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# The experimental modeling for the analysis of the impact of international organizations on the national economy, in the context of the globalization

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**Abstract**
Achieving macroeconomic forecasts on future developments of key national economy indicators is needed to anticipate future phenomena, with the main purpose of modeling being to mitigate risks. The regression model is an essential statistical and econometric tool for estimating future developments with the help of analyzing existing links and measuring correlations between the main macroeconomic indicators. The datasets to be used in macroeconomic forecasts need to be identified to ensure a real correlation between the levels of evolution of the indicators used. At the same time, special attention is paid to the study of the evolution of the indicators based on tabulated data and then to the graphical representation of the series. The scientific novelty of the obtained results results in: the development of the theoretical and methodological aspects regarding the expansion of globalization and its impact on the national economies; highlighting the correlations between the identified variables, elaborating a regression model for testing the importance given to globalization by the decision makers within the international organizations, in the conditions of the specific influences of the globalization phenomenon.

**Keywords:** The indicator of globalization KOF, globalization in Romania, the Gross Domestic Product, the net flow of direct foreign investments (ISD), influence, impact, factor, the correlation

## 1. Introduction

At the end of the last decade, FDI became the main source of foreign private capital in most countries of the world. It should be borne in mind that they do not create an external debt for that country, and the capital outflows they involve (repatriation of profits) depend on the economic results of the enterprise and respond both to the investor's interest and to the interest of the state that encourages economic growth. FDI stock participation in gross domestic product is an indicator showing the importance of these investments in growth and economic development.

The Gross Domestic Product, is the main macroeconomic indicator and represents the synthetic expression of the results of the economic activity in the territory of Romania within a period of time, regardless of the contribution which have an internal subjects or from abroad [4], [5].

According to the National Institute of Statistics, gross domestic product is the main macroeconomic aggregate, which reflects the final output of the production of resident units. The experimental solution developed in this study aims at analyzing a system of multifactorial regression models, in which the GDP indicator will be considered both the dependent variable and the independent variable.

From the specialized analysis carried out on the factors determining the change of the Gross Domestic Product, there is a direct dependence on the sum of the components expressing final consumption (FC), foreign direct investment (FDI) and net export (EXPN).

$$GDP \approx FDI + FC + EXPN$$

According to the IMF, direct foreign investment represents "a category of cross-border investment made by a resident in one economy (the *direct investor*) with the objective of establishing a lasting interest in an enterprise (the *direct investment enterprise*) that is resident in an economy other than that of the direct investor. The motivation of the direct investor is a strategic long-term relationship with the direct investment enterprise to ensure a significant degree of influence by the

direct investor in the management of the direct investment enterprise. The "lasting interest" is evidenced when the direct investor owns at least 10% of the voting power of the direct investment enterprise. Direct investment may also allow the direct investor to gain access to the economy of the direct investment enterprise which it might otherwise be unable to do. The objectives of direct investment are different from those of portfolio investment whereby investors do not generally expect to influence the management of the enterprise" [6].

FDI is an important indicator of economic growth, including in times when economic stability is under threat and growth is under pressure because:

- FDI is complementary to public funding sources and provides the capital needed to develop an economy;
- FDI creates new jobs not only in the company where they invest, it also stimulates the development of other upstream and downstream companies;
- FDI is not only a flow of capital but also technology, knowledge, organizational practices that stimulate and generate economic growth. Foreign investors impose their own way of working the company they are developing and bringing new technologies that increase employee efficiency and company competitiveness. These beneficial effects propagate across the entire chain of companies involved in building a product or service that adapts to survive on the market;
- FDI is characterized by long-term stability. What defines FDI is precisely the investor's sustainable interest in the company he invests in. Therefore, an investor who has set up a new company will not give up its investment so easily, even in turbulent economic times.

The most well-known statistical tool for measuring globalization is the composite index of globalization KOF (Konjunktur for Schungsstelle - Economic Research Center) and was defined by Axel Dreher of the KOF Swiss Economic Institute. This indicator includes social, political and economic factors, so we can define the intensification of the international economic, political, cultural, social and technological interactions that provide the foundation of transnational structures and the economic, political and social integration of processes.

