

Capitolul 9 – IMPACTUL PIB-ului ASUPRA OCUPARII POPULAȚIEI ÎN REPUBLICA MOLDOVA

Chapter 9 – GDP IMPACT ON THE POPULATION EMPLOYMENT IN THE REPUBLIC OF MOLDOVA

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Abstract

The article presents the research of the relationship between the number of employed population and economic growth in the Republic of Moldova. The applying of econometric method allowed to assess the quantitative impact of the number of employed population on the value of GDP, as the principal macroeconomic indicator of stable economic development. Based on the obtained results of the econometric model, conclusions were carryout about the impact of the dynamics of employed population on the changes in the Gross Domestic Product.

The article was developed within the framework of the institutional project “Demographic transition in the Republic of Moldova: particularities, socioeconomic implications and consolidation of demographic resilience (2024-2027)”.

Keywords: GDP, employment, regression model.

JEL: C 20; J 01; J 21

Introduction

One of the factors of production is labour. The purpose of given article is to analyse the impact of labour, as a factor of production, on the economy of the country. The principal objective is to quantitatively assess the research of the impact the factor of labour force on economic development. The Gross Domestic Product (GDP) indicator is defined as the main macroeconomic indicator. GDP characterizes production capabilities, including in terms of the use of factors of production. The employed population, which most fully reflects the quantitative use of labour in the process of production of material goods, was defined for characteristic the labour force.

The number of labour force through the labour market can either limit or expand capabilities of production. In its turn, the number of labour force is limited by the number of working age population, which annually declines in the Republic of Moldova.

The assesses the relationship between the economy and labour market through the impact of employed population on the production of GDP in the country. GDP determines the possibilities of the economy in the perspective period.

Consideration the relationship between the two indicators of population and GDP is necessary to determine the possibility to influence to the stable economic development through labour market.

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Research methodology

1. *Evaluation of statistical information.* The number of employed population and GDP are presented by official statistical data of the National Bureau of Statistics of the Republic of Moldova for the period 2014-2023. Based on the statistical data of the National Bureau of Statistics of the Republic of Moldova, all calculations were performed and the results are presented in given article. The value indicator of GDP in dynamics has been adjusted to comparable data on the basis of recalculation to 2014 prices, i.e. deflated. This made it possible to eliminate the influence of the consumer price index on the GDP indicator.

2. *Analysis of GDP and employed population indicators.* The index of physical volume of GDP was used to assess the GDP indicator. Comparison the dynamics of indicators of annual growth – growth the number of employed population and the index of the physical volume of GDP (GDP). Correlation of these indicators through the scatter-plot graph. Calculation of indicators of employment elasticity on GDP (in current prices and 2014 prices) and their analysis for different periods.

3. *Econometric research.* Includes the construction of the linear econometric model and assessment of the relationship between the dependent and independent variables on the basis of the pair correlation coefficient. Estimation of model parameters on the basis of criteria the quality of the regression model: standard errors of coefficients (*Std. Error*), *t* – statistics (*t Student's criterion*), coefficient of determination (R^2), Fisher's criterion (*F*), autocorrelation of residuals on the basis of Durbin-Watson statistics (*DW*), determination of the average error of approximation of the regression equation ($\bar{A}$).

Result and Discussions

The indicator of the number of employed population changed over the study period 2014-2023 was analysis for assessment the relationship between the economy and labour market. The linear function $f(x)$ represented by the dots, is negative. Given function reflects the decrease in average employment rate for 9 years (2014-2023), of which the indicator increased for 6 years. It should be noted, the calculation of the employment indicator based on the usual residence population started from 2019 and this indicator for 2014-2018 has been recalculated.

