

Realities and Perspectives concerning Employment in Romania: Trends and Forecast Based on the Box & Jenkins Methodology

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Abstract

The paper addresses first theoretically and then from a practical perspective the notion of employed population and its components, based on an analysis concerning the employees' evolution in Romania between 2001-2010 and makes a forecast of employment for the first semester of 2015, using the values of this indicator for the 2002-2010 period. The paper's originality results from the use of Box & Jenkins methodology to forecast the employment for that horizon of interest.

The importance of this topic derives from the role held by the employed population in the proper performance of the activities involved by the labor market. Following the forecast, it is estimated that the past trends for the analyzed indicator are maintained in the future.

Key words: *employed population, employees' number, labor market, forecast, time series*

Jel Classification: *J21, C53*

Introduction

As a market of the most important production factor, the labor market holds a fundamental position in the competitive economy. Its role and importance in the functioning of an economy and in regulating the phenomena and processes that affect the society at a certain time are in a permanent increase, as a result of those processes and developments with impact on the labor demand and supply, on employment and on the management and control labor market's mechanisms: processes of economic globalization, evolutions of demographic phenomena concerning the population migration or the technological progress.

A special feature of the labor market is derived from its sources of absorbing the available labor resources. From this perspective, the literature identifies a number of labor market *supply channels*:

- the demographic channel includes young people with the working age, but with no training for this purpose and people that are looking for a job for the first time;
- the channel of the educational system, as a provider of skilled professional graduates;

- the channel of the released labor in the economy, as a consequence of the transition to market economy, through restrictions, retraining, closure of enterprises etc.¹.

In the last 20 years Romania was marked by major and complex changes from the economic, social and political perspective, changes that were felt on the labor market, also, and that generated mutations in terms of the volume, quality and structure for those indicators which characterizes the labor in Romania. From economic point of view, an important component of these indicators is the employed population, as the producer of the goods and services that are required for the existence of the society.

The purpose of this article is to inform about the developments that took place in the Romanian labor market, primarily through a brief analysis of the number of employees in Romania during 2001-2010, followed by a modeling for the employment dynamics in Romania, using volume Box & Jenkins methodology. The motivation for approaching such an issue is founded on the importance of the indicator analyzed in the labor market functioning and organization and, without any doubt, in ensuring the economic efficiency.

The problem that caused an overall analysis of employment and of the employees' evolution derive from the reality that characterizes Romania in the recent years, when on the labor market the economic crisis' effects have a great impact upon the good progress of those activities involved by this market.

The literature in the field which treats labor market in general, and the problem of employment, in particular, is varied. Considered an expression of the effective use of manpower, employment represents a macroeconomic indicator of labor market, that includes all those persons (employees, employers, self-employed, members of agricultural societies or members of cooperatives) who had a job in formal and informal sector, with or without legal forms. Two of the employment's components are the employees and individual workers. On the one hand, the first category is represented by all the persons carrying out a productive activity based on a formal or informal agreement, for another unit residence, for remuneration. The individual workers are persons working on their own, being the owners of the entities within which they are operating the activities. This category includes: home workers, unpaid family workers producing for the market etc. In Romania, in the last four years the individual workers' number registered a decrease between 2008 and 2010 (3.1 million in 2008, 2.5 million in 2009 and 2.4 million in 2010), followed by a slight increase in 2011: 2.6 million².

The employment also includes those present and those temporarily absent from work, but which keep formal links with the job (vacations, strikes, professional courses, temporary suspension of work due to the weather conditions, economic circumstances etc.)³.

A narrow definition argues that, in economic terms, the employees are the individuals who have a job in a resident institution with a work contract and receiving a salary⁴.

