STUDY REGARDING THE EVOLUTION OF THE CORRELATION BETWEEN THE LABOR FORCE AND THE GROSS DOMESTIC PRODUCT

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Abstract

The labor force is important in terms of the results obtained in the national economy. In general terms, work according to the theories of some economists is a main factor of production. Along with capital and financial-material resources, work comes to complete, from a factorial point of view, the conditions for achieving the best possible production.

The labor force must be interpreted as part of the employed population, which operates on the basis of an employment contract. In the concrete situation of Romania, the number of employees (labor force) is completed with the number of unemployed who together constitute the employed population of Romania. In this context we can talk about the labor force as a factorial element that has a direct contribution on the results recorded in the Gross Domestic Product achieved in a given period of time, usually one year.

The labor force, as a rule, must be recruited from the unemployed population, the population that is part of the unemployed or is the active population without fulfilling the conditions to pass into the category of employed population. In this context, the territorial employment offices keep track of persons registered as unemployed, who are thus considered or as a population looking for a job.

Studying the concrete aspects in the context of the current COVID 19 crisis, we specify that the elements from May 2020, regarding the structure of the labor force is irrelevant and therefore our research stops at the end of 2019. For the future, this consequence of COVID 19, will be able to it is the basis of another analysis that correlates the effect of the health crisis on the evolution and structure of the workforce.

Keywords: regression, spectral analysis, GDP, labor force, active population.

JEL Classification: C20, E24, J21

Introduction

In this article, the authors started from the variant of economic factorial coverage according to which, in addition to other correlations that are established between a series of statistical variables and the Gross Domestic Product, a sufficiently important one is the one referring to the labor force. The labor force is a determining factor and it was analyzed in the perspective of the situation in 2019, the results from the last quarter of 2019, but also with an extension on the labor force situation until April 30, 2020.

The article progressively goes from the analysis of the results in the last month of 2019, the results recorded in the fourth quarter of 2019 and for the whole year 2019. The comparisons based on nominal and deflated data showed a somewhat positive perspective. The extension of the analysis to the perspective of the evolution in the next period must be accompanied by a forecast taking into account the effects of the COVID crisis 19 and, later, the economic-financial crisis that will find many European countries, but especially Romania, in a situation not exactly positive.

The results of this analysis based on reliable data provided by the National Institute of Statistics (press releases, TEMPO database) reveal this perspective.

The article urges the in-depth analysis of the correlation that exists between labor, capital, resources, factors of production, according to the Cobb-Douglas concept and the result of these three determinants of the evolution of Gross Domestic Product. It is not the time to intersperse the results of the analysis for 2019 with the assessments regarding the evolution perspective, but at the time of the analysis, we can say, simplifying, that this correlation of production factors with Gross Domestic Product can be maintained and predicted, not only in the purpose of determining the trends (trend), but also to intuit some measures to be taken.

We close this article with an econometric analysis using the spectral model, based on the data we have with a short anticipation of what is to happen in the future.

Literature review

Anghel and Radu (2020) studied a series of aspects regarding the vacancies on the Romanian labor market. Anghel, Grigorescu and Dumbravă (2020) studied the relationship between labor force and GDP. Anghelache and Anghel (2017) conducted a comprehensive analysis of EU labor resources. Anghelache, Avram, Burea and Petre (2018) studied the correlation between the natural movement of the population and the labor force. Bar and Leukhina (2010) analyzed the main elements regarding demographic evolution.

Donangelo (2014) and Kurmanov et al. (2017) focused on the effects of labor mobility. Hili, Lahmandi-Ayed and Lasram (2016) referred to the effects of globalization on the workforce. Iacob and Măhărea (2020) performed a spectral analysis of the evolution of the number of unemployed. Iacob (2019) applied econometric instruments in economic analyzes. Maestas, Mullen and Powell (2016) studied the correlation between population aging, labor force and economic growth. Neumark and Yen (2020) analyzed the implications of larger age groups on labor force participation. Van Houtven, Coe and Skira (2013) addressed a number of issues related to the effect of informal care and the implications on work and wages. Wonka, Baumgartner, Mahoney and Berkhout (2010) addressed a number of issues regarding interest groups in the European Union.

