

IS AGRICULTURAL PRODUCTION CORRELATED WITH THE LABOUR FORCE? CASE STUDY ON ROMANIA

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Abstract

The article aims to analyze the correlations between the volume of labour in agriculture and the value of some indicators of agricultural production. The volume of the labor force in Romania, between 2007 and now, can be represented by a chronological series with a decreasing trend. The value of agricultural production shows an inverse trend, more precisely, the period in which the volume of labour was high corresponds to a period with a low value of agricultural production and vice versa. The paper contains discussions of possible interactions between these data series, analyzed from a statistical point of view. Discussions on the possible causes underlying the relationships between the studied indicators can also be found.

Keywords: *labour force, the value of agricultural production, agricultural statistics*

JEL: *Q18*

Introduction

Labor is a decisive vector of economic growth in agriculture (Blanco – Raurich, 2022; Popescu et al. 2021). Labor productivity is dependent on a wide range of factors, the most important of which are: agricultural production, gross value added (Tudor et al. 2022), employment and its type in agriculture: full-time or part-time, farm structure, the average size of the farm (Patyka et al. 2021), the economic environment, the level of investments (Nolte – Ostermeier, 2017), the production structure, the degree of mechanization and chemicalization, the production potential of the varieties and breeds of animals used, the share of production for farm consumption, labor input (Baros et al, 2012, Brezuleanu et al. 2013, Iancu et al. 2022; Icociu et al. 2021; Istrate et al. 2016), the training level of farmers, age and experience (Koncz-Nagyné Demeter, 2015; Michalcewicz-Kaniowska et al. 2015; Raicov et al. 2020).

The statistical analysis for the period from 2007 to Romania's accession to the EU), shows that the labor force had a downward (Thenia, 2021). In fact, the downward trend of the population employed in agriculture, forestry and logging can be seen right from the 1950s. Statistics indicate approximately 6200 thousand people in 1950, values that decrease to 3600 thousand people in the year 2000. It is assumed that the agrarian revolution led throughout Europe in the number of people employed in agriculture by very large values (Chivu, 2002). At the same time, in Romania, the value of agricultural production has had an increasing trend in the period from 2007 until now. However, this phenomenon does not occur in the case of the animal branch. The degree of use of resources, the capacity of investments, the processing index of production, are factors that were the basis of making forecasts that indicate the growing situation of this growth trend in the future (Steriu, 2013, Khademi-Vidra, 2014).

The total value of agricultural production in Romania, and respectively agricultural labour force, are statistical series in inverse proportionality (Rujescu, 2021). Calculations on the correlation of

the statistical data indicate a negative value of the correlation coefficient, thus an inverse correlation. In this study, we want to establish which of the segments of the value of agricultural production in Romania, by sectors and by forms of ownership, are correlated more strongly with the agricultural labour force, in the period 2007-2020.

Material and method

The data used in this paper are those presented by the National Institute of Statistics of Romania regarding the value of agricultural production (VAP) and the agricultural labour force expressed in the annual work unit (AWU). The series each contains 14 values according to the period 2007-2020 (NIS 2022). The VAT description for the type of ownership and agricultural branches was made using the notations: VAP/TAB/TO (value of agricultural production for total agricultural branches and for a total of ownership), VAP/V/TO (for vegetal branch and for a total of ownership), VAP/A/TO (for animal branch and for a total of ownership), VAP/AS/TO (for agricultural services branch and for a total of ownership), VAP/TAB/PP (value of agricultural production for total agricultural branches and for private property), VAP/V/PP (for vegetable branch and for private property), VAP/A/PP (for animal branch and for private property), VAP/AS/PP (for agricultural services branch and for private property).

Statistical data provided by Eurostat were also used, regarding the values of the agricultural labor force in the European Union, in order to create a comparison between the trend of evolution in Romania and that in the European Union (Eurostat, 2022).

