



## STATISTICAL ANALYSIS OF CORRELATION BETWEEN GROSS DOMESTIC PRODUCT PER INHABITANT AND EMPLOYMENT RATE OF PEOPLE BY PARTICIPATION IN ECONOMIC ACTIVITY BY REGIONS

Ligia PRODAN<sup>1</sup>, Raluca Georgiana MOSCU<sup>2</sup>, Carmen Judith GRIGORESCU<sup>3</sup>

<sup>1,2</sup>Dimitrie Cantemir Christian University/ Bucharest Academy of Economic Studies, <sup>1</sup>E-mail: [prodanligia@yahoo.com](mailto:prodanligia@yahoo.com).

<sup>2</sup>E-mail: [moscu.raluca@yahoo.com](mailto:moscu.raluca@yahoo.com)

<sup>3</sup>Faculty of Finance, Banking and Accountancy, Dimitrie Cantemir Christian University, <sup>3</sup>E-mail: [judithgrigorescu@yahoo.com](mailto:judithgrigorescu@yahoo.com)

### Abstract

*This article analyzes the evolution of the gross domestic product per inhabitant correlated with the variation of the employment rate by participation in economic activity in the eight development regions of Romania in 2000-2012 period. To achieve the correlation between the two indicators, the article proposes the use of the linear regression model that is the base of many micro and macro analyzes. In this regression model, the gross domestic product per inhabitant is considered as outcome variables and the employment rate in each development region as variable factorial.*

### Key words:

Employment rate, Gross Domestic Product per inhabitant, simple regression, model, correlation, variable

### JEL Codes:

J1, O47

### 1. Introduction

This paper analyzes the relationship between gross domestic product per inhabitant and employment rate of people by participation in the economic development regions of Romania, using "time series" data for the eight development regions of the country for the 2000 - 2012 period.

### 2. Literature review

The synthetic indicator that characterizes economic growth is the gross domestic product or per capita. Under these conditions, economic growth is defined as a complex process of increasing the size of the results of the national economy, based on the combination and the use of direct inputs: labor, fixed capital and working capital consumption materials.

A series of works - Anghelache, Isaic-Maniu, Mitrut and Voineagu (2007), Anghelache and Capanu (2003), Capanu, Wagner and Mitrut (2004) addressed issues concerning the evolution of GDP/capita, consumption role in the development of living standards population, macroeconomic analysis, System of National Accounts, macroeconomic modeling, statistical and econometric models and so on. The results of the measurement principles in System of National Accounts were treated by Anghelache, Isaic-Maniu, Mitrut and Voineagu (2005, 2007), Anghelache and others (2007), Anghelache (2004), Biji and others (2010).

Reference works can be mentioned regarding macroeconomic modeling, statistical and econometric

models and forecasts of foreign authors, such as B.C. Arnold, Balakrishnan, B.N. Naraja, O. Aukrust, M.J. Baker, J.P. Jacobsen, G. Bardsen, C. Benjamin, A. Herrard, P.A. Brodin, C.F. Christ, C.S. Davies, B.T. Ewing, M. Gilbert, I. Kravis, D.F. Hendry, L.R. Klein, D. Power, T. Sargent, J.B. Taylor, Wen Fang Liu, U. G. Yulle, N.G. Kendall and so on.

The technological development explains the changes taking place in the labor market. Thus, if the investment level increases, labor productivity is likely to increase, wages for example, can grow and employment to decline.

A series of works - Gali (1999), Francis and Ramey (2002), Basu, Fernald and Kimball (2004) - indicates that a strong positive change in technological development can lead in short-term to a decrease of the total hours worked. Mollick and Cabral (2009) observed that the productivity exerts a positive effect on employment. Chang and Hong (2006) tested whether technological improvements in industry causes decrease or increase in employment in the U.S. - they found that the effect varies significantly among industries (but there are many more industries in which both employment and hours worked increase on short-term). For Romania, Aparaschivei, Vasilescu and Pîrciog (2011) tested the effect that the labor productivity has on employment examining the main activities of the national economy.

### 3. The methodology of research

Econometric and Statistical Analysis involves the following steps:

- Identification of economic theory on the studied phenomenon;
- Specification of the theoretical model in mathematical form;
- Specification of the econometric model;
- Econometric estimation of the model parameters;
- Statistical testing of hypotheses suggested by economic theory;
- Forecasting variables in the econometric model;
- Using econometric model for decision making in economic policy.

Simple regression aims to reveal the relationship between a dependent variable explained (endogenous, outcome) and an independent variable (explanatory factors, exogenous predictors).

In order to build a linear regression model we defined the employment rate of the population by participation in economic activity by region as independent variable, while the value of GDP/capita was considered as a dependent variable.

The form of the simple linear regression model is:

$$y_t = a_0 + a_1x_t + \varepsilon_t; \quad t=1, 2, \dots, T$$

in which:

$y_t$  - Endogenous variable: GDP/capita (lei);

$x_t$  - Exogenous variable: Employment rate of population by participation in economic activity by region (%);

$\varepsilon$  - variable error (residual), random variable that summarizes the influence of other variables on the GDP/capita, but not specifically described in the model.

The variable  $\varepsilon$  expresses the deviations between

observed values and the values estimated by the model.

It has T observations (13 years) on the Y and X, ie T couples  $(x_t, y_t)$  which are realizations of X and Y.

