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ANALYSIS OF MACROECONOMIC FACTORS EFFECT TO GROSS DOMESTIC PRODUCT OF BOSNIA AND HERZEGOVINA USING THE MULTIPLE LINEAR REGRESSION MODEL

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ABSTRACT

This paper presents the application of the multiple regression analysis model in macroeconomic research using the model of Bosnia and Herzegovina in the period from 2005 to 2018. The objective of the research is to evaluate the effects of macroeconomic factors (independent variables) to gross domestic product (dependent variable), and based on theoretical and methodological research. Applying the Enter method, out of six independent variables, they are all included in the regression model, whereas the sequence of inclusion in the model is the following: foreign direct investments, Import, Export, Growth rate, unemployment and inflation. Numerous research indicate positive connection between gross domestic product as the dependent variable and foreign direct investments, Import, Export, Growth rate, unemployment and inflation, as independent variables. Other factors negligibly explain the most important indicator of economic activities of a country. Our assignment is to either confirm or reject the abovementioned statement.

Keywords:
Gross domestic product, multiple regression linear model, Enter method, determination coefficient.

JEL: C44

INTRODUCTION

Numerous factors have effect on economic growth and country development, and one of the most important ones is gross domestic product (GDP). On the other hand, many factors also influence the gross domestic product. The selection of these factors represents a subjective issue of the decision-maker and the analyst (researcher). Besides these, there are also other factors important for the functioning of economies: market openness, offer and demand for goods and services, unequal income distribution, population, political situation etc. Natural factors have equally important influence on economic growth: climate changes, diversification and sustainable development.
With the purpose of quantification of relation between economic growth and other macroeconomic indicators, we have selected extended multiple linear regression model by applying Enter method and regression procedures, as well as residual analysis. Enter method gradually includes independent variables, and then one by one variable is removed from the model (in accordance with the previously set criteria). The sequence of including independent variables in the model is determined by the contribution of each specific independent in the explanation of the variability of the dependent variable.

1. PREVIOUS RESEARCH

Economic growth includes the processes of implementing successful development strategies of a country and determines the level of its wealth. The issue of relation between export, foreign direct investments and economic growth has caused great attention and interest of both economists and creators of economic politics worldwide.
Regardless of the fact whether a country is developed, in transition or under-developed, market openness encourages economic growth (Etale, 2016).
When analysing the relations and possible effects of macroeconomic factors to GDP of the Western Balkans countries, it is necessary to define the ”new growth model” (Estrin and Uvalic, 2013). Taking into account unfavourable structure of foreign direct investments, export/import, instability of political and social circumstances, (non)compliance of the legislation with EU regulations and directives, as well as many other factors, one may not expect positive effects of analysed phenomena to GDP in a short period of time.
The conducted panel analysis (Mahmoodi, M. and Mahmoodi E., 2016) indicates long-term connection economic growth and export and foreign direct investments. Their results have indicated a long-term two-way connection between foreign direct investments, export and economic growth.
The results of research on the effect of foreign direct investments to economic growth of countries in transition (Nestorovic, 2015) based on regression analysis, show positive, but not statistically significant correlation between foreign direct investments and economic growth in the countries in transition.
To support this statement, we also point out the fact that the correlation between, for example, foreign direct investments and economic growth in negative, since the dominant form of foreign direct investments in the Western Balkan countries was acquisition. Acquisitions cannot be considered as investments into real property, since the sale income can be used for expenditure and investments, and in that way foreign direct investments cannot reflect on economic growth (Mencinger, 2003).

2. APPLIED METHODOLOGY

Gross domestic product (dependent variable) has been analysed, and which is in function of foreign direct investments, import, export, growth rate, unemployment and inflation, as independent variables, in Bosnia and Herzegovina in the period (from 2005 to 2018). The statistical data have

been retrieves from the Eurostat database. The analysis and model comparison is carried out by using the programme IBM SPSS Statistics 23.

2.1 DEPENDENT VARIABLE

Gross domestic product. GDP – gross domestic product represents the total value of all the final goods and services produced in a specific time period on a specific territory. GDP is stated in monetary units, and includes only goods and services intended for further processing and production. GDP indicates the measure of production activities and it is a generally accepted indicator of the condition of a specific economy.

