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SEASONAL ADJUSTMENT AND FORECASTING OF THE ROMANIAN AGRICULTURAL EMPLOYMENT RATE

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Abstract

The economic policy directly related to employment and labour force aims the economic growth and the increase of the living standard using the best the capacities of economy: increasing productivity, reducing unemployment, using a larger proportion of working time. This paper aimed to use the statistical and econometric techniques to test and reveal trends in the evolution of the quarterly employment rate in agriculture, and on this basis to extrapolate the investigated characteristic.

Key words**:** *autocorrelation function, Buys Ballot model, employment rate, seasonality, time series*

INTRODUCTION

The activity of the economic agents in agriculture consists of a complexity of phenomena, characteristically interdependent and mutual conditioning. Indicators are used to determine and characterize the various economic phenomena and to determine the trends in agriculture dynamics.

In the broadest sense, any numerical expression obtained in an actual research process is called a statistical indicator. According to Biji, E.M. et al. (1998), each indicator must meet: the condition of content that is to characterize the related phenomenon (process) in a clear definition; the qualitative comparability condition (its content should have a single definition), in time (the dynamics) and space (the territory), meaning that an indicator should have the ability for its varying sizes to be compared between different periods on a national or international level. [1] The statistical methodology usually distinguished specific groups in the system of statistical indicators, as follows:

-By their composition, the indicators can be simple or elementary, when they express in absolute sizes statistical phenomena of a statistical collectivity or on a part of it and the related indicator, obtained by the processing or combination of simple indicators;

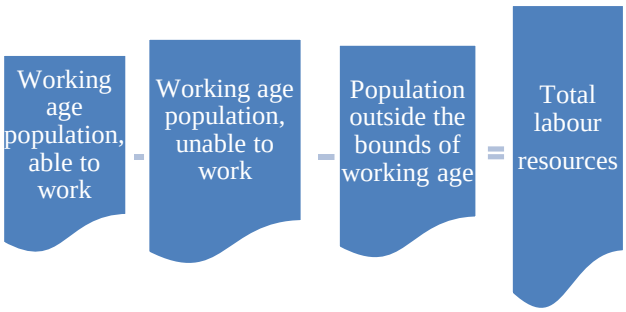
-According to the function they perform in a statistical analysis, indicators may be synthetic, offering a global knowledge of the phenomena and analytical indicators that highlight the group structure of a collectivity and the influence of some factors in its configuration in time and space;

-By their scope, statistical indicators show a growing variety, with the development of the scope of phenomena and processes in the economy.

Due to the complexity of the indicators it is necessary to develop specific methodologies to group data starting with the components, continuing with hierarchical management and decision-making levels and proceeding to the entire (Biji, E.M. et al., 1999) [2].

From the point of view of economic analysis, the indicator population is the basis for the calculation of statistical indicators that highlight the size, structure and use of labour resources. The labour resources existing at a given time in society show the number of people of working age, i.e. that segment of the population that holds all physical and intellectual capacities which enable it to carry out a useful activity (Capanu, I., Wagner, P., Secareanu, C., 1997). [3]

The human resources volume is determined based on the relationship:



Population, total			
Working age population			Population outside the bounds of working age
Working age population, able to work		Working age population, unable to work	
Economically active population		Non-economically active population	
Employment		Work reserves	
Employees	Other categories of employed population		

Fig.1. Population structure by participation in economic activity

In the context of the information included in the work resources balance, in the economic statistics, a number of derived indicators can be calculated to highlight how these resources were used, for example: general activity rate, the activity rate of working age population, the unemployment rate, the economic dependence rate, the maintenance rate etc. The present paper aimed to test and reveal the trends in the evolution of the quarterly employment rate for working age population (15-64 years) in agriculture, using statistical and econometric techniques, and on this basis to extrapolate the investigated characteristic.

MATERIALS AND METHODS

In the present paper the Buys Ballot model was used to study the variation in the employment rate for the working age population in the agricultural sector. The model can be applied if the time series meets the following conditions:

- the evolution of trend is linear:
  $Y_t = at + b$;
- the seasonality is constant:
  $s_j = s_t = ct$,
  where:
  $t = j+m(i-1)$;

  $j = \overline{1,m}$ - the number of subperiods;

  $i = \overline{1,n}$ - the number of periods;
  s_j – the seasonality coefficients of subperiod j;
  $s_t = s_{j,i}$ - the seasonality coefficients of subperiod j in periods i;
- the studied phenomenon undergoes a random perturbation u_t, its nature is a bruit blanc.