The statistical calculations and graphical representations were performed using SAS Studio (SAS 2022; Brudiu, 2012). The SAS procedure used was Correlation Analysis / Nonparametric Correlations / Kendall's tau-b.

Since the analyzed period was characterized by multiple instabilities of the national currency, the data was converted into euros, using the annual average values indicated by the National Bank of Romania (NBR, 2022).

Since in agriculture, in Romania, many of the activities are carried out in small farms, sometimes with the involvement of family members, it is difficult to establish the exact volume of the labor force. For the same reason, the value of agricultural products and services is difficult to estimate. These are possible limitations of the study.

Results

The branch of vegetal production shows the highest value of production. It is followed by the value of animal production and then by that of agricultural services. The hierarchy is the same in the case of private property but also in the situation of the total for the forms of ownership.

Table 1. Statistical summary for the value of agricultural production (VAP), by type of ownership and agricultural branches, in the period 2007-2020 ($\times 10^9$ EURO)

Type of ownership	Agricultural branches	N	Mean	Std. Dev.	Minimum	Maximum
1. Private property	Vegetal (VAP/V/PP)	14	10.69	1.68	8.13	13.05
	Animal (VAP/A/PP)	14	5.33	0.20	4.84	5.56
	Agricultural services (VAP/AS/PP)	14	0.11	0.03	0.05	0.16
	TOTAL agric. branches (VAP/TAB/PP)	14	16.13	1.66	13.71	18.51
2. Total - ownership	Vegetal (VAP/V/TO)	14	10.97	1.66	8.43	13.26
	Animal (VAP/A/TO)	14	5.33	0.20	4.84	5.57
	Agricultural services (VAP/AS/TO)	14	0.21	0.08	0.12	0.37
	TOTAL agric. branches (VAP/TAB/TO)	14	16.52	1.66	14.14	18.96

Source: Own statistical processing using SAS Studio software of data by the National Institute of Statistics of Romania

This result is observed by following the average values indicated by the statistical summary in Table 1 and the boxplot diagram in Figure 1. Also, the minimum and maximum values of the period 2007-2020 confirm this hierarchy.

The VAP/TAB/PP series presents the highest slope value, 0.19, which indicates a VAP increase of approximately 0.19×10^9 EURO in each year of the analyzed period, 2007-2020.