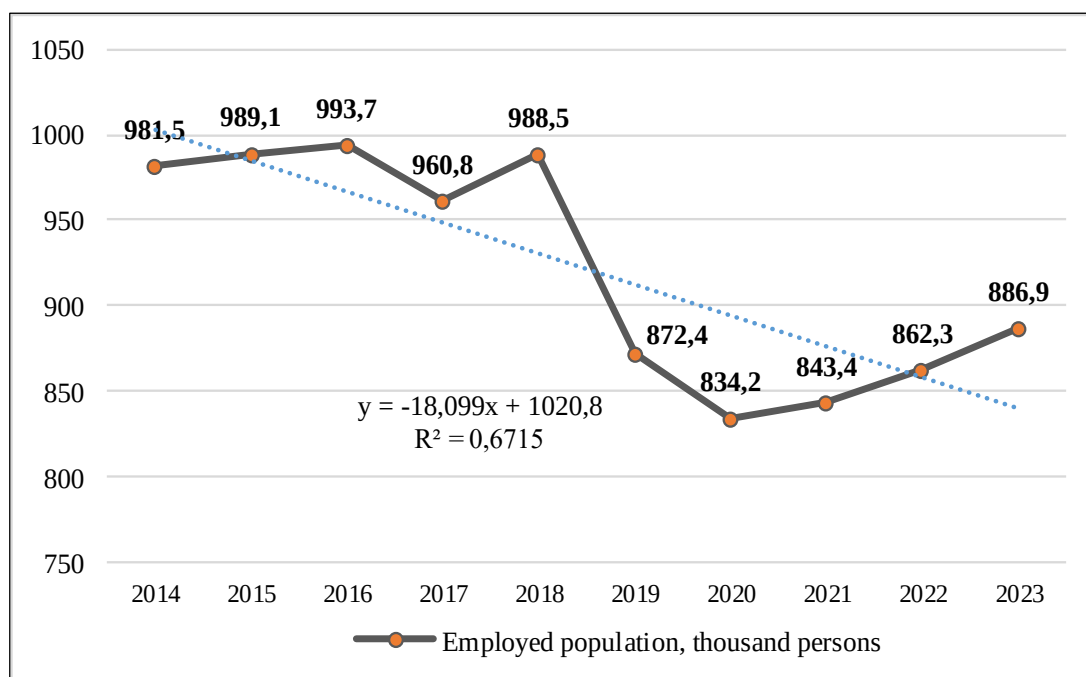


Fig. 1. Employed population, 2014-2023, thousand persons

Source: NBS RM, www.statistica.md

The decrease in 2020 and further increase in the indicator is explained to the effects of the COVID-19 pandemic. Employment has decreased at the expense of female and urban. The employed population indicator in 2023 is higher than in 2019, also due to an increase in employed population in rural as in agriculture. Further increase in the number of employed population will be limited by the decline in working-age population.

The analysis of GDP in current prices shows a sharp increase in GDP values after 2020, which is associated with the galloping growth of energy prices and the subsequent inflation in the country.

The GDP indicator in 2014 prices reflects the real situation with GDP production compared to the GDP indicator in current prices. The dynamics of the indicator for the research period 2014-2023 is limited. Practically after 2019 there is no growth of the GDP indicator, except for 2021.