The economic globalization index (with a weight of 38% of the value of the composite index of globalization KOF) is characterized by long-distance flows of goods, services and information and perceptions that accompany market exchanges: trade (final consumption + 19% of GDP), foreign direct investment as a percentage of GDP (20%), portfolio investments, income payments to foreign citizens (as a percentage of GDP 21%)[8], [9].

## 2. Theoretical Background

Regression models predict a value of the Y variable based on the variable values known in X's predictions. The range of values in the dataset used for the model is known as interpolation. Data outside this range is known as extrapolation, which relies heavily on the assumption of the regression model.

For the purpose of constructing the regression model, we define the value of the Gross Domestic Product and the globalization index KOF, and as independent variables: the value of the final consumption, the FDI flow (net foreign direct investment), the net export and the inflation rate Romania, for the statistical period 2007-2017. The database is based on the information provided by the National Institute of Statistics and the official data published by the National Bank of Romania.

Once the regression model has been built, it is important to confirm the relationship between the model and the estimated significance of the parameters. Checks include common tests, assumptions and residual values. Statistical significance can be verified by F-test as a general test, followed by a T-test for individual parameters [3].

When using large series of data we can use the central limit theorem, so hypothetical testing can continue using asymptomatic approximations. The variable response can be continuous (limited

data covers a subset of linear regression). For binary variables, if applicable to the last square regression analysis, the model is called a linear probability model.

## 3. Aims of the research

The main objective of this study is to assess the impact of FDI (direct foreign investment) in Romania over 10 years, starting in 2007, directly on GDP and indirectly on the globalization index KOF, using a system of 2 multiple regression models.

## 4. Research methods

The system consists of two linear regression models with the following meanings:

- a first $\mathbf{M_1}$ linear regression model, where the exogenous variable is considered GDP and the predictive variables are FDI, final consumption and net export;
- a second $\mathbf{M_2}$ linear regression model in which the exogenous variable is considered the globalization index KOF and the predictive variables are the GDP and the inflation rate.

The Multiple Regression Model $\mathbf{M_1}$ is used to accurately measure the effect of the predictor variables (Foreign Direct Investments, Final Consumption and Net Export) on the growth of the resulting macroeconomic indicator (Gross Domestic Product). As a relationship of interdependence, the following relationship is used:

$Y=a_0+a_1*x_1+a_2*x_2+a_3*x_3+e_1$ (the equation of multiple linear regression)(1)

where:

**Y**= Gross Domestic Product (resultant characteristic);
$\mathbf{x_1}$= Foreign Direct Investments (factorial characteristic);
$\mathbf{x_2}$= Final consumption (factorial characteristic);
$\mathbf{x_3}$= Net export (factorial characteristic);
$\mathbf{e_1}$ = residual variable;
$\mathbf{a_0}$, $\mathbf{a_1}$, $\mathbf{a_2}$, $\mathbf{a_3}$= parameters of the regression function.

The Multiple Regression Model $\mathbf{M_2}$ is used to accurately measure the effect of predictor variables (GDP and Inflation Rate) on the rise in the globalization indicator KOF. As a relationship of interdependence, the following relationship is used:

$Z=b_0+b_1*y_1+b_2*y_2+e_2$ (the equation of multiple linear regression) (2)

where:

**Z**= the globalization indicator KOF (resultant characteristic);
$\mathbf{y_1}$= Gross Domestic Product (factorial characteristic);
$\mathbf{y_2}$= Inflation Rate (factorial characteristic);
$\mathbf{e_2}$ = residual variable;
$\mathbf{b_0}$, $\mathbf{b_1}$, $\mathbf{b_2}$ = parameters of the regression function.

