Modelling the Economic Determinants of Unemployment Using the Multiple Linear Regression: a Case Study of Romania

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Abstract

Unemployment represents a negative phenomenon in almost all countries of the world. It is a complex phenomenon that has multiple causes and important economic and social-human consequences. This paper aims to analyze the correlation between the unemployment rate, respectively the number of unemployed persons and some of the influencing factors. Therefore, we identified the main influencing factors of unemployment in Romania based on an econometric model using the multiple linear regression. This model allows forecasting the future economic trends of the indicators highlighting the level of unemployment. The result showed that the growth rate of the Gross Domestic Product, the volume of foreign direct investments and the exports, as well as the inflation rate are significant factors influencing the unemployment.

Key words: unemployment, economic growth, investments, exports, inflation
J.E.L. classification: C15, E31, F16, J64

1. Introduction

The unemployment represents a current phenomenon that affects the economies of all countries in different proportions. It became a problem during the industrial development, starting with the second half of the 18th century, during the periods of recession, when the industrial companies reduced their production and, as a result, released a significant number of workers who became unemployed (Țoțan, Popescu, Cristache, 2013).

In the beginning, the unemployment was considered a temporary, conjunctural phenomenon. The reality in all countries has demonstrated that the unemployment has a permanent character, so that the economists have turned their attention to it since the dawn of economics, as a science. The unemployment is a negative phenomenon present in almost all states of the world. Comprising a large part of the active population, the unemployment is illustrated by the international statistics as a macroeconomic phenomenon that requires multiple economic, political, social solutions, depending on place and time. Through the economic-social effects it generates, the unemployment has become a problem of concern for all the states of the world in recent decades. That is why the dynamics of the economic theory about unemployment, as well as the expression of some points of view, must reflect not only the nature and causes of unemployment, but also the measures and remedies for reducing its effects.

The unemployment is a negative state of the available active population, which does not find jobs, due to the disruption of the relation between the economic development, as a source of labor demand, and the evolution of the population, as a source of labor supply. Given the contemporary situation, the unemployment is considered as an imbalance of the national labor market, meaning an imbalance between the global labor demand and offer (Popescu, Gavrilă, Ciucur, 1999).

The study on the correlation between the evolution of the number of unemployed persons, respectively the unemployment rate, and the influencing factors starts from the interpretation of the data series that were recorded in the last twenty-five years, respectively in the period 1999-2023. The statistical study of the data series shows that there is a negative relation between the unemployment indicators (the number of unemployed persons and the unemployment rate) and the growth rate of

the Gross Domestic Product, respectively the volume of foreign investments and the exports. Instead, we identified a positive relation between the same unemployment indicators and the inflation rate. We established then an econometric function that highlights the evolution trend of the two indicators that characterize the unemployment in close dependence on the influencing factors.

2. Literature review

The issue of unemployment, its nature, size and combating has been one of the most serious problems faced by the Romanian economy in the process of transition to the market economy. The efficient use of labor resources, the size of unemployment are parameters that show how the labor market works, but also express how the national economy functions as a whole. Through its direct effects, the unemployment goes beyond the actual framework of the labor market and shapes the macroeconomic imbalances.

After 1990, the unemployment has become a permanent phenomenon in Romania, drawing the attention of political decision-makers. We know that the national economy went through an extensive restructuring process, recording a continuous decline until the beginning of the 2000s. Therefore, the lesson learned during that period urges us to understand the causes and trends of unemployment and to determine the relation between this imbalance and certain macroeconomic variables in order to create a model that could predict the level of unemployment.

Our analysis first considered the growth rate of the Gross Domestic Product. From an empirical point of view, the level of unemployment and the rate of economic growth are in a negative relation, since a healthy increase in the Gross Domestic Product determines low unemployment rates (Zhong, 2024).

The relation between these two variables was studied by the economist Arthur Okun who proposed the law that bears his name. This law provides that for every 2% decrease in the Gross Domestic Product, the unemployment increases by 1% (Okun, 1962). This over 60-year-old theory provided a reference for the governments of the world's states in establishing economic policy objectives, but it may prove to be an outdated model in the 21st century, marked by the economic and financial crisis of the first decade and the crisis generated by the pandemic coronavirus. Due to the fact that Okun's law is relatively outdated today, the economists have tried to develop new models to better explain the relation between the evolution of the Gross Domestic Product and the unemployment by expanding the variables used.