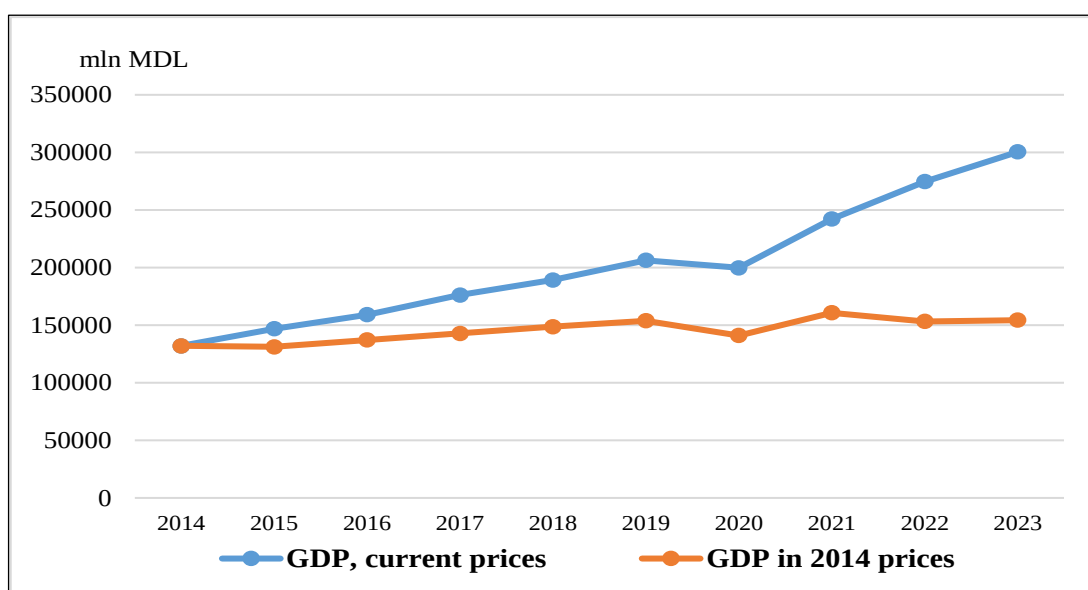


Fig. 2. GDP, 2014-2023, current prices and in 2014 prices, mln MDL

Source: NBS, www.statistica.md, authors' calculations

To assess the relationship between the economy and labour market, the analysis of dynamics the indicators number of employed population and GDP was perfected. Thus, the assessment of relationship between the index of physical volume of GDP and the number of employed population on the basis of their annual growth is presented in Figure 2. a). b).

Relatively stable index of physical volume of GDP was observed in the period 2014-2019. And a sharp drop in 2020 (the beginning of the COVID -19 pandemic) by about 15 p.p.. After a jump in the growth the index of physical volume of GDP in 2021 by almost 25 p.p., the positive estimates of the World Bank, the International Monetary Fund and the Ministry of Economy of the Republic of Moldova regarding the growth of the index in 2022-2023 were not realised.

It should be noted a clear contradiction when comparing the functions of employed population in natural indicators (%; Fig. 1.) and relative indicators (%; Fig. 3. a). At relative indices the linear function $f(x)$ represented by dots, is positive (Fig. 3. a), at the same time it is negative at natural indices (Fig. 1.).

The economic recession of 2009 was accompanied by a decrease in GDP and, accordingly, a decrease in demand for labour, the situation was repeated in 2014. [Zaharov S., 2017, p. 187]. In the pandemic COVID – 19 in 2020, the fall in the index of physical volume of GDP is reflected

in the relative indicators of employed population (Fig. 3. b). And the fall of given GDP indicator in 2022 is accompanied by a small increase in demand for labour, repeats the situation in 2015.

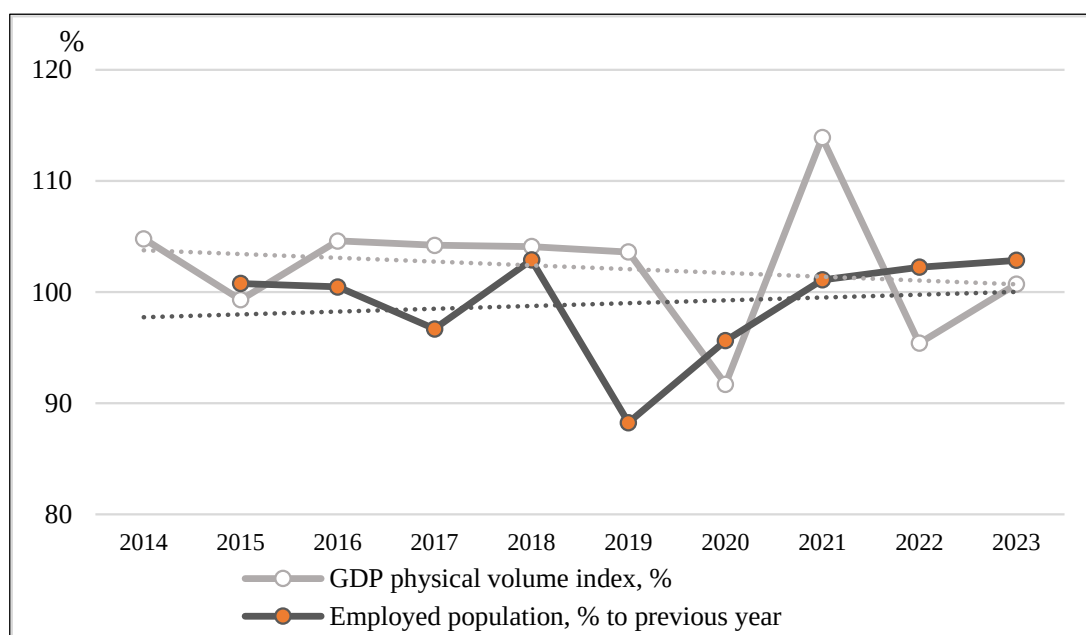


Fig. 3. a). GDP physical volume index, employed population, % to previous year, 2014-2023