$a_0$  și  $a_1$  - the unknown real parameters that we want to estimate using observations  $(x_t, y_t)$  known.

The validity of the selected model can be formulated on the basis of the determination coefficient that shows the proportion from influence of all factors on variance results. To verify the hypothesis significance of regression coefficients t test (Statistics) will be applied for each factor separately. If the associated probability is less than the relevant coefficients that we are working on, the coefficient is considered statistically significant. To determine the intensity of the correlation between two variables the correlation coefficient will be calculated. The correlation indicates the intensity of the relationship between variables by measuring the scattering data recorded around the regression line. To verify the significance of the correlation coefficient t-test (Student) is applied.

### 4. Results

#### Data

The data source was the National Institute of Statistics and Workforce Balance. The employment rate of working age population is the proportion of employed population aged 15-64 by total population aged 15-64 years. To analyze the correlation between the evolution of GDP/capita and employment rate of people after participation in economic activity by development region we submitted research data series that contains the values of the two indicators in the period 2000-2012. This information is centralized in a table form (Table 1):

Table 1. The evolution of the GDP/capita and the employment rate of people by participation in economic activity by development region in the period 2000 – 2012

Year	Employment rate (%)								GDP/capita (lei - current price)
	Development Region								
	North-West	Central	North-East	South-Eastern	South - Muntenia	Bucharest - Ilfov	South- West Oltenia	Western	
2000	63.4	59.8	67.1	60.8	64.7	60.0	69.1	62.2	3582.6
2001	64.0	59.6	66.4	59.9	64.0	56.7	69.5	61.2	5210.9
2002	57.8	55.9	60.1	55.3	58.2	56.9	61.8	57.6	6974.9
2003	57.2	55.2	59.9	55.8	58.1	56.5	62.0	57.1	9084.0
2004	56.1	53.9	62.4	54.7	58.1	59.7	59.9	56.9	11413.5
2005	56.0	54.2	61.5	54.7	58.1	59.4	60.1	56.6	13362.8
2006	57.1	56.0	60.1	56.4	59.6	62.9	60.1	58.7	15967.6
2007	57.0	55.1	61.3	54.7	60.5	62.4	59.3	59.6	19315.4
2008	56.4	56.6	60.5	55.3	61.1	63.3	60.0	59.3	25061.0
2009	55.2	55.1	60.6	55.4	60.1	63.8	59.9	58.6	24604.9
2010	57.7	53.5	62.0	55.5	59.7	64.3	59.2	57.9	25865.5
2011	58.8	52.3	63.7	53.9	55.3	64.7	60.3	58.4	27663.2
2012	61.6	53.4	64.9	53.9	57.1	64.5	60.9	58.9	29197.4

### Statistical and econometric analysis

Next we analyzed the existence or non-existence of a link connection between the employment rate of the people by participation in economic activity in the eight development regions and GDP/capita.

#### • North-West Development Region

As can be seen from the graphic below (Figure 1), between the two indicators there is an inverse linear relationship which allows us to conclude that it is possible to use simple linear regression model to study the dependence of the value of GDP/capita and the

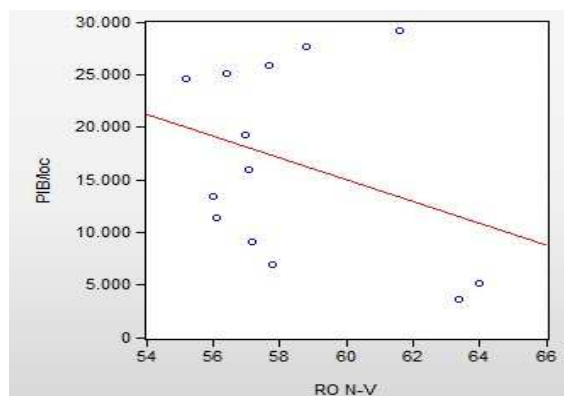


Figure 1. The relationship GDP/capita vs. RO\_N\_V

Analyzing the results of Figure 2 it is possible to formulate some practical conclusions concerning the dependence that exists between the two indicators as follows:

- R-squared coefficient of determination  $R^2 = 0.105711$  shows that only 10.57% of the variation in GDP/capita is explained by the employment rate; it can be said that the employment rate is not a decisive factor variation in GDP/capita.

- The correlation coefficient  $r_{yx} = -0.3251$  indicates a weak link between the two variables.

$$r_{yx} = \sqrt{R^2} = \sqrt{0.105711} = -0.3251.$$

- For each independent and constant variable EViews reports the standard error of the coefficient, the test t -

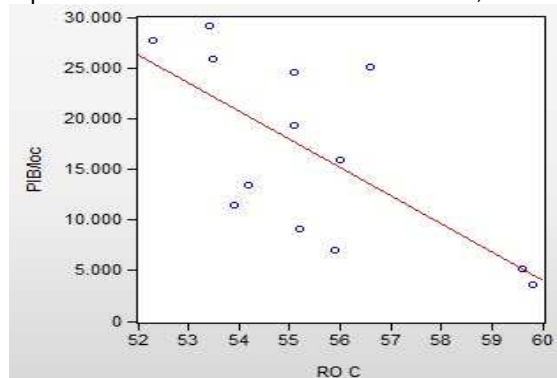


Figure 3. The correlation GDP/capita vs. RO\_C

employment rate of the population of the North-West development region.