Research methodology, data, results and discussions

This study was based on data provided by the National Institute of Statistics and was based on the situation in 2019, which showed that, in general terms, the workforce used, both in 2019 in the fourth quarter or even December 2019 , was satisfactory. There was still an unemployment rate of 354 thousand registered unemployed on 31 December 2019. In this regard, a forecast for 2020 was favorable in the sense that, in line with the government's strategy, investment would be allocated. for the creation of new jobs, which will have a positive impact both in increasing production in all areas of activity, but also in terms of employment of people who are unemployed during this period.

The employment rate of the population aged 20-64, in the fourth quarter of 2019, was 71.1%, with 1.1 percentage points above the national target of 70% set in the context of the Europe 2020 Strategy.

In table no. 1 presents the evolution of the employment rate of the population in Romania, by age groups in 2019.

The evolution of the employment rate of the population aged 15 and over, by age groups, in Romania, in 2019 (%)

Table 1

	15-24 years	25-54 years	55-64 years	65 years and over
Quarter I	23,0	79,9	46,0	7,2
Quarter II	25,6	82,2	48,1	8,1
Quarter III	25,6	82,1	48,9	7,8
Quarter IV	24,4	81,6	48,1	7,1

Source: National Institute of Statistics, Press release no. 82 / 27.03.2020, own systematization

The year 2020, which began to show positive developments, according to the data presented in this article, was brutally broken by the onset of the COVID crisis 19, with significant effects on the socio-economic evolution of many countries in Europe and on other continents, but let's not forget with effects beyond the expectations in Romania, especially in the context in which it is anticipated that this crisis will be poured into a future economic and financial crisis.

Speaking of the correlation between the labor force and the Gross Domestic Product, which from a theoretical point of view is a positive one, in the sense that as the factorial variable increases, the labor force (number of employees), logically evolves the Gross Domestic Product by increasing to. Even in the period after March 1 to April 30, 2020, but also in the future, the correlation between the labor force and the Gross Domestic Product will also remain a direct one, in the sense that, as the number of employees decreased (we can no longer talk about a productivity of national labor), there is no alternative but to decrease the Gross Domestic Product.

The labor force in Romania after February 26, when the first COVID 19 case was registered, began to have a non-essential effect, in the sense that a series of health restrictions had to be met, with immediate effects on national economic results and prospects. to be perpetuated.

The positive workforce at the beginning of 2020 has entered an unprecedented situation. It was necessary to interrupt some activities (HoReCa, social, cultural, sports activities), which have no other effect than the termination of the employment contract in many cases, the suspension of the employment contract in most cases and, on this background, the unemployment technically with prospects to break the legal provisions to return as an employee and who have gone through this phase, somewhat intermediate, of unemployment. To this was added the large-scale repatriation from Western European countries (especially Italy, Spain, Germany, Great Britain, Austria) of Romanian citizens who at this time did not put pressure on the employment ratio used and the number of unemployed in the country. . This upheaval has changed the statistical indicators active population, employed population and salaried workforce. Thus, a segment of the unemployed population appeared without any perspective, we refer here to those who repatriated from the countries where they had previously emigrated, especially those without documents, employment contracts and sufficient and legally certain conditions. . On the other hand, there have been people who have lost their jobs, people who have been placed in the category of technical unemployment or simply lost their jobs. It is appropriate in this article to analyze how facilities were granted or not, and we refer to the fact that in the category of labor there has been

a destructuring that will be very difficult to rearrange, especially in the foreseeable conditions of a strong crisis. financiaro economic.