Source: authors' calculations and NBS, www.statistica.md

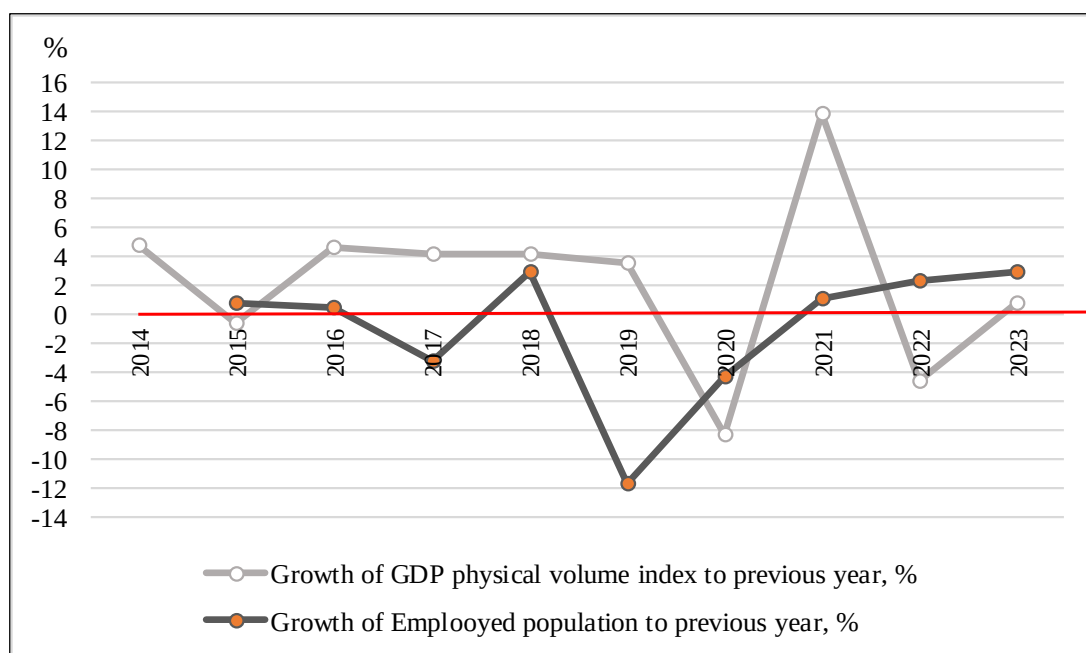


Fig. 3. b). Growth of GDP physical volume index, employed population to previous year, 2014-2023, %

Source: authors' calculations and NBS, www.statistica.md

For further analysis the impact of the number of employed population on GDP, the indicator of elasticity the employed population on GDP is used. Given indicator assesses the flexibility of labour market, the ability of labour market to expand or decline, the possibility to respond to external shocks [Giltman M.A., Votyakova A.A., 2015].

Employment elasticity of employment by GDP is presented in Fig. 4. The values of *elasticity of employment by GDP* in current prices are close to zero and indicate a weak relationship between

employment and GDP. The values of the indicator in 2014 prices are different from zero and do not give a smooth picture.