The estimation of regression model parameters which is using the employment rate of the people in the North-West Development Region as an independent variable and the value of GDP/capita as dependent variable was performed automatically (Figure 2) using specialized software package Eviews 7. In it the method of least squares (Least Squares) is implemented as a method for estimating model parameters, requiring only the definition of the two variables (PIB\_LOC and RO\_N\_V) and a constant term (C).

Dependent Variable: PIB\_LOC  
 Method: Least Squares  
 Date: 03/18/14 Time: 16:51  
 Sample: 2000 2012  
 Included observations: 13

Variable	Coefficient	Std. Error	t-Statistic	Prob.
RO_N_V	-1036.840	909.2713	-1.140298	0.2784
C	77195.36	53097.17	1.453851	0.1739
R-squared	0.105711	Mean dependent var	16715.67	
Adjusted R-squared	0.024412	S.D. dependent var	9109.890	
S.E. of regression	8998.005	Akaike info criterion	21.18803	
Sum squared resid	8.91E+08	Schwarz criterion	21.27495	
Log likelihood	-135.7222	Hannan-Quinn criter.	21.17017	
F-statistic	1.300280	Durbin-Watson stat	0.146767	
Prob(F-statistic)	0.278382			

Figure 2. The characteristics of the regression model

Statistic and its associated probability. Working at the 5% level of relevance, as, in the example above, the probabilities attached of the test t- Statistics are not below this level, the coefficients are considered statistically insignificant, which leads us to conclude that the model used can be developed and depth to ensure better results.

#### • Central Development Region

To highlight the link between GDP/capita and employment rate in the Central Development Region it is useful at first to make a graphical representation of X-Y (Figure 3).

Dependent Variable: PIB\_LOC  
 Method: Least Squares  
 Date: 03/18/14 Time: 16:57  
 Sample: 2000 2012  
 Included observations: 13

Variable	Coefficient	Std. Error	t-Statistic	Prob.
RO_C	-2781.219	895.2694	-3.106572	0.0100
C	170880.8	49662.83	3.440818	0.0055
R-squared	0.467333	Mean dependent var	16715.67	
Adjusted R-squared	0.418908	S.D. dependent var	9109.890	
S.E. of regression	6944.411	Akaike info criterion	20.66990	
Sum squared resid	5.30E+08	Schwarz criterion	20.75682	
Log likelihood	-132.3544	Hannan-Quinn criter.	20.65204	
F-statistic	9.650788	Durbin-Watson stat	0.556743	
Prob(F-statistic)	0.009986			

Figure 4. The characteristics of the regression model

The graph shows a reverse and straight connection between the two indicators analyzed.

To analyze the correlation between the evolution of GDP/capita and employment rate we have submitted research data series that contains the values of the two indicators. These were processed using the software package Eviews 7 (Figure 4). The estimation method defined in this program is the method of least squares-Least Squares.

The obtained results using Eviews program are as follows:

- The probability that this is a fair model is about 47%, this conclusion can be drawn from the values determined using Eviews program for testing R - squared (0.4673) and Adjusted R - squared (0.4189); in this example, the employment rate in the Central Region,  $x$ , explains the variation of the GDP/capita,  $y$  at a proportion of 46.73%.

- The validity of this model is confirmed by the values of regression tests F - statistic (9.650788 - far superior value table level that it is considered to be the benchmark in the analysis of the validity of econometric models) and the degree of risk almost null (reflected by test Prob F -statistic value).

- For each independent variable and constant EViews reports the standard error of the coefficient, the t - statistic test and its associated probability. Working at the 5% level of relevance, as, in the example above the probabilities attached t -statistic test are below this level, the coefficients are considered significant in statistical terms.

- Based on the above, we consider the regression model describing the correlation between the GDP/capita and the employment rate of the people is correct and it reflects accurately the real evolution of the two indicators.

- Based on the values estimates previously we considered the regression model may be given as follows:

$$\text{PIB\_LOC} = 170,880.8 - 2781.219\text{RO\_C.}$$

- Between the GDP/capita and the employment rate of the people recorded in Romania in the period 2000 - 2012 there is an inverse relationship. Thus, we can say that a one percent increase in employment rate will lead to a decrease in the value of GDP/capita with 2781.219 lei.

- The high value of the constant term reflects the fact that the influence of unspecified factors in the model of

the evolution of the resulting variable (GDP/capita) is significant, which leads us to conclude that the model used (although it is correct) can be developed and deepened in to ensure better results for the activity of forecasting. The positive value of free term indicates that the variables were not included in the econometric model have a positive effect on the evolution of the GDP/capita.

- The correlation coefficient  $r_{yx} = - 0.6836$  indicates a moderately link between the two variables.

To verify the significance of the correlation coefficient the t-test (Student) is applied. With a probability of 95%

and 11 degrees of freedom,  $t_{tabled}$  has a value of

2.201. Since  $|t_{calc}| > |t_{tabled}|$ ,  $|-3.106| > |2.201|$  we

can appreciated that the hypothesis of the significance of correlation between the variables studied is checked and there is a significant relationship, so  $r_{yx}$  is statistically significant and the analysis model is correctly specified.

#### • North- East Development Region

The graph from the Figure 5 shows the missing link between the two variables: X and Y. As we can see, there is not a linear relationship between the two variables. In this case, the value of a possible correlation coefficient will be low ( $r_{yx} = \sqrt{R^2} = \sqrt{0.038759} = - 0.1968$ ) and certainly the correlation between the two variables is not significant (Figure 6).

