Statistical Modeling of Stochastic Dependences between Variables that Characterize Labor Market in Romania for Taking Relevant Management Decisions for a Competitive and Sustainable Development of Labor Force

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ABSTRACT
The labor market is an important component of the entire economic system and for social-economic development. However, the labor market is known as the most inflexible of markets, the existence of the phenomenon of permanent labor mobility. After 1990, the Romanian society has experienced a series of economic and social transformation, new reforms covering all areas of activity. Increasing labor resources was accompanied by a continued reduction in employment and increase in unemployment. The government tried to initiate programs, including external funding to create jobs, but compared to the massive layoffs that occurred following the restructuring of sectors, the number of new jobs created has proved insufficient. The paper presents a multiple regression model for employment and prognosis for this until 2020.

KEYWORDS: *employment, economic development, labor market, analysis.*

JEL CLASSIFICATION: *J20*

1. INTRODUCTORY ASPECTS FOR CHARACTERIZING LABOUR FORCE IN ROMANIA AND OTHER UE COUNTRIES

Skills, competencies are an essential part of the economic infrastructure and the choices made by policy makers and by enterprises and individuals to invest in education and skills can contribute to determining the horizon economy is heading. EU Member States have investigated several methods to identify employment forecasting future labor needs to take into account factors by sectors, occupational, educational and training that affect supply and demand for jobs (Tudose et al., 2013). European countries need to adapt to the demographic changes represents a major challenge. Pension reform - especially extension activity and increasing the employment rate of older people - is undoubtedly one of the major axes of their policies. However, improving working conditions, vocational training and communication activities / information / publicity are other levers on which one can act. And to ensure the success of measures to extend working life, is regarded as

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indispensable health promotion in general and the workplace for older people in particular. In this respect, the participating actors (public power companies, social security bodies / Labor Protection) must be mobilized for a cultural revolution, to change attitudes and practices (Tudose et al., 2013). Some Eastern European countries are interested in developing such models in order to provide employees (Dekker & Heijke, 1994) with adequate training labor market required. Considering the single labor market requirements and increasing international mobility, states must develop models that can be comparable to the forecast for the training and qualification of the existing Member State (Hughes, 1991). This goal requires regular medium-term forecasts will extend the timeframe by decision makers that can be applied throughout the national economy, taking into account factors such as future investments in the economy, forecasts of income and labor productivity and, of course, technological exchanges. The development of such predictions will require the use of quantitative and qualitative methods will systematically organize and integrate data and analysis on education and training, as well as occupational needs. Netherlands and France are two European countries that have extensive experience in educational and occupational projections, Ireland is the country that most recently joined them. France has the longest tradition in the prediction of occupational and educational needs, followed by the Netherlands and Ireland, which recently have developed expertise in this area (Eijs, 1994). Global demand for labor is labor market needs expressed by businesses within the economy. The businesses understand people or groups of people active in various sectors of the national economy using production elements that are at their disposal (including labor) to get a certain amount of goods or provide certain services in quantities higher costs and lower cam. This category includes credit and insurance, government or private Romanian and foreign companies employing labor in Romania. Labor demand depends on a number of variables: growth rate, the demand for goods and services, investment rate, technical progress, labor costs. In ideal conditions, having a perfectly competitive labor market as possible only with a very good communication system characterized by informational decentralization giving individuals the opportunity to choose between different options, but taking into account the disadvantages of risk. Generally, in Romania, due to deficient labor market information system is only possible to estimate the total demand and the activities at some point, given the working age population, employment and labor force (Jigău et al., 1998).