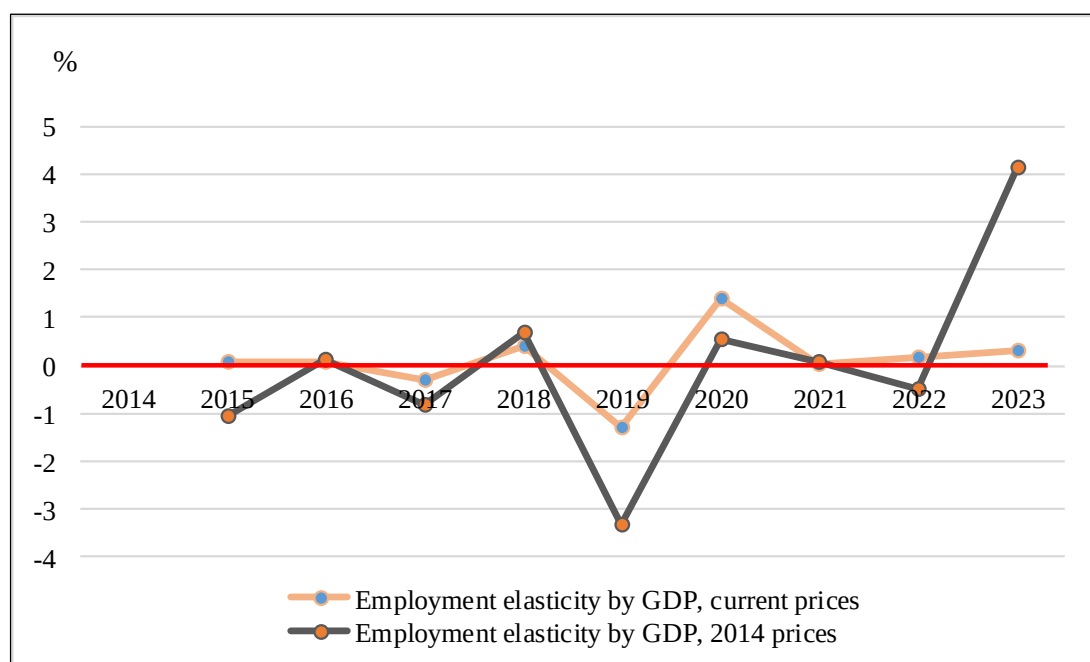


Fig. 4. Employment elasticity by GDP, 2015-2023, %

Source: authors' calculations

The average indicators of the elasticity of employment to GDP have low values (0.09 in current prices and -0.02 in 2014 prices) and indicate on the absent the relationship between employment and GDP. Only the elasticity values for the period 2019-2023 are positive and above zero ($A_{z\ 2019-2023} > 0$), including the highest value of employment-to-GDP elasticity in 2014 prices in 2013 (4.15).

Table 1. Employment elasticity by GDP, %

	Employment elasticity by GDP, current prices	Employment elasticity by GDP, 2014 prices
2015	0.07	-1.08
2016	0.06	0.10
2017	-0.31	-0.80
2018	0.39	0.71
2019	-1.29	-3.35
2020	1.38	0.53
2021	0.05	0.08
2022	0.17	-0.48
2023	0.30	4.15
Average elasticity values: 2015-2018	0.05	-0.27
Average elasticity values: 2019-2023	0.12	0.18
Average elasticity values: 2015-2023	0.09	-0.02

Source: authors' calculations

For assessment the relationship between the indicators of growth of the index of physical volume of GDP and growth of employed population, a scatter-plot was constructed (Fig. 5.). The points of the trend line have a large deviation and the line itself is close to zero. The coefficient of determination, which explains the closeness of relationship between the variables, is 0.0017. There is practically no relationship between the growth of these variables.

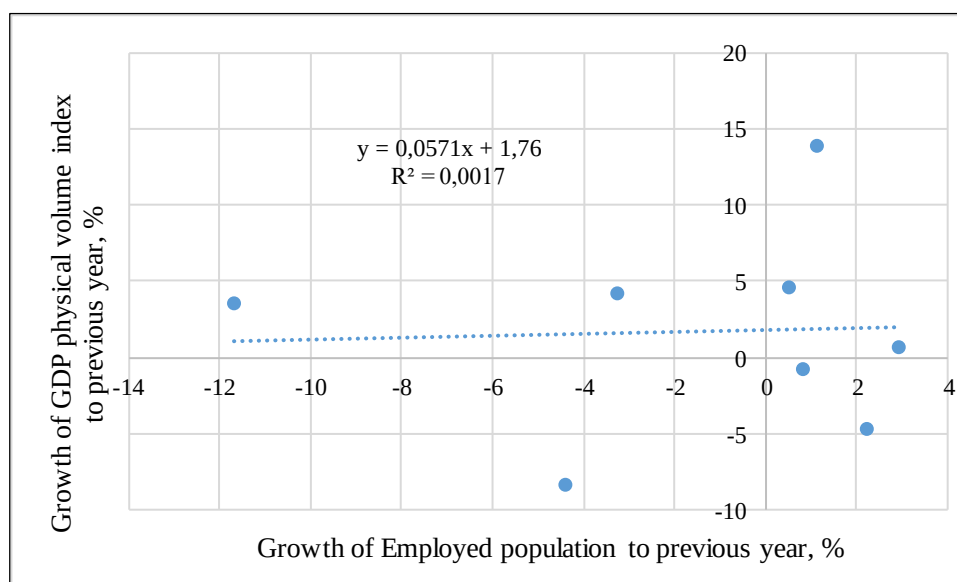


Fig. 5. Relationship between Growth of GDP physical volume index (vertical axis), employed population (horizontal axis) to previous year, 2014-2023, %

