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DOMESTIC INVESTMENT IN THE AGRICULTURAL SECTOR AND ECONOMIC GROWTH IN TUNISIA

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Abstract

Our aim in this paper is to investigate the nexus between agricultural investment and economic growth in Tunisia. We compiled annual data for the period from 1965 to 2016 and we adopted an empirical methodology based on the cointegration analysis and on Vector Error Correction Models. In the long run, our results show a positive unidirectional causality from agricultural investment to economic growth and a negative one from other investments to economic growth. In the short run, Granger tests identify only a bidirectional causality between other investments and economic growth. These results confirm that investment in agriculture is conductive for economic growth in Tunisia and justifies the adoption of sound policies to encourage this sector.
Keywords: *Agricultural Investment, Economic Growth, Cointegration, VECM, Tunisia.*
JEL Classification:*O47, O55, Q10, Q18.*

1. Introduction

Agriculture is a foundation for economic growth, development and poverty eradication in developing countries. In fact, some authorsare convinced that this sector is an engine and a panacea for economic prosperity[1]. As examples, Gunner Myrdal (1984) confirms that "the battle for long-term economic growth will be won or lost in the agricultural sector"[2], whereas Arthur Keith (1947) supports that "the discovery of agriculture was the first great step towards a civilized life"[3].

However, how this path leads to economic prosperity is still not resolved among development economists. A part of the early literature on this issue coincided with the debate on the promoting development role of agriculture in low-income economies as a result of long periods of colonial rules [Fei& Ranis (1961), Johnston & Mellor (1961), Jorgenson (1961), Lewis (1954), & Schultz (1964)]. This literature was mainly qualitative and focused on the potential impact of intersectoral linkages between agriculture and industry. More recently, a renewed debate on the subject has been observed (Echevarria (1997), Gardner (2005), Gemmell et al. (2000), Gollin et al. (2002), Kogel & Prskawetz (2001), Olsson & Hibbs (2005), and Tiffin &Irz (2006)). Research on this issue is crucial as it could help policymakers to better understand the potential impact of investment in agriculture on the economy as a whole. Thus, policy decisions on resource allocations could be improved[4].

In this paper, we investigate the link between agricultural investment and economic growth in Tunisia for a period ranging from 1965 to 2016. Our empirical methodology is based on the cointegration techniques and on Vector Error Correction Models (VECM). The objectives we are trying to attain are, first, to fill a gap in the literature on the subject. Indeed, in our knowledge, the question we treated in this paper was never examined for the Tunisian case. Second, to show if the agricultural sector is a future justified option for Tunisia. Actually, the post revolution period starting since 2011 in Tunisia questioned its development model adopted since many years later. This latter produced unsatisfactory results in employment, in regional development, and in economic growth.

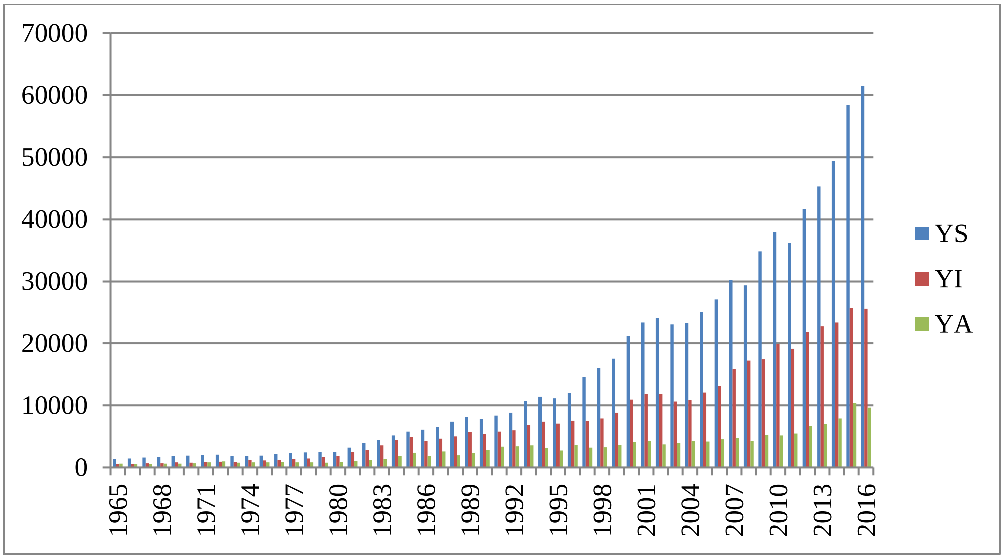
The paper is organized as follows: section 2 is devoted to a descriptive analysis of the evolution of investment and of economic growth in Tunisia. Section 3 reviews the main literature. Section 4 and Section 5 present and discuss our empirical methodology and results, respectively. Section 6 concludes.

