ECONOMETRIC MODEL FOR STUDYING THE CORRELATION BETWEEN THE EVOLUTION OF THE NUMBER OF UNEMPLOYED AND THE GROSS DOMESTIC PRODUCT

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Abstract

Gross Domestic Product is the most complete indicator of results, which is calculated at the macroeconomic level. Starting from the calculation methods of the Gross Domestic Product, in the system of national accounts, there are also a series of statistical variables that are in fact factors that determine and influence the level of the Gross Domestic Product that is calculated. Thus, labor productivity, endowment of labor with modern fixed assets, robotization of industry, number of employees, inflation rate, unemployment rate, branch structure and the contribution of each branch to the Gross Domestic Product and much more.

It is important when forecasting the growth prospect of the Gross Domestic Product, in such a forecast we must also take into account the estimation of the influence that each of these factors can have on the Gross Domestic Product. These influences, of some variables on the evolution of the Gross Domestic Product, are in reality correlations that are established between them and the final result of the economic activity at the level of a country.

In an in-depth study, especially when we aim to predict the evolution of Gross Domestic Product, we must perform individual analyzes of the correlation between each factorial statistical variable and Gross Domestic Product, but also multifactorial analyzes in which to consider all indicators that influence on Gross Domestic Product.

In the present study we aimed to analyze the correlation and interdependence between the number of unemployed (unemployment rate)

and the Gross Domestic Product. We know that the number of unemployed is inextricably linked to the employed population and the way in which this employed population is found in the number of employees and the number of unemployed in the national economy. There is a close connection between the two variables: the number of employees and the number of unemployed. When the economy aims for improvement, the development of new activities, the creation of jobs through investments, it is normal for a part of the number of unemployed to be attracted among employees. In fact, the territorial labor institutes (ITMs) track and record the number of unemployed people, and therefore also the unemployed, who must be attracted to the economic circuit in order to facilitate the contribution from the consolidated budget to the financing of unemployment. In particular, we can appreciate that Romania is a particular case, in the sense that the number of registered unemployed corresponds to people in the country, who have lost their jobs or graduated certain studies, regardless of level and have not yet found a job. . This is due to the fact that there is no close correlation between the labor market and the requirements of the economy on qualification structures and so on.

In turn, the Gross Domestic Product is influenced by the number of unemployed in two ways. On the one hand, by attracting a larger number of unemployed people to work, based on contracts for finite or indefinite periods of time, then it means that it increases the number of employees, who certainly contribute to the increase of the Gross Domestic Product. . There are also cases, sometimes limited, but there are, in which the Gross Domestic Product is influenced by the number of unemployed even if their number remains constant or even decreases, when applying robotics or other modern methods developed in the national economy, thus ensuring productivity growth faster.

It should be noted that in general terms, there is an inverse link between the number of unemployed and the Gross Domestic Product, in the sense that the lower the number of unemployed, the higher the Gross Domestic Product and also, consequently, the higher the Gross Domestic Product the number of unemployed must fall.

In this article, after a brief presentation of these aspects, the authors chose the simple linear regression method that they applied in order to determine the inverse correlation, we can anticipate, between the evolution of unemployment and the Gross Domestic Product.

Keywords: unemployment, labor force, employed and unemployed population, Gross Domestic Product, econometric model, indicators, variables.

JEL classification:C15, E20, J20.

Introduction

The study on the correlation that exists between the evolution of the number of unemployed and the Gross Domestic Product starts from the interpretation of the data series that were registered in twenty-nine years, respectively the period 1991-2019 in the evolution of the two macroeconomic indicators that we mentioned. .

From the simple study of this data series it is found that, with small exceptions, the positive evolution of the Gross Domestic Product was influenced by the decrease in the number of unemployed, as a consequence of the fact that the economy in its evolution, offers more jobs, absorbs the unoccupied occupation and passes it among the active population on the basis of employment contracts, so that the correlation is an inverse one, easily deducible even from the way of presentation in the data series. It follows that as the Gross Domestic Product increases, to an approximate extent, the number of unemployed decreases. I said an approximate evolution in the sense that, from time to time, there are some economic phenomena such as crises, there are some market disturbances, ie the ratio between supply and demand, the contribution of some branches to the formation of Gross Domestic Product changes, in - net export (difference between export and import) makes a different contribution to the formation of Gross Domestic Product.

The graphical representation of the data in this data series reveals in principle the same oscillation that exists in the evolution of the Gross Domestic Product, compared to the revolution in the number of unemployed in the national economy.