Source: authors' calculations

Regression model construction

The above analysis showed that despite the increase in the number of employed population after 2020, the closeness of relationship between Growth of GDP physical volume index and employed population to previous year is very low ($R^2 = 0.0017$, Fig. 5.).

For quantitative assessment it is necessary to conduct econometric research, i.e. to use the method of building regression models. Gross Domestic Product (GDP) is the dependent variable (Y_t), and the number of employed population is used as an independent factor of influence on GDP – X_t . As mentioned above, the value of GDP is deflated in 2014 prices. The number of observations in the regression model is 10.

The regression model is presented in linear form, the estimation criteria are presented in graphical and tabular form (Fig. 5., Table 2.).

Pair correlation

In order to graphically evaluate the pairwise correlation, scatter-plot were constructed, reflecting the intensity of relationship between variables X and Y (Fig. 6.). For any random variables X and Y the correlation coefficient will be in the interval $[-1; 1]$. The pair correlation coefficient between the factor and GDP is equal to -0.694 and characterizes the intensity of linear relationship between the indicators. The factor *employed population* is significant and influences the change in GDP, and the sign “minus” indicates the *inverse* nature of the relationship. The value of the paired correlation coefficient characterizes the relationship as noticeable according to the Cheddock scale⁴.

⁴ Criteria for assessing the closeness of relationship between independent factor and GDP on the Cheddock scale.

Table. Cheddock scale

Quantitative characteristic of closeness of connection	Qualitative characteristic of closeness of connection
$0,1 < r_{xy} < 0,3$	Weak
$0,3 < r_{xy} < 0,5$	Medium
$0,5 < r_{xy} < 0,7$	Noticeable
$0,7 < r_{xy} < 0,9$	High
$0,9 < r_{xy} < 1$	Very high

Source: Correlation and Regression. <https://math.semestr.ru/corel/primer.php>.

The economic sense of the *inverse* relationship between the number of employed population and GDP is that a decrease in the number of employed population will not serve as an obstacle to an increase in GDP. Perhaps the loss of employment will be compensated by another factor of production – capital.

The regression model to assess the research of the quantitative impact of factor – employed population on the change in GDP is presented in linear form and relates to the first-order regression equation:

$$Y_t = 242697.145 - 105.621X_t + \varepsilon_t \quad (1)$$

where Y_t – GDP, 2014 prices, mln. lei;

X_t – number of employed population, thousand persons;

ε_t – sampling error on unaccounted factors, random variable;

t – year of observation.



Figure 6. Scatter-plot of GDP from the model factor of number of employed population (pair correlation coefficient)

Source: authors' calculations

Econometric model includes one variable and is a pairwise regression. Quantitative assessment of the impact of factor – employed population (X_t) is that its decline by 1 unit, i.e. by 1 thousand persons, will increase GDP in 2014 prices by 105.621 million lei, and per person 105.621 lei per year. Statistical assessment of the quality of the model parameters is presented in the form of criteria in Table 2. and Table 3.

Analysis by Student's t-criterion of the regression coefficient values showed that the coefficient and free term are statistically significant for given model. The coefficient of determination characterizing the closeness of relationship between the factor and GDP is equal to 0.482, which means that only 48.2% of GDP change depends on the factor described in the regression model. The F criterion (Fisher's criterion) calculated by the model exceeds the values of F table, which means that the model is statistically reliable and significant with an error probability of 5%. Fisher's criterion confirms the influence of the factor on the resultant sign. The test of autocorrelation of residuals indicates the influence of the previous observation on the subsequent one. The test based on the Durbin-Watson (DW) statistic showed the absence of

autocorrelation of residuals when falling into the interval $1.5 \leq DW \leq 2.5$. The calculated average approximation error, which characterizes the deviation of the model-based calculations from the actual data, is within acceptable limits. The existence of dependence between the considered indicators is confirmed.