2. Descriptive Analysis

Since the beginning of the 1960s, economic and social development actions in Tunisia have been governed by medium-term plans reflecting the major orientations of public policies. These global choices as well as the sectoral policies and programs resulted in structural transformations characterized by a decrease of the agriculture share ingross domestic product (GDP), a change in the composition of manufacturing industries, and an increase of market services, especially those of communications, transport, and tourism.[5]

2.1. Evolution of the GDP Structure

Policies introduced throughout Tunisia's development process have led to the diversification of growth sources, giving the economy greater resilience to exogenous shocks. More specifically, they produced different growth rates of agricultural GDP (YA), industrial GDP (YI), and services GDP (YS), as illustrated by Figure 1.



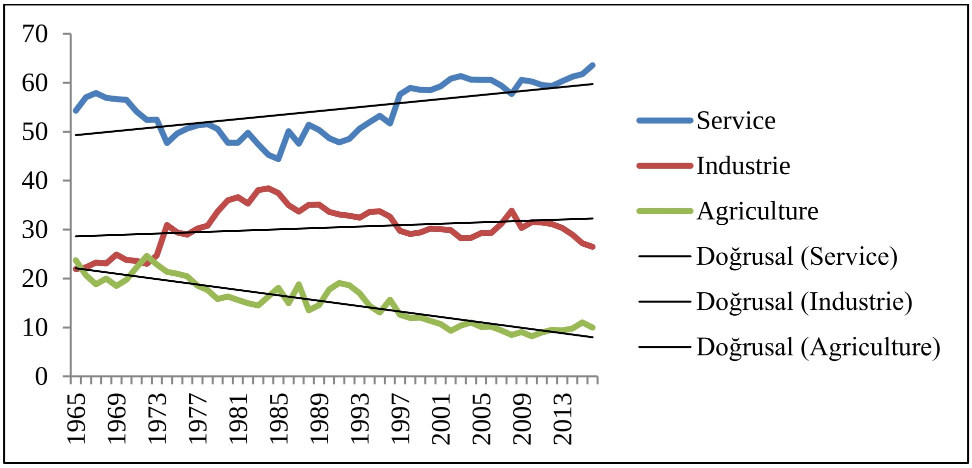
Source: Financial Statistics of the Central Bank of Tunisia**.**

Figure 1. GDP by Sector (1965-2016; in Constant Dinar and in Millions)

During the whole period of observation, the share of services in GDP has always been the largest (Figure 2). It is followed by industrial and agricultural sectors, respectively.

In 1972, the agricultural sector achieved its highest contribution (24%) in GDP and surpassed that of the industrial sector (22%). These results are explained by very favorable climatic conditions during this period that boosted the productivity of agricultural investments.

The linear trends of the evolution of each one of the three sectors share in GDP show that, while that of agriculture declined, the shares of Industry and, mainly, of services increased.

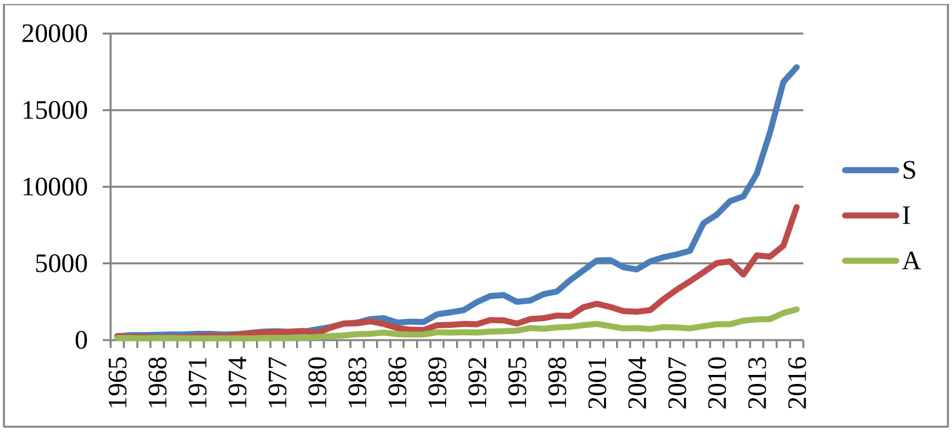


Source: Financial Statistics of the Central Bank of Tunisia.

Figure 2. Evolution of the Sectoral Shares in GDP (1965 – 2016; in%)

2.2. Domestic Investment by Sector

Tunisia has made a considerable investment effort since its first decade of development (the 1960's). The investment rate relative to GDP was indeed higher than that of several countries with similar income[6].



Source: Financial Statistics of the Central Bank of Tunisia.

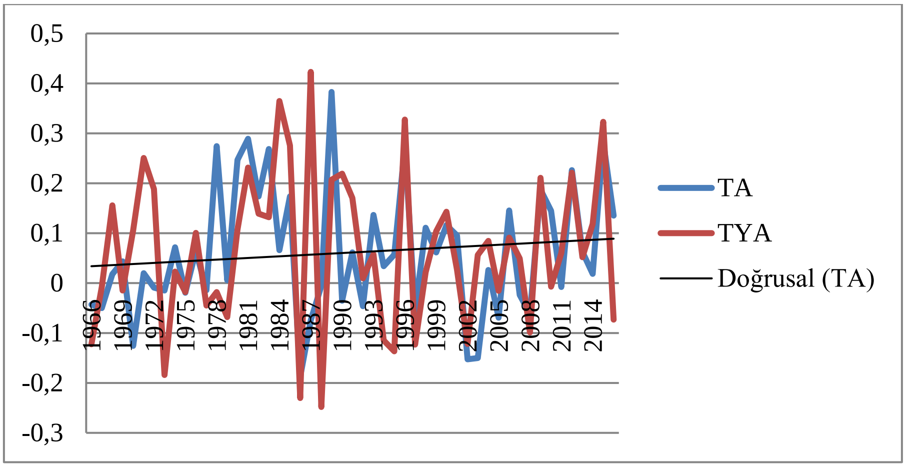
Figure 4. Gross Fixed Capital Formation by Sector (1965-2016; in Constant Dinar and in Millions)