The economic growth has a positive effect on employment and the unemployment rate is influenced by the change rate of the Gross Domestic Product (Hjazeen, Seraj, Ozdeser, 2021). The economic growth should be the most important macroeconomic objective, because it increases the budget revenues through the additional collection of taxes and fees, it improves the quality of life and contributes to the increase of public and private investments that create new jobs (Valentinavičius, 2001). However, there are also studies that have not identified a relevant link between the growth of the Gross Domestic Product and the level of unemployment (Lydeka, Z., Karaliute, A., 2021).

Another factor that influences the level and dynamics of unemployment is represented by the foreign direct investments. The countries with a low level of development (but not only) have focused on measures to attract foreign investments and multinational corporations to create jobs and thus to combat unemployment. Studying the interdependencies between the flow of foreign direct investments and the unemployment rates has become of great importance for the countries interested in attracting foreign direct investments.

A series of studies argue the above statement. For example, several Turkish economists proved that there is a direct influence of foreign direct investment on employment (Bakkalci&Argin, 2013; Aktar and Öztürk, 2009; Saray, 2011). There are studies that showed the long-term effects of foreign direct investments on the level of employment (Ajaga&Nunnekamp, 2009).

The same conclusion was reached by Grahovac and Softić (2017), who analyzed the impact of foreign investments on unemployment in the countries of the Western Balkans. Also, there are studies showing that the transfer of economic agents from the property of local economic agents to the property of foreign economic agents had a significant effect in reducing unemployment (Lipsey, 2010).

There are studies that claim that the foreign direct investments have no impact in terms of employment growth (Rizvi&Nishat, 2009). The same conclusion was reached by Stamatieu&Dritsakis (2014) analyzing the statistical data for the period 1970-2012 in Greece. Simionescu&Simionescu (2017) examined the relationship between the foreign investments and the unemployment rate in the United States for the period 2000-2016, concluding that there is no short-term relation between the two variables, but that in the long term there is a strong link.

The conclusion is that the interdependencies between the foreign direct investments and the level of employment are not fully clarified, but there are enough studies that show that the foreign direct investments are inversely related to the employment rate, respectively inversely related to the unemployment rate, but this relation largely depends on the country and the analyzed period.

The exports may significantly impact the level of employment and unemployment. There are points of view that specify that the more a country exports, the higher the employment rate is in that country. However, the number of jobs created by exports varies significantly from country to country. The exports of products from certain sectors such as the natural resources, textiles and services create more jobs, while products with high added value lead to a smaller effect in terms of employment and implicitly to a significant reduction of unemployment (Johnson&Noguera, 2012). Using the input-output analysis, various authors showed the impact of exports on the level of employment and unemployment in different countries (Los, 2015; Feenstra&Sasahara, 2019): the impact of exports on the number of jobs depends on the specific conditions in each country.

The inflation-unemployment correlation has also been studied by many authors. The relation between inflation and unemployment is clearly explained through the Phillips curve, who using a series of phenomena and statistical data, highlighted an inverse relation between the inflation rate and the unemployment rate on the example of Great Britain. Thus, when inflation increases, the unemployment rate in a country decreases, because the increase in prices stimulates the economic activity, increasing employment and mitigating unemployment. Conversely, when the inflation rate decreases, the unemployment rate increases, because the economic agents are not interested in expanding their activity (Phillips, 1958). Just like Okun's law, the Phillips curve is relatively outdated today.

Many of the studies carried out later highlighted an inverse relation between the inflation rate and the unemployment rate, while others identified a positive relation. Many following studies highlighted a series of controversies related to the inflation-unemployment relation (Dixon, 1998; Nickell, 1998; Pissarides, 2013). The economic uncertainty recorded after the 70s of the last century determined many countries to create additional jobs and limit the effects and duration of the economic crises by stimulating demand through expansionary monetary or fiscal measures. On the other hand, the central banks took measures to target inflation (Svenson, 1997). The result was that the inflation rate and the unemployment rate remained low for a long period of time in many countries.

Other authors also highlighted a direct relation between the inflation rate and the unemployment rate, disputing the Phillips curve. Friedmann (1976) observed that there is a strong relation between inflation and unemployment, specifying that it is possible that a high inflation determines a high level of unemployment. Many studies validated or contradicted this theory. Palley (2012) showed that inflation is the cost for reducing unemployment. Blanchard and Gali (2008) found that an optimal policy should consider a balance between unemployment stabilization and strict inflation targeting strategies, to achieve a substantial reduction of unemployment at relatively low costs in terms of inflation.