The changes generated by the transition to a market economy had a negative impact in the economic trends concerning the actual employees number, which registered constant reductions over the years. Among the causes for this downward trend one can mention:

- the increased aging of population;

¹ Baldan, C., Neacșu, M., The Employment and Unemployment in Romania - Decisive Factors, *Analele Universității din Oradea, Economics and Business Administration series*, Tom XVII, Vol. II, 2008

² Anghelache, C., Populația și piața forței de muncă, *Economie teoretică și aplicată*, Vol. XIX, nr.1 (566), 2012, pp. 21

³ Chivu, M., *Piața muncii- studiu statistic*, Independența Economică Publishing House, Pitești, 2007, pp. 87

⁴ Ghizdeanu, I., Tudorescu, V., Unit labor cost in Romania, *Romanian Journal of Economic Forecasting*, No.1, 2007, pp. 58

- the labor migration (outside the country but also from rural to urban areas);
- the economy's incapacity to generate enough jobs;
- the massive layoffs in the last 20 years in many economy sectors;
- the professional rigidity and difficulty in retraining the workforce⁵.

Developments on the Number of Employees in Romania

Labour market developments in recent years can be characterized by three major trends experienced especially after 2007: the market liberalization, the job instability and labor mobility, all with a pronounced influence on employers and employees, but also on Romania's economic situation.

Labor market liberalization increased the migration, which produced imbalances in the Romanian labor market and gaps between supply and demand. The 2008-2010 period was characterized by economic instability and lack of candidates for certain jobs, which imposed the hiring of many insufficiently trained people, as the consequence of the more frequent migration.

The uncertainty and the economic instability on the labor market generated the reduction of the staff costs by firms, action that induced the employees the feeling of job insecurity, both in the private and in the public sector. The year 2009 involved the reorganisation of the labor supply and demand, being characterized by a lack of wage increases and requests of competent candidates. The end of the year recorded the lowest number of employees from the last 11 years, when there were concluded only 1.6 work contracts, compared to 2.3 million in the previous year. Another explanation for the drastic decrease in the number of employees derives from the high value of the unemployed registered at the end of 2009, about 700,000, and from the reduced number of jobs available in the early 2010, about 50000. In 2010 there were some decreases both in terms of number of employees and in terms of wages. In other words, in 2009 and 2010 Romania's economy lost twice as many jobs as were gained in the period 2004-2008.

Some of those descriptions are illustrated below, based on Table 1 and Figure 1, which highlights the evolution of the number of employees in Romania during 2001-2010, as a component of the occupied population. Between 2001 and 2010, according to Table 1, the nationwide number of employees decreased from 4470300 to 4101600 people.

Table 1. The values recorded on employees' number for the period 2001-2010 (thousands)

2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
4470.3	4331	4333.8	4398.3	4501.2	4575	4717.2	4738.6	4367.7	4101.6

Source: National Institute of Statistics

According to Table 1, the maximum value of the analyzed indicator was achieved in 2008, when there were 4738600 people employed. A graphical representation of employees is shown in Figure 1.

⁵ Vădășan, I., Părean, M., O., The evolution of Romania's labor market in the last 20 years, *Analele Universității din Oradea, Economic Science series*, Tom XX, Vol.2, 2011, pp.203