Figure 4 shows that the share of gross formation in the agricultural sector (A) is the lowest compared to the services (S) as well as to the industrial (I) sectors. Hence, Tunisia opted much more on services and industrial than on agricultural investments.

The choice of the latter economic policy seems to have started in early seventies. Indeed, from Fig.4, we deduce that the amount of investment was not very different between the three sectors until 1972. This may be the result of the change of economic policy focusing on more openness since 1972 and/or the result of the first oil choc of 1973.

2.3. Domestic Investment in the Agricultural Sector and Economic Growth

In the last years of the French protectorate, agriculture accounted for 29% of total economic activity. This rate fell to 22% with the nationalization in 1964 of the 850,000 hectares exploited by French companies and settlers[7].



Source: Financial Statistics of the Central Bank of Tunisia.

Figure 5. Growth Rates of Investment (TA) and GDP in the Agricultural Sector (TYA)

Despite the continuing decline in the share of the agricultural sector in GDP in Tunisia, agriculture recorded very high growth rates during the 1970s at almost 8% per year. This has allowed the country to improve its level of food security.[8]

Figure 5 shows that over the entire period of our descriptive analysis, an increase in the growth rate in agricultural investment was often accompanied by an increase in GDP in the agricultural sector. Exceptions are the two years 1970 and 1984, which were characterized by an increase in the growth rate of agricultural investment and a decrease in agricultural GDP.

Consequently, investment in the agricultural sector seems to be favorable for Tunisia's economic growth. In fact, an increase in agricultural investment was frequently accompanied by an increase in the GDP of agricultural sector and, consequently, in the GDP of the whole economy.

3. Literature Review

We focus on empirical studies that have examined the link between agricultural and economic growth in a one hand and between sectoral investment and economic growth in another hand. The justification is the lack of literature examining the direct link between agricultural investment and economic growth. This literature review will inspire our empirical methodology.

3.1. Agriculture andEconomic Growth

Many studies suggest that agriculture contributes significantly to the process of economic growth. Iyoha & Oriakhi (2002) found that agriculture is one of the main sources of economic growth in Nigeria. They also noted that the agriculture share in total labor force was too high and suggested reallocating some of it to other sectors of the economy to accelerate economic growth.In a more recent study, Olajide et al. (2012) concluded also that agriculture has a positive impact on Nigerian economic growth from 1970 to 2010. Odetola & Etumnu (2013) and Oyakhilomen & Zibah (2014) shared the same positive impact in Nigeria for the periods 1960-2011 and 1970-2011, respectively.

Katircioglu (2006) employed the cointegration analysis and Granger causality tests over the period 1975-2002, and concluded that the agricultural sector still had an impact on the economy of the Northern part of Cyprus. Based on the same latter empirical methodology, Jatuporn et al. (2011) found also a positive impact of agriculture on economic growth in Thailand in the period 1961-2009. The results of Yusuf (2014) provide strong evidence of the long-term relationship between agricultural production and economic growth in Nigeria. He concluded also, in the basis of the impulse-response analysis, that positive agricultural production drives economic growth. Finally, the author adopted the variance decomposition analysis and proved an important contribution of agricultural sector in economic growth.

Some authors studied the role of agricultural in the economic growth of a sample of countries. For example, Gollin et al. (2002) observed in a sample of 62 developing countries over the period 1960 - 1990 that improvements in agricultural productivity would help free up resources for other non-agricultural activities, which will favor economic growth. To justify their finding, the authors mentioned two stylized facts. First, there was a negative relationship between agricultural productivity and the share of employment in agriculture. Second, there was a positive relationship between the growth of agricultural productivity and the transfer of labor to other non-agricultural sectors. Awokuse (2015) examined the agriculture growth impact in 15 developing and transition economies in Africa, Asia and Latin America. Based on the Autoregressive Distributed Lag (ARDL) approach, He found a strong evidence that agriculture is an engine of economic growth.

Other authors have challenged the conclusions of the literature cited above. For Nigeria, Ehui &Tsigas (2009) cast doubt on the ability of the agricultural sector to grow because of ineffective agricultural policies. Ocholi (2011) found that Nigeria's agriculture is constrained by traditional techniques and a low capital-intensity, which result on low productivity and low investment in this sector. For a panel of 52 developing countries, Gardner (2003) found no significant evidence that agriculture is the engine of economic growth. Finally, using the Granger causality test and cointegration in panel data for 85 countries, Tiffin & Irz (2006) found evidence that supports the conclusion that agriculture is a source of economic growth in developing countries, but that the direction of causality in developed countries is unclear.