For each independent variable and constant EViews reports the standard error of the coefficient, the t - statistic test and its associated probability. Working at the 5% level of relevance, as, in the example above, the attached probabilities of t- test statistics are not below this level, the coefficients are considered statistically insignificant, which leads us to conclude that the model used can be developed and depth to ensure better results.

To validate the regression model test F is calculated. Since  $F = 3.344068$  and Prob (F -statistic), (significance threshold) is 0.094665 (higher than 0.05), then the regression model is built valid and should be developed to provide better results and it can be used to analyze the dependence between variables. In this situation, we can say that the two variables are not related.

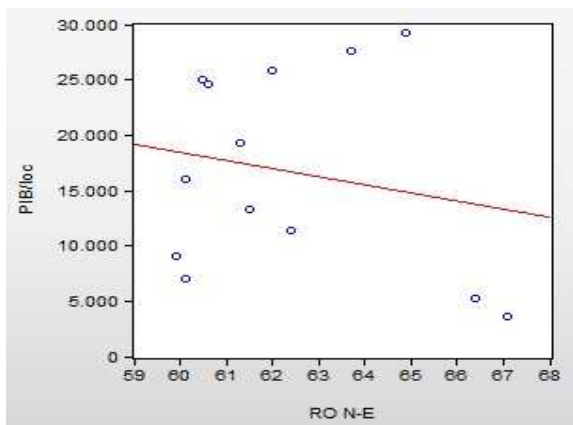


Figure 5. The correlation GDP/capita vs. RO\_N\_E

• **South- Eastern Development Region**

A first step in this research was the identification of the type of econometric model that reflects the evolution of the phenomenon studied. In this respect, we generated the pairs of points chart GDP/capita - RO\_S\_E. The graph from the Figure 7 shows a reverse and straight connection between the two indicators analyzed.

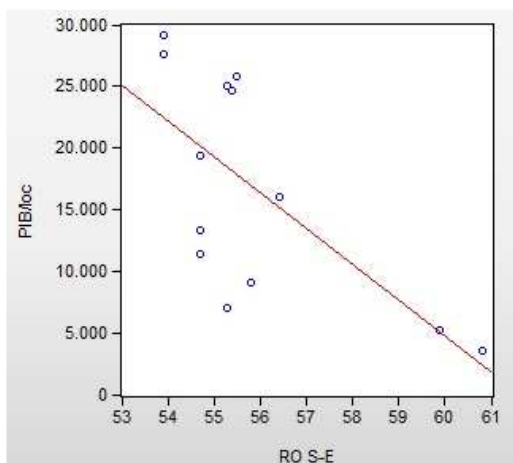


Figure 7. The correlation GDP/capita vs. RO\_S\_E

The obtained results using Eviews program is as follows:

- The probability that this is a fair model is about 46%, this conclusion can be drawn from the values determined using Eviews program for testing R - squared ( 0.4569 ) and Adjusted R - squared ( 0.4076 ); in this example, the employment rate in the South Eastern Development Region, x, explains the variation of the GDP/capita, y at a proportion of 45.7%.
- The validity of this regression model is confirmed by the values of tests F - statistic (9.257254 - far superior value then the table level that is considered to be the benchmark in the analysis of the validity of econometric

Dependent Variable: PIB\_LOC  
 Method: Least Squares  
 Date: 03/18/14 Time: 17:49  
 Sample: 2000 2012  
 Included observations: 13

Variable	Coefficient	Std. Error	t-Statistic	Prob.
RO_N_E	-732.9435	1100.533	-0.665989	0.5191
C	62411.88	68662.78	0.908962	0.3829

R-squared	0.038759	Mean dependent var	16715.67
Adjusted R-squared	-0.048626	S.D. dependent var	9109.890
S.E. of regression	9328.751	Akaike info criterion	21.26023
Sum squared resid	9.57E+08	Schwarz criterion	21.34714
Log likelihood	-136.1915	Hannan-Quinn criter.	21.24236
F-statistic	0.443542	Durbin-Watson stat	0.104116
Prob(F-statistic)	0.519140		

Figure 6. The characteristics of the regression model

To analyze the correlation between the evolution of GDP/capita and employment rate we have submitted research data series that contains the values of the two indicators. There were processed using the software package Eviews 7 (Figure 8). The estimation method defined in this program is the method of least squares- Least Squares.

Dependent Variable: PIB\_LOC  
 Method: Least Squares  
 Date: 03/18/14 Time: 17:56  
 Sample: 2000 2012  
 Included observations: 13

Variable	Coefficient	Std. Error	t-Statistic	Prob.
RO_S_E	-2910.969	956.7404	-3.042590	0.0112
C	179349.3	53487.72	3.353093	0.0064

R-squared	0.456987	Mean dependent var	16715.67
Adjusted R-squared	0.407623	S.D. dependent var	9109.890
S.E. of regression	7011.523	Akaike info criterion	20.68914
Sum squared resid	5.41E+08	Schwarz criterion	20.77605
Log likelihood	-132.4794	Hannan-Quinn criter.	20.67127
F-statistic	9.257354	Durbin-Watson stat	0.521737
Prob(F-statistic)	0.011195		

Figure 8. The characteristics of the regression model

models) and the degree of risk almost null (reflected by test value Prob F - statistic) .