2.2 INDEPENDENT VARIABLES

Foreign direct investments (FDI). Foreign investments include: foreign direct investments, joint investments, portfolio investments, concessions and other forms, such as: greenfield and brownfield investments, merging, absorptions etc.
GDP growth rate: Growth rate is the ratio between the GDP in the analysed year and the GDP in previous year, in current prices. Increase of GDP is mostly influenced by the growth of foreign trade balance, increase of export as opposed to import, and increase of consumption of the population.
Unemployment rate. It represents the participation of the unemployed in the total work power. Total work power represents the sum of employed and unemployed people, who are actively seeking work (aged between 17 to 74 years).
Export of goods and services. It includes transactions of goods and services from residents to non-residents. Export has positive effect on GDP growth, and it indicates the activity of domestic companies in the foreign market.
Import of goods and services. It includes transactions of goods and services from non-residents to residents. Export has negative effect on creating GDP because it decreases the positive effects of export and increases the dependency of one country on products from other countries.
Inflation. Inflation is measured using the index of consumer prices. The index of consumer prices measures the changes of average level of prices of products and services per main groups of products and services classified in accordance with their intention in consumption (personal consumption).

The selection of indicators has been carried out based on macroeconomic development indicators that are available on the website of the European Statistical Office1.

1 http://ec.europa.eu/eurostat.

3. APPLICATION OF MULTIPLE LINEAR REGRESSION MODEL: ANALYSIS OF BOSNIA AND HERZEGOVINA GDP

Data sources used for application of regression model
The analysis starts with specification of regression model elements which includes the selection of exogenous variables and functional model forms.

Table 1. Macroeconimic indicators of Bosnia and Herzegovina economy

	Nominal GDP	FDI	Import	Export	Growth rate	Unemployment	Inflation
2005	17.650,00	552,3	12611,18	5.910,82	5,1	509.224,00	3,8
2006	20.057,00	864,8	13183,18	6.010,82	5,4	519.224,00	6,1
2007	22.548,00	2.599,80	13.811,18	6.110,82	5,9	520.014,00	1,5
2008	25.519,00	1.337,50	16.058,45	6.851,45	5,4	477.609,00	7,4
2009	24.799,00	351,9	12.634,02	6.201,96	-3	510.534,00	-0,4
2010	25.365,00	599,7	13.730,68	7.532,26	0,9	522.989,00	2,1
2011	26.231,00	698,6	15.640,25	8.403,44	1	536.728,00	3,7
2012	26.222,70	601,1	15.577,04	8.483,19	-0,8	550.255,00	2,1
2013	26.778,80	700	15.297,22	9.035,97	2,4	553.481,00	-0,1
2014	27.358,70	811	16.523,27	9.296,53	1,1	547.134,00	-0,9
2015	28.589,10	636,9	16.319,44	9.969,31	3,1	537.568,00	-1
2016	29.904,50	564	16.832,09	10.659,83	3,1	512.496,00	-1,1
2017	31.376,20	777,7	19.160,91	12.574,50	3,2	478.191,00	1,2
2018	32.954,00	800	20.139,38	13.565,16	3,2	437.783,00	1,4

Results of applying the multiple linear regression model
Analysis of multiple linear regression model is carried out with the IBM SPSS software package of the latest version Statistics 23. From the exit results we pay attention to the key tables.

Table 2 Correlations, indicates the values of the Pearson correlation coefficient between all the variables. Import is in the strongest correlation with Export (-0,944), following GDP with Export (0,915), as well as GDP with Import (-0,895); and the weakest correlation is FDI with Import (-0,067).

Table 2.

		GDP	FDI	Import	Export	Growth rate	Unem-ployment	Inflation	
Pearson Correlation	GDP	1,000	-,196	-, 895	,915	-,257	-,332	-,501
	FDI	-,196	1,000	-,067	-,254	,575	-,104	,223
	Import	,-895	-,067	1,000	-, 944	,072	-,494	-,240
	Export	,915	-,254	,-944	1,000	-,064	-,403	-,454
	Growth rate	-,257	,575	,072	-,064	1,000	-,324	,463
	Unemploy-ment	-,332	-,104	-,494	-,403	-,324	1,000	-,274
	Inflation	-,501	,223	-,240	-,454	,463	-,274	1,000

We used the Enter method, where the initial situation implies that all independent variables are included in the model, without any restrictions. Then one by one variable is excluded from the model according to a predefined criteria that is related to the value of the F to removal statistics. The following table (Table 3) indicates that, according to the defined statistical criteria, all independent variables were retained in the regression model.

