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Food security in Tunisia: an econometric analysis

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Introduction

Food security issue is getting more attention by many countries in the world for the last years even in middle-income countries. Tunisia is one of the middle-income countries able to produce her own food, but, after the revolution in 2011, factors affect its food security are multiplied. This paper analyzes these factors during the period from 1991 to 2017. The analysis in this paper include food production index as food security proxy and some independants variables including consumer prices, Tunisian population, land under cereals production, food importation and climatic variables. An econometric analysis of food security was done through the Vector Error Correction Model approach (VECM).

Purpose of this paper

This study will address the issue of food security in a quantitative way by trying to identify the determinants of food security in Tunisia reflecting the key dimensions through an econometric approach adequate to this issue for interesting policy and strategic recommendations.

Data and Methodology

The variables of food security in Tunisia (Figure.1) used in this study during the period of 1991-2017 are:

Dependent variable

FPI **= Food production index for based year(2004-2006=100)**

Independent variable

INF **= Inflation, consumer prices (annual %)**
LCER **= Land under cereal production (hectares).**
FIMP **= Food imports (% of merchandise imports)**
POP **= Total population in million**
PRC **= Precipitation (mm)**
TEMP **= Temperature (c°)**

These variables are expressed in long terms. Those data obtained from World Bank and Department of Statistic (DOS) , but for the precipitation and temperature from basic data of National Institute of Metrology (INM).

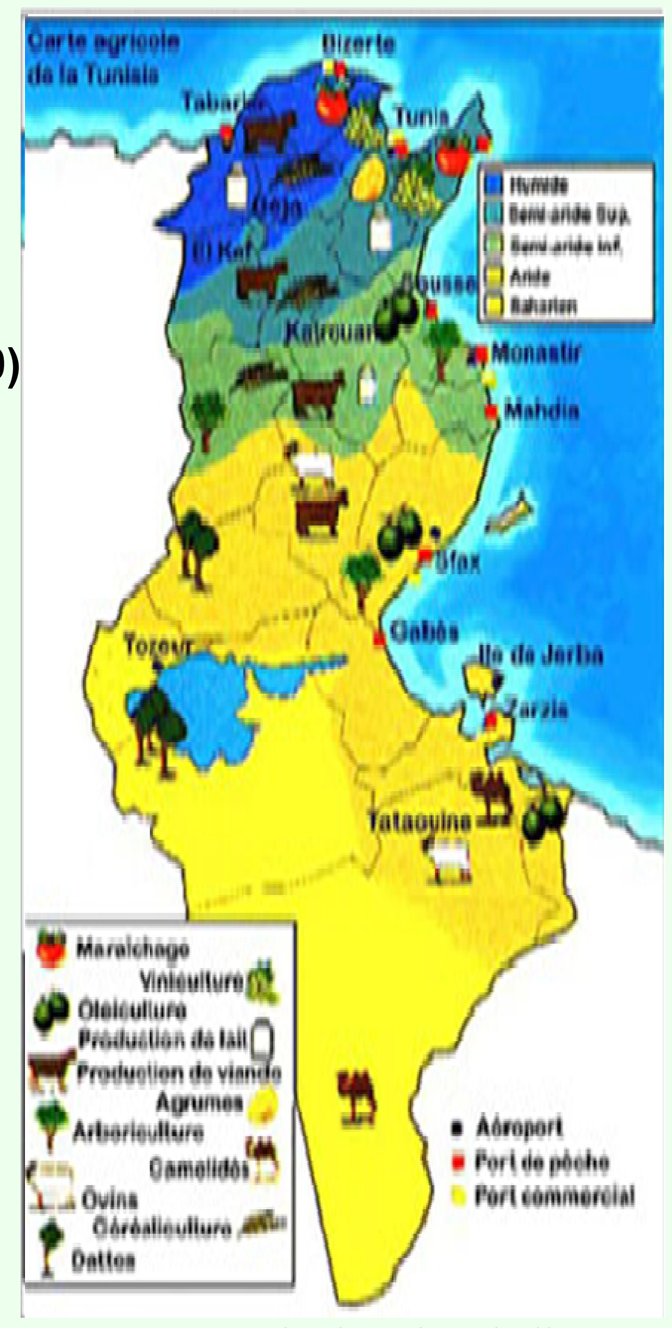

Figure1. Agricultural and climate map in Tunisia.