The Gross Domestic Product, which also, as a synthetic indicator of Romania's national results, had an increasing evolution, with encouraging results, even in December 2019. The year 2020, from the point of view of the Gross Domestic Product, started with hopes that things will increase and at least prospects will be ensured through the investments that were to be made, through the increase of labor productivity, by attracting the unemployed to employment, by creating new jobs, etc. However, the great economic and financial crisis blocked everything and called into question the activity in the main sectors of the national economy. Thus, investments did not appear and, at the same time, the creation of new jobs, on the contrary, jobs were closed, a series of protective laws were implemented, as is usually the case. in such circumstances. Gross Domestic Product will certainly have a rebound at the end of this year 2020, which can be recorded as a decrease of this indicator of results near two digits. The correlation is still maintained if we refer only to the employed labor force and the Gross Domestic Product, only that this indicator will suggest the parameters that show a simultaneous decrease of the labor force factor variable and with the influence of the resultant variable Gross Domestic Product.

The data series on the evolution of the Gross Domestic Product and the labor force in the period 1991-2018 are structured in table number 2.

Evolution of Gross Domestic Product and labor force in Romania, during 1991-2018

Table 2

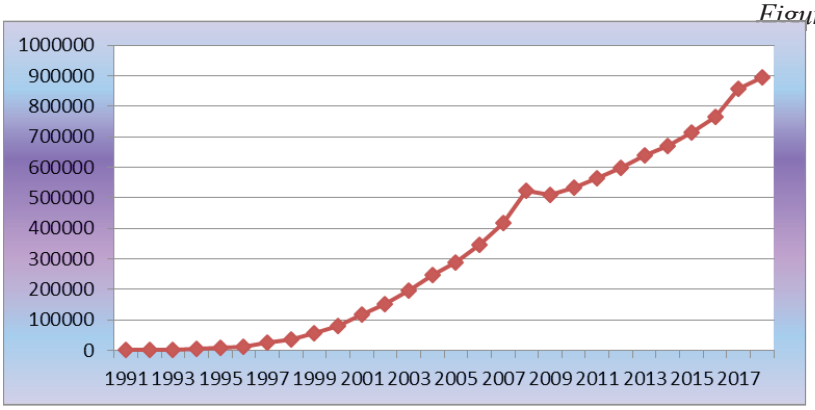
YEAR	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
GDP (million lei)	220,4	602,9	2.003,60	4.977,30	7.213,50	10.891,90	25.292,60	37.379,80	55.191,40	80.377,30
Number of Employees (thousands of people)	10786	10548	10062	10011	9493	9379	9023	8813	8420	10508
YEAR	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**
GDP (million 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
Number of Employees (thousands of people)	10440	9234	9223	9158	9267,2	9330,7	9364,8	9365,9	8952	8713
YEAR	**2011**	**2012**	**2013**	**2014**	**2015**	**2016**	**2017**	**2018**		
GDP (million 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		
Number of Employees (thousands of people)	8528	8605	8549	8614	8535	8449	8671	8896		

Source: National Institute of Statistics

For a better visualization of the evolution of the Gross Domestic Product in the period 1991-2018, figure number 1 was elaborated.

The evolution of the Gross Domestic Product during the period 1991-2018

Figure 1

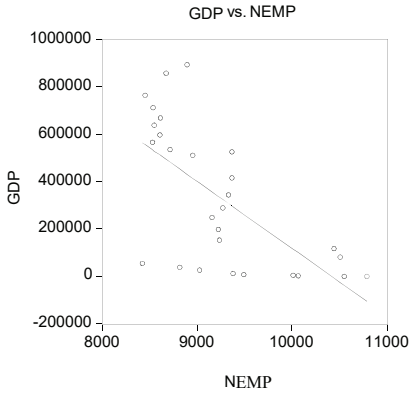


In the period of twenty-eight years subject to analysis, respectively 1991-2018, it is found that the evolution of GDP registered increases, reaching in 2018 a maximum of RON 894,422.6 million, aspects highlighted in figure no. 1.

Figure 2 shows the correlation between Gross Domestic Product and the number of employees.

Correlation between Gross Domestic Product and the number of employees

Figure 2



The point cloud related to the values recorded by the two studied indicators describes a straight line, which allows the continuation of the statistical-econometric study, using a simple linear regression model, in the form:

$$GDP = \alpha + \beta \cdot NEMP + \varepsilon$$

where: GDP = dependent variable;
NEMP = independent variable;
α şi β = regression parameters;
ε = residual variable.

