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ANALYSIS OF ECONOMIC PERFORMANCE IN AGRICULTURE USING ECONOMETRIC MODELING

Sorina Simona Bumbescu*
"1 Decembrie 1918" University of Alba Iulia, Romania
E-mail: sorina.bumbescu@gmail.com

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Abstract: Agriculture is a priority sector of the national economy, so the analysis of the economic performance of agricultural holdings in Romania using modern methods, such as econometric modeling, is of particular importance. In this article is made an analysis of economic performance, expressed by ROA and ROE, for the first 500 farms in Romania (ordered by turnover size), over a period of 5 years, the purpose being to provide an answer to a fundamental research question: Which are the economic indicators/ variables that significantly influence the economic performance expressed by ROA and ROE? The results of this study highlight the relevance of the econometric modeling applied for performance analysis as well as the main indicators that significantly influence the economic performance of agricultural holdings expressed by ROA and ROE. The paper brings a significant contribution to make correct decisions aimed at the economic performance of the agricultural sector.

Keywords: performance, agriculture, return on assets, return on equity.

JEL Codes: M21, C01

1. Introduction

In Romania, agriculture is one of the most important branches of the national economy, having a significant growth potential due to the existing natural and human resources. Romania is one of the countries of the European Union with important resources for agriculture, occupying the 6th place in the EU in terms of used agricultural area but the agricultural structure is not adapted to the developed countries of the EU. Romanian agriculture is characterized by a high degree of fragmentation (with the largest number of farms in the EU, most of which are subsistence farms) and a low degree of technology.

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*Corresponding author: Sorina Simona Bumbescu. *E-mail: sorina.bumbescu@gmail.com*

Due to its importance for the rural economy, the CAP is a widely debated topic, with a widely asked question referring to the extent to which the CAP has achieved the objective of contributing significantly to the productivity growth. The answers to this question are varied, being approaches that result in the positive effect of the CAP (Kazukauskas et all, 2011), others highlight the negative impact (Rizov et all, 2013). The major challenges facing the CAP have started from economic, social and environmental changes, as well as from huge heterogeneities within the EU, due to its expansion to the east. The successive reforms of the Common Agricultural Policy (CAP) aim at the transition to a fully sustainable, intelligent, competitive agricultural sector, the development of dynamic rural areas, which will provide high quality and safe food for the population. The main priorities set by the European Commission (EC) for the post-2020 CAP are: environmental protection and combating climate change, emphasizing the link between research-innovation-counseling; the transition from compliance to performance; restoring the balance between the Member States in terms of responsibilities.

In this context, farms in Romania too, must face economic, social, environmental and technological challenges of contemporary society and operate in accordance with the principles of sustainable development. For an integrated approach of economic, social and environmental aspects it is necessary the adoption of a new perspective, which facilitates the conversion of the profit-based financial accounting towards monitoring of business sustainability (Chousa & Castro, 2006). Extending the information range used in traditional accounting and approaching it as Sustainability Accounting, ensures knowing about the various types of company impacts.

The objective of this article is to analyze the economic performance of Romanian farms through specific financial indicators in order to be a viable tool in decision making on future actions, using econometric modeling.

2. Literature review

Organizational performance is a widely debated topic in the literature, with multiple connotations, its importance being underlined by the need for organizations to cope with the competitive environment. The evaluation and measurement of the organizations' performance must be viewed in a global context due to the multitude of variables acting on it as well as the fact that reaching a certain level of performance implies the functioning of the economic systems.

The performance represents a state of competitiveness of the organization which, on the one hand, determines the achievement of results due to the achievement of strategic objectives, and on the other hand, ensures sustainable maintenance on the market (Jianu, 2007).

The performance consists of the efficiency and effectiveness with which the resources (effort) are consumed and the results (effects) generated which ensure the development of the organization sphere of interest (Petcu, 2009).

In specialized economic literature, performance is perceived in three distinct ways (Doinea, 2011):

- performance - the level of achievement of strategic objectives;
- defining the performance by taking into account the created value;
- efficiency versus effectiveness in defining the performance.

The performance evaluation indicators are diverse and reflect the degree of use of available resources to achieve the desired/planned results. The annual financial reports of the organizations facilitate the monitoring and evaluation of the performance with the help of financial indicators (Burja, 2015). The financial indicators provide a real basis for analyzing the performance and evaluating the financial health of the company (Knight & Bentoneche, 2001).