- For each independent variable and constant EViews reports the standard error of the coefficient, the t - statistic test and its associated probability. Working at the 5% level of relevance, as in the example above the probabilities attached t -statistic test are below this level, the coefficients are considered significant in statistical terms.
- Based on the above, we consider the regression model describing the correlation between the GDP/capita and the employment rate of the people one correctly, that it reflects the accurately of the real evolution of the two indicators.



- Based on the values estimates previously we considered the regression model may be given as follows:

$$\text{PIB\_LOC} = 179,349.3 - 2910.969 \text{ RO\_S\_E.}$$

- Between the value of the GDP/capita and the employment rate of the people registered in our country in the period 2000 - 2012, there is an inverse relationship. Thus, we can say that a one percent increase in employment will lead to a decrease in the value of GDP/capita with 2910.969 lei.

- The high value of the constant term reflects the fact that the influence of unspecified factors in the model of the evolution of the resulting variable (GDP/capita) is significant, which leads us to conclude that the model used (although it is correct) can be developed and deepened in to ensure better results for the activity of forecasting.

- The correlation coefficient  $r_{y/x} = -0.676$  indicates a moderately link between the two variables.

$$r_{y/x} = \sqrt{R^2} = \sqrt{0.456987} = -0.676.$$

To check the significance of the correlation coefficient t-test (Student) is applied. With a probability of 95% and

11 degrees of freedom  $t_{tabled}$  has a value of 2.201.

Since  $|t_{calc}| > |t_{tabled}|$ ,  $|-3.042| > |2.201|$  can be appreciated that the hypothesis significance correlation between the variables studied is checked and there is a significant relationship, so  $r_{y/x}$  is statistically significant and the analysis model is correctly specified.

#### • Bucharest - Ilfov Development Region

The graphic method is the best method for checking the existence of the link between two variables x and y; chart point cloud provides information on the existence, shape and nature (direction) of the link between the variables analyzed.

The graph in Figure 9 shows a linear connection (placing points is the direction of the first bisector) and direct (positive slope of the regression line) between the employment rate of Bucharest - Ilfov Development Region and GDP/capita. In the chart below there is direct link: increases X, increases and Y and we can approximated the evolution of their link by a straight; the linear model can be chosen.

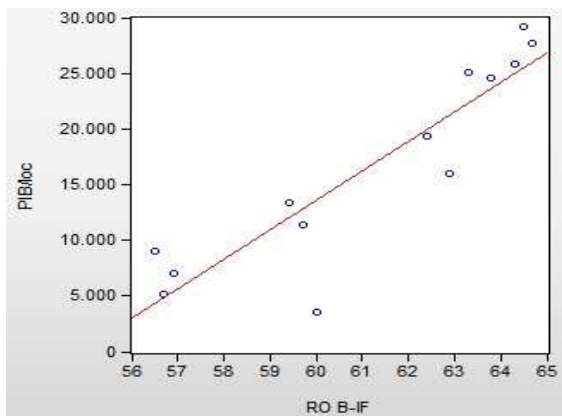


Figure 9. The correlation GDP/ capita vs. RO\_B\_IF

Adjusting or modelling a series consists in calculating the theoretical values corresponding to the empirical values observed. The adjustment technique used is the least squares criterion for determining the parameters of the model retained.

To solve the problems, we used specialized computer package Eviews, from where there were obtained the following results (Figure 10):

- The probability that this model is correct is relatively high - about 82%, this conclusion can be drawn from the test values R - squared (0.816073) and Adjusted R - squared (0.799352);

- The validity of this model is confirmed by the values of the regression tests F - statistic (48.80637 - far superior value then the table level that is considered to be the benchmark in the analysis of the validity of econometric

Dependent Variable: PIB\_LOC  
 Method: Least Squares  
 Date: 03/18/14 Time: 18:07  
 Sample: 2000 2012  
 Included observations: 13

Variable	Coefficient	Std. Error	t-Statistic	Prob.
RO_B_IF	2647.016	378.8945	6.986156	0.0000
C	-145179.9	23201.39	-6.257379	0.0001
R-squared	0.816073	Mean dependent var	16715.67	
Adjusted R-squared	0.799352	S.D. dependent var	9109.890	
S.E. of regression	4080.656	Akaike info criterion	19.60654	
Sum squared resid	1.83E+08	Schwarz criterion	19.69346	
Log likelihood	-125.4425	Hannan-Quinn criter.	19.58868	
F-statistic	48.80637	Durbin-Watson stat	1.362996	
Prob(F-statistic)	0.000023			

Figure 10. The characteristics of the regression model

models) and the degree of risk almost null (reflected by the value Prob test F - statistic). A value close to zero as the probability ( $p(F) =$  probability associated F statistics) will indicate a high significance of the estimate results of the, respectively of the model.

- For each independent variable and constant EViews reports the standard error of the coefficient, the t - statistic test and its associated probability. Working at the 5% level of relevance, as in the example above the probabilities attached test t- statistics are below this level, the coefficients are considered significant in statistical terms.

- Standard Error (S.E. of regression) is the standard error and it shows how the observed values deviate from average on the theoretical values that are on the regression line (in this case  $\pm 4080.656$ ). This value

raised to the power of 2 represents the residues dispersion.

- Based on the above, we consider the regression model describing the correlation between the GDP/capita and the employment rate of the people as one correctly, that reflects accurately the real evolution of the two indicators.