In order to estimate the parameters α and β, respectively $\hat{\alpha}$ and $\hat{\beta}$, the least squares method will be applied. In order to test the significance of the model, the EViews statistical-econometric analysis program is used, the results being presented in figure number 3.

The results of the analysis of the dependence of the Gross Domestic Product on the evolution of the number of employees

Figure 3

Dependent Variable: GDP
Method: Least Squares
Sample: 1991 2018
Included observations: 28

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	2949772.	590692.4	4.993753	0.0000
NEMP	-283.2373	63.69905	-4.446491	0.0001

R-squared	0.431958	Mean dependent var	330448.4
Adjusted R-squared	0.410110	S.D. dependent var	300808.4
S.E. of regression	231033.7	Akaike info criterion	27.60726
Sum squared resid	1.39E+12	Schwarz criterion	27.70242
Log likelihood	-384.5017	F-statistic	19.77128
Durbin-Watson stat	0.454546	Prob(F-statistic)	0.000145

Analyzing the obtained results, it is found that the values of the coefficients are significantly different from zero. At the same time, the model is confirmed by statistical tests. Thus, F-statistic = 19.77 has a higher value than the tabulated one, the same situation being confirmed by the t-Statistic test, with values superior to the tabulated ones and with a probability of almost zero error. The value of 0.43 recorded by R-squared confirms that there are other factors that influence the evolution of GDP. The equation for calculating the predicted values of this macroeconomic indicator is written as follows:

$$\widehat{GDP} = 2.949.772 - 283{,}2373 \cdot \widehat{NEMP} + \varepsilon$$

Next, the authors set out to approach an econometric analysis of the evolution of the number of employees in Romania between 1991 and 2018, using the spectral method, in order to identify the seasonality, cyclicality and trend of the data series. .

The half-yearly data regarding the evolution of the indicator subject to spectral analysis is structured in table number 3.

The evolution of the number of employees during the period 1991-2018

Table 3

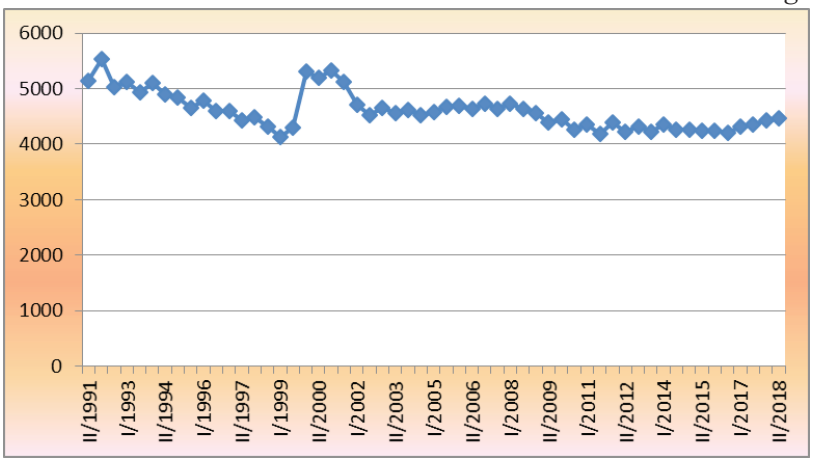
semester / year	I/1991	II/1991	I/1992	II/1992	I/1993	II/1993	I/1994	II/1994	I/1995	II/1995	I/1996	II/1996
number of employees	5650	5136	5526	5022	5130	4932	5104	4907	4840	4653	4782	4597
semester / year	I/1997	II/1997	I/1998	II/1998	I/1999	II/1999	I/2000	II/2000	I/2001	II/2001	I/2002	II/2002
number of employees	4600	4423	4493	4320	4125	4295	5306	5202	5323	5117	4708	4526
semester / year	I/2003	II/2003	I/2004	II/2004	I/2005	II/2005	I/2006	II/2006	I/2007	II/2007	I/2008	II/2008
number of employees	4658	4565	4625	4533	4588	4679	4688	4642	4729	4635	4729	4636
semester / year	I/2009	II/2009	I/2010	II/2010	I/2011	II/2011	I/2012	II/2012	I/2013	II/2013	I/2014	II/2014
number of employees	4564	4388	4442	4271	4348	4180	4387	4218	4317	4232	4350	4264
semester / year	I/2015	II/2015	I/2016	II/2016	I/2017	II/2017	I/2018	II/2018				
number of employees	4271	4246	4244	4205	4314	4357	4425	4470				

Source: National Institute of Statistics (data processed by authors)

The evolution of the number of employees in Romania, in the period between 1991 and 2018, was illustrated in figure 4.