Some research points out that the performance measurement can be achieved by dividing the production process into stages, the objective being to provide more detailed information on the weaknesses that lead to non-performance and at the same time to identify the strengths that can be proposed as a reference point for the entire production system (Keramidou et al., 2013).

We can see that there are a lot of conceptual approaches, the performance influencing factors, but considering the specificity of the agriculture sector, from our point of view, the performance is influenced by a number of factors that concern: the farm size, the degree of technology, the natural conditions, the soil quality, education, age, together with other factors specific to other branches of the national economy (legislative, economic, social, political factors).

ROA highlights how much profit an organization makes as a result of the investments in its assets. It is calculated as the ratio between the net income and the total assets held by an entity. The high level of this indicator highlights a high performance. ROA is considered to be the most comprehensive indicator of performance measurement because it combines efficiency (doing the right thing) and effectiveness (doing what is right) measurement (Courtis, 2003).

ROE is one of the most important performance assessment indicators because it "allows the performance general evaluation of the organization's management" (Flamholtz & Aksehirli, 2000). ROE is calculated as the ratio between net profit and equity and measures the profitability of an organization, highlighting how much profit a company generates through the money invested by the shareholders.

3. Research methodology

This article combines qualitative and quantitative research. We chose a general to a specific approach, starting from a theoretical presentation of the current state of

knowledge and continuing with the case studies based on data analysis and interpretation. Considering the importance of economic performance analysis using econometric modeling, following an extensive documentation process, two performance measurement indicators were chosen: ROA, ROE, which represent the dependent variables of the linear regression model.
The research question considered is: Which are the economic indicators/ variables that significantly influence the economic performance expressed by ROA and ROE?
The financial-accounting information required for multiple linear regression models was extracted from mfinante.ro database. The data necessary to realize the econometric models are Panel data, for a period of 5 years for 500 agricultural holdings in Romania, respectively 2500 observations. The selection of agricultural holdings was made according to two criteria:
- the turnover size, being selected the first 500 agricultural holdings that have the highest turnover;
- CAEN code, being selected the agricultural holdings that have the CAEN code 014 "Animal breeding".
To interpret the data we used EViews statistical modeling program.
The dependent variables used are ROA - return on assets and ROE - return on equity.
The independent variables used in the two models are: fixed assets rate (Raf), general solvency (Sg), financial leverage (Lf), total asset turnover (Rot.at), gross margin (Mb).
We mention that in the initial phase of the model we started with 10 independent variables (fixed assets rate, general solvency, financial lever, total asset turnover, gross margin, turnover, number of employees, current assets rotation, total expenses, net profit) that based on professional reasoning were introduced in several combinations. After performing several statistical tests, 5 predictors were eliminated (turnover, number of employees, current assets rotation, total expenses, net profit) because the results obtained by applying the multiple regression were not statistically significant.
According to the literature, the equation for the multiple linear regression model is (Anghelache & Mitruţ, 2009):

$$Y= \beta_0+\beta_1*X_1+\beta_2*X_2+\beta_3*X_3+\beta_4*X_4+\beta_5*X_5+\mathcal{E} \qquad (1)$$

Y- dependent or resultant variable, in our case ROA and ROE
$\beta 0$- constant;
$\beta 1$-$\beta 5$- regression equation parameters
X1-X5- independent or explanatory variables, in our case Raf, Sg, Lf, Rot.at, Mb

Ɛ- error variabile.

In order to test the validity of multiple linear regression models, four hypotheses are considered:

1. The multiple regression equation is significant at the global level;
2. The parameters of the multiple regression models are statistically significant;
3. The independent variables of the models are not affected by multicollinearity;
4. The values of the residual variable are independent, respectively they are not correlated.

Durbin Watson test values range from 0 to 4; if the test values are around 2, the autocorrelation is absent (Anghelache et al., 2012). For a 95% confidence level, the Durbin Watson statistic has two values dL and dU, which are obtained from the Durbin Watson table (Ganea & Cârstina, 2013).

In testing the null hypothesis (H_0*:p=0)* there are four situations (Ganea & Cârstina, 2013):

- If DW belongs to the range [d_L, d_U] or [4-d_L,4-d_U] then a decision cannot be made; in our case [1,718;1,820];
- If DW belongs [d_U,4-d_U] the null hypothesis of non-correlation is accepted; in our case [1,820; 2,18];
- If DW belongs [0, d_L] the null hypothesis is rejected, being positive autocorrelation; in our case [0; 1,718];
- If DW belongs [4-d_L,4] the null hypothesis is rejected, being negative autocorrelation; in our case [2,282; 4].

