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Structure of Agricultural Investment and Economic Growth in Tunisia: An ARDL Cointegration Approach

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Abstract
In this work, we examine the impact of the structure of domestic investment in the agricultural sector on economic growth in Tunisia in the long run employing annual time series data for the period 1990-2016. Our empirical strategy is founded on the autoregressive distributed lag approach (ARDL). According to our empirical results, it has been discovered that investments in fruit trees, investment in livestock farming, investment in agricultural irrigation and investment in studies, extension and research in the agricultural sector have a positive effect on economic growth. Unfortunately, we found that investment in fishing has a negative incidence on economic growth. These results imply and propose that the diversification of domestic investment in the agricultural sector and investment in the agricultural sector are well-respected as a fountain of economic growth in Tunisia in the long run.

Keywords: Structure, Agricultural Investment, Economic Growth, ARDL, Tunisia

JEL classification: Q10, E22, F43, C20

1. Introduction

Various experiences have exposed that social stability and political stability are always attached to the stability of economic growth and sustainable development.[1] Moreover, diversification in the agricultural sector incorporates at least partly the last accusative.

In Tunisia, agriculture is one of the fundamental sectors of the national economy in terms of its efficient ability, its contribution to the gross domestic product and the expansion of this activity in various regions of the country, which is mirrored in regional development. This is a motif that guides

[1] See Özler and Tabellini (1991); Fosu (1992); Alesina and Perotti (1996); Clagueet al. (1996).

us to look into the structure of domestic investment in the agricultural sector and to identify branches of activity in which they are most efficacious in terms of economic growth. To do this, we will employ ARDL Model and annual data for the period 1990-2016.

The second section introduces a succinct overview of the literature. The empirical methodology and its results will be treated within sections three and four respectively.

2. Literature survey

Away from excessive dependence on a sole prevalent sector or a few characteristically natural resource based products, economic diversification is very subservient because it minimizes the risks and vulnerabilities correlated with a weak economic base.

In addition, well-diversified economies reach to be more effective and more unlock to trade, and thus to have greater capability for economic growth in the long run. Besides, some economists have exposed the profitable effects of economic diversification on economic growth.[2]

Nonetheless, economic diversification may equally not be contributing to economic growth. For example, in the case of the absence of such natural resource running policies to variegate and avert risks, and without suitable stimulant structures; private parties where public entities or even entire nations may have an interest for egotistical reasons for looting natural resources. For this reason, economic diversification policies should be integrated by means that take into account righteousness in the profiteering of common natural resources.[3]

In the context of commerce openness, there are sundry empirically analyzes that have demonstrated that export diversification creates a very significant contribution to the growth of the country's per capita income and a positive influence on economic growth. Love (1986), for example, articulated that export diversification is a perfect strategy for reducing instability, as it minimizes the effect of cyclical variation in some export sectors. He concluded that it is very important to obviate heavy dependence on the export of a restricted number of products. Greenaway, Morgan and Wright (1999) also expounded that not only does the accretion in the value of exports participate in a higher level of economic growth, but also the structure of exports is also influential.

Furthermore, it, in their research of Latin American countries, Gutiérrez de Piñeres and Ferrantino (2000) discovered a positive interaction between economic growth and export diversification. For their part, Feenstra and Kee (2004) examined the nexus between productivity and the sectoral variety of their exports in 34 countries over the period 1984-1997. They decided that a 10% augmentation in export diversity in all industries drove to a 1.3% increase in a country's productivity. Shared by, Hesse (2008) who discovers on the basis of Solow model, that the concentration of exports has a significant negative coefficient on growth.

2 See Auty (2002), Sachs and Warner (1995) and Van der Ploeg (2011).
3 See Bergstrom (1982) Blinder (1987), Mankiw (2009) and Van der Ploeg (2014).

Agricultural productivity and land abundance have drawn impressive attention in the literature on economic development.[4] The effects of particular specialization models have also been widely elaborated.[5]

But contrary to the powerful influence of some products, the model of the diversification in agricultural sectors sticks mainly undiscovered. In a similar way, empirical studies that seek to lighten the incidence of investment model in the agricultural sector are still unkempt. For this reason, we utilized many investigates that concentrated on the links between export structure and economic growth to identify and examine the relationship between the structure of agricultural investment and economic growth.[6]

3. Empirical strategy

We operate the ARDL approach of Pesaran et al (2002) because it has various advantages. It is more apt for testing the existence of relationships in small data in the long run and it permits testing between variables with different integration orders.