The system of the $\mathbf{M_1}$ and $\mathbf{M_2}$ models, given by equations (1) and (2), allows for the equation (3) describing the dependence of the KOF with direct foreign investment (FDI) globalization indicator:

$Z=b_0+b_1*y_1+b_2*y_2+e_2=b_0+b_1*(a_0+a_1*x_1+a_2*x_2+a_3*x_3+e_1)+b_2*y_2+e_2=(b_0+b_1*a_0)+b_1*a_1*x_1+b_1*a_2*x_2+b_1*a_3*x_3)+b_2*y_2+(b_1*e_1+e_2)$ (3)

## 5. Findings

### 5.1. Method of calculating net FDI flow

**Table 1.** Assessment of data

| Year | Investments in the share capital (million EUR) | Reinvested profit (according to the BPM6) (million EUR) | The net credit received (million EUR) | The net flow FDI (million EUR) |
|---|---|---|---|---|
| 2007 | **2220** | **1327** | **3703** | **7250** |
| 2008 | **5265** | **-392** | **4623** | **9496** |

| | | | | |
|---|---|---|---|---|
| 2009 | **3118** | **-1389** | **1759** | **3488** |
| 2010 | **4067** | **-2243** | **396** | **2220** |
| 2011 | **4009** | **-2497** | **303** | **1815** |
| 2012 | **2676** | **-1881** | **1343** | **2138** |
| 2013 | **2764** | **-337** | **285** | **2712** |
| 2014 | **4222** | **-1376** | **-425** | **2421** |
| 2015 | **3085** | **510** | **-134** | **3461** |
| 2016 | **3203** | **1138** | **176** | **4517** |
| 2017 | **3822** | | **764** | **4586** |

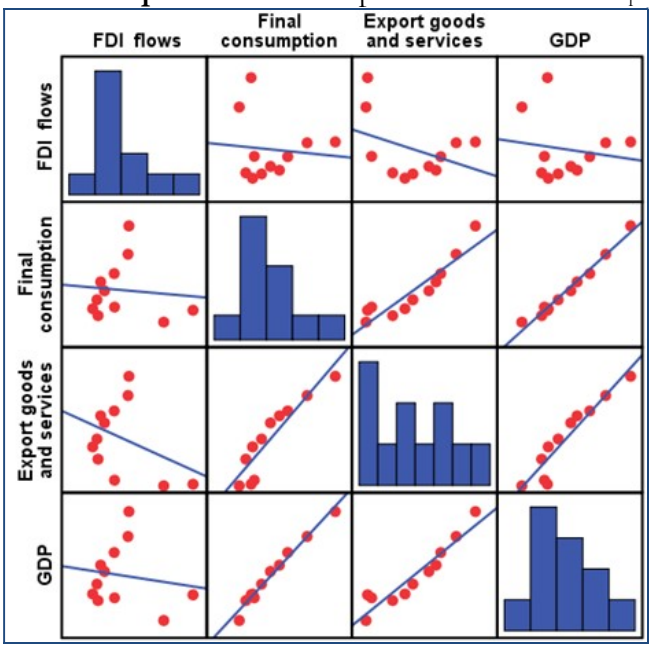
## 5.2. Influence of Net FDI Flow (Foreign Direct Investment) and Final Consumption on Gross Domestic Product

**Table 2.** The data set needed to analyze the correlations between the indicators

| Year | The net flow FDI (million EURO) | Final Consumption (million RON) | Export goods and services(million RON) | GDP (million RON) |
|---|---|---|---|---|
| 2007 | **7250** | **99215.3** | **33592.9** | **116663.8** |
| 2008 | **9496** | **108282.1** | **34451.9** | **141150.1** |
| 2009 | **3488** | **110715.2** | **36613.8** | **138263.9** |
| 2010 | **2220** | **104185.9** | **47891.6** | **135645.8** |
| 2011 | **1815** | **109425.5** | **54470.1** | **141971.1** |
| 2012 | **2138** | **116307.2** | **58689.4** | **151418.8** |
| 2013 | **2712** | **123095.5** | **67303.3** | **163514.3** |
| 2014 | **2421** | **129973.8** | **71120.0** | **169556.9** |
| 2015 | **3461** | **136316.1** | **73694.3** | **181636.7** |
| 2016 | **4517** | **151155.8** | **81916.1** | **196917.4** |
| 2017 | **4586** | **172751.3** | **92223.3** | **220766.7** |

The data has been taken over and statistical procedures (interpolation) have been applied to complete the statistical series. The correlation can also be analyzed using a scatter matrix chart in which we were comparing the benchmarking of the indicators for the 2007-2017 period.