4. Results, discussions

We present in tables 1, 2, 3, 4 the results of the first multiple linear regression model, having ROE as dependent variable.

Table 1 Descriptive statistics – ROE model

Variable	Average	Standard deviation
ROE	0.076150	15.25854
Rot.at	-0.186631	1.071788
Raf	0.461250	0.249025
Sg	0.444814	0.598767
Mb	0.017200	0.114805
Lf	1.123093	1.707443

Source: author's view based on data processed in EViews

Table 2 Variables correlation- ROE model

Indicators	Rot.at	Sg	Raf	Mb	Lf
Rot.at	1.000000	-0.057117	-0.289160	-0.233125	-0.211347
Sg	-0.057117	1.000000	0.075813	0.248093	-0.326678
Raf	-0.289160	0.075813	1.000000	0.033878	-0.111095
Mb	-0.233125	0.248093	0.033878	1.000000	-0.249559
Lf	-0.211347	-0.326678	-0.111095	-0.249559	1.000000

Source: author's view based on data processed in EViews

Tabel 3 Parameters of the regression model - ROE model

Variable	Coefficients	Standard error	t- statistic	Probability (p value)	Collinearity - VIF
Rot.at	0.364844	0.091434	3.990234	0.0001	1.134
Raf	0.419985	0.311268	1.349270	0.0003	1.010
Sg	0.450573	0.205460	2.192996	0.0028	1.784
Mb	2.841297	0.630466	4.506661	0.0000	1.061
Lf	0.299584	0.087019	3.442754	0.0006	1.800
Constanta	-0.972544	0.258399	-3.763727	0.0002	-

Source: author's view based on data processed in EViews

Table 4 Summary of the econometric model - ROE model

Name	Value
R^2	0.984688
R^2 adjusted	0.979779
Standard error	2.169798
F-statistic	200.5655
Probability (F-statistic)	0.000000
Durbin-Watson test	2.060

Source: author's view based on data processed in EViews

R^2 is one of the most important indicators for assessing the quality of an econometric model. R^2 takes values between 0 and 1, it is recommended that its value be as close as possible to 1 and it highlights the proportion in which the variation of the dependent variable is explained by the independent variables. R^2 adjusted represents R^2 corrected for the number of the independent variables. In the case of our model, it is found that R^2 and R^2 adjusted register values very close to 1, thus it results that the dependent variable ROE is explained in a proportion of 98% by the independent variables included in the model. The difference between R^2 and R^2 adjusted is very small, 0.004909, being recommended that the difference between them to be as small as possible, thus resulting in high accuracy of the

model. The values of R^2 and R^2 adjusted to highlight a high level of quality of the model.
F statistic tests the global significance of the independent variables, from table no. 4 noting that the value of Sig. it is below the significance threshold of 0.05. Also, F statistic calculated has a higher value than F form the Fisher table for the number of observations and degrees of freedom. Thus, we can state with an error of p <0,05% that the obtained results are not random and that the independent variables explain at the global mode the variation of the dependent variable, thus proving the *hypothesis no. 1* according to which the regression equation is significant at the global level.
Regarding the parameters of the regression model, taking into account the information for table no. 3, we find that the significance level (p value) of the 5 variables is below the significance threshold set at 0,05, thus proving the *hypothesis no. 2*, according to this the parameters of the multiple regression model are statistically significant.
If the value returned by VIF<6 is considered that there is no collinearity between variables (Pecican, 2001). In our case, the values registered by VIF are below 2, thus proving the *hypothesis no. 3*, the independent variables of the model are not affected by collinearity.
Hypothesis no. 4 regarding the error mismatch we tested it using the Durbin Watson test.
In order to establish the acceptance or rejection of the null hypothesis, we process the information from the Durbin Watson table for k = 5 (number of independent variables), n> 200 (sample volume), significance threshold p <0,05%, dL=1,718; dU=1,820.
As shown in the table no. 4, the value of the Durbin Watson test obtained for our model is 2,060 which is in the range [1,820;2,18], which implies the acceptance of the null hypothesis, respectively there is no autocorrelation of the errors, thus verifying *hypothesis no. 4.* We present in tables 5, 6, 7, 8 the results of the second multiple linear regression model, having ROA as dependent variable.