However, they should not be integrated of order 2, that is why our empirical strategy would be found first of all on the fixation of the stationary of variables (attachment of the order of integration of each variable) utilizing the two ADF and PP stationary tests. All variables must be stationary in I(0) and I (1) to maintain to the upcoming step of clenching cointegration analysis.

The second stage, we will put to test the cointegration between the variables of the model by applying the Bounds Test. As soon as the Bounds test nominates the existence of a cointegration relationship, the third stage would be to estimate the relationship of equilibrium of long term using the ARDL model. In the final stage, we will employ diagnostic and stability tests to examine the robustness and credibility of our model and our empirical findings.

3.1. Model and ARDL specification

We will bestow lineaments instigated by the neoclassical model in which gross domestic product is the variable to be explained and gross fixed capital formation in the agricultural sector by branch of activity as an explanatory variable. Therefore, we will commence from the equation below:

4 See Matsuyama (1992), Gollin et al (2002), Galiani et al (2008).
5 See Engerman and Sokoloff (1997 and 2002), Nunn (2008), Chay and Munshi (2011), Bruhn and Gallego (2012).
6 To our knowledge only, Fiszbein (2013) examined the effect of diversification in the agricultural sector for long-term economic growth in America. He found that a 1% increase in agricultural sector diversification leads to a 5% increase in gross domestic product. In his study he showed that the diversification of the agricultural sector affected the process of industrialization during the second industrial revolution (1860-1920).

$$Y = F(Ka) \text{ and } Y = A K_a^{\alpha} \quad (1)$$

The disaggregation of agricultural investment by branch of activity drives us to the following equation:

$$Y = A \prod_{i=1}^{n} K_{a_i}^{\alpha_i} \quad (2)$$

with K_{a_i} : Agricultural investment by branch of activity i et α_i : the elasticity of this investment. The linearization of equation (2) by a logarithmic transformation leads to equation (3) below:

$$\text{Log } Y = \text{Log } A + \sum_{i=1}^{n} \alpha_i \text{Log} K_{a_i} \quad (3)$$

The available data allow us to distinguish between five branches of activity (n = 5); which allows us to write:

$$\text{Log } Y = \text{Log } A + \alpha_1 \text{Log } K_{a_1} + \alpha_2 \text{Log } K_{a_2} + \alpha_3 \text{Log } K_{a_3} + \alpha_4 \text{Log } K_{a_4} + \alpha_5 \text{Log } K_{a_5} \quad (4)$$

with,

K_{a_1} = Investment in fruit trees;

K_{a_2} = Investment in livestock farming;

K_{a_3} = Investment in agricultural irrigation

K_{a_4} = Investment in fishing

K_{a_5} = Investment in studies, research and extension in agricultural sector

After having constant technology, the final linear model for our estimation can be written as follows:

$$\text{Log } Y_{(t)} = \alpha_0 + \alpha_1 \text{Log } K_{a_{1(t)}} + \alpha_2 \text{Log } K_{a_{2(t)}} + \alpha_3 \text{Log } K_{a_{3(t)}} + \alpha_4 \text{Log } K_{a_{4(t)}} + \alpha_5 \text{Log } K_{a_{5(t)}} + \varepsilon_{(t)} \quad (5)$$

with ε is an error term and (t) is a time index.

3.2. Estimation period and source of data

To look into the nexus between the structure of domestic investments and economic growth, we will employ data covering the period 1990-2016, and assemble annual reports from the Central Bank of Tunisia and the annual reports of the agency for the promotion of agricultural investments from Tunisia. The brief description of the variables is determined in Table 1.