The three components work additively, resulting a model of the form given below:

$$y_t = at + b + s_j + u_t.$$

Writing $b_j = b + s_j$, it is obtained:

$$y_t = at + b_j + u_t.$$

Substituting in the model $t=j+m(i-1)$, using the least squares method, one could estimate the parameters a and b_j based on which we will determine the coefficients of seasonality, s_j, and the value of term b, their calculation formulas being the following:

$$\hat{a} = \frac{12}{mn(n^2-1)} \cdot \left(\sum_{i=1}^{n} i \sum_{j=1}^{m} \frac{y_{ij}}{m} - \frac{n+1}{2m} \sum_{i=1}^{n} \sum_{j=1}^{m} y_{ij} \right);$$

$$\hat{b} = \sum_{i=1}^{n} \sum_{j=1}^{m} \frac{y_{ij}}{nm} - \hat{a} \frac{nm+1}{2};$$

$$\hat{s}_j = \sum_{i=1}^{n} \frac{y_{ij}}{n} - \sum_{i=1}^{n} \sum_{j=1}^{m} \frac{y_{ij}}{nm} - \hat{a} \left(j - \frac{m+1}{2} \right)$$

The additive model can be equivalent to a multiplicative model after the logarithmic transformation because the linear relationship affects the parameters and not the variables:

$$\ln(y_t) = at + b + s_j + u_t$$

where:
$a=\ln(1+a')$; $b=\ln(b')$; $s_j = \ln(s_j')$; $u_t = \ln(\eta_t)$.
Thus, the multiplicative model becomes:

$$y_t = b' \cdot s_j' \cdot \eta_t \cdot (1+a')^t$$

An additional condition, relative to the seasonal factors postulates the existence of offsetting seasonal movements:

$\sum_{j=1}^{m} s_j = 0$ - for additive model;

$\sum_{j=1}^{m} s_j = \sum_{j=1}^{m} \ln(s_j) = 0 \rightarrow \prod_{j=1}^{m} s_j = e^0 = 1$-for multiplicative model.

The forecast for phenomenon y in the forecasting horizon (T, T+Q) is based on the following relationship:

$$\hat{Y}_{T+h} = \hat{b} \cdot [j + m \cdot (i + h - 1)] + \hat{a} + \hat{s}_j,$$

where: $h = \overline{1,Q}$ - forecast period.

The data were represented by the considered indicator: the quarterly employment rate for working age population (15-64 years) in agriculture.

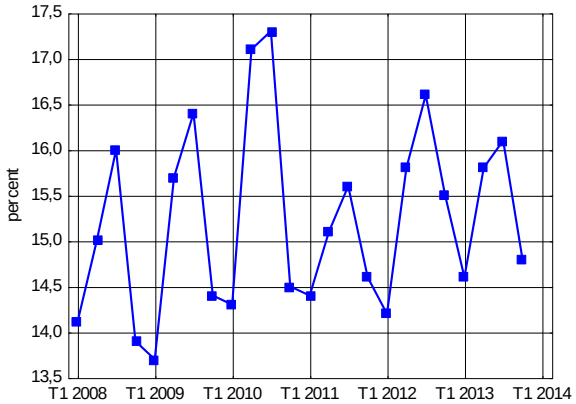


Fig. 2. The evolution of the employment rate for working age population in agriculture
Source: Own calculations based on data released by EUROSTAT [5]

In the period 2008-2013, the average quarterly employment rate for working age population (15-64 years) in agriculture was 15.23 %.
The absolute amplitude of the variation reached 3.6 %.
The coefficient of variation (6.67 %) reflected the absence of heterogeneity, the calculated mean being representative for the investigated series.
The flattening coefficient indicates a platykurtic distribution (Kurtosis= 2.17).

Table 1. Descriptive indicators

Series: The employment rate for working age population in agriculture. Sample: 2008Q1 2013Q4 Observations: 24	
Mean	15.22917
Median	15.05000
Maximum	17.30000
Minimum	13.70000
Std. Dev.	1.015737
Skewness	0.419574
Kurtosis	2.170509
Jarque-Bera	1.392224
Probability	0.498520