Analyzing economically based on statistical data we can appreciate that this correlation between the Gross Domestic Product and the number of unemployed is reciprocal, in the sense that we can consider the Gross Domestic Product as a resultant variable due to the decrease in the number of unemployed or we can consider as a resultant variable the number of unemployed in line with the increase in Gross Domestic Product.

Next, some presentations were made about the significance of statistical-econometric models to determine the parameters that highlight the interdependence between the two variables, so we can estimate either the evolution of Gross Domestic Product and how the number of unemployed will evolve, either from the interpretation of the way in which the number of unemployed will evolve and will have an influence of increasing the Gross Domestic Product.

We make some references in the article about the current situation, in the sense that the number of unemployed registered in Romania is that part of those who lose their job or do not have a job, but are looking for a job according to statistical definitions given to unemployment and does not take

into account the population that emigrated and thus contributes to it, in the sense that it does not increase the number of unemployed, which would give a different interpretation to the correlation we submit to this analysis. Also, at the time of writing this article, we are considering the crisis caused by the coronavirus pandemic (COVID 19) and perhaps from here in development could be identified the onset of the economic and financial crisis, which of course will have an effect on the two sizes. statistics. In this respect, the number of unemployed is expected to increase, either through the loss of jobs as a result of the reduction of activities in a number of areas (HoReCa, service activities in certain areas, commercial activities, etc.), who may go into technical unemployment as is happening now, but when they resume work they may be passed over, assimilated to the unemployed. Increasing this indicator on the basis of correlation, which we are establishing at the moment, results that the Gross Domestic Product will have a decreasing field from one period of time to another, whether we are talking about the Gross Domestic Product monthly, quarterly, annually or multiannually. .

Next, we pointed out on the basis of reversibility that an econometric function can highlight the evolution of the Gross Domestic Product in close dependence with the change in the number of unemployed and on the other hand how the number of unemployed evolves in reverse the Gross Domestic Product changes. The established indicators are interpreted and underline the aspects mentioned above.

Literature review

Anghelache (2008) approaches both theoretically and through concrete, practical analyzes, statistical indicators. Anghelache și Angel (2016, 2018) addresses theoretically and practically problems of economic statistics and econometrics. Anghelache (2018) analyzes the economic evolution of Romania in the last hundred years. Anghelache, Petre și Olteanu (2019) approached some econometric concepts and ways of analyzing macroeconomic performance.Ghysels și Osborn (2001) studied from an econometric point of view the time series affected by seasonality. Iacob și Stoica (2020) approached econometric models, using simple linear regression in the analysis of various correlations between indicators such as profitability, labor productivity and turnover. Johansen și Nielsen (2010) deals with issues related to inference.

Methodology, data, results and discussions

In the presented article, the authors aimed to follow the dependencies that exist between the Gross Domestic Product and the evolution of the number of unemployed in Romania. Thus, the data series related to the Gross

Domestic Product and the number of unemployed in Romania for a period of twenty-nine years, which includes the period 1991-2019, are structured in table number 1.

Gross Domestic Product and the number of unemployed in Romania during 1991-2019

Table 1

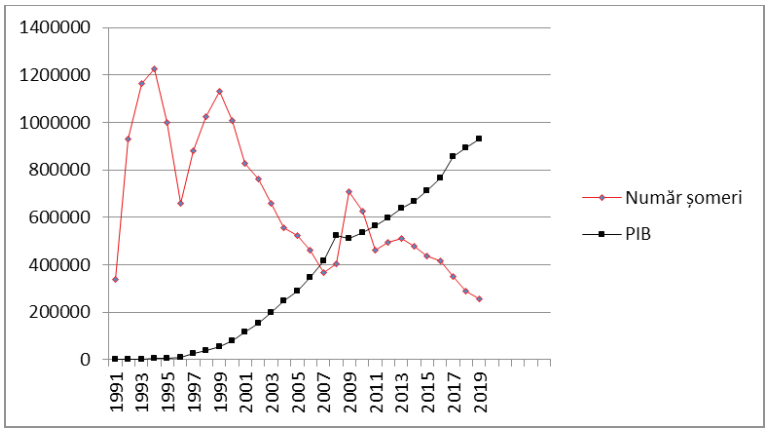
YEAR	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
Number of unemployed	337.440	929.019	1.164.705	1.223.925	998.432	657.564	881.435	1.025.056	1.130.296	1.007.131
GDP (mil. lei)	220,4	602,9	2.003,60	4.977,30	7.213,50	10.891,90	25.292,60	37.379,80	55.191,40	80.377,30
YEAR	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
Number of unemployed	826.932	760.623	658.891	557.892	522.967	460.495	367.838	403.441	709.383	626.960
GDP (mil. lei)	116.768,70	151.475,10	197.564,80	247.368,00	288.954,60	344.650,60	416.006,80	524.388,70	510.522,80	533.881,10
YEAR	2011	2012	2013	2014	2015	2016	2017	2018	2019	
Number of unemployed	461.013	493.775	512.333	478.338	436.242	418.237	351.105	288. 896	257.865	
GDP (mil. lei)	565.097,20	596.681,50	637.583,10	668.590,10	712.587,80	765.135,40	856.726,60	894.422,60	931.093,90	