Tabel 5 Descriptive statistics - ROA model

Variable	Average	Standard deviation
ROA	0.050867	0.082607
Rot.at	-0.186631	1.071788
Raf	0.461250	0.249025
Sg	0.444814	0.598767
Mb	0.017200	0.114805
Lf	1.123093	1.707443

Source: author's view based on data processed in EViews

Table 6 Variables correlation- ROA model

Indicators	Rot.at	Sg	Raf	Mb	Lf
Rot.at	1.000000	-0.057117	-0.289160	-0.233125	-0.211347
Sg	-0.057117	1.000000	0.075813	0.248093	-0.326678
Raf	-0.289160	0.075813	1.000000	0.033878	-0.111095
Mb	-0.233125	0.248093	0.033878	1.000000	-0.249559
Lf	-0.211347	-0.326678	-0.111095	-0.249559	1.000000

Source: author's view based on data processed in EViews

Table 7 Parameters of the regression model- ROA model

Variable	Coefficients	Standard error	t- statistic	Probability (p value)	Collinearity - VIF
Rot.at	0.036688	0.002586	14.18741	0.0000	1.219111
Sg	0.023305	0.005608	4.155420	0.0000	1.819572
Raf	-0.001036	0.002292	-0.451817	0.0430	1.039612
Mb	0.031680	0.001348	23.50718	0.0000	1.176746
Lf	-0.005913	0.002307	-2.562961	0.0105	1.983987
Constanta	0.167429	0.007343	22.80082	0.0000	-

Source: author's view based on data processed in EViews

Table 8 Summary of the econometric model - ROA model

Name	Value
R^2	0.779974
R^2 adjusted	0.687244
Standard error	0.046198
F-statistic	8.411255
Probability (F-statistic)	0.000000
Durbin-Watson test	1.905

Source: author's view based on data processed in EViews

Analyzing the information presented in table no. 5; 6; 7; 8, the following conclusions are drawn:

- R^2 and R^2adjusted register values close to 1, the difference between R^2 and R^2 adjusted is 0,09273, which highlights, on the one hand, that the dependent variable ROA is explained in a proportion of 77% by the independent variables, and on the other hand emphasizes the relevance of the model;
- F statistic calculated registers a value higher than F from the Fisher table, the sig. value being below the significance threshold of 0,05, so that the obtained results are not random and the independent variables explain the variation of the dependent variable, thus verifying the hypothesis no. 1 according to which the regression equation is significant at a global level;

- the significance level (p value) of the 5 independent variables is below the significance threshold set at 0,05, thus testing the hypothesis no. 2 according to this the parameters of the multiple regression model are statistically significant;
- The variables of the model are not affected by multicollinearity, the VIF value being below 2, thus verifying the hypothesis no. 3;
- The value of 1.905 returned by the Durbin Watson test, emphasizes that the errors are not correlated, thus verifying the hypothesis no. 4.

5. Conclusions

The development of econometric models for measuring the performance of Romanian agricultural holdings represents an important and useful objective for the economic theory and practice due, on the one hand, to the uncertain, dynamic and competitive environment in which it operates, and on the other hand to the influence of the external natural and climatic factors.

Analyzing the information provided by the two econometric models, a valuable conclusion can be drawn: the economic performance expressed by ROA and ROE is explained in a very high proportion (98% ROE and 77% ROA) by 5 financial indicators (fixed assets rate, general solvency, financial leverage, total asset turnover, gross margin) which on the one hand emphasizes the relevance of the econometric model, and on the other hand, provides a clear answer to the research question, being highlighted in a scientific way the indicators that influence the economic performance of agricultural holdings.

The research hypotheses formulated for both models were verified (the results obtained are not random and the independent variables globally explain the variation of the dependent variable; the parameters of the multiple regression model are statistically significant; the model variables are not affected by collinearity; the errors are not correlated), thus resulting that the models are valid and the analyzed indicators significantly influence the economic performance.

The economic significance of these results is obvious so that decision-makers must take into account the impact of these five financial indicators on the economic performance of agricultural holdings, expressed by two of the most relevant variables (ROA, ROE), so it is necessary to pay attention and properly manage issues such as:

- improving economic and financial strategies;
- adopting reasonable strategic decisions on the asset and capital management that need to accelerate the turnover in order to contribute more to revenue growth;
- diversification of investment strategies by using different sources of financing.

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