THE IMPACT OF ADDED VALUE OF AGRICULTURE IN ROMANIA'S ECONOMY

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Abstract
Agricultural production has an important role in economic growth, especially in case of emerging economies. The increase of the added value of agriculture in economy signifies additional income for the rural population, a vulnerable category within Romania, an increase of external trade, lower imports and higher exports and also an increase of demand from non-agricultural sectors, as the financial situation of farmers improve. The research was performed in order to provide empirical information regarding the relationship between the Romanian agricultural added value and the macroeconomic variables: FX rate, real GDP, inflation and interest rate. The source of the time series data have been EUROSTAT and World Bank. The analyses has been performed using the unit root tests: ADF (Augmented Dickey-Fuller), PP (Phillips-Perron) and KPSS (Kwiatkowski–Phillips–Schmidt–Shin) and the cointegration test Johansen and Engle-Granger.
Keywords
agriculture, unit root, cointegration, real GDP

Introduction

The agriculture sector in Romania has undergone important changes within the last 20 years, evolving from a centralized system to private farms. The majority of this farms have very small size, do not have technology, financial support, infrastructure and know how to be profitable. The large majority of Romania rural population lives in poverty and this is due mainly to an agriculture of subsistence.

Due to the structure of the rural population: advanced age, lack of education, lack of funds for investments, reluctance to associate there is an important gap between the actual profitability and the potential.

Government subsidizes, investment funds provided by the European Community as well as various Credit Guarantee Funds have improved marginally the situation of rural life. Nevertheless, although is a slow process, people are starting to see the possibilities granted by this facilities and new small business enterprises (SME) are created.

If in the beginning local banks were not focused to grant loans for agricultural sector, in recent years this situation changed. The banks realized the growth potential within the agriculture sector and start creating customized loans for farmers and simplified the approval conditions. At present, most of the Romanian Banks have already been actively using the credit guarantee scheme for SMEs. On average, guarantees cover between 1 and 10% of the SME loan portfolio of banks[9].

In order to analyze the agricultural impact within the country's economy I used econometric methods, that prove the link between the agricultural added value and the main macroeconomic variables.

[9] Credit Guarantee Schemes for SME lending in Central, Eastern and South - Eastern Europe, A report by the Vienna Initiative Working Group on Credit Guarantee Schemes, November 2014

1. Model specification

The first step represents the validation of data stationarity using Augmented Dickey-Fuller (ADF) test, Phillips-Perron (PP) and Kwiatkowski (KPSS). The series are considered stationary if the average, variation and covariance are constant.

Augmented Dickey-Fuller test starts with an AR(1) process: $y_t = \mu + \alpha y_{t-1} + \varepsilon_t$,

where μ and α are parameters to be estimated and ε_t is white noise.

If we deduct from both sides of the equation y_{t-1} will result the following equivalent equation:

$$\Delta y_t = \mu + \gamma y_{t-1} + \varepsilon_t$$

where $\gamma = \alpha - 1$

The series is stationary if $-1 < \alpha < 1$; in case $\alpha = 1$ the series has a unit root and if $\alpha > 1$ the series is not stationary.

The null hypothesis of the test is that the series has a unit root $H_0 : \gamma = 0$

the alternate $H_1 : \gamma \neq 0$

Two series are considered cointegrated if the linear combination of the series is stationary, even though each series separately is not stationary in level.

In order to test the cointegration I used the Engle-Granger method, that stated that the endogenous variable X_t and exogenous variable $Y_{i,t}$ form a long term relationship if the residuals of the equations are stationary:

$$X_t = \alpha_1 + \sum_{i=1}^{n} \alpha_i Y_{i,t} + \varepsilon_t$$

I used ADF test in order to test if the residuals are stationary.

This method has the problem that can only estimate at most one cointegration relation between the variable. Because the system has more variables there can be more than one relations of cointegration.

An alternative to this is represented by the Johansen method, that test the series cointegration within a VAR of rank p :

$$y_t = \mu + A_1 y_{t-1} + ... + A_p y_{t-p} + \varepsilon_t ,$$

where y_t is an nx1 vector of first degree variables and $\boldsymbol{\varepsilon_t}$ is an *n*x1 vector. This VAR can be written as:

$$\Delta y_t = \Pi y_{t-k} + \Gamma_1 \Delta y_{t-1} + \Gamma_2 \Delta y_{t-2} + ... + \Gamma_{k-1} \Delta y_{t-(k-1)} + \varepsilon_t$$

were:

$$\Pi = \sum_{i=1}^{p} A_i - I \text{ and } \Gamma_i = -\sum_{j=i+1}^{p} A_j$$

If the matrix of the coefficients Π has a reduce rank r<*n* then there are *n*xr matrixes α and β , each with rank r, so that $\Pi = \alpha \beta^{'}$ and $\beta^{'}$ y is stationary, r represents the number of

cointegration relationships. The elements of α are known as adjustments parameters in the vector error correction model and each column of β is a cointegration vector. Johansen uses two different tests in order to establish the number of correlations, so that the low rank of the matrix Π is given by trace value and maximum eigenvalue:

$$\lambda_{trace}(r) = -T\sum_{i=r+1}^{g}\ln(1-\hat{\lambda}_i)$$

and

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

where T represents the size of the series, r represents the number of cointegration vectors and $\hat{\lambda}_i$ represents the estimated eigenvalue of rank i of matrix Π.