Employment effect is generated by the international division of labor. Production site and services may exert a significant influence on the demand for labor, changes in technology and innovation can influence the demand for labor, competition from different sectors can affect the demand for labor in different ways: for example, encouraging firms to rationalize production to become more innovative, the regulatory framework may affect demand occupations or skills (for example, new environmental and safety standards may force firms to recruit employees with special skills), job offers. A surplus or shortage of work can influence a firm's hiring decisions. With regard to labor supply, the following factors are important: demographic trends affecting the size, age and gender composition of the labor force; participation rates expected labor; net migration and population structure and migration flows; the education and training of the population; occupational preferences of workers; regional mobility - enabling people to choose work according to his wishes and working conditions in his country and in EU countries (Tudose et al., 2013).

2. ANALYSIS OF STATISTICAL DISTRIBUTIONS TO CHARACTERIZE THE EVOLUTION OF LABOR FORCE IN ROMANIAN DURING 1997-2011

As a result of systematic statistical data on labor market in Romania during 1997 -2011 were determined derived indicators, which enable a first form of macroeconomic indicators that characterize this area.

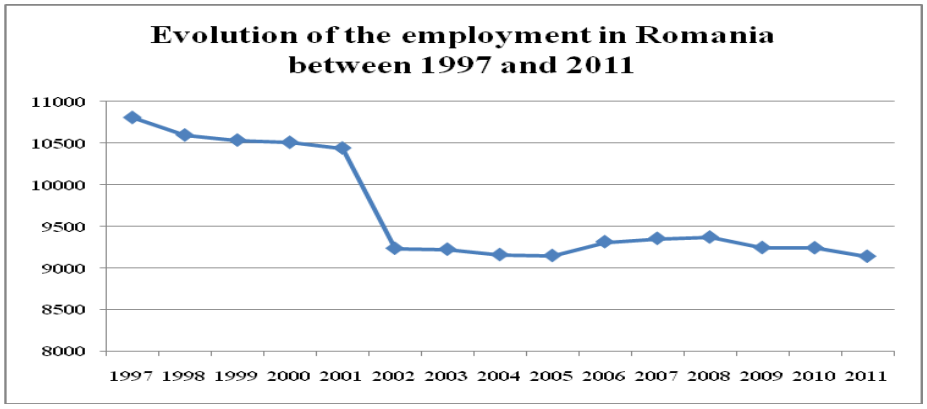

Figure 1. Evolution of the employment in Romania between 1997 and 2011

Source: Statistical Yearbook, National Institute of Statistics, 2012

From figure 1, we can conclude that the evolution of employment population in Romania between 1997 and 2011 registered a decrease trend. The annual average value of the number of employment population amounted to 9686 persons, with a very high representativeness (coefficient of variation of 6.8 %). The maximum range of variation of 10807 persons is low, because the asymmetry coefficient is also low and positive (skewness coefficient = 0.8, computed with median). (see table 1)