**Graphic nr. 1** Scatterplot Matrices from $M_1$



**Model Summary**

| | Multiple R | R Square | Adjusted R Square | Std. Error of the Estimate |
|---|---|---|---|---|
| $M_1$ | 0.993 | 0.986 | 0.980 | 4294.2307 |

**Change Statistics**

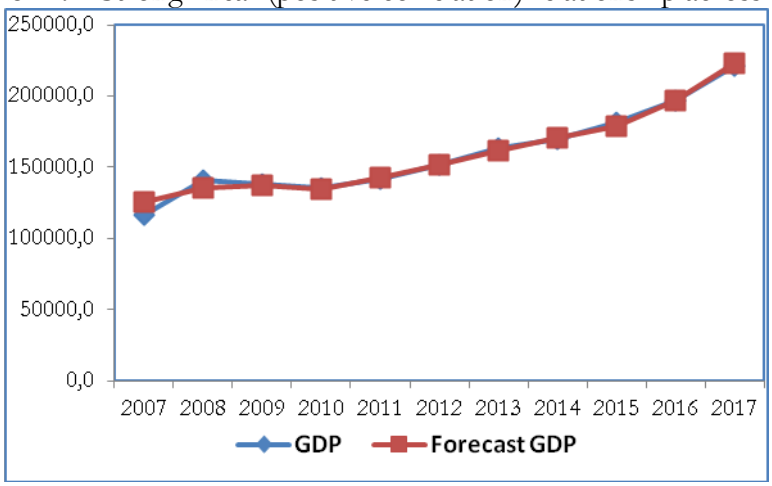
| | R Square Change | F Change | df1 | df2 | Sig. F Change | Durbin-Watson |
|---|---|---|---|---|---|---|
| $M_1$ | 0.986 | 166.216 | 3 | 7 | 0.000 | 2.120 |

**ANOVA**

| $M_1$ | Sum of Squares | df | Mean Square | F | *Significance F* |
|---|---|---|---|---|---|
| Regression | 9.195E9 | 3 | 3.07E+09 | 166.216 | 0.000 |
| Residual | 1.291E8 | 7 | 18440417.580 | | |
| Total | 9.324E9 | 10 | | | |

The $M_1$ model, represented in Figure 1, has a 99.3% confidence level, and can be implemented in practice in the macroeconomic analyzes. At the same time, we can see that the correlation and default existing interdependence between the macroeconomic indicators Gross Domestic Product (GDP), the foreign direct investment (FDI) flow, the final consumption (CF) and the export of goods and services (EXPN) - (Figure 2).

**Graphic nr. 2** Strong linear (positive correlation) relationship across indicators of $M_1$




From the above explained, we obtain the equation of the multiple linear regression model, which shows the correlation between the analyzed macroeconomic indicators. Thus, the equation can be represented as:

GDP = 1.018598335*FC + 0.265540434*FDI + 0.4087958*EXPN + 8411.722038 (1)

From the equation of the regression model (1), we can note that the consumption variable influences in a particularly high proportion the evolution of the Gross Domestic Product, while the foreign direct investment flow has a slightly positive impact on the dependent variable.

These aspects are confirmed, in terms of consumption, by the Romanian economy, which relies heavily on stimulating consumption, on the one hand, and on the flow of investments, we must mention that the adverse effects of the economic and financial crisis have determined the departure of a significant mass of investors from the territory of our country.

These results confirm both the validity of the model and the low risk of its use in macroeconomic analysis.

At the same time, we note that the presence of several endogenous variables has increased the level of accuracy of the regression model. The results of the F-statistical test, well above the reference value, confirm once more the correctness of the model and the possibility to use it in the macroeconomic forecasting analyzes of GDP at the level of Romania. At the same time, we have to mention that the value 0 of the prob (F-statistic) test confirms the previously asserted, namely that the econometric multiple regression model, which uses as a dependent variable the GDP of Romania, and as independent variables the final consumption (CF) and the net foreign direct investment (FDI) flow is a fair one and can be used in our country's macroeconomic forecasting analyzes.