3.2. Investment Diversification and Economic Growth

De Long &Summers (1991) looked at equipment investment in 61 countries between 1960 and 1985. Using ordinary least squares regression, they found that investment in machinery and equipment was closely linked to growth. This result was not shared by Auerbach et al. (1994), who examined the same relationship using the same data, technique and period as De Long &Summers (1991). They found that investment in equipment had no effect on economic growth.

Devarajan et al. (1996) used annual data from 43 countries and applied a linear regression model to analyze the relationship between central government expenditure components (such as investment in education, investment in health, investment in transport and investment in communication) and economic growth. Their empirical results have shown a negative relationship between these components and economic growth, which were explained by public investment mismanagement.

Canning &Pedroni (1999) examined the relationship between investments in three types of infrastructure (paved road, power plants and telephony network) and economic growth in 67 countries for the period 1960-1990. Using the Granger causality tests, they found frequently bidirectional relationships. Esfahani & Ramirez (2003) attempted to explore the relationship in 75 countries by applying a structural model of growth. They concluded that infrastructure investments have made a positive and substantial contribution to GDP. Their results also suggest that institutional capacities, conferring credibility and effectiveness to the government policy, play important role in the development process through infrastructure growth.

The positive impact of infrastructure investment was also found by Canning &Pedroni (2004) in a panel of countries over the period 1950 - 1992. They used cointegration and the error-correction model in their empirical analysis, and found that infrastructure investments have a positive effect on long-term economic growth in most countries. This is also the case for Nigeria from 1970 to 2010, where Babatunde et al. (2012) found that the latter type of investment had a positive effect on economic growth with a two-way causal link.

The results of Herrerias (2010) showed that industrial investment impacted positively the China's long-term economic growth between 1964 and 2004. However, in the short term, there was no relationship between the two variables.

Kumo (2012) investigated the causal relationship between economic growth, investment in infrastructure, and employment in South Africa between 1960 and 2009. Based on the ARDL approach, He concluded that there is a strong evidence of a long-term cointegration relationship between economic growth, investment in economic infrastructure, formal employment, exports and imports.

Soto & Bustillos (2014) studied the relationship between infrastructure investment and economic growth for Mexico's major urban areas over the period 1985-2008. The methodology consists of a production function estimated using panel data techniques. The results highlight that the economic impact of infrastructure investment is spread over time and that it cannot be only contemporary. This result suggests long-term effects. In addition, the authors found that in the urban areas where significant infrastructure exists, higher growth rates were observed. Applying the vector error correction model (VECM) in the context of Pakistan, Younis (2014) showed however that there is a negative effect of infrastructure investment on economic growth in the long run. Otieno (2016) applied the same empirical methodology and found that investment in education had positive long-term and short-term impacts on economic growth in Kenya between 1967 and 2010.

Finally, Bakari et al. (2018) studied the relationship between domestic investment in the industrial sector and economic growth in Tunisia for the period 1969-2015. Their cointegration analysis and the estimation of error-correction vector models showed a negative relationship between the two variables in the long-term. This result highly justifies the need to know if the economic growth of Tunisia was caused by other sectors outside of industry. This is what we are going to do in the next sections by an investigation of the relationship between investment in agriculture and economic growth in Tunisia.

4. Empirical Methodology

To examine the relationship between agricultural investments and economic growth in Tunisia, we will apply an empirical methodology based on the cointegration approach and on the Sims(1980) model.

4.1. Empirical Strategy

Our empirical strategy consists, first, in determining the stationarity of the variables. Indeed, all variables must be stationary to proceed to the next step of cointegration analysis. The two unit root tests we rely on are the Augmented Dickey-Fuller (ADF) and the Phillipps-Perron (PP) tests.

Second, we will determine the number of lags of each variable in our model by reference to a set of information criteria such as the Akaike criterion (AIC), the Schwarz criterion (SIC), and the Hannan-Quinn criterion (HQ). In the third step, we will use the Johansen test to examine the cointegration between the variables involved in our model. If a cointegration relationship is observed, the causality tests will be based on Vector Error Correction Models (VECM). If not, they will be based on traditional Vector Auto Regressive (VAR) models. In the last step, we will use diagnostic and stability tests to verify the robustness and the credibility of our model and of our empirical results.

4.2. The Model

Our starting point is a production function deduced from a neoclassical model developed by Awokuse (2007). As determinants of economic growth, the latter takes into account the capital factor (K), the labor factor (L), imports (M) and exports (X). It is as follows :

$$Y_t = F[(K_t, L_t) \ ; X_t, M_t] \tag{1}$$

The augmented Cobb-Douglas form of this function can be expressed as:

$$Y_t = AK_t^{\alpha_1} L_t^{\alpha_2} M_t^{\alpha_3} X_t^{\alpha_4} \tag{2}$$

In equation (2) Y is GDP, K is domestic capital stock, L is population (labor factor approximation), X is exports, M is imports and A is an exogenous factor assumed to be constant and reflecting the level of technology. Elasticitiesα_1,α_2, $\alpha_3$and $\alpha_4$are associated with the capital factor, the labor factor, exports and imports, respectively.