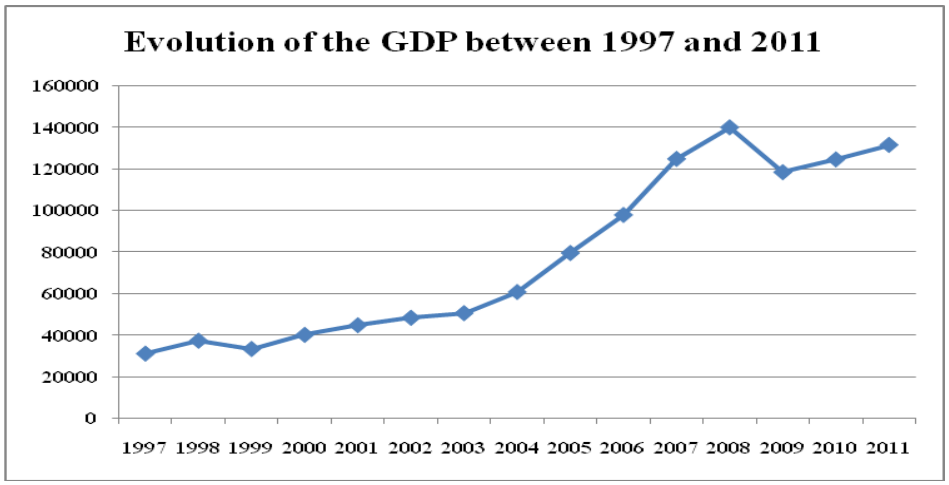

Figure 2. Evolution of the Gross Domestic Product (GDP) between 1997 and 2012

Source: Statistical Yearbook, National Institute of Statistics, 2012

Real GDP in economy is computed in million euro in comparable prices with an average of 77535 million euro, which is a significant indicator (coefficient of variation 22.37% < < 35%) as the amplitude variation is 108498 million euro, the asymmetry is positive and its value is high (0.2237). There are periods in the analysis when real GDP was located above the value of 108498 million Euro and periods in which GDP showed a lower value of the central value of 108498 million euro. (see figure 2).When the economic crisis begins, the value of real GDP in economy begins to decrease in 2009 and in 2011 it registered a positive trend.

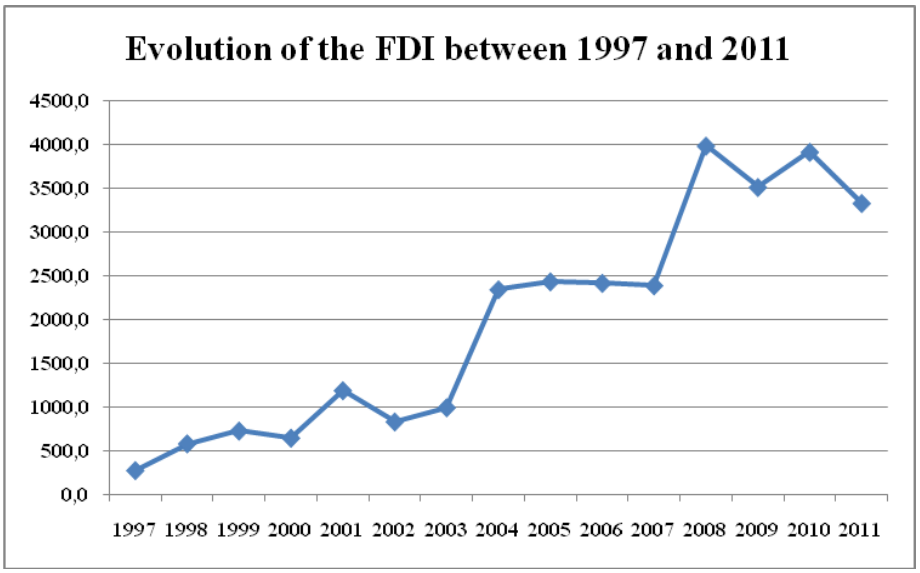

Figure 3. Evolution of the Foreign Direct Investments (FDI) between 1997 and 2011

Source: Statistical Yearbook, National Institute of Statistics, 2012

Table 1. Determination of the central tendency, variation and asymmetry for the main variables which influence the labor market between 1997 and 2011

Indicator	Average	Coefficient of variance-%	Median	Skewness
Employment population (persons)	9686	6.8	9313	0.80
GDP (million euro)	77535	22.37	60808	0.36
FDI (million euro)	1972	25.97	2343	0.27

Source: Statistical Yearbook, National Institute of Statistics, 2012

Real foreign direct investments. The annual average of real foreign direct investments in economy in the period 1997-2011 amounted 3329.4 million Euros which has a high representativeness, slightly under the threshold of 35%, caused by a dispersion degree of 1693626 which makes the value of the asymmetry coefficient (0.27) indicate a value of real direct investments in economy with a small amount above its average value of 1972 million Euro. (see table 1).

3. THE CORRELATION ANALYSIS BETWEEN THE INDICATORS CHARACTERIZING THE LABOR FORCE IN ROMANIA DURING 1997-2011

The model reflects the relationship between employment (endogenous variable), Gross Domestic Product (GDP) and Foreign Direct Investments (FDI) (exogenous variables). GDP and FDI were transformed in comparable prices in million euro. In the last 20 years after the Revolution was employed in the state sector a large number of employees. These employees are those who produce value added economy. Employees in this branch of the national economy must be qualified.