Source: National Institute of Statistics

In order to better visualize the evolution of these two indicators in the period under analysis, according to the data structured in table number 1, the graph number 1 was drawn up.

Evolution of the Gross Domestic Product and the number of unemployed in Romania during 1991-2019

Graph 1

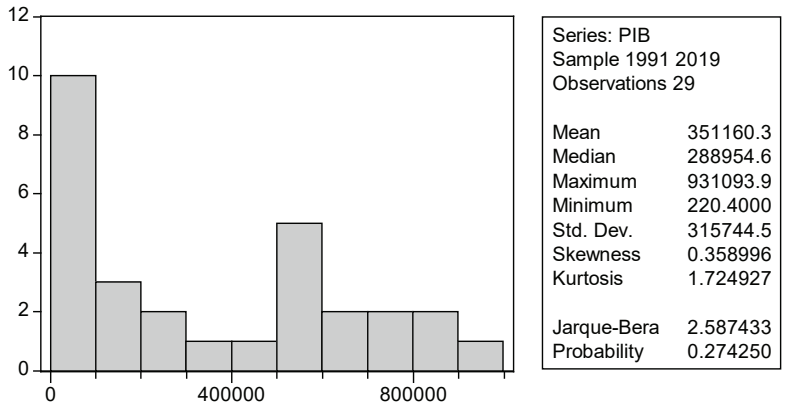


From graph number 1 we find that the evolution of the Gross Domestic Product in the last 29 years is a positive one with year-on-year increases with one exception in 2009, while the evolution of the number of unemployed in the same period under analysis is one oscillating, perhaps even cyclical, observing the maximum peaks that are positioned in periods of economic, financial or political crises such as the financial crisis of 2008-2009 where we see in chart number 1 and table number 1 that this macroeconomic indicator registers a maximum in recent years. years of 709,383 unemployed, and on the other hand has a favorable evolution of the national economy, in the sense that the trend in the number of unemployed is downward, registering in 2019 the minimum of the period subject to analysis of 257,865 unemployed.

Next, the evolutions of the two macroeconomic indicators subject to analysis will be analyzed in turn and in graph number 2 is presented the histogram of the evolution of the Gross Domestic Product of Romania in the period 1990-2019.

Histogram of the evolution of the Gross Domestic Product of Romania in the period 1991-2019

Graph 2

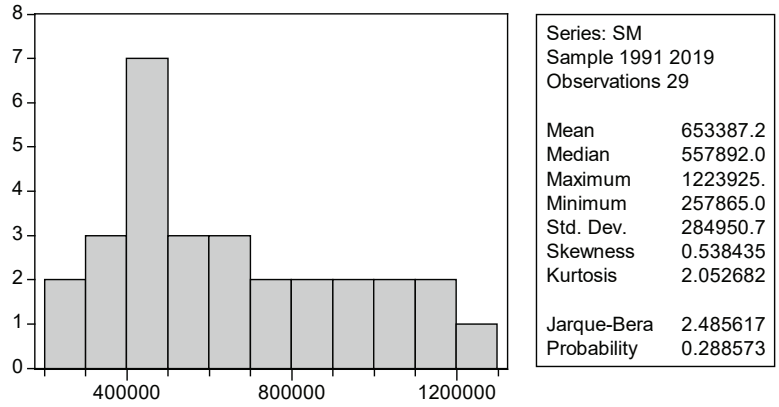


Interpreting the results presented in graph number 2, we find that the maximum value it registered for the Gross Domestic Product of Romania in the period between 1991 and 2019 is 931,093.90 million RON, while the average is 351,160.30. In other words, the value of 0.35 of the Skewness test indicates that the distribution is not perfectly symmetrical and at the same time, having the value of 1.72 less than 3 of the Kurtosis test, the distribution is slower.

The histogram of the evolution of the number of unemployed in Romania in the period 1990-2019 is presented in graph number 3.