Representation of the evolution of the number of employees in the period 1991-2018

Figure 4



In order to be able to analyze the intensity of the fluctuations generated by the oscillations of the analyzed process, the data of the numerical series were entered in the STATISTICA economic analysis program, and the results regarding the frequency of oscillations, Euler-Fourier coefficients (sine and cosine) and periodogram and spectral densities are structured in table number 4.

The results of the spectral analysis of the evolution of the number of employees

Table 4

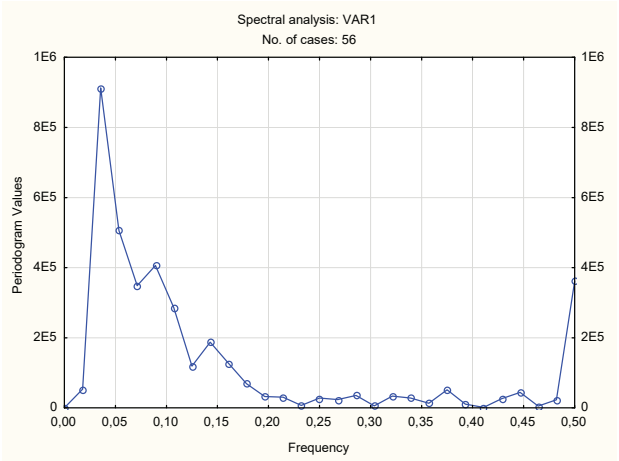
Spectral analysis: VAR1 No. of cases: 56 Largest Periodog. values

	Frequency	Period	Cosine - Coeffs	Sine - Coeffs	Periodogram	Density
2	0,035714	28,00000	178,9586	-23,8872	912709,6	554922,8
3	0,053571	18,66667	124,7066	50,3158	506336,0	546638,9
5	0,089286	11,20000	68,6942	-99,0106	406616,1	357066,4
28	0,500000	2,00000	113,6407	0,0000	361597,7	173065,2
4	0,071429	14,00000	-83,6977	73,8802	348980,7	418710,9
6	0,107143	9,33333	89,8939	46,3849	286509,3	273853,3
8	0,142857	7,00000	29,5700	-76,3843	187850,6	156037,1
9	0,160714	6,22222	59,8110	31,2057	127432,2	124271,2
7	0,125000	8,00000	-59,2833	27,2938	119264,7	186671,0
10	0,178571	5,60000	-36,4787	33,7704	69191,8	77223,1

Figure 5 shows the evolution of the values of the periodogram relative to the oscillation frequency.