3. Research methodology

The main purpose of this paper is to analyze the unemployment evolution in Romania in close connection with the influencing factors. We examined the data for the period 1999-2023. The research datas started in 1999, when the major imbalances from the period of transition to the market economy began to be mitigated, thus eliminating the uncertainty period of the first decade of transition. We can talk about a period of relative predictability, except for the global economic crisis from 2007-2011, which had a significant impact on the labor market, including the unemployment evolution. This period of 25 years is long enough to provide a complete and complex picture of the

unemployment phenomenon in Romania and the influencing factors. The main goal was to analyze which indicators have impacted the level of unemployment. We used a multiple linear regression model. The data were taken from the Eurostat database, and the calculations were made using Excel.

4. Materials and methods

The research was conducted using a multiple regression model for the time series data. A general form of a linear multiple regression model is:

$$Y_t = b_0 + b_1X_{1t} + b_2X_{2t} + \cdots + b_nX_{nt} + u_t$$

Y_t is the dependent variable of the model;
$X_1, X_2, \ldots, X_n$ are the independent variable of the model;
b_0 is the coefficient representing the predicted value of Y when all X_n are equal to 0;
$b_1, b_2, \ldots, b_n$ are the coefficients denoting the average predicted change in Y for one unit increase in $X_1, X_2, \ldots, X_n$;
u_t is the error term;
t denotes the time period.

In this study, we analyzed the unemployment (*Unempl*) as a dependent variable (*Y*) of the regression model. Other macroeconomic factors the model includes are: the GDP growth (*%GDP*), the foreign direct investments (*Invest*), the exports (*Exp*) and the inflation rate *(%Infl*), representing the independent variables (X_n) of the regression model.

The regression model of this research can be presented as the following expression:

$$Unempl_t = b_0 + b_1\%GDP_t + b_2Invest_t + b_3Exp_t + b_4\%Infl_t + u_t$$

Table no. 1. Variables of the model

Variables	Variable abbreviation	Indicator
Unemployment	*Unempl*	Unemployment (persons) or Unemployment rate (% of total labor force)
GDP growth	*%GDP*	GDP growth (annual %)
Foreign direct investments	*Invest*	Foreign direct investment (million euros)
Exports	*Exp*	Exports (million euros)
Inflation	*%Infl*	Inflation rate (annual %)

Source: own determination

Based on the specialized literature and the results of our previous studies, we issued the following hypotheses:

H1: The economic growth has a negative effect on unemployment. This hypothesis is based especially on the results provided by Okun's law.

H2: The level of foreign direct investment has a negative effect on unemployment. An important number of researchers have reached this conclusion.

H3: The exports have a negative effect on unemployment. Some of the mentioned researchers argued this relation.

H4: Inflation negatively affects unemployment. This hypothesis takes into account the correlation explained by the Phillips curve.

5. Results

In this research, the level of unemployment and the factors influencing it were analyzed for the period 1999-2023. We made two correlations. The first correlation is between the unemployment rate and the factors influencing it and the second one between the number of unemployed persons and the same factors.

The table below shows how the unemployment rate is influenced by the changes in the economic growth rate, the foreign direct investments, the exports and the inflation rate. In Romania, during the analyzed period, the unemployment rate was not constant and fluctuated, reaching the highest values at the beginning of the interval and the lowest currently. After a constant decrease in the unemployment rate until 2008, the global economic-financial crisis also affected the Romanian economy, thus two years of increasing unemployment followed, after which it recovered almost to the pre-crisis values.

The type of model that can actually be used was identified through the graphic process. We made a scatterplot graphic that allowed us to identify the relation between the variables. Based on this representation, we considered that a linear regression model can successfully show the connection between the analyzed indicators.

Using the Data Analysis section of Excel, we reached the following results:

Table no. 2. Summary output of the regression statistics for the unemployment rate

Regression Statistics					
Multiple R	0.96700963				
R Square	0.935107625				
Adjusted R Square	0.92212915				
Standard Error	0.663523634				
Observations	25				
ANOVA					
	df	*SS*	*MS*	*F*	*Significance F*
Regression	4	126.8851277	31.7212819	72.05065551	1.37064E-11
Residual	20	8.805272265	0.44026361		
Total	24	135.6904			

Source: own determination

The data in the table above shows that the regression model is statistically relevant, with the F-statistic test value of 0.000, well below the significance threshold of 0.05. We can also note that the correlation coefficient R is 0.967, and the values of the R^2 (0.935) and adjusted R^2 (0.922) tests are very high, indicating a strong correlation between the unemployment rate and the chosen factors. All this shows us that the chosen regression model is a correct one and it can be successfully used for economic analyses.

We check if there are abnormal values that may have a negative impact on the research in the sense of changing the coefficients of the regression model.

