), among others.

[2] Bos, Sanders and Secchi (1974), Blomstrom and Kokko (1996), Barrell and Pain (1999), Carkovic and Levine (2002).

The set of new measures has encouraged national and international investors to do business in Tunisia. According to the statistics from UNCTAD (2012), the stock of inward foreign direct investment in Tunisia in 2010 was estimated at TND 45 billion ($31.4 billion), an amount equivalent to 78 per cent of Tunisia's GDP. In 2010, Tunisia was the host to more than 3,000 foreign affiliates employing 325,000 people.

Since the first step of the liberalization in 1987 up to the onset of the social and political revolution in January 2011, Tunisia attracted huge inflows of FDI. Therefore, we aim in this paper to examine the dynamic relationship between FDI inflows, export activities and economic growth in Tunisia during the period 1976-2010. To this end, we use a multivariate econometric model based on cointegration analysis and error correction model techniques. Overall results reveal that foreign direct investments did not have significant impacts on Tunisian economy; however exports are the main engine for growth.

The remainder of the paper is as follows. Section 2 presents the data and methodology; section 3 provides empirical results and finally, section 4 concludes.

2. Methodology

2.1. Data

The multivariate model is based on the following four variables: real gross domestic product per capita (GDPpc) which reflects economic growth, real total exports (TEX), real foreign direct investment inflows (FDI) and gross fixed capital formation to GDP as a proxy of investment (INV). The time series data is recorded annually; it covers the period from 1976 to 2010. The main source of our data is the World Bank's World Development Indicators (WDI). All the variables are transformed into log form to reduce the problem of heteroscedasticity.

2.2. Econometric approach

2.2.1. Unit root testing

We employ the Augmented Dickey–Fuller (F-ADF) unit root tests to identify whether the variables contain a unit root and confirm the stationarity of each variable. Common criticisms of ADF tests is that they exhibit low power properties and they are quite sensitive to any improper establishment of lag parameter. Given this weakness, we also conduct the Phillips-Perron (PP) test (1988), which allows for the presence of a non-zero mean and a deterministic time trend.

2.2.2. Cointegration

The cointegration tests is 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 $\lambda r + i \ldots . \lambda n$, are the least value of eigenvectors $(p-r)$. The second test is the maximal eigenvalue test $(\lambda_{\max})$ 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:

$\lambda_{\max}(r, r+1) = -T\ln(1-\hat{\lambda}r+1)$

While numerous papers have used bivariate and trivariate frameworks to test for causality between financial FDI and economic growth, in this paper we use multivariate procedure by the mean of a VECM. Moreover, we added a dummy variable which reflects the liberalization date; equal to 1 for t=1988 to 2010 and zero otherwise.

$$\text{Dummy}_{87} = \begin{cases} 0 \text{ for } 1976\text{-}1987 \\ \text{and} \\ 1 \text{ for } 1988\text{-}2010 \end{cases}$$

In cases where liberalization makes entry easy, we expect higher growth as a result of a huge inflow of foreign capital.

The VECM is now specified as follows:

$$\Delta LGDP_t = \alpha_1 + \sum_{i=1}^{p} \beta_{1i} \Delta LGDP_{t-i} + \sum_{i=1}^{q} \beta_{1i} \Delta LFDI_{t-i} + \sum_{i=1}^{r} \beta_{1i} \Delta LExport_{t-i} + \sum_{i=1}^{s} \beta_{1i} \Delta LIINV_{t-i} + Dummy_{87} \quad (1)$$
$$+ \lambda_1 ect_{t-1} + \mu_{1t}$$

$$\Delta LFDI_t = \alpha_2 + \sum_{i=1}^{p} \beta_{2i} \Delta LGDP_{t-i} + \sum_{i=1}^{q} \beta_{2i} \Delta LFDI._{t-i} + \sum_{i=1}^{r} \beta_{2i} \Delta LExport_{t-i} + \sum_{i=1}^{s} \beta_{2i} \Delta LIINV_{t-i} + Dummy_{87} \quad (2)$$
$$+ \lambda_2 ect_{t-1} + \mu_{2t}$$