Table 1 - Description of variables

No	Variable	Description	Source
1	**Y**	Gross domestic product (constant TND of 2010)	Central Bank of Tunisia
2	K_{a_1}	Gross fixed capital formation in fruit trees (constant TND 2010)	Agricultural Investment Promotion Agency of Tunisia
3	K_{a_2}	Gross fixed capital formation in the livestock sector (constant TND of 2010)	Agricultural Investment Promotion Agency of Tunisia
4	K_{a_3}	Gross fixed capital formation in agricultural irrigation (constant TND 2010)	Agricultural Investment Promotion Agency of Tunisia
5	K_{a_4}	Gross fixed capital formation in studies, research and extension in agricultural sector (constant TND 2010)	Agricultural Investment Promotion Agency of Tunisia
6	K_{a_5}	Gross fixed capital formation in the fishing sector (constant TND of 2010)	Agricultural Investment Promotion Agency of Tunisia

After having the recognition of our estimation model and the variables enclosed in our estimation, the sequent section sits in an empirical authentication that investigates the impact of the structure of agricultural investment on economic growth in Tunisia.

4. Empirical analysis

This section is an empirical analysis of the impact of the structure of domestic investment in the agricultural sector on economic growth in Tunisia. To reach our target, we divide this section into five steps. The first step is to plot the sequence of integration of the variables. In the second step, we study the cointegration relationship between the variables included in our model. The third step is the estimation of the ARDL model. Finally, the appliance of diagnostic tests and the analysis of the stability of our model are the last two stages in our empirical analysis.

4.1. Tests For unit root

The results of the stationarity tests are tabled in the table underneath. They point that neither of the variables are integrated in order 2; (I (2)). The application of the ARDL approach is therefore feasible.

Table 2 - Tests For unit root (ADF and PP)

Tests for unit root	ADF		PP	
	Constant	Constant and trend	Constant	Constant and trend
Y	(0.236877)	(2.854933)	(0.532880)	(2.854933)
	[5.365236]***	[5.232585]***	[5.616359]***	[5.440521]***
K_{a_1}	(1.369953)	(3.080734)	(1.198071)	(3.046680)
	[6.890614]***	[6.449688]***	[6.233323]***	[6.836921]***
K_{a_2}	(0.593464)	(1.972286)	(0.593464)	(1.957223)
	[6.957407]***	[6.866552]***	[6.936847]***	[6.844510]***
K_{a_3}	(0.811716)	(2.012917)	(0.720192)	(2.066774)
	[5.443115]***	[5.327193]***	[5.519946]***	[5.395467]***
K_{a_4}	(1.034834)	(2.474745)	(0.874179)	(2.214823)
	[6.212483]***	[6.839852]***	[6.291673]***	[8.127699]***
K_{a_5}	(1.586453)	(5.072354)***	(3.699871)	(4.187916)**
	[6.203810]***	[6.023498]***	[10.37510]***	[10.13125]***

Note: ** and *** denote significances at 1% and 5% levels, respectively;
( ) denotes stationarity in level;
[ ] denotes stationarity in first difference;
Source: Calculations done by the authors based on the EViews 9 software.

4.2. Cointegration analysis

As part of an estimation based on the ARDL model, we harness the (Bounds Tests) to ascertain if there is a cointegration relationship in our model or not. Otherwise, to carry out this verification, we will pursue this hypothesis:

- ✓ Test value F is not higher than any bound value I1➔ no cointegration between these variables;
- ✓ Test value F is higher than any bound value I1➔ cointegration between these variables.

Table 3- Bounds Tests

ARDL Bounds Test		
Test Statistic	Value	K
F-statistic	4.244158	5
Critical Value Bounds		
Significance	I0 Bound	I1 Bound
10%	2.26	3.35
5%	2.62	3.79
2.5%	2.96	4.18
1%	3.41	4.68

Source: Calculations done by the authors based on the EViews 9 software.

Table 3 indicates that our test value F (4.244158) is higher than the bound I1 Bound critical value of the 5% threshold (3.79). Therefore, a cointegration relationship exists between the variables of the model. This makes it workable to look into the impact of agricultural investments by branch on economic growth in the long term.

