

THE INFLUENCE OF RELEVANT FACTORS ON FARM OUTPUT VALUE: AN ANALYSIS OF AGRICULTURAL HOLDINGS FROM ROMANIA

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Abstract

This paper investigates the socio-economic factors which have defined the evolution of farm output in Romania after the integration into the European Union. The performed statistical and regression analysis, highlights the elements that impact the output value, the relevance changing of the main production factors and the agricultural production's growth reserves. The obtained results suggest that for Romanian farms, an important factor of economic growth is the used agricultural area. This element is one of the main production factors through which increased scale effects can be obtained. On this basis we have formulated some suggestions regarding the substantiation of farms consolidation strategies in Romania and their competitiveness increase.

Key words: agricultural holdings, production factors, utilized agricultural area, regression analysis

JEL Classification: Q12, Q15

1. Introduction

The Romanian agriculture's changes from the last two decades, initiated by the transition to the market economy and the integration into the European Union, are deep. The agricultural sector's economic and social reforms led to the transformation of the old production structures into many private farms. On joining the EU, in Romania there were over 3.8 million farms of which about 43% had an agricultural area of less than 1 hectare (NSI, 2010). In time this excessive fragmentation of agricultural land produced negative effects on agriculture competitiveness and rural development (Burja and Burja, 2014).

At present, the Romanian agriculture has the largest number of farms in the European Union (29%) and most of them are subsistence farms. The Farm Accounting Data Network of the European Commission centralizes dates for 1042350 farms which are of commercial type. They have, in average, an agricultural area of 10 hectares, which represents about a third of EU's average.

The commercial sector of Romanian agriculture is also characterized by using capital that is five times lower than the EU average, and particularly low labour productivity which represents only 29% of the European average. Under these conditions farm performance is reduced, the indicators farm net value added and total output having one of the lowest levels in the EU member states (FADN, 2014).

Nevertheless, the Romanian agricultural sector still performs an important role in the national economy and has significant production potential at EU level. In 2012, Romanian agriculture participated with 5.3% to the National Gross Domestic Product and still detained a share of 29% of total employment. Within the EU, Romanian agricultural sector has about 8% of the total utilized agricultural area and 16% of the total labour force (EC, Eurostat). The country's agricultural potential is considerable, but it is not entirely used.

The aspects presented show that Romania has significant agricultural production capacity among European countries, but it is characterized by low competitiveness, the existence of structural problems and a deficient management of resources.

The recent objectives of the new Common Agricultural Policy 2014-2020 promote measures and actions to increase the competitiveness of agriculture, in order for it to become sustainable, efficient and to strongly contribute to the development of rural areas (EC, 2013).

This paper's main aim is the empirical analysis of the production model of Romanian farms and to explain their functionality. The proposed objective is achieved by presenting certain economic and social factors that can influence the economic output variation in farms, establishing the evolution of their impact on the phenomenon manifestation and identifying ways of economic growth. The results can be a basis for formulating micro and macroeconomic decisions regarding the efficient use of production factors in agriculture.

2. Literature review

Agriculture is an important productive sector of the EU economy because of the economic, social and ecological functions that it has, namely: providing jobs, creating value, supply of raw materials for the food industry, rural economic development, and environmental conservation. During the last decade most countries in the EU and especially the new members, made structural adjustments in order to adapt their agricultural sectors to the rapid changes of the technological, economic or social environment.

The geographical, socio-economic and cultural features specific to Romania, have marked a certain path for the agricultural sector development. The analyses carried out in EU documents situate Romanian agriculture in the segment of the countries where agriculture has a great potential because of the owned agricultural area and the jobs that it provides. The employment in Romanian agriculture is still nearly 30%. The percentage of employment in agriculture exceeds 50% in some regions of the country, like Ialomita, Calarasi, Vaslui and Teleorman (COM, 2011).

The process of privatization and restitution of agricultural land in Romania has generated the largest number of holdings in the EU characterized by small size of the lands and low efficiency. The agricultural census in Romania from 2010 shows that out of 3.8 million farms, over 99% have no legal personality and have an agricultural area, in average, of less than 2 hectares. About 31.000 farms with legal personality together hold 44% of the agricultural area and have an average size of 190.84 hectares.