The decomposition of the capital factor into capital in agriculture (K_{ag}) and capital in other sectors (K_{as}) leads to rewriting equation (2) as:

$$Y_t = AK_{ag_t}^{\beta_1} K_{as_t}^{\beta_2} L_t^{\alpha_2} M_t^{\alpha_3} X_t^{\alpha_4} \tag{3}$$

The basic assumption in equation (3) is that the elasticities of agricultural capital and capital in other sectors are different (β_1 #β_2). This is a very plausible assumption as the two sectors have very different characteristics.

The linearization of equation (3) by a logarithmic transformation makes it possible to rewrite it as follows:

$$Log(Y_t) = Log(A) + \beta_1 Log(K_{ag_t}) + \beta_2 Log(K_{as_t}) + \alpha_2 Log(L_t) + \alpha_3 Log(M_t) + \alpha_4 Log(X_t) \tag{4}$$

The empirical counterpart of this equation is:

$$Log(Y_t) = \alpha_0 + \beta_1 Log(K_{ag_t}) + \beta_2 Log(K_{as_t}) + \alpha_2 Log(L_t) + \alpha_3 Log(M_t) + \alpha_4 Log(X_t) + \varepsilon_t \tag{5}$$

4.3. Data and Estimation Period

To examine the relationship between agricultural investment and economic growth, we will use annual data covering the period from 1965 to 2016. The Central Bank of Tunisia and the National Institute of Statistics are our data sources.

Table 1.Description of the Variables

No	Variable	Description	Source
1	*Y*	Gross domestic product (constant dinars)	Central Bank of Tunisia
2	*Kag*	Gross fixed capital formation in the agricultural sector (constant dinars)	Central Bank of Tunisia
3	*Kas*	Gross fixed capital formation in other sectors (constant dinars)	Central Bank of Tunisia
4	*L*	Population (in millions of inhabitants)	National Institute of Statistics
5	*X*	Exports (constant dinars)	Central Bank of Tunisia
6	*M*	Imports (constant dinars)	Central Bank of Tunisia

In the financial statistics of the Central Bank of Tunisia, gross fixed capital formation in the agricultural sector is at current prices. We transformed the data at constant prices using the GDP deflator.

5. Empirical Analysis

5.1. Unit Root Tests

ADF and PP unit root tests were both used to ensure the robustness of our results obtained. For the each one of the two tests, a variable is stationary when the absolute value of its computed statistic is higher than its critical value at the thresholds of 1%, 5% or 10%.

Table 2. Results of Unit Root Tests

Variable	Model	ADF		PP	
		Level	First Difference	Level	First Difference
Log(Y)	Constant	0.01	6.792***	0.016	6.792***
	Constant, Linear Trend	2.113	6.709***	2.276	6.71***
Log(Kag)	Constant	0.333	6.524***	0.179	6.547***
	Constant, Linear Trend	1.991	6.522***	2.258	6.549***
Log(Kas)	Constant	0.614	5.531***	1.29	5.515***
	Constant, Linear Trend	4.08**	5.543***	2.903	5.543***
Log(L)	Constant	6.322***	1.296	3.31***	2.037
	Constant, Linear Trend	1.714	3.404*	0.445	3.202*
Log(X)	Constant	0.563	8.031***	0.639	8.862***
	Constant, Linear Trend	3.284*	7.931***	3.284*	8.711***
Log(M)	Constant	0.321	6.95***	0.57	7.132***
	Constant, Linear Trend	3.183*	6.9***	3.24*	7.057***

Notes:***, ** and * indicate significance at the 1%, 5% and 10% level respectively

According to the results of Table 2, all the variables included in our model are stationary in first difference[9]. This result justifies performing a cointegration analysis in the next step.

5.2. Cointegration Analysis

To analyze the cointegration between the variables of the model, it is necessary to proceed with two successive steps. The first one is to determine the appropriate number of lags and the second one is to determine the number of cointegration relationships.

After several tests based on information criteria, a number of lags equal to 3 was selected[10].

To verify the existence of cointegration relationships between the variables used in our model, we rely on the Johansen's method. The purpose of the latter is to:

- ✓ Confirm or not the existence of a cointegration relationship between the variables of the model.
- ✓ Determine the number of cointegration equations.
- ✓ Determine the equation of long-run equilibrium, which aims to clarify the long-term relationships between the variables estimated and the value of their elasticities.

The Johansen test is based on the Trace and on the Eigen Value statistics. The following table presents the results of the latter test.