$$\Delta LEXOPORT_t = \alpha_3 + \sum_{i=1}^{p} \beta_{3i} \Delta LGDP._{t-i} + \sum_{i=1}^{q} \beta_{3i} \Delta LFDI_{t-i} + \sum_{i=1}^{r} \beta_{3i} \Delta LExport_{t-i} + \sum_{i=1}^{s} \beta_{3i} \Delta LIINV_{t-i} \quad (3)$$
$$+ Dummy_{87} + \lambda_{31} ect_{t-1} + \mu_{3t}$$

$$\Delta LINV_t = \alpha_4 + \sum_{i=1}^{p} \beta_{4i} \Delta LGDP_{t-i} + \sum_{i=1}^{q} \beta_{4i} \Delta LFDI_{t-i} + \sum_{i=1}^{r} \beta_{4i} \Delta LExport_{t-i} + \sum_{i=1}^{s} \beta_{4i} \Delta LIINV_{t-i} + Dummy_{87} + \quad (4)$$
$$\lambda_4 ect_{t-1} + \mu_{4t}$$

Where ECT is expressed as follows:

$$ECT_t = LGDP_t - \alpha_1 - \beta_{1i} LFDI - \beta_2 LExport_{t-i} + \beta_3 LINV_{t-i} + Dummy_{87} \quad (5)$$

Where $t=1...T$, denotes the time period.

A major advantage of VECM is that it can also be used to verify causality among the variables in case of cointegrated series. Although cointegration indicates the presence of causality, yet the direction of causality amongst the variables is identified through VECM. Moreover, one can also distinguish between the short- and long-run causality with the help of vector error correction model.

3. Empirical results

3.1 Unit root tests

The results of the unit root tests of the Augmented Dickey-Fuller (*ADF*) and Phillips-Perron (*PP*) for the four variables of the model are presented in Table 1. The test statistics for the log levels are statistically insignificant. The results show that the null hypothesis cannot be rejected

in each series in the level where the series contain a unit root. Therefore, *LGDP*, *LFDI*, *LExport and LINV* appear to be non-stationary in the level. By testing through first difference, the results clearly indicate that the null hypothesis of non-stationary can be rejected. This means that *LGDP*, *LFDI*, *LEXPORT and LINV* become stationary and do not contain unit root after first differencing at the 1 per cent level of significance. Hence, from all of the tests, the unit roots tests indicate that each variable is integrated of order one.

Table 1. Augmented Dickey-Fuller (*ADF*) and Phillips-Perron (*PP*) Unit root tests

	ADF		PP		Order of Integration
	Level	1st diff,	Level	1st diff,	
LGDP	0.481	-5.271***	0.481	-5.2753***	I(1)
LFDI	-1.309	-6.818***	-1.193	-6.7805***	I(1)
LExport	-2.285	-5.064***	-2.390	-5.39726***	I(1)
Linv	-1.358	-10.435***	-2.054	-11.119***	I(1)

According to Engle and Granger (1987), variables with the same order of integration can be tested for cointegration. In this way, the result from the unit root test facilitated us in proceeding to the cointegration test for the variables under study.

3.2. Cointegration and Granger causality analysis

The purpose of the cointegration test is to identify whether it exists a long run relationship between the GDP with *LFDI, LExport and LINV*. Table 5 presents the results of the trace and the maximum-eigenvalue tests from the Johansen (1980) and Johansen and Juselius (1990) maximum Likelihood analysis. The results suggest the existence of one cointegrating vectors at 5% of significance.

Table 2 Results for Johansen test contegration

Hypothesized	Trace Statistic	Max-Eigen Statistic
None *	83.53813	41.61510
At most 1 *	41.92303	30.81121
At most 2	11.11182	11.04034
At most 3	0.071477	0.071477

Trace and Max-eigenvalue test indicates1cointegrating eqn(s) at the 0.05 level

* denotes rejection of the hypothesis at the 0.05 level

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

According to Engle and Granger, (1987), 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 through the error correction term (ECT).

The results of the long-run equilibrium relationship are presented in Table 4 below. They show that the coefficients of *LFDI*, *LExport and LINV* are statistically significant at 1% level of significance.

Results show that export has the most important coefficient (0.43) which reveals its weight in the Tunisian economy. This result confirms the one found by Hamdi (2013) in which he found evidence to support the export-led-growth hypothesis in Tunisia.

FDI has an important role in economic growth, and its reforms appear to have successful impacts on Tunisian economy. As mentioned in the introduction, FDI in Tunisia is a significant factor for job creation and market dynamics.