4.3. Estimation of ARDL model

The long-term equilibrium relation is posed as follows:

$$\mathbf{LOG(Y)} = \mathbf{0.2571\,Log}\,(K_{a_1}) + \mathbf{0.0364\,Log}\,(K_{a_2}) + \mathbf{0.2212\,Log}\,(K_{a_3}) - \mathbf{0.0788\,Log}\,(K_{a_4}) + \mathbf{0.0171\,Log}\,(K_{a_5}) + \mathbf{0.0067} \quad (6)$$

It manifests the following results:

- ✓ Investment in fruit trees has a positive effect on economic growth; a 1% increase in investment in fruit trees leads to an increase of 0.2571% of GDP.
- ✓ Investment in livestock farming has a positive effect on economic growth; a 1% increase in investment in livestock raises GDP by 0.0364%.
- ✓ Investment in agricultural irrigation has a positive effect on economic growth; a 1% increase in investment in agricultural irrigation leads to an increase of 0.2212% of GDP.
- ✓ Investment in studies, research and extension has a positive effect on economic growth; a 1% increase in investment in studies, research and extension leads to an increase of 0.0171% of GDP.
- ✓ Investment in fishing has a negative effect on economic growth; a 1% increase in investment in fishing results in a decrease of 0.0788% of GDP.

To warrant the robustness of the last result and to substantiate that this long-term relationship is equitable or not, we must test the significance of these variables. In the long run, if the error correction term has a negative coefficient and a negative probability in this case, we can say that the equilibrium cointegration equation is significant and that there is a long term relationship between the variables.

Table 4 - Résultat de l'estimation du modèle ARDL

ARDL Cointegrating And Long Run Form
Dependent Variable: DLOG(PIB)
Selected Model: ARDL(1, 2, 0, 0, 1, 0)
Cointegrating Form

Variable	Coefficient	Std. Error	t-Statistic	Prob.
D Log (K_{a1}, 2)	0.133589	0.042665	3.131128	0.0069
D Log (K_{a1} (-1), 2)	-0.077633	0.041603	-1.866033	0.0817
D Log (K_{a2}, 2)	0.038952	0.063402	0.614365	0.5482
D Log (K_{a5})	0.018339	0.030842	0.594613	0.5610
D Log (K_{a3}, 2)	0.114930	0.080482	1.428022	0.1738
D Log (K_{a4}, 2)	-0.084348	0.033069	-2.550651	0.0222
Coint Eq(-1)	-1.069826	0.225830	-4.737304	0.0003

Coint eq = D Log(Y) - (0.2571*D Log (K_{a1}) + 0.0364*D Log (K_{a2}) + 0.0171*Log (K_{a5}) + 0.2212*D Log (K_{a3}) -0.0788*D Log (K_{a4}) + 0.0067)

Source: Calculations done by the authors based on the EViews 9 software.

The error correction term has a negative coefficient (-1.069826) and a probability less than 5% (0.0003) in this case, we can say that the equilibrium cointegration equation is significant and that there is has a long-term relationship between the variables. So we can substantiate that investments in the (AF), (EB), (IA) and (P) sectors have a positive effect on economic growth, while investments in the fishing sector have a negative effect on economic growth.

4.4. Diagnostics tests

To ascertain the robustness of our empirical results we practice a set of tests that we call the diagnostic tests, these are presented in the following table.

Table 5 - Diagnostics Tests

Heteroskedasticity Test: Breusch-Pagan-Godfrey			
F-statistic	0.265085	Prob. F(9,15)	0.9751
Obs*R-squared	3.430630	Prob. Chi-Square(9)	0.9448
Scaled explained SS	1.577393	Prob. Chi-Square(9)	0.9965
Heteroskedasticity Test: Harvey			
F-statistic	0.650331	Prob. F(9,15)	0.7394
Obs*R-squared	7.016960	Prob. Chi-Square(9)	0.6354
Scaled explained SS	4.578109	Prob. Chi-Square(9)	0.8694
Heteroskedasticity Test: Glejser			
F-statistic	0.313586	Prob. F(9,15)	0.9580
Obs*R-squared	3.958909	Prob. Chi-Square(9)	0.9141
Scaled explained SS	2.568377	Prob. Chi-Square(9)	0.9790
Heteroskedasticity Test: ARCH			
F-statistic	0.371693	Prob. F(1,22)	0.5483
Obs*R-squared	0.398747	Prob. Chi-Square(1)	0.5277
Breusch-Godfrey Serial Correlation LM Test:			
F-statistic	2.556038	Prob. F(2,13)	0.1158
Obs*R-squared	7.056170	Prob. Chi-Square(2)	0.0294
Test of Normality			
Jarque-Bera	2.090761	Probability	0.351558
Test of Quality			
R-squared	0.769810	F-statistic	5.573737
Adjusted R-squared	0.631696	Prob(F-statistic)	0.001822

Source: Calculations done by the authors based on the EViews 9 software.