Various studies from the scientific literature approach the lack of competitiveness of Romanian agriculture, the causes of its low performance, its economic and financial situation and so on. Campos et al. (2010) investigates the agricultural productivity in some of the new member states of the EU, including Romania for the period 2003-2005. The analysis carried out shows that the factors that can increase agricultural productivity are: favourable structural conditions for agriculture, developed market infrastructure, capital (inputs, investments), economic stability and favourable demographic trends.

Macours and Swinnen (2000), through the analysis performed on countries in economic transition show that the decline of agricultural output since 1989 in Central and Eastern European countries is due to several factors such as trade deterioration, extreme weather conditions and changes of production structure as a result of privatization, technological efficiency and labour force decrease.

An analysis conducted in Romania shows that the disparities of agricultural performance between regions are caused by the modality of utilization of the agricultural labour force and capital, being necessary to restructure the consumption of the production factors and increase their efficiency (Burja, 2012).

In other studies, among farm-specific factors of agricultural growth, various impact elements are identified such as farm size, livestock intensity, agri-environmental subsidies, part time jobs, share of grassland area (Bren Munoz et al., 2012) or the group - labour input, irrigated land, access to resources, cash input (Thapa, 2007). The soil quality, workforce and technological capital used are determinant factors on which the agricultural output amount depends (Macours and Swinnen, 2000).

One of the factors considered to have a strong connection with the growth of farms is land. This is also the main production factor needed for conducting agricultural activities, the results obtained depending on its way of use. But there is not a general consensus on the impact that the land size has on the output value.

Through the conducted research, our work highlights the contribution of the production factors to the agricultural output in the specific context of Romanian economy in the period after the accession to EU.

3. Data and methodology

To carry out the proposed study, we collected data concerning the commercial farms in Romania. The information comes from the database Farm Accounting Data Network of the European Commission and covers the period 2008-2012.

The data set summarizes information about the agricultural holdings, taking into account two group of characteristics, namely the 8 regions of Romania (NUTs II) and the activity type - TF8 grouping (field crops, horticulture, wine, other permanent crops, milk, other grazing livestock, granivores, mixed). The data set obtained is an unbalanced panel that consists in 317 observations for 64 farms over a period of five years.

In order to achieve the objectives of this study we used an analysis based mainly on econometric modelling techniques. The data used are the relevant socio-economic variables acting at the microeconomic level and influencing the variation of results and the farms' economic growth.

The dependent variable is "Total Output", an indicator that expresses the value of the total agricultural output on farm originated from crops and livestock products.

The independent variables involved in the analysis define the key economic factors that contribute to the agricultural holdings incomes, namely labour force, technical capital and agricultural land.

The employment in agriculture is characterized by the indicator "Total labour input" expressed in AWU (annual work unit). This shows the contribution of all persons who are carrying out farm activities expressed in full-time equivalent.

Technical capital includes many elements such as machinery and equipment, livestock breeding, farm buildings, fertilizers, seeds and plants, crop protection substances, etc. For a synthetic expression of their contribution to the value formation, the indicator "Average farm capital" is used. It shows the dimension of the material and technical support on which the productive capacity of the farms depends.

Appreciation of the influence of land size is done by using the indicator "Used agricultural area" which shows the average number of hectares on farm. This indicator reflects to a large extent the farm size.

The definition of variables that are used in this research and their statistical characterization are presented in Table 1.

Table 1. The model variables

Variables	Symbols	Mean	Std. Dev.
Total Output, euro	OUT	21208.91	21708.52
Logarithm (Total Output)	log(OUT)	9.65	0.73
Utilized agricultural area, ha	UAA	13.31	20.96
Logarithm (Utilized agricultural area)	log(UAA)	1.87	1.09
Total labour input, AWU	LI	4219.34	1724.73
Total labour input on ha, AWU/ha	LIHA	1047.18	1189.94
Logarithm (Total labour input on ha)	log(LIHA)	6.42	1.12
Average farm capital, euro	AFC	49620.23	48011.51
Average farm capital on ha, euro/ha	AFCHA	11694.36	19127.78
Logarithm (Average farm capital on ha)	log(AFCHA)	8.66	1.15

Source: FADN database

In the first stage of the analysis, we study the significance and contribution of the selected variables to the formation of output value and the trends manifested in the period. For each year, individual estimates of the output are performed according to different variables, using a single-factor model:

$$OUT_i = a_0 + a_1 F_i + \varepsilon_i \quad (1)$$

where F refers to production factor (used agricultural area, total labour input, average farm capital); i is the agricultural holding in the commercial sector.