Turning now to investments, the coefficient (LINV) is negative and significant. This result appears unusual as investment did not contribute to economic growth. This can be explained by the fact that previous investments done in Tunisian were not productive, and did not contribute at improving the level of Tunisian GDP.

Table 3. Long-run elasticities

Dependent Variable: LGDPpc

Regressors	Coefficients	T-Value
LFDI	0.204587	-6.91019 ***
LEXPORT	0.429444	- 9.31192***
LINV	-0.70332	5.08104 ***
C	0.024608	-

The results of the short-run estimations are presented in table 4. In fact, since the optimal lag length was two, the short-run results are also presented for two lags of each variable. These results seem interesting in the sense that only the coefficient of LEXPORT is statistically significant at 10% level of significance. This means that in the short-run, only one of these variables contribute significantly to per capita GDP. FDI did not have any positive impact on Tunisian economy. In the same line of analysis, investment contributed positively but non-significantly to GDP.

It is also evident from table 4 that error correction term is statistically significant and has the expected sign. The coefficient -0.202 indicates that when GDP per capita is above or below its equilibrium level, it adjusts by 20.2% within the first year. Therefore, the pace of adjustment toward the equilibrium is moderately fast in case of any shock to GDP.

Table 4. ECM results based on Johansen cointegration

Error Correction:	**Coefficient**	**t-value**
Δ LFDI (1)	-0.027464	-0.87036
Δ LFDI (2)	-0.016336	-1.30862
Δ LEXPORT(1)	-0.189607	-1.88394*
Δ LEXPORT(2)	0.091529	1.10205
Δ LINV(1)	0.084554	0.91942
Δ LINV(2)	0.051327	0.57922
Dummy $_{87}$	-0.031347	-1.30275
C	0.042019	2.23646**

ECT	-0.202885	-1.92845*
Diagnostic tests	**t-stats**	**p-value**
White Test	0.296887	0.9644
Normality	0.5936	0.7812
Serial Correlation LM Test	0.145090	0.8658
ARCH	0.749413	0.3960
Breusch-Pagan-Godfrey	0.712775	0.6903

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

We performed various diagnostic and stability tests to the ECM model[3]. The results are reported in the lower part of Table 4. They confirm the absence of serial correlation (Breusch-Godfrey Serial Correlation LM Test), heteroskedasticity (White Test) and autoregressive conditional heteroskedasticity (ARCH) in the model. The underlying model also passes diagnostic test for normality (Jacque-Bera).

After examining the dynamics of long and short-run estimations, we turn to investigate the direction of causality between the variables of the model. This is done by the use of three Granger causality tests: short-run causality, long-run causality and the joint short and long run. The results are reported in table 5.

Table 5. Direction of Granger causality tests

Variable	*Short run (F-stats)*				***ECT*** *(t-stat)*	*Joint short and long run (F-stats)*			
	ΔLGDP	ΔLFDI	ΔLExport	ΔLINV		ΔLGDP & ECT	ΔLFDI & ECT	ΔLExport & ECT	ΔLInv & ECT
ΔLGDP	-	0.163	3.113**	0.661	-0.202*	-	0.312	2.912*	0.689
ΔLFDI	1.616	-	2.839**	1.019	- 1.4556	0.979	-	3.148**	1.749
ΔLExport	0.49	4.756**	-	0.209	- 0.588	2.975**	5.277***	-	2.711*
ΔLInv	1.249	1.073	0.157	-	-1.810	1.979*	1.131	0.135	-

The table above shows that GDP responds positively and significantly to export in the short and long run. Hence, we can confirm the presence of a unidirectional relationship running from export to GDP while FDI and investment did not Granger cause GDP. These results confirm the one found in table 4.

The first conclusion from Table 5 is that FDI did not have an immediate impact on GDP. In fact, in Tunisia FDI are concentrated in some areas, notably the coast line of Tunisia, while regional locations suffered from exclusion for a long time. Therefore, some regions enjoyed the presence of foreign companies and investors who created employment opportunities and improved their

[3] The stability of the model was also checked by applying cumulative sum of recursive residual (CUSUM) and cumulative sum of squares of recursive residual (CUSUMQ). They show that the model is stable. We did not provide the CUSUM and CSUMSQ figures to save space, but they are available from the authors upon request.

well-being, while some other regions have been suffering from social and economic exclusion. Otherwise, not all Tunisian households and regions have seen significant change due to FDI. This conclusion might explain why FDI did not Granger cause GDP. These results are similar to those of Darrat et al. (2005), Hisarciklilar *et al.* (2006) and Belloumi (2012).