The diagnostic tests mark that the adopted specification is globally satisfying. The Jarque-Bera test does not dismiss the hypothesis of normality of errors. The tests carried out do not unfold any trouble of heteroscedasticity at the threshold of 5%.
The coefficient of determination R^2 and the coefficient of determination R^2 adjusted are more elevated than 60%, which endorses that our estimation is adequate and acceptable. Or else, the probability of Fisher is less than 5%, which designates that the overall significance of the model is very satisfactory.

4.5. Stability of ARDL model

To audit the stability of our model, we practice the stability tests that are "CUSUM" and "CUSUM square". The two graphs below show that our model is stable.

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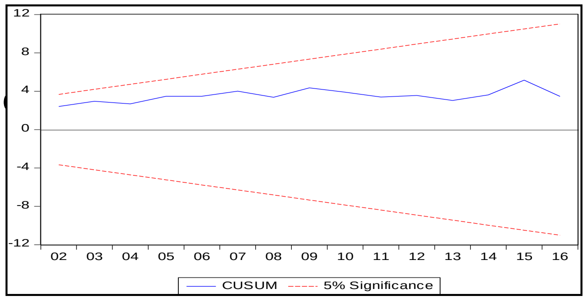

Figure 1 - Test of CUSUM

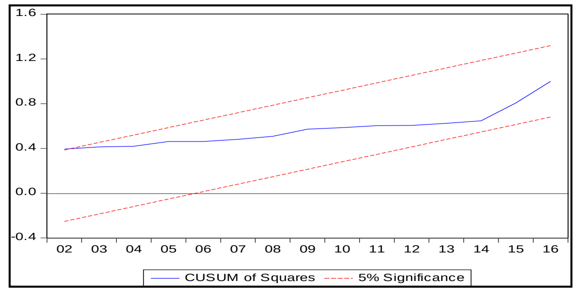

Figure 2 - Test of CUSUM Square

5. Conclusion

The point of this article was to determine the impact of the structure of domestic investment in the agricultural sector on economic growth in Tunisia. To reach this lens, we involved annual series over the period 1990 - 2016. The empirical methodology is founded on the ARDL Model.
In our empirical examination, we have divided the variable for gross fixed capital formation in the agricultural sector into five variables that designate investments in fruit trees; investments in livestock farming; investments in agricultural irrigation; respectively; investments in studies, extension and research in the agricultural sector; and investment in fisheries.
The estimation of the ARDL model has shown that there is a co-integrating relationship between the structure of agricultural investments and economic growth. In the long run, it has been found that investments in fruit trees, livestock farming, agricultural irrigation, studies, extension and research in the agricultural sector have a positive effect on economic growth. However, investment in fishing has a negative effect on economic growth in the long run.

Otherwise, the empirical results show that the investment coefficients in fruit trees and agricultural irrigation are higher than the investment coefficients in livestock farming and research. This means that investments in fruit trees and agricultural irrigation are the most profitable than other investments to stimulate economic growth.

The negative effect of fishing investments on long-term economic growth is explained by several reasons, including:

- ✓ Marine resources are constantly decreasing, which is not specific to Tunisia. It is indeed a phenomenon that encompasses marine resources around the world.
- ✓ Professionals have claimed for years the biological rest of the fish, but the State does not worry about the phenomenon of the excesses in the ports of the sea. The port, which has a capacity of 100 fishing boats, is 300 times more likely to drain the fish wealth.
- ✓ The negative impact of industrial pollution, particularly in Sfax, Gabes, Medenine, Bizerte.
- ✓ The phenomenon of violation of foreign vessels of the fish wealth of Tunisia.

Our findings in this article emphasize the importance and the effectiveness of agricultural investments in contributing to economic growth.

References

Alesina A, Perotti R (1996). Income Distribution, Political Instability and Investment. *European Economic Review*. 40, 1203-1228.

Amin Guitiérrez de Pineres S, Ferrantino MJ (2000). *Export Dynamics and Economic Growth in Latin America*. Ashgate Publishing Ltd, Burlington, Vermont.