- On the basis of the estimated values previously, the considered regression model may be given as follows:

$$PIB\_LOC = -145,179.9 + 2647.016 RO\_B\_IF.$$

Thus, we can say that a one percent increase in the employment rate will lead to an increase in the value of GDP/capita with 2647.016 lei.

- The high value of the constant term reflects the fact that the influence of unspecified factor in the model of the evolution of the resulting variable (GDP/capita) is significant, which leads us to conclude that the model used (although it is correct) can be developed and expanded to ensuring better results for the activity of forecasting.

- The correlation coefficient  $r_{y/x} = 0.903367$  indicates a strong link between the two variables:

$$r_{y/x} = \sqrt{R^2} = \sqrt{0.816073} = 0.903367$$

- The determination report confirms that the employment rate is a determinant factor ( $R^2 > 50\%$ ) for growth of the GDP/capita, it influencing variation in GDP/capita in a ratio of 81.6%.

- To verify the significance of the correlation coefficient is applied t-test (Student), by calculating the variable  $t_{calc}$  following relationship:

$$t_{calc} = \frac{r_{y/x}}{\sqrt{1 - r_{y/x}^2}} \times \sqrt{n - 2}$$

Where:  $r_{y/x}$  = linear correlation coefficient ;

$n$  = number of pairs of values observed = 13.

The value of the  $t_{calc}$  is compared with the critical, tabled value, that is set for probabilistic significance level

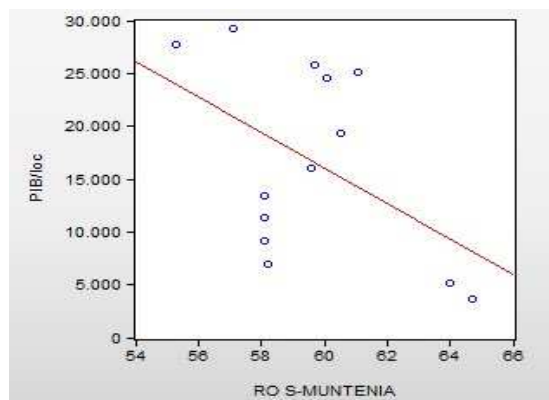


Figure 11. The relation GDP/capita vs. RO\_S\_MUNTENIA

$\alpha$  and  $n-2$  degrees of freedom. If  $|t_{calc}| > |t_{tabled}|$ , it is checked the hypothesis significance correlation and if  $|t_{calc}| < |t_{tabled}|$ , the link is negligible, so you have found another determinant factor to apply the correlation method.

With a probability of 95% and 11 degrees of freedom

$t_{tabled}$  has a value of 2.201. Because  $|t_{calc}| > |t_{tabled}|$ ,

$|6.986| > |2.201|$  it can be appreciated that the hypothesis significance correlation between the variables studied is checked and between the variables studied there are significantly linked, so  $r_{y/x}$  is statistically significant and the analysis model is correctly specified.

### • South - Muntenia Development Region

As can be seen from the graphic below (Figure 11) between the two indicators there is an inverse linear relationship which allows us to conclude that it is possible to use simple linear regression model to study the dependence of the value of GDP/capita and the employment rate of the people of South-Muntenia Development Region.

The estimation of regression model parameters that is using the employment rate of the people in the South Muntenia Development Region as independent variable and the value of GDP/capita as dependent variable was performed automatically (Figure 12) using specialized software package Eviews 7. In it is implemented the method of least squares (Least Squares) as a method for estimating model parameters, requiring only the definition of the two variables ( PIB\_LOC and RO\_S\_MUNTENIA ) and a constant term (C).

Dependent Variable: PIB\_LOC  
 Method: Least Squares  
 Date: 03/18/14 Time: 19:36  
 Sample: 2000 2012  
 Included observations: 13

Variable	Coefficient	Std. Error	t-Statistic	Prob.
RO_S_MUNTENIA	-1681.264	919.3870	-1.828679	0.0947
C	116893.1	54830.04	2.131918	0.0564
R-squared	0.233132	Mean dependent var		16715.67
Adjusted R-squared	0.163417	S.D. dependent var		9109.890
S.E. of regression	8332.351	Akaike info criterion		21.03432
Sum squared resid	7.64E+08	Schwarz criterion		21.12123
Log likelihood	-134.7231	Hannan-Quinn criter.		21.01645
F-statistic	3.344068	Durbin-Watson stat		0.300636
Prob(F-statistic)	0.094665			

Figure 12. The characteristics of the regression model

Analyzing the results of Figure 12 it is possible to formulate practical conclusions concerning the dependence existing between the two indicators as follows:

- R -squared, the coefficient of determination  $R^2 = 0.233132$  shows that 23.31% of the variation in GDP/capita is explained by the employment rate; it can be said that the employment rate is not a decisive factor in variation of GDP/capita.