Representation of the periodogram by frequency

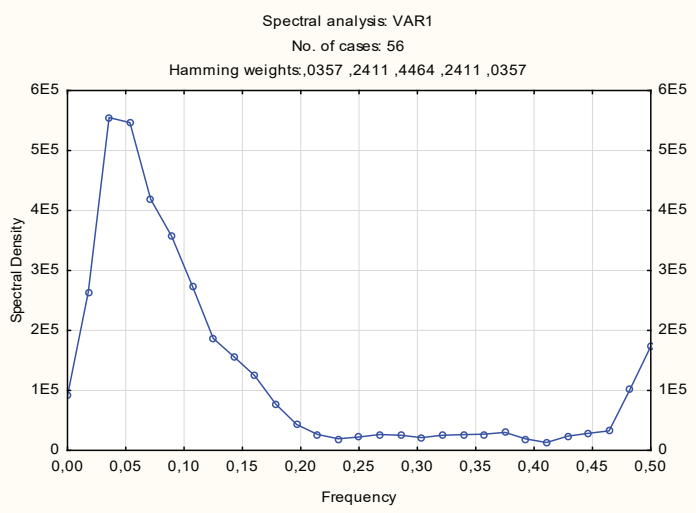
Figure 5



In figure number 5 we can identify on the horizontal axis the base frequency $\left(\frac{1}{56}\right) = 0{,}018$ with its harmonics up to $\left(\frac{1}{56}\right) \cdot 28 = 0{,}50$ and vertically the values of the periodogram are registered. Therefore, interpreting the data presented in table number 4 and graph number 3, we find that the most important oscillations appear at 28 months, in which case the size of the periodogram related to it has the value of 912709.6 and also at 18 months, case in which the size of the periodogram related to it has the value of 506336. Therefore the peak oscillations in terms of the evolution of the number of employees in Romania in the period between 1991 and 2018 are recorded at 28 months and 18 months, respectively, which means that we can not report a accentuated presence of seasonality in this case. But at the same time we can signal the existence of the trend through the high values of the amplitude (indicated by the periodogram in table number 4 column six) for frequencies lower than the unit value (table number 4 column two). At the same time, the slightly downward trend can be identified in chart number 6.
Regarding the cyclicity of the labor force evolution, this is confirmed by the high amplitude values for periods longer than one year.

Representation of spectral density as a function of frequency

Figure 6



According to the results structured in table number 3 and graph number 6, we find that the maximum values of the spectral density as a function of frequency are also recorded in periods longer than one year, respectively at 28 and 18 months.

Conclusions

The article made by the authors based on a study of the economic and financial situation registered by Romania at the end of 2019 clearly shows that a series of results were obtained based on the contribution of production factors on the growth of Gross Domestic Product, the most complex and representative of results in the analysis of any country.

In the present analysis, we limited the study only to the correlation that exists between the employed labor force and the Gross Domestic Product. In this context, some theoretical and practical conclusions were drawn. Thus, the study undertaken and the econometric model used highlighted the fact that the labor force (labor factor) contributes to have a decisive influence on the change (increase or decrease) of the Gross Domestic Product. Certainly, such an analysis could be extended to the structure of the labor force, the correlation between labor supply, according to the requirements of the labor market, where some inaccuracies are manifested, but which are mainly less obvious, if we take into account the fact that some adjustments were made along the way.

We can't talk too much about vocational retraining, but given the number of unoccupied jobs, which are usually not at job fairs, it would be necessary to use vocational retraining on a larger scale.

Another conclusion that emerges from this analysis is that the workforce actually contributes in three ways to increasing the output and performance of microeconomic entities and then ultimately to macroeconomic performance. For example, a first quantitative element is that of the number of employees working in the economy, structured on the branches of the national economy or on the economic entities. A second factor is the quality of the workforce used, which also explains why at job fairs, those vacancies are not required by those looking for a job and, last but not least, the qualification and quality of work that leads from the perspective of increasing labor productivity, staff employed, combined with improving technologies, robotics and adapting the economy to the conditions offered by the current economy.

This analysis can also be correlated with the evolution of the number of employees (labor force) with the active population, the employed population, the unemployed population and the number of unemployed. In an economy with a strong emphasis on stability, it is clear that in the labor force category as much as possible should be absorbed from the employed population and, in turn, the employed population should attract as many staff as possible from the active population.

Extending the analysis, we also made some studies related to the perspective of the evolution of the Romanian economy and the correlation between the labor force and the Gross Domestic Product. In this sense, we

must specify that this correlation between the labor factor and the Gross Domestic Product will remain a direct one, only that, in the context produced by the COVID 19 crisis, which will expand in the economic-financial crisis, it will be in a direct sense, but with a tendency to reduce both the number of employees and, as a consequence, the Gross Domestic Product.

Although it is not the purpose of this analysis, we specify that the two successive crises, which are discharged into each other, will have special effects in terms of decreasing the number of employees, but also the Gross Domestic Product, as a consequence. In setting forecasts for the next period, it is necessary, in the opinion of the authors, to take into account the possibility of switching to additional investments to create new jobs, in order to absorb a significant number of the employed population or the unemployed so that the economy recovers. gradually. Microeconomic support needs to be provided to force important results.