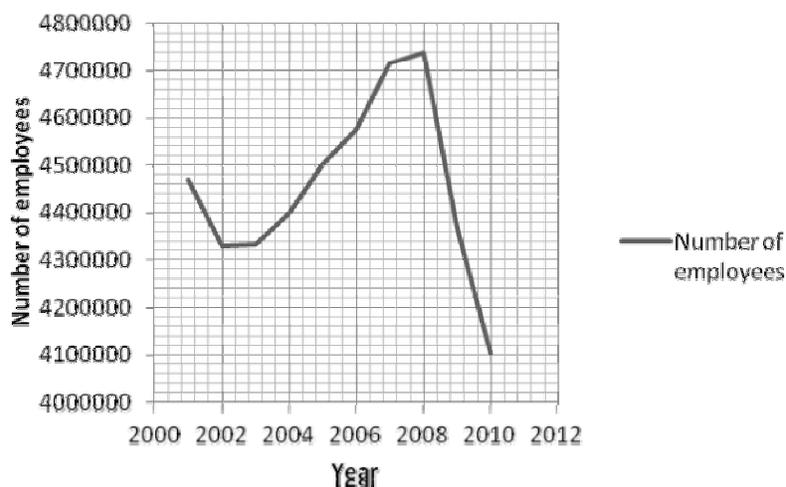


Fig.1. Evolution of the number of employees in Romania during 2001-2010

Source: created by author

The graph highlights variations in the number of employees registered in the boom period (2004 - 2008), when it is observed a continuous growth of the analyzed indicator, following its sharp decrease in the next period.

The Pattern of Modeling the Romanian Employed Population's Dynamics Using the Box & Jenkins Methodology

In 1976 Box and Jenkins propose a general methodology for forecasting the univariate series starting from a model based on the ARIMA processes (autoregressive integrated models and moving average). Both accept the idea of a non-stationary stochastic process' trend type, which is commonly found in reality, and propose a method to eliminate this trend through differentiation. The time series analysis based on Box & Jenkins methodology has two stages:

- I. To identify the estimated model, through the assertion of the general class of models, the identification of the model estimated a priori (in relation to the graphs form for the autocorrelation function and the partial autocorrelation function);
- II. To estimate and test the model, through the estimation and testing the parameters of the identified model and to test and validate the model⁶.

This paper will use this methodology for analyzing the quarterly dynamics of the volume of employed population in Romania between 2002-2010 and it will determine a forecast for this volume level for a horizon of interest.

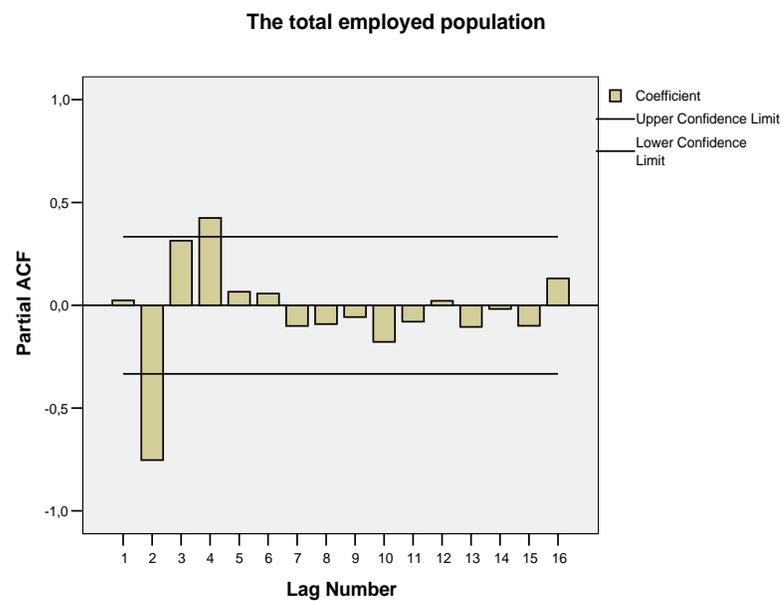
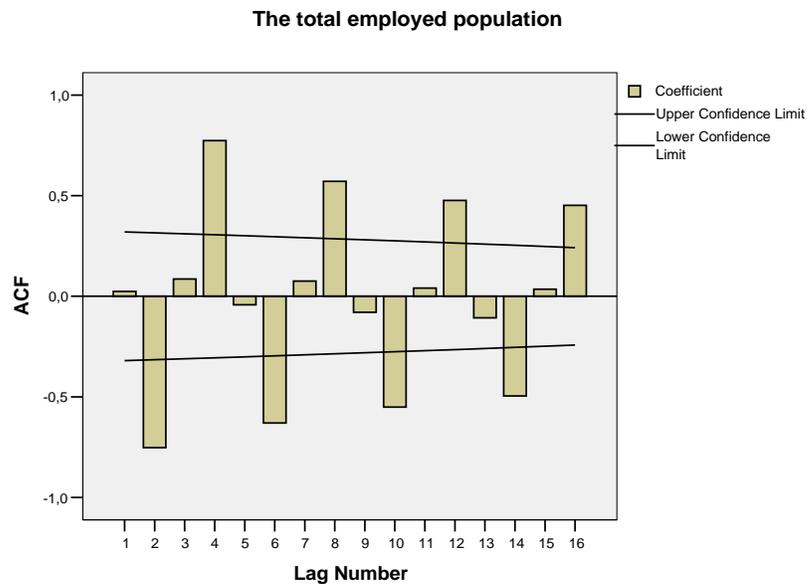
To start with, we emphasize that we have a time series resulted from the quarters values of a variable- the employed population registered in Romania, fact that makes us think at the seasonal series, at the time series' components, and also at a seasonal variation and a random one. The one who introduced in the field the decomposition in those four components is WM Pearson in 1919. However, this issue will be studied in another analysis, while the present analysis will make an extrapolation of trends in the observed period, based on the following assumptions:

⁶ Turturean, I.C., *Metode statistice de analiza a seriilor de timp*, Sedcom Libris Publishing House, Iasi, 2006

I1: the past trends will remain in the future;

I2: the fluctuations for the variable under study are repeated at regular intervals.

In the first stage it will be examined the autocorrelations and the partial autocorrelations for the time series to provide a quantitative conclusion about its periodicity and to see more clearly if this presents the characteristics of a seasonal series. The autocorrelation function ACF and the partial autocorrelation function Partial ACF are represented in Figure 2 and Figure 3 for gaps (LAGs) to the order $k = 16$ (values resulted after achieving the two graphs).



Source: created by author

The analysis of the two figures shows that the autocorrelation function takes values significantly different from zero outside the confidence interval for the lags 2, 6, 10, 14 on one side of the gap axis and 4, 8, 12, 16 on the other side, fact which suggests the existence of a four months periodicity. So, the definition of a seasonal quarterly data is correct. The same situation can be found in the other figure, for the partial autocorrelation function: values significantly different from zero are found for gaps 2 and 4, suggesting the existence of an autoregressive AR component with the order 2 and probably order 4. In conclusion, the two graphs suggest that the time series is seasonal.

Next a modeling concerning the dynamics of employment in Romania using the methodology Box & Jenkins (1976) will be developed. This methodology is based on the ARIMA (autoregressive integrated models and moving average) processes. The stages of the analysis based on Box & Jenkins method are as follows:

- o identifying the estimated model (a model is estimated according to the form of the autocorrelation function graphs and partial autocorrelation function);
- o model estimation and testing (through testing the parameters for the identified model and its validation).

On the graphs presented in Figure 2 and Figure 3 we can estimate an autoregressive model of order 4 AR (4) or an autoregressive model with a seasonal component and moving average. After using several tests were validated two categories of models: a model AR (4) (as we estimated in the previous step) and a model with seasonal component SARMA(3,0)(0,1)₄, according to the Tables 2 and 3.

Table 2. The estimated parameters for the AR (4) model
Parameter Estimates

		Estimates	Std Error	t	Approx Sig
Non-Seasonal Lags	AR1	,213	,143	1,485	,148
	AR2	-,395	,137	-2,883	,007
	AR3	,224	,140	1,604	,119
	AR4	,553	,141	3,912	,000
Constant		9251634.275	39917,015	231,772	,000

Melard's algorithm was used for estimation.

Source: created by author

Table 3 The estimated parameters for the SARMA(3,0)(0,1)₄ model with seasonal component
Parameter Estimates

		Estimates	Std Error	t	Approx Sig
Non-Seasonal Lags	AR1	,398	,162	2,454	,020
	AR2	-,775	,104	-7,459	,000
	AR3	,380	,160	2,382	,024
Seasonal Lags	Seasonal MA1	-,488	,177	-2,750	,010
Constant		9256250.319	29881,196	309,768	,000

Melard's algorithm was used for estimation.