Auty RM (2002). *Sustaining Development in Mineral Economies: The Resource Curse Thesis*, Routledge, London.

Bergstrom TC (1982). On Capturing Oil Rents with a National Excise Tax. *American Economic Review*. 72(1), 194–201.

Blinder AS (1987). *Hard Heads, Soft Hearts: Tough-Minded Economics for a Just Society*. Addison-Wesley Publishing Company, Reading, Massachusetts.

Chay K, Munshi K (2011). *Black Mobilization after Emancipation: Evidence from Reconstruction and the Great Migration*. Brown University.

Clague C, Keefer P, Knack S, Olson M (1996). Property and Contract Rights in Autocracies and Democracies. *Journal of Economic Growth*. 1(2), 243-276.

Engerman S, Sokoloff K (1997). Factor Endowments, Institutions, and Differential Paths of Growth among New World Economies, A View from Economic Historians of the United States. *Working Paper No. H0066*. National Bureau of Economic Research.

Engerman S, Sokoloff K (2002). Factor Endowments, Inequality, and Paths of Development among New World Economics. *Technical Report*. National Bureau of Economic Research, Inc.

Feenstra RC, Kee HL (2004). Export Variety and Country Productivity. *World Bank Research Working Paper No. 3412*. Washington, DC: The World Bank.

Fiszbein M, (2013). Agricultural Diversification and Development: Evidence from US History. *Paper presented at the 5th Bolivian Conference on Development Economics*. UPSA, Santa Cruz de la Sierra, 14-15 November. Available online: http://www.inesad.edu.bo/bcde2013/papers/BCDE2013-101.pdf

Fosu AK (1992). Political Instability and Economic Growth: Evidence from Sub-Saharan Africa. *Economic Development and Cultural Change*. 40, 829-841.

Galiani S, Heymann D, Dabus C, Tohmé, F (2008). On the Emergence of Public Education in Land-Rich Economies. *Journal of Development Economics*. 86(2): 434 - 446.

Greenaway D, Morgan W, Wright P (1999). Exports, Export Composition and Growth. *Journal of International Trade and Economic Development*. 8, pp.41-51.

Gollin D, Parente S, Rogerson R (2002). The Role of Agriculture in Development. *The American Economic Review*. 92(2): 160 - 164.

Hesse H (2008). Export Diversification and Economic Growth. *Working Paper No. 21*, Commission on Growth and Development.

Love J (1986). Commodity Concentration and Export Earnings Instability : A Shift from Cross-Section to Time Series Analysis. *Journal of Development Economics.* (24)2, pages 239 - 248.

Mankiw NG (2009). Smart Taxes: An Open Invitation to Join the Pigou Club. *Eastern Economic Journal.* 35, 14–23.

Matsuyama K (1992). Agricultural Productivity, Comparative Advantage, and Economic Growth. *Journal of Economic Theory.* 58(2): 317-334.

Nunn N (2008). *Slavery, Inequality, and Economic Development in the Americas: An Examination of the Engerman-Sokoloff Hypothesis.* In E. Helpman (Ed.), Institutions and Economic Performance (Cambridge, MA: Harvard University Press, 2008).

Ozler S, Tabellini G (1991). External Debt and Political Instability. *NBER Working Paper 3772.* National Bureau of Economic Research, Inc

Pesaran, Mohammad H, Yongcheol S (1999). *An Autoregressive Distributed Lag Modeling Approach to Cointegration Analysis.* In Econometrics and Economic Theory in the 20th Century: The Ragnar Frisch Centennial Symposium, ed. Steinar Strøm, 371-413. Cambridge: Cambridge University Press.

Sachs JD, Warner AM (1995, revised 1997, 1999). Natural Resource Abundance and Economic Growth. *NBER Working Paper 5398*, Cambridge, Massachusetts.

Shiimi IW, Kadhikwa G (1999). Savings and Investment in Namibia. *Namibia: Bank of Namibia Publications.*

Van der Ploeg F (2011). Natural Resources: Curse or Blessing? *Journal of Economic Literature.* 49 (2), 366-420.

Van der Ploeg F (2014). Untapped Fossil Fuel and the Green Paradox. *OxCarre Working Papers 119,* Oxford Centre for the Analysis of Resource Rich Economies, Oxford University.