The equation of regression is:

$$\hat{Y}_i = 10443.36 + 15.002074x_{1i} + 7.301979x_{2i} \quad (1)$$

The results presented were obtained with EVIEWS.

Table 2. Output EVIEWS for the multiple regression model

Dependent Variable: EMPLOYMENT
Method: Least Squares
Date: 07/23/13 Time: 15:37
Sample: 1997 2011
Included observations: 15
EMPLOYMENT=C(1)+C(2)*GDP+C(3)*FDI

	Coefficient	Std. Error	t-Statistic	Prob.
C(1)	10443.36	302.1362	34.56506	0.0000
C(2)	15.00207	3.009568	5.216722	0.0321
C(3)	7.301979	2.299590	3.007974	0.0234
R-squared	0.915587	Mean dependent var		9686.933
Adjusted R-squared	0.934852	S.D. dependent var		659.2031
S.E. of regression	495.5648	Akaike info criterion		15.42613
Sum squared resid	2947013.	Schwarz criterion		15.56774
Log likelihood	-112.6960	Durbin-Watson stat		1.807411

Source: author's calculation in EViews

The test t so calculated is compared with a theoretical value of Student distribution table corresponding to the significance level α = 0.05 (5%) and a number of degrees of freedom equal to n-3 (12): $t_{\alpha/2;n-3} = t_{0,05/2;12} = 2,179$. However, $|t_{calc}| > |t_{theoreticd}|$, previously determined that the estimator is statistically significant.

For testing the validity of linear regression model, we use the Fisher test, as:

$F_{computed} = 14.95$. Compared to the theoretical value of Fisher-Snedecor distribution table corresponding to the significance level α = 0.05 (5%) and a number of degrees of freedom equal to r-1 and n-r $F_{\alpha;r-1;n-r} = F_{0,05;2;12}$ = 3.88 and $F_{computed}$ is higher than

$F_{theoretical}$ that the model used is valid, correctly identified the statistically and can be used for making predictions for the future.

The coefficient of determination (R^2) indicates the percentage by which we explain the influence of significant factors. It is used in evaluating the quality of the model. It can take only values in the range [0,1]. The values are closer to 1, the model is better. In this case R^2 = 0.91 and so we can say that the regression model is good. Approximately 91% of employment population is explained by multiple linear regression model chosen.

The adjusted coefficient of determination is computed as:

$$R_c^2 = 1 - \frac{n-1}{n-k} \cdot \left(1 - R^2\right) \quad . \tag{2}$$

It is used to reflect the number of factorial variables included in the model, and the number of observations on which the model parameters were estimated. In a multiple model will record a lower value than the coefficient of determination.

Checking the accuracy of the multiple regression models and of the multiple correlation ratios, based on "Fisher" criterion, leads to the following conclusion: because the probability Significance F is less than 0.05 the multiple regression models is valid, with a significance threshold of 0.05.

The coefficient β_0 has the value 10443. It does not have economic significance. It represents the number of employment when the others factors do not have influence. Since t = 34.56 and p-value = 0.00<0.05 it means that the coefficient β_0 is valid for a significance level of 0.05.

The slope β_1 has the value 15.0027. It represents the number of employed persons when the real GDP increased by one million euro. Since t = 3.009 and p-value = 0.03<0.05 it means that the coefficient of regression is valid for a significance level of 0.05.