Table 3. Johansen Test

Unrestricted Cointegration Rank Test (Trace)				
Hypothesized No. of CE(s)	***Eigenvalue***	***Trace Statistic***	***0.05 Critical Value***	***Prob.*****
None *	0.696	170.448	95.754	0.000
At most 1 *	0.593	114.537	69.819	0.000
At most 2 *	0.429	72.281	47.856	0.000
At most 3 *	0.324	45.966	29.797	0.000
At most 4 *	0.276	27.573	15.495	0.000
At most 5 *	0.232	12.413	3.841	0.000
Trace test indicates 6 cointegrating equations at the 0.05 level				
Unrestricted Cointegration Rank Test (Maximum Eigenvalue)				
Hypothesized No. of CE(s)	***Eigenvalue***	***Max-Eigen Statistic***	***0.05 Critical Value***	***Prob.*****
None *	0.696	55.911	40.078	0.000
At most 1 *	0.593	42.255	33.877	0.000
At most 2	0.429	26.316	27.584	0.072
At most 3	0.324	18.393	21.131	0.116
At most 4 *	0.276	15.16	14.264	0.036
At most 5 *	0.232	12.413	3.841	0.000
Max-Eigenvalue test indicates 2 cointegrating equations at the 0.05 level				

Notes:* denotes rejection of the hypothesis at the 0.05 level. **MacKinnon-Haug-Michelis (1999) p-values

The results in Table 3 show that the trace and the Eigen Value tests indicate the existence of six cointegration relationships between the variables.

5.3. Estimation of the Vector Error Correction Model (VECM)

The estimation of the vector error correction model (VECM) has two steps. The first is to estimate the equation of long-run equilibrium by applying Gauss-Newton linear regression. The second step is to determine the causal links between the different variables in the short term by applying the WALD test.

Table 4.Vector Error Correction Model (VECM) Estimation

Independent Variables	Dependent variables					
	Y	$\mathbf{K_{ag}}$	$\mathbf{K_{os}}$	**L**	**X**	**M**
Y	-	0.513	0.095*	0.541	0.67	0.643
$\mathbf{K_{ag}}$	0.122	-	0.314	0.327	0.484	0.471
$\mathbf{K_{os}}$	0.035*	0.772	-	0.904	0.214	0.486
L	0.47	0.597	0.328	-	0.57	0.789
X	0.609	0.709	0.718	0.957	-	0.69
M	0.896	0.465	0.458	0.962	0.643	-
Lagged ECT	[-0.134]**	[0.044]	[-0.089]	[0.001]	[-0.059]	[0.044]
Values in brackets are estimated t-statistics for each cointegration equation. All other values are asymptotic Granger causality F tests.						

Notes: ***,** and * denote significances at 1% , 5% and 10% levels respectively

5.3.1. The Equation of Long-Term Equilibrium

The equation of long-run equilibrium where the dependent variable is GDP in real terms is:

$$Log(Y) = 0{,}689924 + 4{,}472908Log(Kag) - 1{,}827057Log(Kas) - 0{,}033652Log(L) - 5{,}933722Log(X) + 3{,}996831Log\ (M)$$

According to the long-run equilibrium equation, agricultural investments have a positive effect on economic growth in Tunisia. Indeed, a 1% increase in agricultural investment leads to nearly a 4.47% increase in GDP. In contrast, other investments have a negative effect on GDP; a 1% increase in them leads to a decrease of nearly 1.83% of GDP. The results show also that, in the long run, exports and labor negatively affect economic growth, while imports positively affect economic growth. More specifically, a 1% increase in the population and in exports decrease GDP by 0.033% and 5.93%, respectively. In contrast, a 1% increase in imports leads to an increase of around 4% in GDP. These results join those of Tahir et al. (2015), Riyath & Jahfer (2016), Akter & Bulbul (2017), Bakari (2017b - 2017e), Bakari et al. (2018), and Zahonogo (2017).

To verify the credibility of our long-term equilibrium equation, we will test its significance. If the equation is significant, we can say that there is a long-term relationship. In the opposite case, we can note the absence of a long-term relationship. The econometric rule requires that the error correction term is negative and statistically significant to confirm that long term equilibrium exists.

Table 10 proves the significance of the long-run equation when GDP is the dependent variable. The error terms associated with the other equations are insignificant. Consequently, long-term causality goes only from control variables and agricultural investment to GDP. We conclude that agricultural investment causes economic growth and exerts on it a positive impact in the long-term.

5.3.2. Short Term Relationships

To determine short-term causal relationships, we use the Granger tests and we retain a probability of error of less than 5%.

The results of Granger tests show that in the short term:

- ✓ Agricultural investment does not cause GDP (error probability equals to 0.12);
- ✓ GDP does not cause agricultural investment (error probability equals to 0.51);
- ✓ Other investments cause GDP (error probability equals to 0.03);
- ✓ GDP causes other investments (error probability equals to 0.09);
- ✓ Agricultural investment does not cause other investments (error probability equals to 0.31);
- ✓ Other investments do not cause agricultural investment (error probability equals to 0.77);
- ✓ Any indirect causal relationship can be identified between agricultural investments and economic growth, and between agricultural investments and other investments.

5.4. Diagnostic and Stability Tests

To verify the credibility and the robustness of our error vector correction model, we apply a set of diagnostic tests. These are the coefficient of determination, the Fisher test statistics, the heterodasticity tests (Breusch -Pagan-Godfrey / Harvey / Glejser / ARCH), the residual autocorrelation test and the Normality test. In addition, we apply stability tests by performing the CUSUM and the square of CUSUM tests.