The estimation of the factors' importance is based on the coefficient of determination R^2 , a measure that shows the response variable variation due to the impact of explanatory variables.

The second stage of analysis consists in building the multifactor regression model of the relationship between output value and the whole group of factors. We started from the reviewed literature (Thapa, 2007) and the availability of indicators in FADN. The functional relationship between the selected variables is a function of production and has the following form:

$$\log(OUT_{it}) = b_0 + b_1 \log(UAA_{it}) + b_2 \log(LIHA_{it}) + b_3 \log(AFCHA_{it}) + \varepsilon_{it} \quad (2)$$

where b_0, b_1, b_2, b_3 are the parameters of the regression equation; ε_{it} is the error term; i means agricultural holding by commercial type and t is the time period.

The coefficients b_1, b_2 and b_3 represent the agricultural output elasticity depending on agricultural land, labour time and technical capital. The size of these coefficients reflects the technological level of agricultural production activities while providing information about the type of the practiced production systems (conventional or organic).

The way in which the variables labour and capital are specified, namely by scaling them according to land utilized, preserves the economic significance of the variables and allows finding how the output responds to the changes in the volume of human and material resources consumed per hectare.

4. Empirical results and discussion

The estimation of the regression equation (1) for each explanatory variable and for each year in the analysed period leads to the observation of changes in the factors relevance for the output value (Table 2).

Table 2. The importance of the explanatory variables for output, Romania agricultural holdings 2008-2012

Coefficients of determination R^2 (%)			
Years	Relevance of used agricultural area	Relevance of labour input	Relevance of average farm capital
2008	-	-	51.9
2009	25.4	20.8	29.5
2010	20.3	33.0	54.6
2011	27.7	50.2	67.3
2012	32.7	16.7	20.1

Source: own calculation

In the analysed period each variable had a positive influence and statistically significance on agricultural output ($p < 0.05$). In 2012 the results obtained for the agricultural activity were influenced mostly by used agricultural area. In summary, the specific trends concerning the influence of the variables on agricultural output are shown in Figure 1.

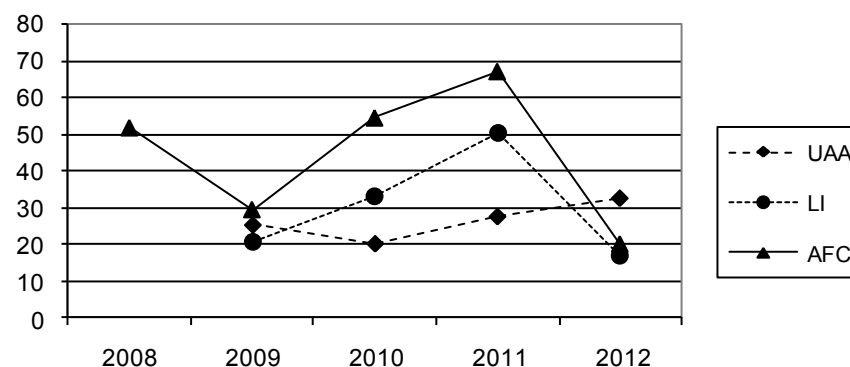


Figure 1. Impact of variables on output variation, Romanian holdings, 2008-2012

The data show that in the period 2008-2011 the impact of the three inputs in achieving output value increased considerably. After this period there was a significant decrease of the influence of labour input and average farm capital in obtaining the agricultural output. A factor, whose contribution is still rising, is used agricultural area. The importance of land for agricultural production increased from the beginning of the period with about 29%.

The multifactorial empirical model that describes the relationship between agricultural output and all three influence factors was estimated with the equation (2). The estimation results are presented in Table 3.