Table 5 also reveals that FDI responds positively and significantly to export, hence we confirm the existence of a unidirectional relationship running from export to FDI. This second conclusion can be explained as follows: the more the export is dynamic, the more the reputation of the country enhances and the more international investors and foreign funds come into Tunisia.

In the export equation we can confirm a unidirectional relationship running from FDI to export. Therefore, we can confirm the presence of a bidirectional relationship between the two variables in the short-run. This conclusion reveals that in reality FDI contribute indirectly to Tunisia economic growth through export. The third conclusion from table 5 is that FDI is a principal factor that boosts the export activity in Tunisia. We recall that a huge number of enterprises in Tunisia export 100% of their output[4]. In the investment equation, there are no significant results.

Turning now to the error correction results, it is observed that deviations from the long-run equilibrium is mainly corrected by GDP, while FDI, export and investments appear to be weakly exogenous.

In the last part of Table 5, the results of F-statistics indicate the significance of combined short-and long-run effects. In the GDP equation, error correction term and export are jointly significant. This reveals the presence of a unidirectional relationship running from export to GDP. Similar result is found between FDI and export.

In the export equation, the F-statistics tests indicate the significance of GDP and FDI. Therefore we can confirm the presence of a bidirectional relationship between GDP and export and another bidirectional relationship between FDI and export. In the investment equation, there are no significant results.

Another interesting result which could be drawn from table 5 is the validity of export-led-growth hypothesis in Tunisia. This results join the one found by Reizman *et al.* (1996) and Hamdi (2013) but differs to the finding of Jung and Marshall (1985), Hutchinson and Singh (1992), Dodaro (1993) and Abu-Qarn and Abu-Bader (2005) where they found no evidence of causality between GDP growth and growth of real exports in the case of Tunisia[5]. Moreover, we can confirm the validity of the growth-led-export hypothesis.

4. Conclusion and policy implications

The aim of this paper was to examine the dynamic relationships between foreign direct investment and economic growth in the Tunisian context by the use of a multivariate framework for the period 1976-2010. Since 1987, Tunisia has implemented several and policy reforms to attract foreign investors. Consequently, the volume of FDI inflows and the number of foreign enterprises increased considerably. Therefore, we think that the implementation of reforms have

[4] In 2010, the number of these enterprises reached 2 740 and they employ 314.159 persons (API, 2010)
[5] Hamdi (2013), op cit p. 683.

contributed to improving economic growth in Tunisia. This was the main motivation of this study.

Our empirical results reveal several important issues which could be useful for policy makers in Tunisia especially following the "Jasmine Revolution" period which began in January 2011. The results show that FDI does not have obvious positive impacts on Tunisia economic growth during the period of our study. This means that the volume of FDI is not large enough to promote global economic growth. It is worth mentioning that several regions in Tunisia have suffered economic, social and financial exclusion for a long time. In these regions, infrastructure is archaic. Moreover, there are no foreign enterprises and no domestically-owned firms. Consequently, unemployment rate is high and the everyday life condition of citizens is unbearable. Further, the poverty level is higher than in other regions, notably those situated in the Tunisian coast. All these arguments could explain why FDI did not have positive impacts on economic growth.

This paper shows that FDI did not boost investment and investment did not contribute to economic growth. These results seem unusual; but looking at the breakdown of foreign enterprises working in Tunisia one can see that a large part of these companies export the totality of their output abroad. Consequently, there is no dynamics in the domestic economy which could in turn encourage investment activities. However, there is a dynamic of exports as the empirical section reveal. Tunisia appears to be following the export-led-growth strategy which is advantageous as it contributes to economic growth.

In this context, the new Tunisia government would need to continue its efforts to attract foreign investors and expand and promote FDI into the other regions in the country. The new government should fight the regionalism and encourage the implementation of enterprises in these regions. Policymakers should also improve the effectiveness of the public sector and encourage the development of the private sector as well, by ensuring proper environment and adequate strategies.

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