Source: created by author

To opt for a model or another we must consider the information criteria (Akaike, Schwartz). Higher values of these criteria are favorable for choosing the best model. Tables 4 and 5 present the situation of these criteria for our situation:

Table 4. Values of the information criteria for the AR (4) model
Residual Diagnostics AR(4)

Number of Residuals	36
Number of Parameters	4
Residual df	31
Adjusted Residual Sum of Squares	440232870566.901
Residual Sum of Squares	481814614212.258
Residual Variance	12400841347.792
Model Std. Error	111359,065
Log-Likelihood	-469,170
Akaike's Information Criterion (AIC)	948,341
Schwarz's Bayesian Criterion (BIC)	956,258

Source: created by author

Table 5. Values of the information criteria for the SARMA(3,0,0)(0,0,1)₄ model
Residual Diagnostics SARMA(3,0,0)(0,0,1)₄

Number of Residuals	36
Number of Parameters	4
Residual df	31
Adjusted Residual Sum of Squares	540083660909.536
Residual Sum of Squares	678649183559.966
Residual Variance	15493938576,656
Model Std. Error	124474,650
Log-Likelihood	-472,858
Akaike's Information Criterion (AIC)	955,715
Schwarz's Bayesian Criterion (BIC)	963,633

Source: created by author

From the Tables 4 and 5 can be read higher values of the information criteria for the SARMA(3,0)(0,1)₄ model. Therefore, the employment dynamics in Romania during 2002-2010 is best modeled by this model.

The general form of the model is the one corresponding to relation (1):

$$\text{SARMA}(p,q)(P,Q)_s: \varphi(B)\Phi(B^S)x_t = \theta(B)\Theta(B^S)\varepsilon_t + \alpha_0 \quad (1)$$

where :

- B: the delay operator with unseasonal gap;
- B_s: the seasonally with the s delay operator;
- x_t: the dependent variable (studied)
- $\varphi(B)$: the autoregressive unseasonal transfer function of order p (equation 2);
- $\Phi(B^S)$: the transfer autoregressive function (of order P) and seasonal (period S);
- $\theta(B)$ the transfer function with moving unseasonal average of order q (equation 3);
- $\Theta(B^s)$: the moving average transfer function (of order Q) and seasonal (period S);
- ε_t : the modeling error;
- α_0 : the constant.

$$\varphi(B) = 1 - \sum_{j=1}^p \varphi_j B^j \tag{2}$$

$$\theta(B) = 1 - \sum_{j=1}^q \theta_j B^j \tag{3}$$

- φ_{kj} : the j^{th} coefficient of the AR(k) model, with $k = \overline{1, p}$;
- θ_j : the j^{th} coefficient cel de-al j-lea coefficient of the MA(k) model, with $k = \overline{1, q}$.

The resulted model based on the processed data is according to the relations (4) and (5):

$$(1 - 0,398B + 0,775B^2 - 0,38B^3)x_t = (1 + 0,488B^4)\varepsilon_t + 9256250 \tag{4}$$

$$x_t - 0,398Bx_t + 0,775B^2x_t - 0,38B^3x_t = \varepsilon_t + 0,488B^4\varepsilon_t + 9256250 \tag{5}$$

With

$$Bx_t = x_{t-1}, \forall x, \tag{6}$$

The model becomes:

$$x_t - 0,398x_{t-1} + 0,775x_{t-2} - 0,38x_{t-3} = \varepsilon_t + 0,488\varepsilon_{t-4} + 9256250 \tag{7}$$

Based on the obtained model, a forecast for the employed population volume in Romania will be made for the first quarter of 2015. This forecast will also be presented graphically (Figure 4), followed by a comparative analysis between the estimated evolution and the real one for this indicator.