Table 3. Estimation of output value, Romania agricultural holdings, 2008-2012

Variable	Coefficient	t-stat	Prob
Log Used agricultural area (LogUAA)	1.199 (0.088)	13.57	0.0000
Log Total labour force on ha (LogLIHA)	0.319 (0.115)	2.77	0.0061
Log Average farm capital on ha (LogAFCHA)	0.673 (0.064)	10.51	0.0000
$R^2 = 0.743$			
R^2 adjusted = 0.74			
F-statistic = 218.08			
Prob(F-stat) = 0.000			

Note: in parenthesis are standard errors

In the preliminary stage of the estimation results' interpretation, verification was performed of the quality of the regression model (F-test), variables (t-test) and residues (normality test, serial correlation test etc). The test results indicate the correctness of the model, which has good explanatory power and presents significant estimators for 1% level. The variation of the output value within the analyzed period can be explained in a proportion of 74% based on the considered factors, the action of the other factors that are not included in the model is 26%.

The analysis of the data obtained through the estimation of the production function shows that the most important contribution to the creation of agricultural output is made by the farm size, appreciated by the indicator Utilised agricultural area. Scale-returns of this factor are supraunitary (elasticity is 1.2) which shows that in the case of Romania, an important way to increase the agricultural output value is increasing the farms size. This also shows that larger farms have a higher growth potential than those with smaller size. The commercial sector of Romanian agriculture currently has farms with an average area of only 10 hectares, size that is about three times lower than the European average. Other EU countries have farms with a size much larger. In Czech Republic the used agricultural area on farm is 228 hectares, followed by France with 126 hectares, United Kingdom with 161 hectares, Sweden with 101 hectares, size above European average having even Bulgaria and Hungary.

Another factor with a significant impact on the economy of farms is the factor Average farm capital on hectare. The elasticity of capital to the agricultural output, although being lower, still has a high level (0.67), which indicates that improvement of farm equipment can be a significant way to increase outputs in farms. However, the adoption of intensive technologies is not likely to lead actual practices to converge to organic agriculture.

The indicator Labour input on hectare has a lower elasticity of 0.32, suggesting that increasing working time per hectare will affect less the increase of agricultural production, so that strategies of production efficiency increase or conversion to organic agriculture should not recommend the numerical growth of labour force, but mostly its productivity growth.

The results suggest in particular the need to stimulate the farms growth in Romania as an important way to improve their economic and financial situation. Other studies that deal with the relationship between agricultural production and the influence factors in different countries identify the land and capital as significant factors for farm growth (Weiss, 1998; Macours and Swinnen, 2000; Shapiro et al., 1987; Gale, 1994; Arabatzis, 2005).

For Romania, in particular, extending the farm size appears to be a viable way to increase agricultural production due to the particularities of its rural economy. Of course, the increase of used agricultural area is not the only solution to stimulate the farms economic growth; it should be the support for performing significant changes in order to strengthen and improve the competitiveness of agriculture.

5. Conclusions

The analysis performed in this study aimed to research the inputs that had a strong influence on the agricultural output of commercial farms from Romania since its joining to the European Union.

The econometric models used showed the factors with significance in the value creation processes, the manifestation of their relevance and the contribution they have in the farm production function.

In the analysed period, the traditional factors of production (labour, capital, land) have maintained their statistical and economic significance at farm level. The dynamic analysis of the output value in correlation with the production factors showed that human capital, technical capital and land have increased their relevance in the process of agricultural output formation. Of the three factors analyzed, the agricultural area is the only that had an increasing influence on agricultural output until present. At the same time, the agricultural land has been identified as the key element that can ensure increasing scale-effects.

Given the favourable conditions for restructuring, established by the Common Agricultural Policy, we can say that in Romania there is potential to improve the economic and financial situation of farms, by expanding the size of used agricultural areas at least up to the level of the EU average indicators. The probability of increasing farm incomes is higher if in addition to increasing the land size, a complex of measures is promoted, aimed at improving competitiveness, performance and sustainability of agriculture.

Future research will consider other approaches of production factors as well, in order to overcome the current analysis of conventional farming. The disaggregation of the indicator average farm capital into machinery, equipment and fertilizer will allow determining the impact of advanced technology on production – increase the mechanization level of farming and stimulate the efficiency by applying chemical or biological fertilizers. Also, other explanatory variables will be used which by their content will complement the traditional agricultural inputs and direct the interest to sustainable agriculture.

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