5.4.1. Diagnostic Tests

The diagnostic tests show that the estimation results are acceptable and that the model meets the MCO application conditions. Indeed, the probabilities of heterodasticity tests are greater than 5%, those of the Fisher test are generally less than 5%, the R^2 determination coefficients are close to or greater than 50%, and the the Jarque–Bera test shows that the residues follow the normality law.

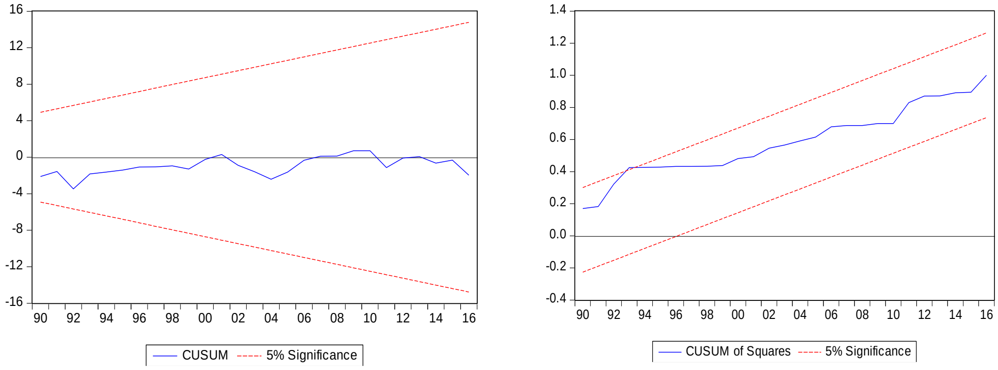
Table 5. Diagnostic Test Results

Diagnostic tests	**Dependent variable**					
	Y	**Kag**	**Kos**	**L**	**X**	**M**
R^2	0.5986	0.5772	0.5365	0.7883	0.5960	0.4643
F-statistic	2.1192	1.9401	1.6449	5.2915	2.0970	1.2321
Prob (F-statistic)	0.0361	0.0560	0.1154	0.0000	0.0381	0.3033
Heteroskedasticity Test: B-P-G	0.9688	0.4274	0.7967	0.0003	0.6929	0.7496
Heteroskedasticity Test: Harvey	0.7076	0.5596	0.3356	0.3402	0.4402	0.8291
Heteroskedasticity Test: Glejser	0.9035	0.5455	0.5326	0.0252	0.3450	0.7414
Heteroskedasticity Test: ARCH	0.9702	0.9317	0.8358	0.1674	0.9069	0.3895
Breusch-Godfrey Serial Correlation LM	0.4293	0.2172	0.3726	0.0656	0.0889	0.0231
Jarque-Bera	0.4833	0.6388	0.7554	0.1331	0.1645	0.5515

5.4.2. Stability Tests

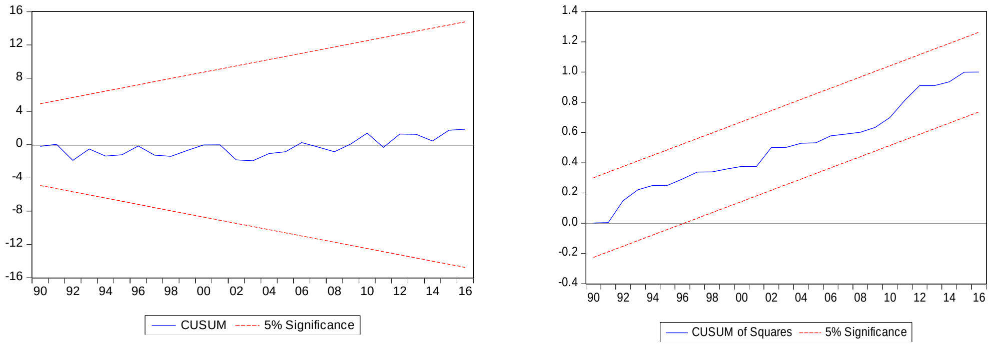
Finally, the tests of CUSUM and CUSUM square indicate that our models are stable. These tests are illustrated in graphs 7, 8, 9, 10, 11 and 12 below.