Another conclusion is that at the moment it appears more important than anything that in terms of the financial resources factor, first of all, we must find those ways to successively ensure investment growth, job creation, absorption of the unemployed and unemployment. , improving economic activity and, consequently, increasing economic performance. We also take into account the recent directives of the European Union which have abandoned the conditioning of the 3% of GDP deficit and it would be desirable for macroeconomic strategies to take into account the attraction of resources through investments, as much as possible, because all European countries feel the same effect, but, as far as possible, attracting resources from the banking system in the form of loans and, extending here, we can go even further to talk about external credit and increase (increase) domestic debt. These funds attracted in the economic circuit, will create some financial obligations, but will ensure, if used with knowledge, skill and national interest, the growth and return to the level of the necessary potential of state and private enterprises (state we say in principle) and will ensure economic growth that will then ensure the return of these funds that have been used.

We must not avoid the way to manage with maximum skill our own resources and attracted resources, directed in order to obtain superior results by relaunching the Romanian economy, than to consider the closed model of not creating debts, but producing losses that can be huge.

The last conclusion is that the analyzes at macroeconomic level must be intensified, especially by the profile institutions (Institute of Forecasting) that can suggest ways in which the Romanian economy can recover. Econometric models are available to all those interested in making relevant analyzes on the basis of which to make appropriate estimates.

References

1. Anghel, M.G., Radu, I. (2020). The study of the evolution of the demand and supply of vacancies in the labor market in Romania. *Romanian Statistical Review, Supplement*, 3, 87-98
2. Anghel, M.G., Grigorescu, D.L., Dumbravă, Ș.G. (2020). Model for analyzing the correlation between the labor force and the Gross Domestic Product in Romania. *Romanian Statistical Review, Supplement*, 4, 52-67
3. Anghelache, C., Anghel, M.G. (2017). Analysis of population development - labour resources of member states of the European Union. *Management&Gouvernance, 17*, January--June 2017, 95-110
4. Anghelache, C., Avram, D., Burea, D. and Petre (Olteanu), A. (2018). Analysis of the Natural Movement of Population and Labor Force Development. *Romanian Statistical Review, Supplement, 2*, 115-123
5. Bar, M., Leukhina, O. (2010). Demographic Transition and Industrial Revolution: A Macroeconomic Investigation. *Review of Economic Dynamics*, *13* (2), 424–451
6. Donangelo, A. (2014). Labor mobility: implications for asset pricing. *Journal of Finance*, *68* (3), 1321-1346
7. Hili, A., Lahmandi-Ayed, R. and Lasram, H. (2016). Differentiation, labor market and globalization. *The Journal of International Trade & Economic Development, 25 (*6), 809-833
8. Kurmanov, N. et al (2017). Labour Migration and Remittances: Strategy for Survival or Development?. *International Journal of Economics and Financial, 7* (1), 334-339
9. Iacob, S.V., Măhărea, E. (2020). Model for analyzing the evolution of employment and unemployment in Romania. *Romanian Statistical Review, Supplement*, 4, 203-221
10. Iacob, S.V. (2019). *Utilizarea metodelor statistico-econometrice și econofizice în analize economice*, Editura Economică, București
11. Maestas, N., Mullen, K., Powell, D. (2016). The effect of population aging on economic growth, the labor force and productivity. National Bureau Of Economic Research, Cambridge, Working Paper no. 22452
12. Neumark, D., Yen, M. (2020). Relative Sizes of Age Cohorts and Labor Force Participation of Older Workers. *Demography,* 57, 1-31
13. Van Houtven, C.H., Coe, N.B., Skira, M.M. (2013). The effect of informal care on work and wages. *Journal of Health Economics, 32* (1), 240-252
14. Wonka, A., Baumgartner, F., Mahoney, C., Berkhout, J. (2010). Measuring the size and scope of the EU interest group population. *European Union Politics, 11* (3), 463-476
15. Institutul Național de Statistică, Comunicat nr. 82 / 27.03.2020