The null hypothesis for test λ_{trace} is that the number of cointegration relationships is smaller or equal to r and the alternate, the number of cointegration relationships is large than r.

For $\lambda_{\max}$ the null is that the number of cointegration relationship is equal to r, alternate, the number of cointegration relationships is $r+1$.

3. Econometric Results

3.1. Data stationarity

Table 1 presents a statistical description of the series in level. I used the ADF (Augmented Dickey-Fuller), PP (Phillips-Perron) and KPSS (Kwiatkowski) test in order to determine the stationarity of the series. If the value of the statistic is larger than the critical value, than the null can be rejected. The series are not stationary in level.

Table 1 Data stationarity

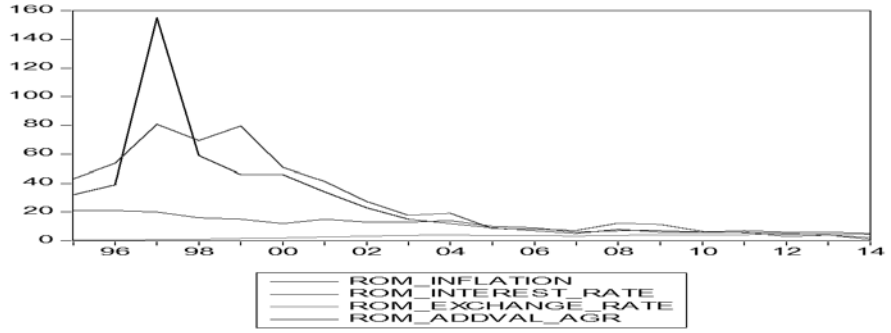
Variable	ADF	PP	KPSS
Agriculture value added	-1,54 (0,50)	-1,41 (0,55)	0,59
Real PIB	-0,07 (0,94)	-0,28 (0,91)	0,55
FX rate	-3.28 (0.03)	-1.98 (0.29)	0.55
Inflation	-4.18 (0.01)	-2.33 (0.17)	0.53
Interest rate	-2.09 (0.25)	-0.87 (0.77)	0.49

Source : Author calculation

The stationarity tests results applied to the first level series show that the test statistic is smaller than the critical value, the null hypothesis of a unit root is rejected at a significance level of 1%.

3.2 Cointegration relationships

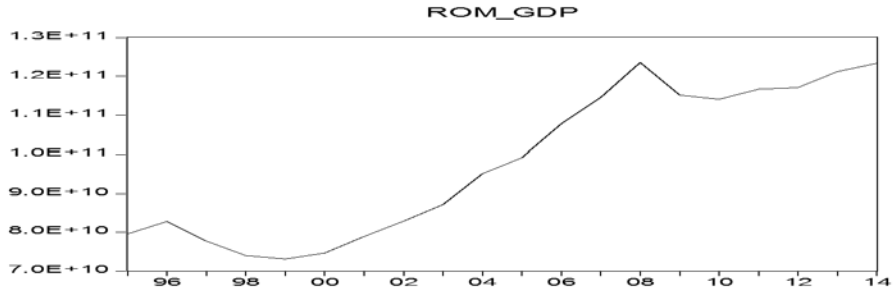
Nonstationary variables can be cointegratied if a linear combination of the variables is stationary. If the series have the same evolution in time it means that they are in a long-run equilibrium. The cointegration term is known as the error correction term, since the deviation from the long-run equilibrium is corrected gradually through a series of partial short-run adjustments.



Source: World Bank, EUROSTAT

Fig. 1 The evolution of inflation, interest rate, FX rate and agricultural added value in Romania

The decrease of the real GDP at the beginning of the '90 it was followed by moderate increase until 1996. In 1999 Romania registered a y-o-y GDP decrease of 3.2% mainly due to the decrease of the industrial production, of services and construction. Thus, the added value of the agriculture was with 4.7% higher than in 1998. An increase of GDP started in 2000 and culminated in 2007-2008, the growth being sustained by growth registered in sectors link: trade, industry and construction. As the value of the GDP rises the agricultural added value within GDP decreases.



Source: World Bank

Fig. 2 Romania`s Real GDP

By using the Johansen test within a VAR we can establish if there are cointegration relationships between the percentage of agricultural added value within GDP, real GDP, inflation rate, interest rate and FX rate. This test is used in order to calculate the number of cointegration relationships that can be established between the variables. If the statistic value is greater than the critical value than the null will be rejected.