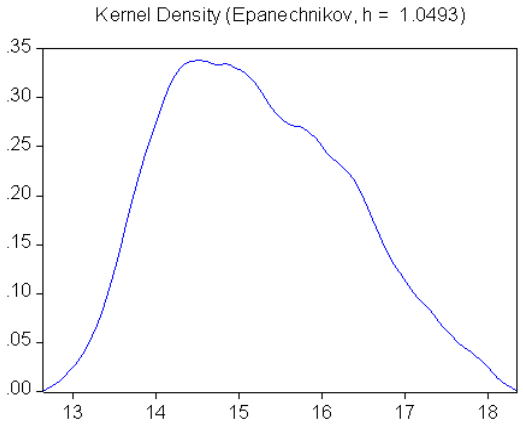


Fig. 3. The density of the distribution for the employment rate for working age population in agriculture

The Augmented Dickey-Fuller test was applied to test for the presence of a unit root in the time series.
The ADF test provided evidence of a presence of a unit root (p-value: 0.3453; where the null hypothesis assumes that the data is non-stationary, i.e. there is a unit root present in the data).
In order to notify that over the quarterly employment rate for working age population in agriculture has acted the seasonal component, we have calculated the autocorrelation coefficients and partial correlation with the help of Statistical programme – the ARIMA model. The obtained results confirm the presence of seasonality.

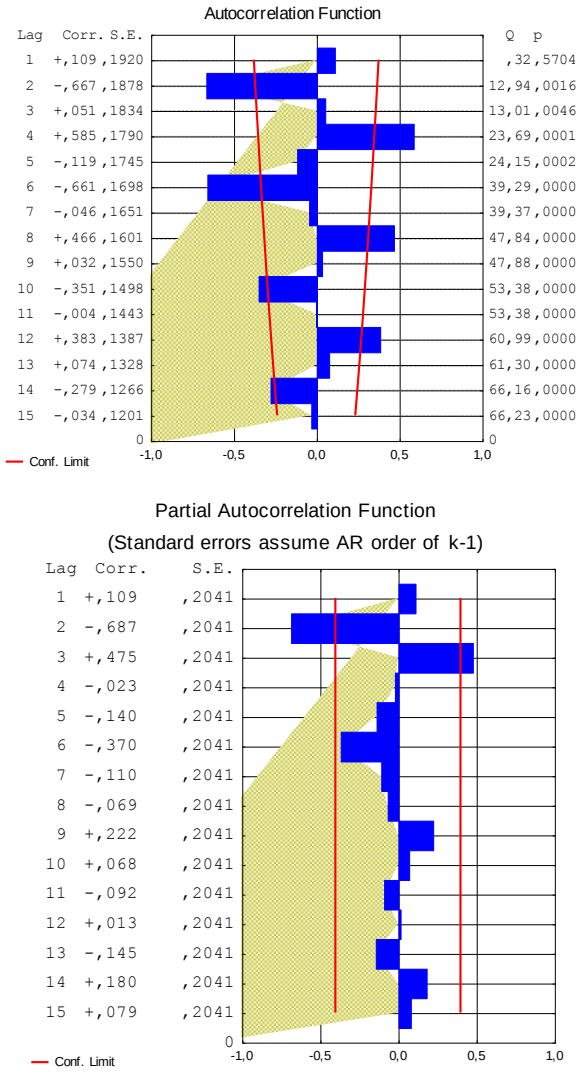


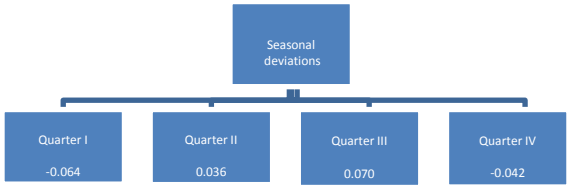
Fig. 4. The Corel gram of the quarterly employment rate for working age population in agriculture

RESULTS AND DISCUSSIONS

As a result of applying the Buys Ballot model for the quarterly data regarding the employment rate for working age population in agriculture in the period 2008-2013, the following average trend equation as logarithmic form has been obtained:

$$\ln(\hat{Y}_t) = 0.0017 \cdot [j + m \cdot (i-1)] + 2,6999 + \hat{s}_j$$

The obtained seasonal deviations are:



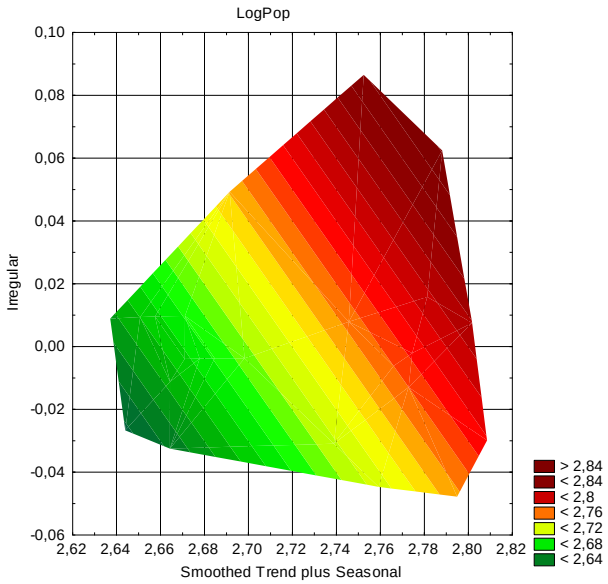


Fig. 5. Component of time series data

Seasonal deviations in the second and third quarters were positive (above the trend line). The intensification of agricultural works claimed an increased workforce, the development of the informal market also being signalled by the expansion of the practice of agricultural units to conduct recruitment activities using their own database, increasing the number of illegal employment.

Seasonal deviations in the first and fourth quarters were negative (under the trend line). Amid the reduction of the excess demand for labour force, the share of skilled unemployed in agriculture, forestry and fisheries in the total number of unemployed was on average 2.9 %. By gender, the indicator registered 3.38 % for men and 2.14 % for women.

Rural labour market in Romania after EU integration is characterized by a decrease of activity rate and an increase of unemployment. (Iorga A., Toma E., Muscanescu A., 2014). [4]

In the period 2008-2013, the average employment rate for population aged 15 years and over in agriculture amounted to 14.75 %, registering the highest values for the age group 55-64 years (19.97 %) and the lowest one for the age group 15-24 years (8.99 %). The gender gap of this indicator, calculated as the difference between the employment rate of

men (16.25 %) and women (13.35 %) was 2.9 % points.

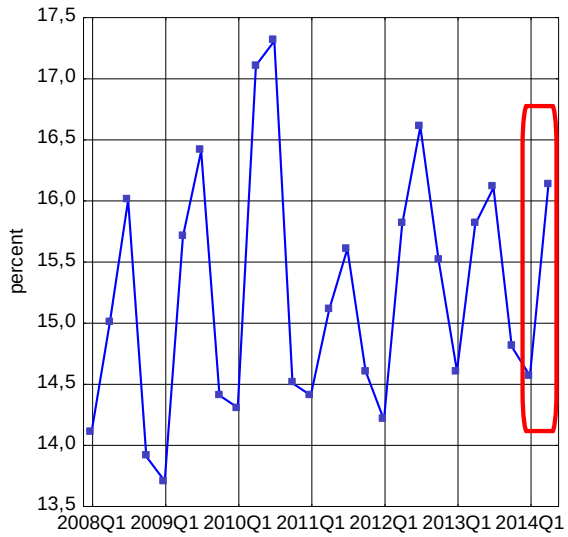


Fig. 6. The projection of the employment rate for working age population in agriculture for the first and second quarter in 2014

The model likelihood was checked up by using the variance analysis. The model is statistically valid, as long as the theoretical value for a significance level ά = 0.05 and 1, respectively 22 degrees of freedom, taken over from Fisher Snedecor distribution table is lower than the calculated F test value ($F_{ά,\ k,\ T-k-1}$ = 4.30 < F_{calc} = 73.93). The correlation ratio is quite close to 1: R = 0.88. The econometric model explained 77 % of the total variance of the analysed phenomenon.
For the first and second quarter of the year 2014, the point estimates of the expected levels for the investigated indicator - obtained by antilogarithmation were: $\hat{y}_{Q1/2014}$= 14.56 % and $\hat{y}_{Q2/2014}$=16.12 %, respectively while the confidence intervals calculated for α=0.05 significance level were:
[13.54;15.66], [14.98;17.34].

CONCLUSIONS

The household labour force statistical survey conducted by the National Institute of Statistics highlighted the continuation of the economy restructuring process, with an impact on the structure of the employed population and unemployment.

Given that the job vacancy rate in the agricultural sector amounted to 0.35 % in 2013, 1.43 % points below the level recorded in 2008, there was a strong warning on the difficulties of the reintegration into the labour market of people with low qualifications.
In the short term, the solution proposed by specialists, i.e. the qualification of the underemployed rural population is difficult to implement, given that the incidence of underemployment in agriculture (the share of underemployed persons in the total employed population in the same category) in 2013 was 6.9 % compared to 6.8 % in 2012.

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[5]http://ec.europa.eu/eurostat