Table no. 3 Regression analysis of the unemployment rate

	Coefficients	*Standard Error*	*t Stat*	*P-value*
Intercept	7.801471363	0.449458359	17.3574953	1.58519E-13
%GDP	-0.108476667	0.04139362	-2.6206132	0.016379198
Investments	-0.153008703	0.068117587	-2.2462437	0.036142101
Exports	-0.000453221	7.51103E-06	-6.0340667	6.72232E-06
%Inflation	0.083470154	0.013044275	6.39898746	3.04746E-06

Source: own determination

The regression model is statistically significant, P-value is less than 0.05 for all the variables included in the model. We mention that we also tested as possible variables the indicators employed population and total population, which we excluded from the model because they proved to be insignificant from a statistical point of view.

Based on the variables resulting from the use of the computer program, we obtained the following regression model:

$$Unempl_t = 7.8014 - 0.1084\%GDP_t - 0.153Invest_t - 0.0004Exp_t + 0.0834\%Infl_t$$

We were also interested in whether the number of unemployed persons has a similar behavior to the change of the analyzed factors. The number of unemployed persons had a similar evolution in Romania during the analyzed period: a significant decrease from 1999 to 2008 given the economic growth generated by the start of Romania's joining process to the European Union (completed by signing the adhering treaty in 2005 and the effective adhering on January 1st, 2007); there was a significant increase in the period 2009-2010, given the global economic crisis triggered in the United States in 2007 (Romania's economy was affected from the second half of 2008); in recent years, the number of unemployed persons has decreased significantly, registering the lowest values of the analyzed period.

Using the Data Analysis section of Excel, we obtained the following results:

Table no. 4. Summary output of the regression statistics for the unemployed persons

Regression Statistics					
Multiple R	0.97204958				
R Square	0.944880385				
Adjusted R Square	0.933856462				
Standard Error	60604.16095				
Observations	25				
ANOVA					
	df	*SS*	*MS*	*F*	*Significance F*
Regression	4	1.25923E+12	3.14808E+11	85.71180929	2.70476E-12
Residual	20	73457286479	3672864324		
Total	24	1.33269E+12			

Source: own determination

The data in the table above show that the regression model is statistically relevant, with the F-statistic test value of 0.000, well below the significance threshold of 0.05. We can also note that the correlation coefficient R is 0.972, and the values of the R^2 (0.944) and adjusted R^2 (0.933) tests are very high, indicating a strong correlation between the number of unemployed persons and the influencing factors. All these shows us that, as in the previous situation, the chosen regression model is correct and it can be successfully used in economic analyzes and forecasts.

We also check if there are abnormal values that may have a negative impact on the research, in the sense of changing the coefficients of the regression model.

Table no. 5 Regression analysis of the unemployment rate

	Coefficients	*Standard Error*	*t Stat*	*P-value*
Intercept	715711.1798	41052.11227	17.43421082	1.45896E-13
%GDP	-10220.63068	3780.763039	-2.703324851	0.013678088
Investments	-14.99788498	6.221646065	-2.410597586	0.025669304
Exports	-4.489051185	0.686034004	-6.543482044	2.23837E-06
Inflation	8466.308717	1191.423056	7.106047409	6.91178E-07

Source: own determination

This version of the regression model is also statistically significant, the P-value is less than 0.05 for all the variables included in the model. After processing the statistical data, we obtained the following version of the regression equation of the model:

$$Unempl_t = 715{,}711 - 10{,}220\%GDP_t - 14.997Invest_t - 4.489Exp_t + 8466\%Infl_t$$

The regression equations we found can be used not only to highlight the influencing factors, but also to estimate the evolution of the two indicators that characterize the level of unemployment: the unemployment rate and the number of unemployed persons, potentially representing an important element for those with attributions in the field of employment policies and unemployment combating. These results can be improved by testing other influencing factors.

6. Conclusions

This paper analyzes how the unemployment is affected by some macroeconomic factors, such as the Gross Domestic Product, the foreign direct investments, the exports and the inflation. These are some of the most used factors in the models identified in the scientific literature and have a strong significance from a statistical point of view.

This research analyzes the statistical data provided by Eurostat, for the period 1999-2023. The research methodology is based on the multiple linear regression model. The statistical analysis showed that there is a strong influence on the level of unemployment. The relation between the growth of the Gross Domestic Product and the level of unemployment is negative, considering that the sign of the regression coefficient is negative, which validates Okun's law. There is also a negative correlation between the unemployment and the volume of foreign direct investments and exports. Instead, there is a direct, positive relation between the level of unemployment and the inflation rate, which contradicts the hypothesis expressed by the Phillips curve. Thus, three of the four working hypotheses were validated using this model.

The correlation coefficient R is high and the values of the R^2 and adjusted R^2 tests are also high, which indicates a strong correlation and that the chosen model is a correct one.

7. References

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