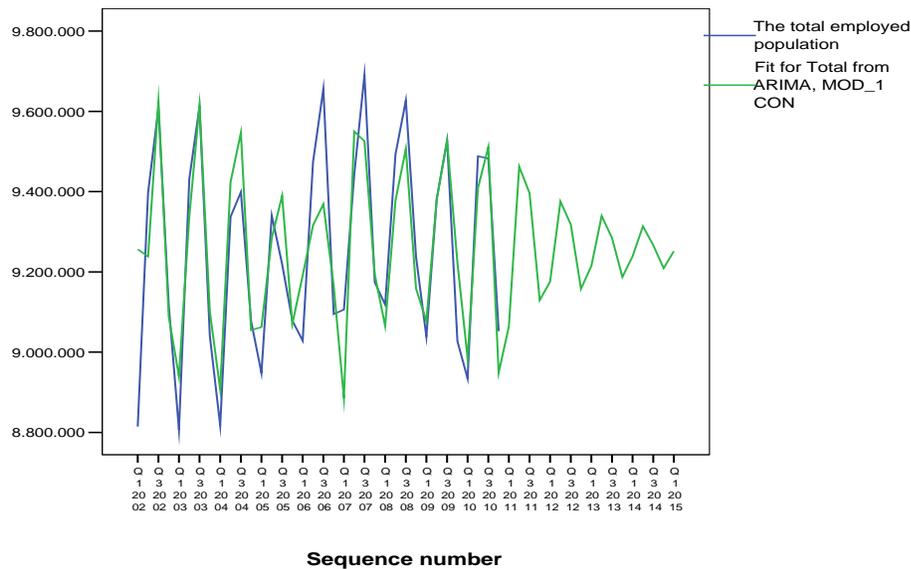


Fig.4. Forecast for the Romanian employed population' volume on the first quarter of the year 2012

Source: created by author

Analyzing Figure 4, it can be stated that the model reproduces quite well the evolution in time of the employed population volume in Romania. Moreover, the values of the forecasts series seem to strive to a stationarity in variance. The forecast value is situated around the average level and also are met the assumed conditions about the fact that the past trends persist in future and the variable fluctuations are repeated at regular intervals.

Conclusions

The employed population is one of the most important macroeconomic indicators that characterize the number and structure of employment. Addressing such a topical subject gives originality to the theme by the way of using and processing the data.

Romania's situation from the employed population perspective, in general, and the employees number, in particular, highlights the fact that the work resources are not exploited at the level at which they should be. This is clear from the analysis realized in the article, which identifies an increase concerning the number of employees in economy from 2001 to the beginning of the boom period, when the number of employees registered significant reductions. There are some similarities regarding the current and future employed population evolution, following the results of forecasting using Box & Jenkins methodology, because there are similarities between the present evolution of this indicator and the trend resulted in analysis.

The paper has a high level of importance, if we consider that employment, as the focus of research, is the concrete expression of the use of labor. Some future research directions pursue a forecast of the same indicator, but grouping the Romanian counties, in other words, will be made a forecast on clusters concerning the employment's evolution for a horizon of 4-5 years.

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Realități și perspective privind ocuparea în România: evoluție și prognoză pe baza metodologiei Box & Jenkins

Rezumat

Articolul abordează inițial teoretic și ulterior din perspectivă practică noțiunea de populație ocupată și componentele sale, pe baza unei analize privind evoluția efectivului de salariați din România în intervalul 2001-2010 și a efectuării unei prognoze a populației ocupate pentru primul semestru al anului 2015,

plecând de la valorile acestui indicator aferente perioadei 2002-2010. Originalitatea articolului rezultă din utilizarea metodologiei Box & Jenkins în scopul prognozei populației ocupate pentru respectivul orizont de interes.

Importanța subiectului abordat derivă din rolul pe care populația ocupată îl deține în buna desfășurare a activităților pe care piața forței de muncă le presupune. În urma prognozei realizate, se estimează faptul că tendințele observate în trecut în cazul indicatorului analizat se mențin și în viitor.