Histogram of the evolution of the number of unemployed in Romania during 1991-2019

Graph 3

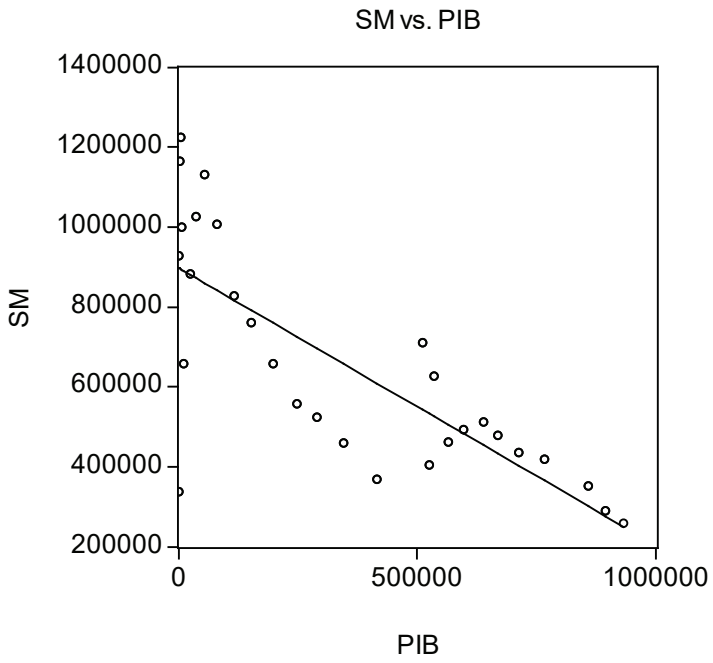


Interpreting the results presented in graph number 3 and table number 1, we find that the maximum value recorded by the evolution of the number of unemployed in Romania, in the period between 1991 and 2019 is 1,273,925 people, value for 1994, while the minimum is 257,865, a value for 2019. Also, the distribution is slower than normal and not perfectly symmetrical if we follow the values of the Kurtosis test of 2.05 less than 3 and that of the Skewness test of 0.53 which is significantly different from zero.

In order to follow and interpret the correlation between the number of unemployed and the Gross Domestic Product, graph number 4 was drawn up.

Correlation between the number of unemployed and the Gross Domestic Product

Graph 4



We observe in graph number 4 that the point cloud related to the values recorded by the two macroeconomic indicators studied in their evolution describes a straight line, which allows us to continue the study, with a statistical-econometric analysis, using a simple linear regression model, which has the following relation:

$$GDP = a + b \cdot SM + \varepsilon \quad (1)$$

where: GDP is the dependent variable;
SM is the independent variable;
a and b are the regression parameters;
ε represents the residual variable.

Both for estimating parameters *a* and *b*, respectively $\hat{a}$ and $\hat{b}$, using the least squares method, as well as to test the significance of the model, the authors used the statistical-econometric analysis program EViews, and the results are presented in figure number 1.

The results of the analysis of the dependence of GDP on the evolution of the number of unemployed

Figure 1

Dependent Variable: GDP
Method: Least Squares
Sample: 1991 2019
Included observations: 29

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	909701.5	96450.22	9.431824	0.0000
SM	-0.854839	0.135682	-6.300297	0.0000
R-squared	0.595164	Mean dependent var		351160.3
Adjusted R-squared	0.580171	S.D. dependent var		315744.5
S.E. of regression	204584.3	Akaike info criterion		27.36182
Sum squared resid	1.13E+12	Schwarz criterion		27.45612
Log likelihood	-394.7464	F-statistic		39.69375
Durbin-Watson stat	0.548750	Prob(F-statistic)		0.000001

According to the results in figure number 1, the model is a good one and can be used in macroeconomic forecasts. This is confirmed both by the significantly different values of zero recorded by the estimated parameters found in the second column (Coefficient column) rows 1 and 2, and by the statistical tests F-statistic and t-Statistic whose values are superior to those tabulated.

In other words, according to the data in figure number 1, we can estimate the theoretical values of the dependent variable, according to the relation:

$$\widehat{GDP} = 909.701{,}5 + -0{,}854839 \cdot \widehat{SM} + \varepsilon \quad (2)$$

Given the studies conducted by a number of researchers, especially in the field of mathematics, in which the proofs of theorems in general are based on the previous ones and the reciprocity of statements is verified, the authors considered it necessary in this article to investigate the reciprocal relationship. the evolution of the number of unemployed may be the effect of the welfare of the society to which they belong, of the national economic situation of the state of which they are part, practically an effect of the evolution of the Gross Domestic Product. Consequently, the statistical-econometric analysis, in this case, involves the use of a simple linear regression, in which the factorial variable is the Gross Domestic Product from 1991 to 2019, and the resultant characteristic is the number of unemployed registered by Romania in this time interval. Therefore, the regression equation will have the following form:

$$SM = a + b \cdot GDP + \varepsilon \quad (3)$$

where: SM is the dependent variable;
GDP is the independent variable;
a and b are the regression parameters;
ε represents the residual variable.