Model Specification

$$FPI = F\left(INF, LCER, FIMP, POP, PRC, TEMP\right) \quad (1)$$

In log terms the equation (1) becomes as follows (equation 2) :

$$\ln FPI = \alpha_0 + \alpha_1 \ln INF_t + \alpha_2 \ln LCER_t + \alpha_3 \ln FIMP_t + \alpha_4 \ln POP_t + \alpha_5 \ln PRC_t + \alpha_6 \ln TEMP_t + \varepsilon_t \quad (2)$$

- α_0, α_1, α_2, α_3 α_{04}, α_5= Coefficient for the explanatory variables
- ε = error term and t = times series period

Results and Discussions

The co-integration test results indicate that the variables are co-integrated each other and **there is a long run significant relationship at the 1% level between food production index and explanatory variables.** **Negative signs of some variables** in the **Table 1** are expected, such as: **INF** (inflation), **POP** (population), **FIMP** (Food import), temperature **(TEMP),** confirms **that climate change will have adverse effects on food security** due to the instability and decline in agricultural production of some crops important for food security, **such as the cereals**. While, the **precipitation variable (PER) will have positive effects on agricultural production and productivity**. **The negative sign** of the variable of **Land under cereal production** (***LCER***) is not expected as increasing cereal areas normally contribute to increase agricultural production and food security. But we can find explanations for the negative sign of the **variable** (***LCER***) in the **classical theory of Ricardo land rent**. **The increase in the area of agricultural land has a negative impact on food security because the extension extends to less fertile marginal lands deprived of the land rent (Ricardo, 1815)1,** This variable also explains the **negative sign of the population variable (POP),** in fact, **to feed a population it is necessary to extend over even less fertile land, Malthus explains this question by the difference between the population with experiential growth and food supply with arithmetic growth due to this decrease in land rent (Malthus, 1970)2.**

1.Ricardo, David (1815) .The Influence of a low Price of Corn on the Profits of Stock.
2.Malthus, T.M. (1970).An inquiry into the nature and the progress of rent and the principles by which it is regulated.

Table 1. Results of co-integration equation

Co-integration equation — Log likelihood 280.1063
Normalized co-integrating coefficients (t-Student in parentheses)

LFPI	LINF	LLCER	LPOP	LFIMP	LPRC	LTEMP
1.000000	-3.463718	-3.030863	-14.15710	-13.87866	8.257720	-22.27614
	-4.5723***	-7.7876***	-5.3058***	-15.513***	12.224***	-2.896***

*** Significant at the 1% level.

Thus, it would be inappropriate to **estimate a VAR model** when the variables **are co-integrated and expressed in first differences** , an **Vector Error Correction Model (VECM) is the most appropriate for this case**. The **VECM essentially estimates the short run dynamics between these variables**. The results of short run Vector Error Correction Model for food security is presented in **Table 2.**

Table 2. Results for estimated Vector Error Correction Model (VCEM)

Variables	Coefficient	t-statistic	Prob.
Constant	-0.013713	-0.141989	0.8891
$\Delta \ln FPI_{t-1}$	0.184697	0.707512	0.4909
$\Delta \ln CPI_{t-1}$	**-1.841640**	**-2.954334**	**0.0084*** **
$\Delta \ln LCER_{t-1}$	**0.534739**	**1.826115**	**0.0492** **
$\Delta \ln FIMP_{t-1}$	**-1.751335**	**-2.073653**	**0.0323** **
$\Delta \ln POP_{t-1}$	3.193411	0.410372	0.6877
$\Delta \ln PRC_{t-1}$	0.164230	0.989621	0.9792
$\Delta \ln TEMP_{t-1}$	-2.070064	-1.075262	0.3004
ECT_{t-1}	**-0.785176**	**-3.497616**	**0.0036*** **
R-squared	0.745817		
F-statistic	4.564281		
Prob (F-statistic)	0.005803		

*** Significant at the 1% level; ** Significant at the 5% level

Based on **the VECM result** in **Table 2,** the value of the **Error Correction Term coefficient (ECT)** is less than one (**ECTt-1 <1**), **negative** and **significant** at a significant level of 1%, which implies that **the series cannot drift too far and that convergence slowly adjusts towards long term equilibrium.** The results also show the existence of significant short-term relationships between food security through proxy **food production index (FPI)** and explanatory variables (**INF (inflation)** and **FIMP (Food import)** ***are*** **significantly negative impact On the other hand, the Land under cereal production variable (*LCER*)** has a **significantly positive impact**.

Conclusion and recommandations

Food security in Tunisia is a serious, evolving and dynamic issue. Factors threatening its short and long term stability were detected through this econometric analysis. These factors are also confirmed in other research such as Mensah, O. (2013) and Amjath-Babu et al, (2019).For these reasons, Public decision-makers must develop measures to mitigate these short-term threats, such as controlling inflation and controlling imports to encourage agricultural cereal production while preserving soil fertility through strategies to adapt to climate change in the short and long term.

References

Mensah, O., James, A., R., and Thomas, T. (2013). Determinants of household food security in the Sekyere-Afram plains district of Ghana. Global Advanced Research Journal of Agricultural Science, 2, 34-40.
T. S. Amjath-Babu, Pramod K. Aggarwal and Sonja Vermeulen (2019) Climate action for food security in South Asia? Analyzing the role of agriculture in nationally determined contributions to the Paris agreement, Climate Policy, 19:3, 283 298.