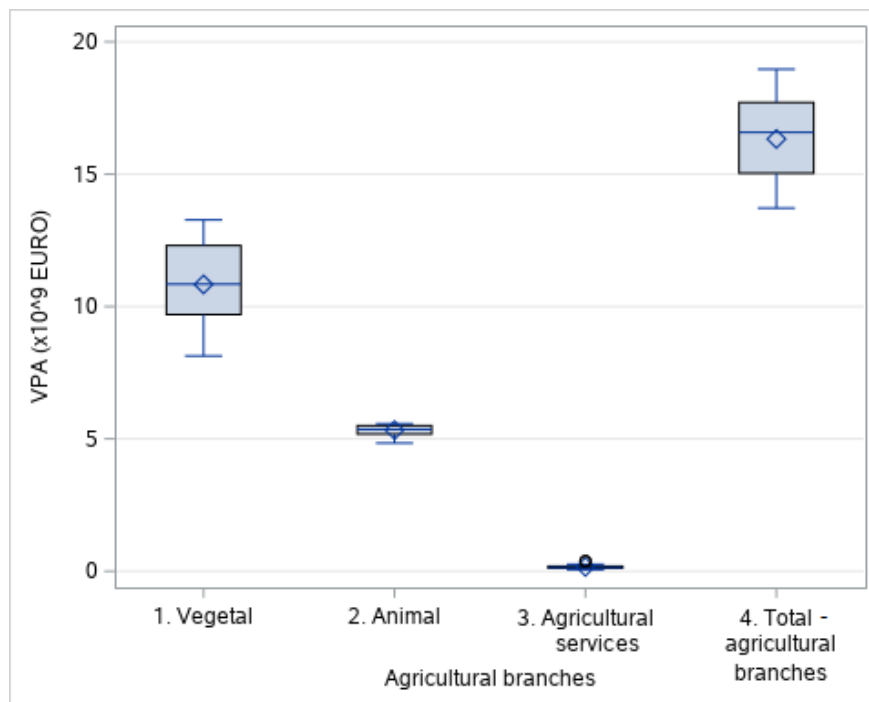


Figure 1. Comparison of agricultural production values between branches, in the period 2007-2020 ($\times 10^9$ EURO)

Source: Own processing using SAS Studio of data provided by the National Institute of Statistics of Romania

The maximum agricultural labour force volume for the studied period is found in 2007, being 2.2 million AWU. The minimum is observed in the current period. Thus in 2020, it reaches 1.32 million AWU. The downward trend is continuously observed during this period, except for short moments of time, for example, the year 2016. The coefficient of variation is 18.52. It indicates a relatively homogeneous series. There are no major changes from one year to the next (Abdi, 2010). The slope value for the AWU series is -59.87, which indicates approximately a decrease of 59870 AWU for each year of the period 2007- 2020. The most important indicators used for describing the AWU series are presented in Table 2.

The evolution trend of agricultural labour force volume is also decreasing in the European Union. In 2012, the agricultural labor force volume was approximately 9.75 million AWU. In 2020, this decreased to 7.95 million AWU. The median value for this time period is 9.3 million AWU (Eurostat, 2022).

A correlation analysis performed for data series from Romania respectively the European Union for the time interval 2012-2020, indicates a moderate but statistically significant direct correlation. The Kendall Tau correlation coefficient has the value $\tau=0.61$ with $p=0.02$ and the Pearson correlation coefficient has the value $r=0.74$ with $p=0.02$. Thus, the evolution trend of the volume of the agricultural labor force in Romania follows the trend also observed in the European Union.

Each statistical series on VAP, by branches of agriculture, by the form of ownership, respectively the series of the volume of labour, in the 14-year period from 2007-2021, were the basis for the calculation of the Kendall correlation coefficient. The values of the coefficients are shown in Table 3. The related graphical representations in matrix form are shown in Figure 2.

Table 2. Statistical summary for the value of the volume of the agricultural labour force in Romania, expressed in AWU x 1000), in the period 2007-2020

Analysis Variable: AWU (x1000)	Mean	1635.21
	Std. Deviation	302.78
	Minimum	1329
	Maximum	2205
	Median	1548
	N	14
	Std Error	80.92
	Variance	91672.80
	Mode	2152
	Range	876
	Lower 95% CI for Mean	1460.40
	Upper 95% CI for Mean	1810.03
	Coeff. of Variation	18.52
	Skewness	1.23
	Kurtosis	0.07