- The correlation coefficient  $r_{y/x} = -0.48281$  indicates a weak link between the two variables:

$$r_{y/x} = \sqrt{R^2} = \sqrt{0.233132} = -0.48281.$$

- For each independent variable and constant, EViews reports the standard error of the coefficient, the t - statistic test and its associated probability. Working at the 5% level of relevance, as in the example above the probabilities attached t -statistic test are not below this

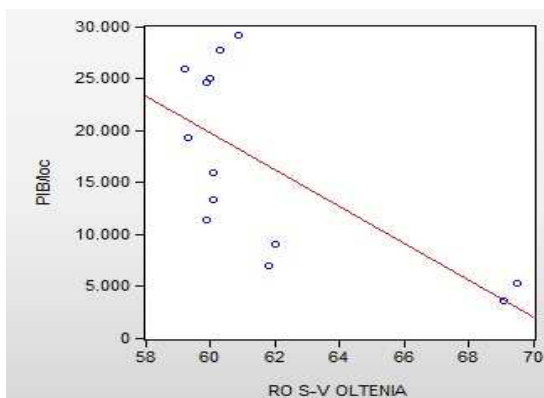


Figure 13. The correlation GDP/capita vs. RO\_S\_V OLTENIA

The estimation of regression model parameters is using the employment rate of the people in the South- West Oltenia Development Region as independent variable and the value of GDP/capita as dependent variable was performed automatically (Figure 14) using specialized software package Eviews 7. In it is implemented the method of least squares (Least Squares) as a method for estimating parameters of the model, requiring only the definition of the two variables (PIB\_LOC and RO\_S\_V OLTENIA) and a constant term (C).

To interpret the results obtained using linear regression model is necessary to establish if this model can be considered correctly and the results that it provides to us can be used in real analysis:

- The probability that this is a fair model is about 46%, this conclusion can be drawn from the test R - squared (0.457647) and Adjusted R - squared (0.408342) values;

- The validity of this model is confirmed by the values of regression tests F - statistic (9.281993 - superior value

level, the coefficients are considered statistically insignificant, which leads us to conclude that the model used can be developed and depth to ensure better results .

- To validate the test regression model is calculated and the F. Since  $F = 3.344068$  Prob(F -statistic), (significance threshold) is 0.094665 (higher than 0.05), then the regression model built is not valid and it should be developed to provide better results and to be used to analyze the dependence between variables.

• **South- West Oltenia Development Region**

We begin the correlation analysis by inspecting the graphic of the relationship between the two variables. The graph from the Figure 13 shows a cloud of points with a linear aspect suggesting an inverse correlation between the two variables and we can also predict the existence of a negative correlation coefficient.

Dependent Variable: PIB\_LOC  
 Method: Least Squares  
 Date: 03/18/14 Time: 19:41  
 Sample: 2000 2012  
 Included observations: 13

Variable	Coefficient	Std. Error	t-Statistic	Prob.
RO_S_V_OLTENIA	-1774.127	582.3233	-3.046636	0.0111
C	126179.3	35981.87	3.506747	0.0049
R-squared	0.457647	Mean dependent var		16715.67
Adjusted R-squared	0.408342	S.D. dependent var		9109.890
S.E. of regression	7007.263	Akaike info criterion		20.68792
Sum squared resid	5.40E+08	Schwarz criterion		20.77484
Log likelihood	-132.4715	Hannan-Quinn criter.		20.67006
F-statistic	9.281993	Durbin-Watson stat		0.445956
Prob(F-statistic)	0.011114			

Figure 14 .The characteristics of the regression model

then the table level that is considered to be the benchmark in the analysis of the validity of econometric models) and the degree of risk almost null (reflected by the value Prob test F - statistic). A value close to zero as the probability (p(F) = probability associated F statistics) will indicate a high significance of the estimate results of the, respectively of the model.

- For each independent variable and constant, EViews reports the standard error of the coefficient, the t - statistic test and its associated probability. Working at the 5% level of relevance, as in the example above the probabilities attached test t- statistics are below this level, the coefficients are considered significant in statistical terms.

- Standard Error (S.E. of regression) is the standard error and it shows how the observed values deviate from average on the theoretical values that are on the regression line (in this case  $\pm 7007.263$ ). This value raised to the power of 2 represents the residues dispersion.



- Based on the above, we consider the regression model describing the correlation between the GDP/capita and the employment rate of the people as one correctly, that reflects accurately the real evolution of the two indicators.
- On the basis of the estimated values previously, the considered regression model may be given as follows:  $PIB\_LOC = 126179.3 - 1774.127 RO\_S\_V$  OLTENIA. Thus, we can say that a one percent increase in the employment rate will lead to a decrease in the value of the GDP/capita with 1774.127 lei.
- The high value of the constant term reflects the fact that the influence of unspecified factor of the model of the evolution of the resulting variable (GDP/capita) is significant, which leads us to conclude that the model used (although it is correct) can be developed and deepened in to ensure better outcomes for business forecasting. The positive value of the free term indicates that the variables that were not included in the econometric model had a positive effect on the evolution of GDP/capita.
- The correlation coefficient,  $r_{y/x} = -0.6764$ , indicates a moderately link between the two variables:

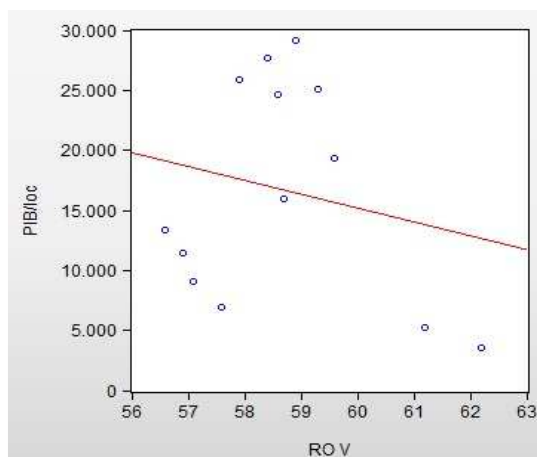


Figure 15. The relation GDP/capita vs. RO\_V

## 5. Conclusions

This paper analyzed the relationship between the GDP/capita and the employment rate of people by participation in economic activity in the eight development regions of Romania. Period for which the analysis is conducted is 2000- 2012. Our analysis revealed that:

- Between GDP/capita and employment rate of the people in the North-West Development Region there is a weak inverse linear relationship;
- Between GDP/capita and employment rate in the Central Development Region has established a link and reverse linear, the correlation between the two indicators is moderate;

$$r_{y/x} = \sqrt{R^2} = \sqrt{0.457647} = -0.6764$$

- The significance of the correlation coefficient is tested by Student ratio. The calculated value is  $t_{calc} = -3.0466$  and the theoretical value is 2.201, with a probability of 95% and 11 degrees of freedom. How,  $|t_{calc}| > |t_{tabled}|$ ,  $|-3.0466| > |2.201|$  it is considered that  $r_{y/x}$  as being significantly different from zero for a significance level  $\alpha = 5\%$ .

### • Western Development Region

The graph from the Figure 15 indicates no link between the two variables analyzed. As we can see, there is a linear relationship between the two variables. In this case, the value of a possible correlation coefficient will be small

( $r_{y/x} = \sqrt{R^2} = \sqrt{0.04259311} = -0.206$ ) and certainly the correlation between the two variables is not significant (Figure 15). In this case we can say that the two variables are not related.

Dependent Variable: PIB\_LOC  
 Method: Least Squares  
 Date: 03/18/14 Time: 19:46  
 Sample: 2000 2012  
 Included observations: 13

Variable	Coefficient	Std. Error	t-Statistic	Prob.
RO_V	-1153.682	1649.187	-0.699546	0.4987
C	84427.94	96829.04	0.871928	0.4019
R-squared	0.042593	Mean dependent var		16715.67
Adjusted R-squared	-0.044444	S.D. dependent var		9109.890
S.E. of regression	9310.130	Akaike info criterion		21.25623
Sum squared resid	9.53E+08	Schwarz criterion		21.34315
Log likelihood	-136.1655	Hannan-Quinn criter.		21.23837
F-statistic	0.489365	Durbin-Watson stat		0.105743
Prob(F-statistic)	0.498737			

Figure 16 .The characteristics of the regression model

- Between GDP/capita and employment rate in the North -East Development Region is missing link existence, the two variables are not related;
- Between GDP/capita and employment rate in the region of South-East Development Region has established a link and reverse linear, the correlation between the two indicators is moderate;
- Between GDP/capita and employment rate of Bucharest-Ilfov Development Region we can appreciate that there is a linear connection (placing points is the direction of the first bisector) and direct (positive slope of the regression line); the link strength was measured by the correlation coefficient  $r_{y/x} = 0.903367$  that indicating a strong link between the two variables and

the determination report confirms that the employment rate is an determinant factor ( $R^2 > 50\%$ ) for growth of the GDP capita, this variation influences the GDP/capita rate of 81.6%;

- Studying the dependence between the value of GDP/capita and the employment rate of the people of South-Muntenia Development Region shows an inverse linear connection, the intensity correlation between the two variables is weak;

- Between GDP/capita and employment rate of South-West Oltenia Development Region there is a linear connection, the direction is reversed and the correlation between the two indicators is moderate;

- Between GDP/capita and employment rate in the Western Development Region the existence is missing the link, the two variables are not related.

### References

1. Andrei, T., Bouronais, R. (2008). „Econometrie”, Editura Economică, București
2. Anghelache, C. (coordonator) și alții (2012). „Modele statistico– econometrice de analiză economic – utilizarea modelelor în studiul economiei României”, Revista Română de Statistică (Supliment), ISBN 1018-046X
3. Anghelache, C., Capanu, I. (2004). „Statistică macroeconomică”, Editura Economică, București
4. Anghelache, C., Mitrut, C., (coordonatori), Anghelache, C., S., Mitrut, C., A., Bugudui, E., Deatcu, C., Dumbrava, M. (2009). „Econometrie-Teorie și studii de caz”, Ediția a II- a revizuită și adăugită, Editura Artifex, București
5. Bardsen, G., Nymagen, R., Jansen, E. (2005). „The Econometrics of Macroeconomic Modelling”, Oxford University Press
6. Benjamin, C., Herrard, A., Hanée- Bigot, M., Tavére, C. (2010). „Forecasting with an Econometric Model”, Springer
7. Sargent, T. (1999). „Macroeconomic Theory, 2<sup>nd</sup> Edition”, Boston, Academic Press
8. Scarlat, E., Chirița, N. (2012). „Bazele ciberneticii economice”, Editura Economică, București
9. Stancu S., Andrei, T., Iacob, A.I., Tusa, E., (2008). „Introducere in econometrie utilizand Eviews”, Editura Economica, București, ISBN 978-973-709-398-1
10. Taylor, J.B. (1979). „Estimation and control of a macroeconomic model with rational expectations”, *Econometrica*, 47
11. Turdean, M.S., (2012). „Statistică”, Editura ProUniversitaria, Bucuresti
- 12.\*\*\* Institutul Național de Statistică – Anuarul Statistic al României, Edițiile 2006- 2013.