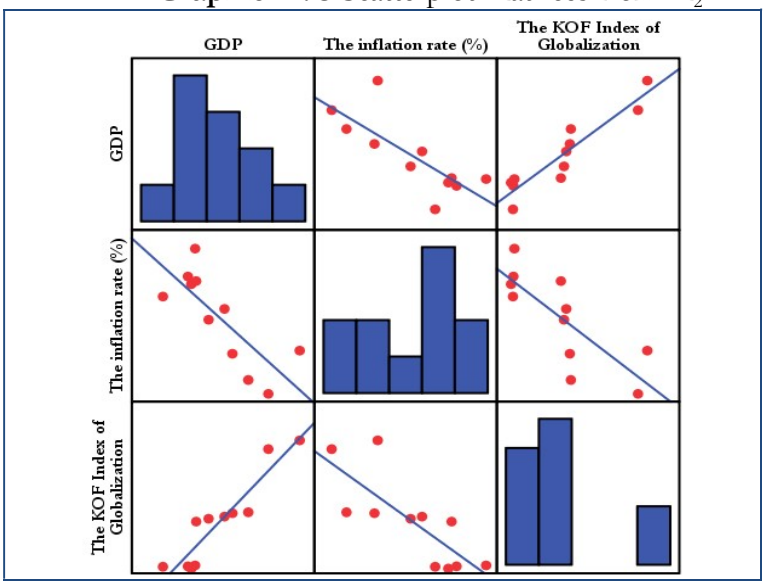
### 5.3. The Influence of GDP and Inflation Rate on the Composite Index of Globalization KOF

**Table 3.** The data set needed to analyze the correlations between the indicators

| Year | GDP (million RON) | Inflation Rate (%) | Composite Index of Globalization KOF[7] |
|---|---|---|---|
| 2007 | **116663.8** | **4.8** | **56.06** |
| 2008 | **141150.1** | **7.9** | **56.28** |
| 2009 | **138263.9** | **5.6** | **55.77** |
| 2010 | **135645.8** | **6.1** | **56.13** |
| 2011 | **141971.1** | **5.8** | **63.36** |
| 2012 | **151418.8** | **3.3** | **63.83** |
| 2013 | **163514.3** | **4** | **64.17** |
| 2014 | **169556.9** | **1.1** | **64.72** |
| 2015 | **181636.7** | **-0.6** | **64.87** |
| 2016 | **196917.4** | **-1.5** | **75.09** |
| 2017 | **220766.7** | **1.3** | **76.51** |

Observing the graphical representation of the link between GDP and the KOF Globalization Index, one can advance the hypothesis that there is a direct link between the two variables (the points are placed in the direction of the first bisector): while the independent variable increases (GDP) and the dependent variable (KOF globalization index) is increasing. We can see that indicators evolve according to similar trends, a fact that encourages the study of correlation through a dedicated software tool.

**Graphic nr. 3** Scatterplot Matrices from $M_2$



**Model Summary**

| | Multiple R | R Square | Adjusted R Square | Std. Error of the Estimate |
|---|---|---|---|---|
| $M_2$ | 0.936 | 0.876 | 0.845 | 2.85898 |

**Change Statistics**

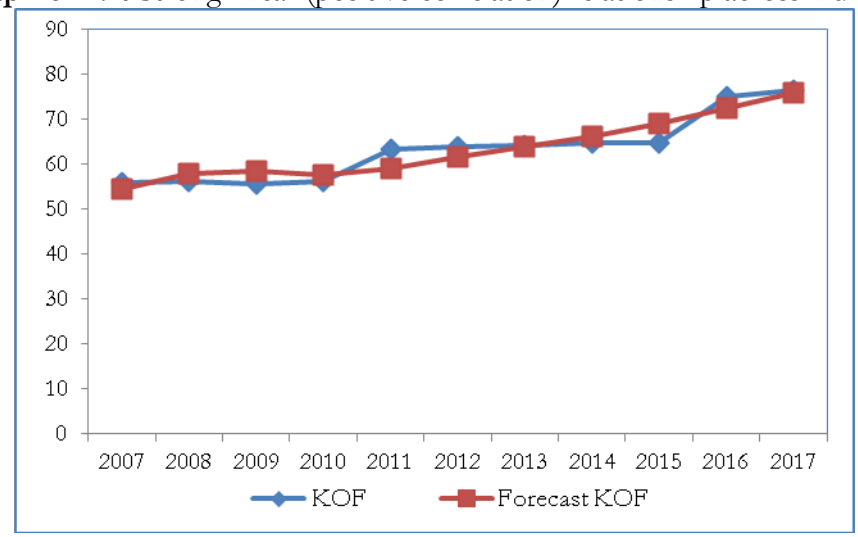
| | R Square Change | F Change | df1 | df2 | Sig. F Change |
|---|---|---|---|---|---|
| $M_2$ | 0.876 | 28.348 | 2 | 8 | 0.000 |