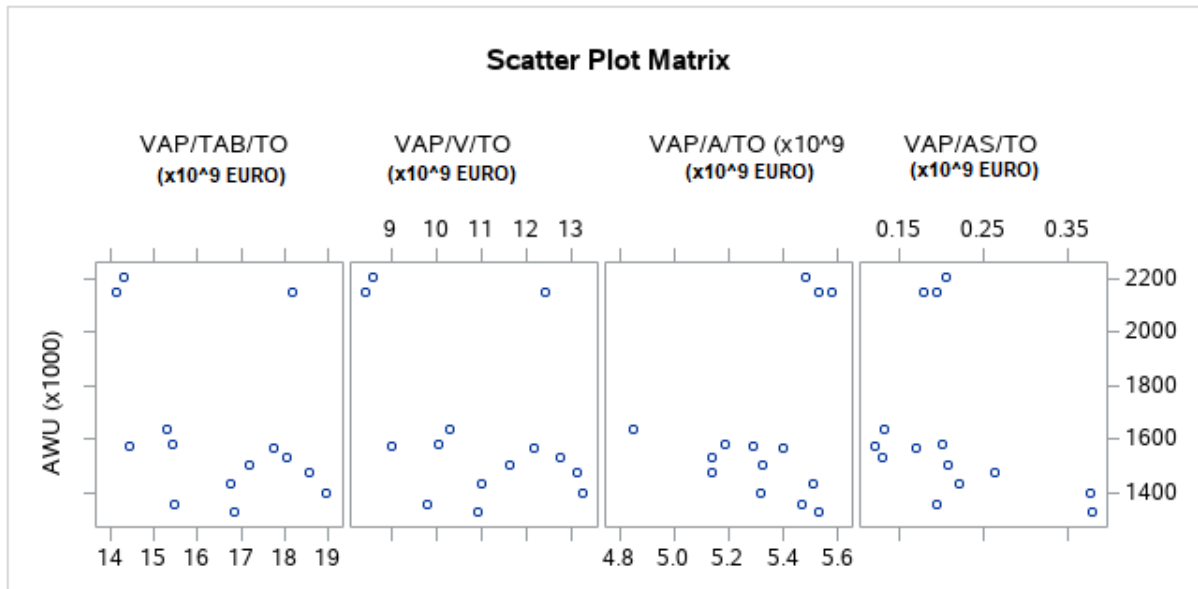
Source: Own statistical processing using SAS Studio software of data by the National Institute of Statistics of Romania

Table 3. Expressing the correlation between the value of agricultural production with agricultural labor force

Kendall Tau b				
Correlation Coefficients, N = 14				
$p > \tau$ under $H_0: \tau = 0$				
	VAP/TAB/TO (x10 ⁹ EURO)	VAP/V/TO (x10 ⁹ EURO)	VAP/A/TO (x10 ⁹ EURO)	VAP/AS/TO (x10 ⁹ EURO)
AWU (x1000)	-0.35360 0.0794	-0.28730 0.1540	-0.02210 0.9127	-0.35360 0.0794
	VAP/TAB/PP (x10⁹ EURO)	VAP/V/PP (x10 ⁹ EURO)	VAP/A/PP (x10 ⁹ EURO)	VAP/AS/PP (x10⁹ EURO)
AWU (x1000)	-0.39780 0.0484	-0.28730 0.1540	-0.04420 0.8264	-0.53039 0.0085

Source: Own processing using SAS Studio of data provided by the National Institute of Statistics of Romania

Kendall coefficient values are negative in each case. This fact indicates an inverse correlation of all VAP series with the AWU series. However, most are close to zero, indicating weak correlations. Only two of the 8 series show correlations of medium intensity, statistically ensured at the $\alpha=5\%$ level. The first one is the VAP/TAB/PP series of agricultural production values for the total branches determined for private property. The correlation coefficient is $\tau=-0.39$ with $p=0.04$. The second one is VAP/AS/PP series of agricultural production values for the branch of the agricultural services determined for private property. The correlation coefficient is $\tau=-0.53$ with $p=0.008$. The graphic representations of the VAP – AWU links are shown in Figure 2.