The second slope has the value 7.30. It represents the number of employed persons when the real foreign direct investments increased by one million euro. Since t = 3.0079, and p-value = 0.0234 < 0.05 it means that the coefficient is valid for a significance level of 0.05. It follows therefore that 91% of the variation in total employment is due to variation of real GDP and real FDI, and the remaining 9% is the influence of other factors (education, earnings). Report showing the intensity correlation relationship between variables will be $R_{y/x}$=0.91, resulting in an direct relationship, a very strong intensity. The employment depends in a proportion of 91% of real GDP and of real investments. To verify the significance of the model we calculated F test, whose value is 14.95. Compared to the theoretical value of Fisher-Snedecor distribution table corresponding to the significance level α = 0.05 (5%) and a number of degrees of freedom equal to r-1 and $F_{computed}$ is higher than $F_{theoretical}$ that model used is valid, correctly identified the statistically and can be used for making predictions for the future. As such, the model that describes the relationship between the phenomena considered are:

$$\hat{Y}_i = 10443.36 + 15.00207x_{1i} + 7.301979x_{2i}; \qquad R_{y/x} = 0.91 \qquad (3)$$

$$(302.13) \qquad (3.0095) \qquad (2.2995) \qquad s_\varepsilon = 495.56$$

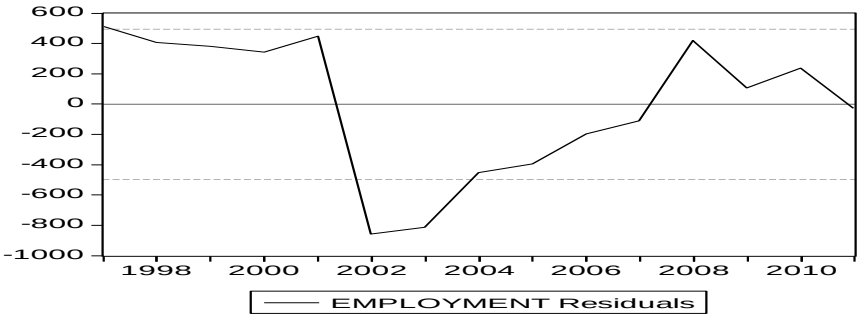

Figure 4. The residual values for multiple regression model

Source: author's calculation in EViews

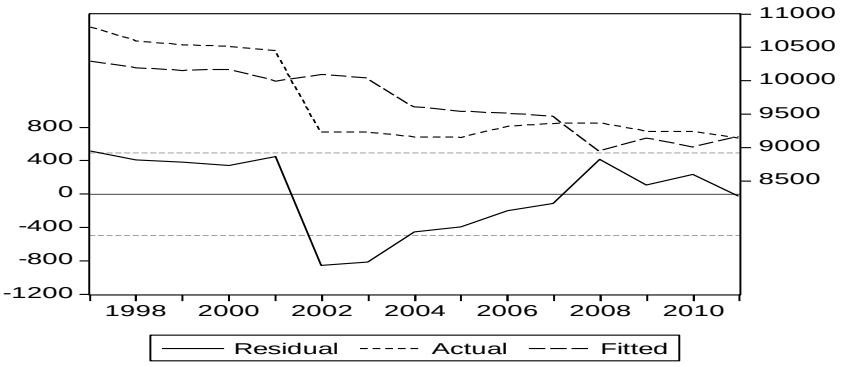

Figure 5. The real values and predicted values for the dependent variable, respectively residual values for multiple regression model