**ANOVA**

| | | Sum of Squares | df | Mean Square | F | Sig. F Change |
|---|---|---|---|---|---|---|
| $M_2$ | Regression | 463.427 | 2 | 231.713 | 28.348 | 0.000 |
| | Residual | 65.390 | 8 | 8.174 | | |
| | Total | 528.817 | 10 | | | |

The $M_2$ model, represented in Figure 3, has a confidence level of 93.6% and can be implemented in the macroeconomic analyzes performed and represents the best correlation and implicitly the interdependence between macroeconomic indicators Gross Domestic Product (GDP), Inflation Rate (IR) respectively, the KOF globalization indicator.

**Graphic nr. 4** Strong linear (positive correlation) relationship across indicators of $M_2$




Based on the data provided by the used computer system, we can write the regression model in the form:

$$KOF = 33.8609 + 0.0001926 * GDP - 0.3782 * IR$$

The model is feasible enough to be used in future analyzes.

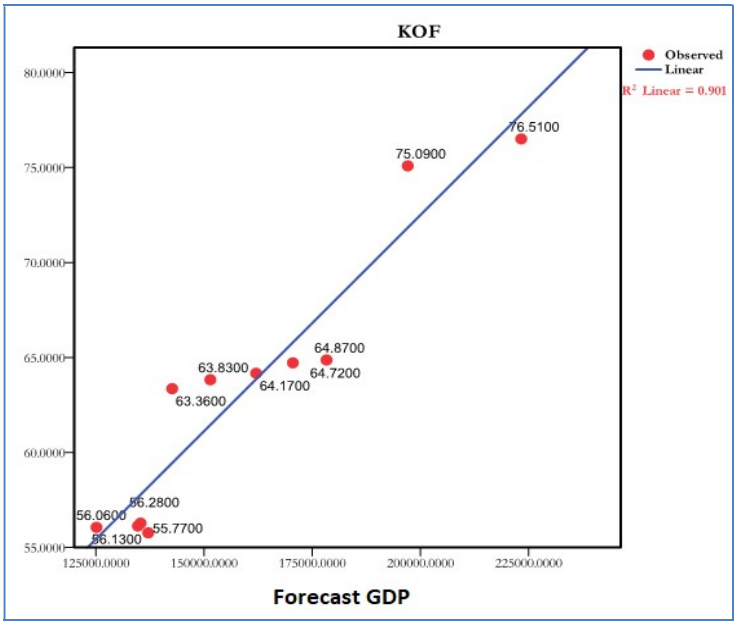
Returning to the results of the statistical tests carried out following the construction of the multiple linear regression model, we have to point out that the econometric model achieved is correct, fact confirmed by the result of the R-squared and Adjusted R-squared tests, which have higher values 0.87. Also, the Prob (F-statistic) test is zero. All these values confirm the model's feasibility.