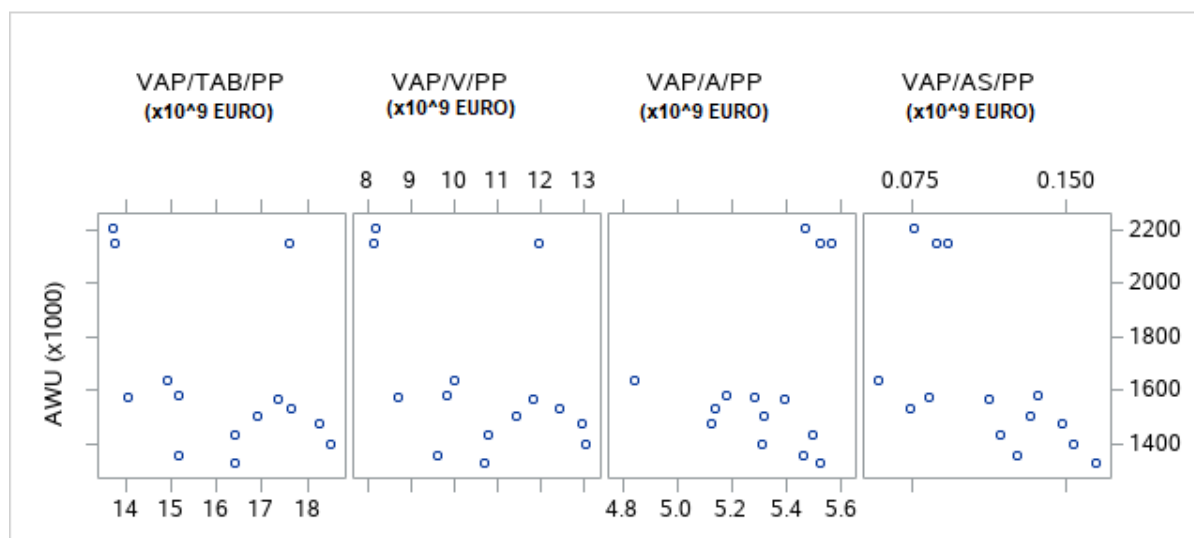


Figure 2. Matrix of scatter plots for the correlation between values of agricultural production with agricultural labour force

Source: Own processing using SAS Studio of data provided by the National Institute of Statistics of Romania

An explanation of these results can be made using the observation that the increase of the productivity in agriculture was due in developed countries, as a result of endowment of the labour force with capital, an aspect that led to the decrease of the volume of labour forces (Steriu, 2013).

The production value of the agricultural branch also increased in 2021 by approximately 11.7% compared to 2020. During this time, agricultural services showed only a slight downward trend compared to the previous year, by 0.7%. Their share reached 1.9% in 2021 regarding the production structure of the agricultural branch (NIS, 2022). This trend occurred even under the restrictions of the period. The value of agricultural services related to private property was observed to be double in 2020 compared to 2007.

At the same time, the labour force employed in agriculture also decreases due to other causes. The period of 1945-1989 represented a period of significant degradation for the Romanian village (Otiman, 2019). Even after 1989, a stagnation of the evolution of rural localities is observed. Their inhabitants, who could constitute an important part of the agricultural labour force, have in many cases chosen to practice other activities.

Even under these conditions and in addition under the conditions of the computerization of agricultural processes, the improvement of specific devices or machinery, it is estimated that the labour force will not disappear (Iftimoaei, 2021).

In Romania, the differences between the number of people working in agriculture as salaried compared to non-salaried are important. During the period 2012-2020, the number of people with salaried status was between 0.15 - 0.22 million AWU. The number of people with non-salaried status was between 0.88 - 1.39 million AWU. Establishing the value contribution that each category brings is difficult to achieve. So, future studies on this topic could lead to a clearer image of the link between the volume of labor and the value of agricultural production, which can reduce the limitations of the present study.

Higher agricultural output values are generated by fewer workers. This fact can also be explained by the higher qualification of the labor force in agriculture. However, many young people in Romania avoid enrolling in the agricultural education system. They frequently believe that agricultural labor has low productivity compared to other branches of the economy. Their opinions are formed from old images, often created by the people around them. People involved in educational activities

in high school and university educational institutions with an agricultural profile, or in counseling and career guidance centers, could provide an updated image of these activities.

Conclusions

After testing the correlation, out of the eight analysed series, which describe agricultural production values, only two of them,

- the series of agricultural production values for the total number of branches determined for private property, and

- the series of values of agricultural production for the branch of agricultural services, determined for private property,

led to correlation coefficients indicating a statistically significant, inverse, medium-sized intensity.

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