Table 3 Johansen cointegration test

No of cointegration relationships	Eigenvalues	Statistical values	5% Critical Value	Probability
No relation	0.981015	207.8935	69.81889	0.0000
Max 1	0.979830	136.5398	47.85613	0.0000
Max 2	0.859007	66.27590	29.79707	0.0000
Max 3	0.649316	31.01309	15.49471	0.0001
Max 4	0.490884	12.15144	3.841466	0.0005

Source: Author calculation

In case of λ_{trace} test, the null " there are no cointegration relationships" is rejected, because the value 12.55 of the t-statistic is larger than 5% critical value. The econometric results show us that within the VAR there are 5 cointegration relationships.
In order to test the cointegration relationships I used the Engle Granger method, the results proving the relationships between the FX rate, real GDP and added value of agriculture.

Table 4 Cointegration relationships

Dependent Variable: ROM_ADDVAL_AGR				
Method: Least Squares				
Sample: 1995 2014				
Included observations: 20				
Variable	Coefficient	Std. Error	t-Statistic	Prob.
ROM_EXCHANGE_RATE	-2.429919	0.694172	-3.500456	0.0032
ROM_GDP	-1.63E-10	5.14E-11	-3.176576	0.0063
ROM_INFLATION	0.030057	0.025102	1.197392	0.2497
ROM_INTEREST_RATE	-0.086400	0.057274	-1.508533	0.1522
C	36.32559	6.161422	5.895650	0.0000
R-squared	0.884371	Mean dependent var		11.45000
Adjusted R-squared	0.853537	S.D. dependent var		5.335827
S.E. of regression	2.042050	Akaike info criterion		4.478103
Sum squared resid	62.54950	Schwarz criterion		4.727036
Log likelihood	-39.78103	Hannan-Quinn criter.		4.526697
F-statistic	28.68132	Durbin-Watson stat		1.938100
Prob(F-statistic)	0.000001			

Source: Author calculation

The calculated probability for inflation rate and interest rate shows that the relationships between them and the added value of agriculture are not statistically significant.

Table 5 Cointegration relationships

Dependent Variable: ROM_ADDVAL_AGR				
Method: Least Squares				
Sample: 1995 2014				
Included observations: 20				
Variable	Coefficient	Std. Error	t-Statistic	Prob.
ROM_EXCHANGE_RATE	-1.997734	0.556771	-3.588069	0.0023
ROM_GDP	-1.22E-10	4.22E-11	-2.886153	0.0103
C	29.36123	2.991306	9.815519	0.0000
R-squared	0.866106	Mean dependent var		11.45000
Adjusted R-squared	0.850353	S.D. dependent var		5.335827
S.E. of regression	2.064121	Akaike info criterion		4.424767
Sum squared resid	72.43009	Schwarz criterion		4.574126
Log likelihood	-41.24767	Hannan-Quinn criter.		4.453923
F-statistic	54.98294	Durbin-Watson stat		1.270218
Prob(F-statistic)	0.000000			

Source: Author calculation

The value of R^2 is large 0.87, so the exogenous variable have explicative value over the endogenous variable. Also, the exogenous variable are statistically significant. The coefficients of FX and GDP are negative, so that there is a negative relationship - when the FX or GDP grow, the agricultural added values decreases. The GDP coefficient is very small, so is not statistically relevant.

Because the Engle-Granger test evaluates the residuals generated by the linear equation of the variables, the critical values are different from the ones used by the ADF test. Engle and Yoo (1987) have calculated a new set of critical values for this application because the residuals have been obtained from a set of estimated coefficients.

For a number of two exogenous variable and a series of 20 observations the critical value is -4.11 for 5% significance level. The critical values become larger as the number of variables increases.

Table 6 Residuals stationarity

Null Hypothesis: RESID_AGR has a unit root				
Exogenous: Constant				
Lag Length: 3 (Automatic based on SIC, MAXLAG=4)				
			t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic			-4.185436	0.0060
Test critical values:	1% level		-3.920350	
	5% level		-3.065585	
	10% level		-2.673459	
*MacKinnon (1996) one-sided p-values.				
Warning: Probabilities and critical values calculated for 20 observations and may not be accurate for a sample size of 16				

Source: Author calculation

At 5% level of significance the results show that the residuals of the regression are stationary, so we can conclude that the series are cointegrated.

Conclusion

The share of agricultural added value is not significant within the Romanian`s real GDP. In recent years Industry, Construction and Services had the major impact within the GDP, while the agriculture`s role decreased. This is a normal process for an emergent economy that has to catch the developed economies within the euro area. In this conditions, the development of sectors with higher addition value is benefic to achieving the real convergence criteria.

Moreover, there is a negative relationship between the exchange rate and agriculture added value. This relationship is due to the fact that most of the agricultural production is exported, so a low FX rate increase the performance of the Romanians product. Unfortunately, the large majority of these exports are row materials, unprocessed, that have very little added value. This is an important issue to solve, as the low profitability of the exports affect the income of the farmers. Furthermore, Romania has significant imports of processed agriculture products, with significantly higher added value. This gap is an important loss for the Romania agriculture, that has to be overcome through investments in the storage and processing of the local agricultural products.

Nevertheless, when analyzing the importance of agriculture, we must consider the important social role of subsistence farms. For a large number of people this is the only means of survival, especially in developing countries, where there is no job alternative. Therefore, customize solutions have to be implemented for this category as well.

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