Source: author's calculation in EViews

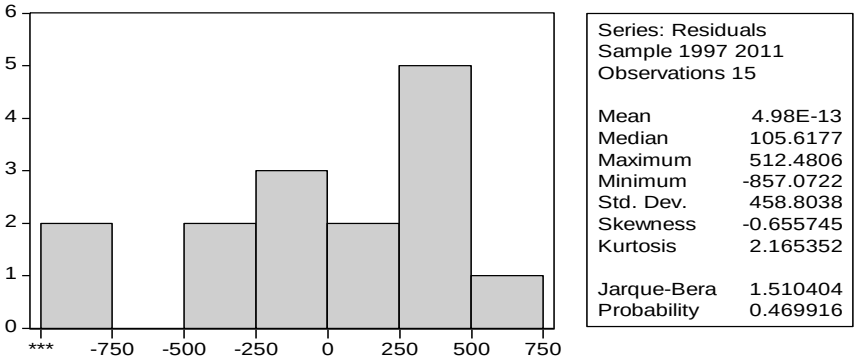

Figure 6. Jarque Bera Test

Source: author's calculation in EViews

The Durbin Watson test is used for detect autocorrelation of order 1 between residuals. Using a level of significance of $\alpha = 0{,}05$, number of exogenous variables $k = 2$ and number of observations $n = 12$, from the Durbin-Watson distribution are identified the values (for case $n = 15$): $d_1 = 1{,}08$ and $d_2 = 1{,}36$. Because $d_2 = 1{,}36 < d = 1{,}80 < 4 - d_2 = 2{,}64$, we can accept the hypotheses of independence for residuals (see table 1).

Verifying the normality of errors using Jarque-Bera test one observes that JB_{calc}=1.51 $<\chi^2_{tabel}$=7.81 which means that the errors are not normally distributed (see Figure 6).

Table 3. White Test

White Heteroskedasticity Test:

F-statistic	1.315439	Probability	0.328972
Obs*R-squared	5.171511	Probability	0.270148

Test Equation:
Dependent Variable: RESID^2
Method: Least Squares
Date: 07/30/13 Time: 15:40
Sample: 1997 2011
Included observations: 15

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-99367.54	497044.5	-0.199917	0.8456
GDP	22.99660	22.21817	1.035036	0.3250
GDP^2	-0.000130	0.000116	-1.121242	0.2884
FDI	-493.4775	440.4161	-1.120480	0.2887
FDI^2	0.085824	0.082988	1.034172	0.3254
R-squared	0.344767	Mean dependent var		196467.5
Adjusted R-squared	0.082674	S.D. dependent var		219533.6
S.E. of regression	210262.9	Akaike info criterion		27.61131
Sum squared resid	4.42E+11	Schwarz criterion		27.84732
Log likelihood	-202.0848	F-statistic		1.315439
Durbin-Watson stat	1.168915	Prob(F-statistic)		0.328972

Source: author's calculation in EViews

The White test is a statistical test which has as a starting point explaining the observed errors in relation to one or more exogenous variables.. (Voineagu V. at all ,2007). Analyzing by the application management software and database analysis (Eviews) shows that $F_c = 220.8 > F_{0,05;3;7} = 4{,}35$ and $LM = 9.97 > \chi^2_{0,05;3} = 7.81$, but the coefficients are not statistically significant for a level of significance of $\alpha = 0{,}05$ ($t_{0,05/2;12} = 2{,}179$) and the homogenity hypthese checked. To detect errors autocorrelation using empirical methods that test Breusch-Godfrey. With this test will analyze the existence of autocorrelation of order k, k≠ 1. It is assumed that the errors of the regression model is given by the equation:

$$\varepsilon_t = \rho_1 \varepsilon_{t-1} + \rho_2 \varepsilon_{t-2} + ... + \rho_k \varepsilon_{t-k} + v_t \text{, for t = k,...,n, but } v_t \sim N(0,\ \sigma_v^2) \quad (4)$$

In order to evaluate the statistical presence of an autocorrelation of the order k to be used the following statistical hypotheses:

H_0: $\rho_1 = \rho_2 = ... = \rho_k = 0$;the residuals are not correlated

H_1: $\rho_1 \neq 0$ or $\rho_2 \neq 0$ or $\rho_s \neq 0$, the residuals are correlated

It is observed by applying statistical software (EViews) statistical probability F is 0.140564 (high) model does not show autocorrelation of order 2.

Table 4. Breusch-Godfrey Test

Breusch-Godfrey Serial Correlation LM Test:

F-statistic	2.402789	Probability	0.140564
Obs*R-squared	4.868683	Probability	0.087655

Test Equation:
Dependent Variable: RESID
Method: Least Squares
Date: 07/30/13 Time: 15:40
Presample missing value lagged residuals set to zero.