## 5.4. The Influence of the FDI Indicator and the Forecast GDP on the Forecast Composite Index of Globalization KOF

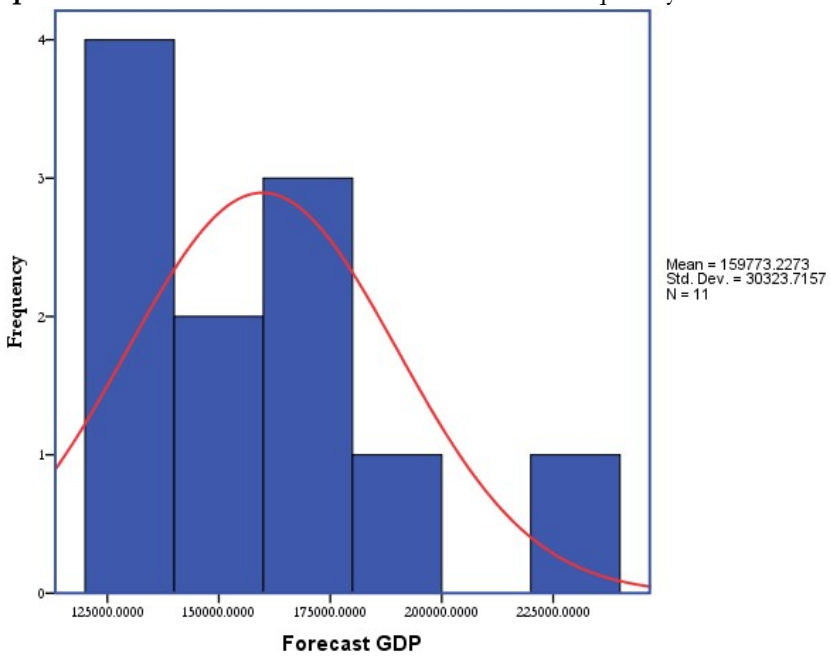
**Table 4.** Predictable economic forecasting GDP

| Forecast GDP | Inflation Rate (%) | Composite Index of Globalization KOF | Forecast KOF |
|---|---|---|---|
| 125130.066 | **4.8** | **56.06** | 54.52295108 |
| 135313.0528 | **7.9** | **56.28** | 58.06822919 |
| 137079.8131 | **5.6** | **55.77** | 58.38204531 |
| 134702.691 | **6.1** | **56.13** | 57.68851086 |
| 142621.4581 | **5.8** | **63.36** | 59.02066416 |
| 151441.7479 | **3.3** | **63.83** | 61.78648222 |
| 162030.0454 | **4** | **64.17** | 63.8521574 |
| 170519.249 | **1.1** | **64.72** | 66.11320509 |
| 178308.0303 | **-0.6** | **64.87** | 69.08357402 |
| 197065.172 | **-1.5** | **75.09** | 72.3680839 |
| 223294.1747 | **1.3** | **76.51** | 75.90409676 |

**Graphic nr. 5** The scatter chart how illustrate the degree of correlation, including a regression line



**Graphic nr. 6** Normal distribution chart of the frequency forecast GDP




## 6. Conclusions

Looking at the evolution of FDI flows in Romania in 2007-2017, the following conclusions can be drawn: 2007-2008: privatizations in the banking sector continued, and 2008 marks the maximum volume of foreign direct investments attracted in Romania, their value being 9,496 million EUR; 2009-2011: the volume of FDI has fallen dramatically compared to previous years, reaching 1,815 million EUR at the end of 2011, this decline being due to the economic and financial crisis; 2012-2017: FDI is rising at a constant rate from 2138 million EUR (2012) to 4586 million EUR (2017), which indicates the post-crisis economic and economic recovery period.

System parameters of multiple linear regression models allow extracts of useful conclusions. In the case of the first $M_1$ model, for the FDI factor, an increase in a unit of the indicator leads to an increase of almost one third of the Gross Domestic Product. Also, the net export of goods and services exerts a positive influence of over 40% on the main indicator analyzed. These values indicate the need to adopt measures in two directions: to increase foreign direct investment and export (considered as a distinct factor in this model).

In the case of the M2 model, for the GDP factor, an increase with a unit of the indicator leads to a slight increase in the KOF globalization index, while the inflation rate exerts a major negative influence of over 30% on the main indicator analyzed. These values indicate the need to adopt measures in two directions: to increase GDP and, respectively, to reduce the inflation rate.

Based on the results obtained with the M1 and M2 models, the dependence equation of the KOF globalization factor is obtained, based on the FDI index.

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