Log (Y) : dependent variable



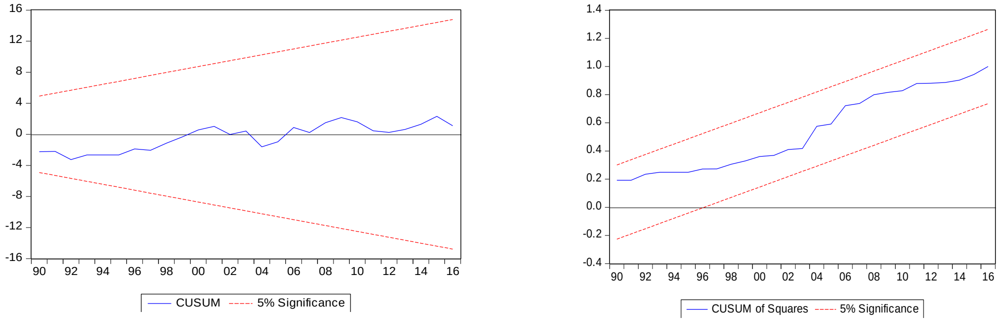
Graph 7.Stability of the Model

Log (Kag) : dependent variable



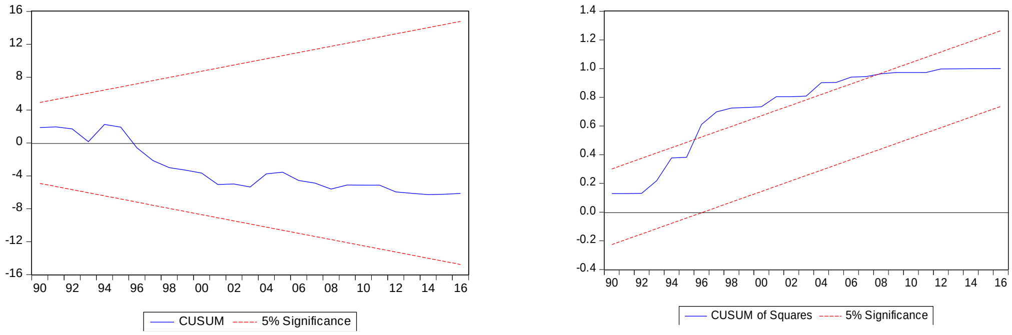
Graph 8.Stability of the Model

Log (Kos) : dependent variable



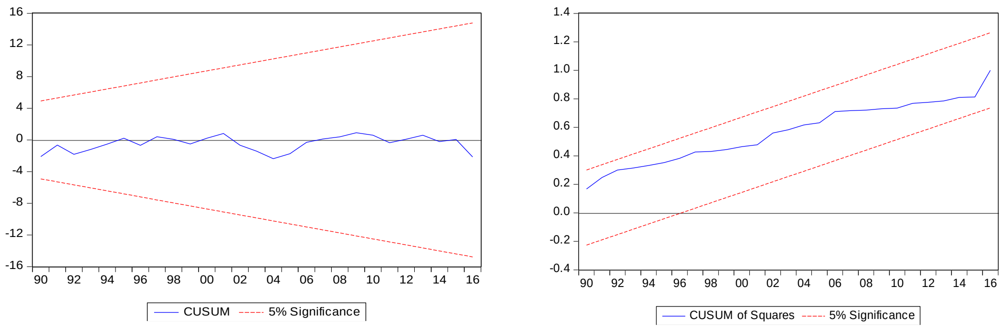
Graph 9.Stability of the Model

Log (L) : dependent variable



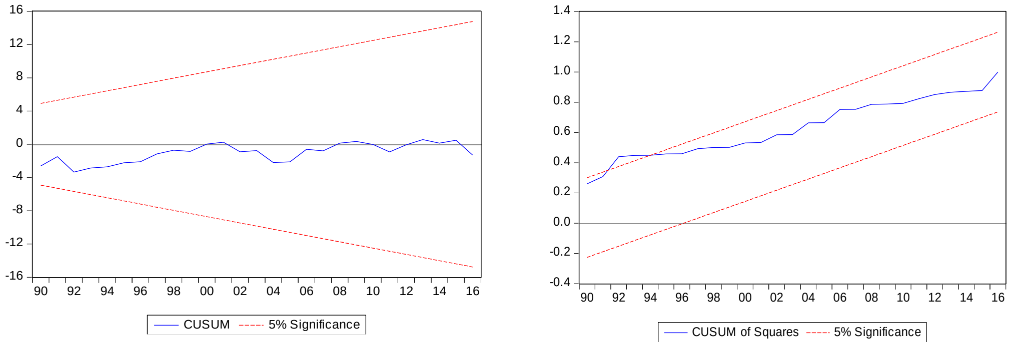
Graph 10. The Stability of the Model

Log (X) : dependent variable



Graph 11.Stability of the Model

Log (M) : dependent variable



Graph 12. Stability of the Model

6.Conclusion

The objective of this paper was to determine the relationship between agricultural investment and economic growth in Tunisia. To achieve this goal, we used an annual database for the period 1965-2016. The cointegration analysis and the error-correction vector model were applied to the variables of the model.

Empirical results have shown that there is a positive and strong relationship between investment in the agricultural sector and economic growth. In the long run, the vector error correction model indicates that agricultural investment has a positive effect on economic growth, unlike other investments that seem negatively affect economic growth. Similarly, our model asserts that there is no long-term or short-term causal relationships between agricultural investments and other investments.

These results highlight that agricultural investments are a fundamental and robust source for economic growth and development in Tunisia. This sector could thus be a relevant solution to promote economic growth in Tunisia and to improve its economic development. Hence, the government should innovate strategies aiming to further encouraging investment in the agricultural sector. In order to better identify the agricultural plants where these strategies would be the most effective, it will be of great importance to examine the link between agricultural investment and economic growth within a more desegregated approach.

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[8] André Wilmots (2003).
[9]The exception is the variable Log (L) which is stationary in level, but only in the model with constant.
[10]Results are available up-on request.