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C(1)	-6.778564	276.9918	-0.024472	0.9810
C(2)	-0.002785	0.008716	-0.319543	0.7559
C(3)	0.111837	0.278116	0.402124	0.6961
RESID(-1)	0.618808	0.315712	1.960043	0.0784
RESID(-2)	-0.071531	0.334467	-0.213866	0.8349

R-squared	0.324579	Mean dependent var	4.98E-13
Adjusted R-squared	0.054410	S.D. dependent var	458.8038
S.E. of regression	446.1474	Akaike info criterion	15.30038
Sum squared resid	1990475.	Schwarz criterion	15.53639
Log likelihood	-109.7528	Durbin-Watson stat	1.754111

Source: author's calculation in EViews

In conclusion, we can say that the model is correctly specified, that real Gross Domestic Product and the real Foreign Direct Investments are significant factors for employment, since the estimators are significantly different from zero and correctly identified as the model explains most of the variation for employment.

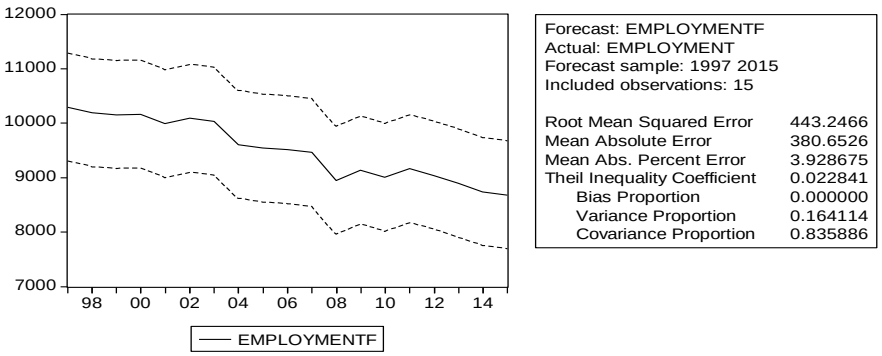

Figure 7. Projections for employed population until 2015

Source: author's calculation in EViews

The analysis of the results shows that the model has good forecasting ability due to low values recorded for Theil coefficient, the weight deviation and weight dispersion and therefore acceptable in order to make a forecast of employed population until 2015.We established the hypothesis that the real GDP and the real FDI will increase from year to year with 10%.In 2014 the employment will be 8743 persons and in 2015 8679 persons which means that the employment will decrease slow due to other factors (the reduction of employees number who work at the state branch).

4. CONCLUSIONS.IMPROVEMENT DIRECTIONS

The study and evaluation processes labor market size, structure and trends is important for defining active employment policies and social protection in the different sides of them. In phase of transformations undergone by Romania after 1989, it is very important to prepare people to understand and accept new processes taking place in the economy and the formation of appropriate behavior of economic agents on employment and labor efficiency employment. Thus, awareness of labor market actors on new phenomena and processes becomes a necessity requirement of the government intervention in regulating certain labor market imbalances. In this sense, one can sketch a picture of existing and potential supply employment of older workers and a picture of the potential demand for goods and services for seniors.

- Total economy employer after two years of implementation of the proposal = 18,773 Euro / employee (unemployed employee), if the minimum wage is referred to employment for youth less than 25 years, the economy is low (about 4 or less, making a calculation relative to older workers);
- After two years, the economy made by the employer with two approx. 27000Ron for the 2 unemployed workers;
- After 15 years in 2027, the economy made by the employer to preserve incentives for older workers will be approx. 30000 euro, plus social assurances contribution economy for 2 years for the younger employee.

The Romanian educational system can be improved under many aspects starting from the allocated GDP percentage, which is kept at a lower level than in Western European countries, and up to education and training results.

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