Table 2. Criteria for assessments the quality of regression model

Indicators		Characteristics
		Model
$Y_t = 242697.145 - 105.621X_t + \varepsilon_t$ (1)		
<i>Quality indicators of regression coefficients (a, b)</i>		
standard errors of coefficients (Std. Error) or standard deviations of assessments of coefficients <i>a</i> and <i>b</i>	S_a, S_b	$S_a = 35748.5$ $S_b = 38.711$
t statistic (Student's t test)	$ t > t_{\text{tabl.}}$; $t_{\text{tabl.}} = t_{1-\alpha; n-m-1}^{**}$	$t_{\text{tabl.}} = t_{0.95;8} = 2.3060^1$ $t_a = 6.789; t_b = 2.728$ $ t > t_{0.95;8}$
<i>Quality indicators of regression model as a whole</i>		
Coefficient of determination (R^2)	$0 \leq R^2 \leq 1$	$R^2 = 0.482$
<i>F</i> – Fisher's criterion	$F_{\text{fact.}} > F_{\text{tabl.}}$, $F_{\alpha; k1; k2} \alpha = 0.05$	$F_{\text{tabl.}} = 7.444$; $F_{\text{tabl.}} = F(\kappa_1; \kappa_2) = F(1; 8) = 5.32^2$; $F_{\text{fact.}} > F(1; 8)$ at $\alpha = 0.05$.
Autocorrelation of residuals (Durbin-Watson statistic, <i>DW</i>)	If $1.5 \leq DW \leq 2.5$ no autocorrelation of residuals	$DW = 1.911$ $1.5 \leq DW \leq 2.5^3$
* $k1 = m; k2 = n - m - 1$, where <i>m</i> is the number of variables in model, <i>n</i> is the number of observations in model. ** $1 - \alpha$, where, α is the significance level; $n - m - 1$ is the number of degrees of freedom. ¹ Special table “The values of Student's t criterion at the significance level of 0.10, 0.05, 0.01”. Afanasiev Econometrics Appendix 2, p. 251. ² Special table “Values of $F_{\alpha; k1; k2}$ -Fisher-Snedekor criterion”. Kremer N.S., Putko B.A. (2007). Econometrics. Moscow: UNITI-DANA, Mathematical and Statistical Tables. Table IV., pp. 295-297. ³ Special table “Values of the Durbin-Watson criterion at the significance level $\alpha = 0.05$” (starts at <i>n</i> equal to 15 observations). Kremer N.S., Putko B.A. (2007). Econometrics. Moscow: UNITI-DANA, p. 298.		

Source: authors' calculations (SPSS)

It should be noted that the parameter *a* does not carry economic sense, if $x=0$ shows the value of the resultant sign *y*.

Table 3. Stage of verification of regression model

Indicators		Characteristics
		Model
Average approximation error	$\bar{A} < 10 \%$	$\bar{A} = 3.972085 \%$ $\bar{A} < 10 \%$

Source: authors' calculations

At the same time, it should be noted that the above calculations (model) are not intended for forecasting economic growth.

Conclusions

The conducted analysis allowed to examine the relationship between the indicators of employed population and GDP, but also to give the assessment the impact of labour market indicator on the indicator of economic growth in the Republic of Moldova. Based on the presented research, the following conclusions can be obtained:

- The application of econometric method allowed to determine that the factor *employed population* is significant and has an impact on the change of GDP, and the sign “minus” indicates

the *inverse* nature of relationship between the indicators. Decline the value of factor – *employed population* by 1 unit, i.e. by 1 thousand persons, increases GDP in 2014 prices by 105,621 million lei, and per person by 105,621 lei per year.

- The calculated Quality Assessment Criteria of regression model showed that the model is statistically reliable and significant with an error probability of 5%. The coefficient of determination (closeness of the relationship between the factor and GDP) means that only 48.2% of the change in GDP depends on the factor described in regression model. The test based on Durbin-Watson (DW) statistic showed absence of autocorrelation of the residuals. The average approximation error, which characterizes the deviation of model-based calculations from factual data, is within acceptable limits.

- The assessment of relationship between the indicators of growth of the index of physical volume of GDP and growth of employed population and indicator of elasticity of employment by GDP (in current prices and 2014 prices) showed the absence of relationship between the variables.

Acknowledgement

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