As in the previous case, the estimation of the parameters *a* and *b* , respectively $\hat{a}$ and $\hat{b}$, and to test the significance of the model, the authors used the statistical-econometric analysis program EViews, the results being presented in figure number 2.

The results of the analysis of the dependence of the number of unemployed according to the evolution of GDP

Figure 2

Dependent Variable: SM
Method: Least Squares
Sample: 1991 2019
Included observations: 29

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	897875.4	51781.94	17.33955	0.0000
GDP	-0.696230	0.110507	-6.300297	0.0000
R-squared	0.595164	Mean dependent var		653387.2
Adjusted R-squared	0.580171	S.D. dependent var		284950.7
S.E. of regression	184631.7	Akaike info criterion		27.15659
Sum squared resid	9.20E+11	Schwarz criterion		27.25088
Log likelihood	-391.7705	F-statistic		39.69375
Durbin-Watson stat	0.920675	Prob(F-statistic)		0.000001

Interpreting the results from figure number 2, we find that even in this case the model is good and can be used in macroeconomic forecasts. This fact is confirmed both by the values significantly different from zero recorded by the estimated parameters, and by the statistical tests F-statistic and t-Statistic whose values are higher than those tabulated. Therefore, according to the data in figure number 1, we can estimate the theoretical values of the dependent variable, according to the relation:

$$\widehat{SM} = 897.875,4 + -0,696230 \cdot \widehat{GDP} + \varepsilon \quad (4)$$

We find that the results of the analysis of the dependence of the number of unemployed according to the evolution of GDP are similar to those of the dependence of GDP on the evolution of the number of unemployed, which implies that the reciprocal is true. In other words, if we look at the values recorded by R-squared in the two analyzed cases, we find that they have the same value, namely 0.59, which is indeed closer to the unit value than zero, but still indicates the existence of other factors. which influences the evolutions of the resultant characteristics in the two cases, on the one hand the Gross Domestic Product, whose evolution is influenced by factorial variables such as gross capital formation, export, import, etc., and on the other hand the evolution of the number of unemployed , which is influenced for example by the level of investment. This aspect is also confirmed by the large and fairly close values recorded by the free term coefficients in the two cases 909,701.5 and 897,875.4, respectively.

Conclusions

The article written on behalf of this study highlights some aspects that are conclusive. Thus, between the evolution of the Gross Domestic Product and the evolution of the number of unemployed is an inversely proportional link, but very close at certain moments. Of course, you can discuss the study performed on the raw data series or the data series adjusted according to the number of days worked or the influence of cyclicity. In both cases, the link between Gross Domestic Product and the number of unemployed remains the same and must be taken into account. For example, as statistics show, an increase or decrease in an indicator does not always have the direct effect of producing influences on the resulting variable in the same sense. Even in this situation in which the reduction of the number of unemployed (by their absorption in the labor field in Romania and not by emigration) has as a certain effect the increase of the Gross Domestic Product. It follows that, within the economic strategies, it must be taken into account that the results materialized in the Gross Domestic Product to be achieved through investments, by creating new jobs, which will undoubtedly have the direct effect of reducing the number of the unemployed. Without being a conclusion it is a signal to draw attention to the fact that when this article will appear on the market as a result of the destabilization of the internal market in the field of labor, demand and supply, this correlation is a new confirmation of what I said about the indirect link between the two variables, but it is an exaggerated one in the sense that plans must be undertaken to relaunch, reactivate production by resuming activity in most economic areas.

Another conclusion is that the statistical methods, in this case simple linear regression, is the one that gives us the possibility to establish the parameters on the basis of which we can estimate, with probabilistically guaranteed accuracy, the evolution of the two indicators we have submitted to. We must also emphasize that, following the model of this analysis, correlations can be made between the Gross Domestic Product or the number of unemployed and other statistical variables that make sense especially when we aim to make short, medium or long term forecasts.

A final conclusion is that this correlation is sometimes destabilized as a result of phenomena other than real ones, which occur in the complex of macroeconomic activity. For example, financial and economic crises, raw material resource crises, sometimes labor crises, the reduced possibility of pulling vacancies and many others, can also have an influence on the change in the number of of the unemployed, but indirectly and changes the evolution of the Gross Domestic Product.

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