Table 3. Variables Entered/Removed[a]

Model	Variables Entered	Variables Removed	Method
1	Inflation, FDI, Import, Unemployment, Growth Rate, Export[b]		Enter

a. Dependent Variable: GDP
b. All requested variables entered.

We now move to Table 4, Summary Model, which provides key information about the validity of the regression model. Table 4 presents two regression models: the first model containing an independent variable and the second one with two independent variables.

Table 4. Model Summary[b]

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Change Statistics					Durbin-Watson
					R Square Change	F Change	df1	df2	Sig. F Change	
1	,966[a]	,932	,874	1459,59007	,932	16,097	6	7	,001	1,942

a. Predictors: (Constant), Inflation, FDI, Import, Unemployment, Growth rate, Export
b. Dependent Variable: GDP

Multiple correlation coefficient of the dependent variable (GDP) and independent variables (FDI, Import, Export, Growth rate, Unemployment, Inflation) is 0,966, meaning that their connection is very strong.
Determination coefficient is 0,932, meaning that 93,2 % of the variability of the dependent variable (GDP) could be explained by the effect of the independent variables (FDI, Import, Export, Growth rate, Unemployment, Inflation).
The value of the adjusted determination coefficient of 0,874 is close to the value of the regular determination coefficient (0,932), due to favourable ratio between the number of variables included in the model and the total number of observations.
Based on retrieved regression coefficients, our multiple linear regression model can be presented as it follows:

$$Y = A_0 + A_1X_1 + A_2X_2 + A_3X_3 + A_4X_4 + A_5X_5 + A_6X_6 + \varepsilon,$$

where:
dependent variable (in our example - GDP),
independent variables (in our example – FDI, Import, Export, Growth rate, Unemployment, Inflation),
Constant,
= unknown parameter with the independent variables (FDI, Import, Export, Growth rate, Unemployment, Inflation),
error which reflects all the influences on the dependent variable (GDP) that do not originate from the independent variables (FDI, Import, Export, Growth rate, Unemployment, Inflation)

Table 5 presents regular regression coefficients – under B and standardized regression coefficients under.

Table 5. Coefficients[a]

Model	Unstandardized Coefficients		Standardized Coefficients	t	Sig.	95,0% Confidence Interval for B		Correlations			Collinearity Statistics	
	B	Std. Error	Beta			Lower Bound	Upper Bound	Zero-order	Partial	Part	Tolerance	VIF
1 (Constant)	7476,930	11385,199		,657	,532	-19444,788	34398,648					
FDI	,639	1,282	,085	,499	,633	-2,391	3,670	-,196	,185	,049	,329	3,040
Import	1,333	,940	,733	1,418	,199	-,889	3,556	,895	,472	,139	,036	27,662
Export	,228	1,017	,135	,224	,829	-2,177	2,633	,915	,084	,022	,027	37,572
Growth rate	-468,346	242,380	-,290	-1,932	,095	-1041,485	104,792	-,257	-,590	-,190	,428	2,335
Unempl.	-,006	,017	-,045	-,337	,746	-,046	,034	-,332	-,126	-,033	,546	1,831
Inflation	-251,522	321,310	-,161	-,783	,459	-1011,299	508,255	-,501	-,284	-,077	,229	4,372

a. Dependent Variable: GDP

In our example, and based on retrieved regression coefficients, our regression model can be presented by the following equation:

$$Y = 7.476,93 + 0,639X_1 + 1,333X_2 + 0,228X_3 - 468,346X_4 - 0,006X_5 - 251,522X_6.$$

Apart from the written model, it can be further concluded that out of all the analyzed independent variables, Import has major effect on GDP, followed by FDI and Export.

CONCLUSIONS

Economic theory and practice do not know any unique set of indicators that affect GDP. The very complexity of this phenomenon relativises any attempt to establish an unchanged list of indicators. Therefore, in selection of these indicators is based on subjectivity of the authors. The actual number of indicators remains to be seen in the specific analysis, taking into account their interdependence and the occurrence of duplicity, since these two facts directly influence the selection of the optimal number of indicators.

With the purpose of quantification of relation between macroeconomic factors and GDP, we have used multiple linear regression model. The analysis showed that GDP with as much as 93.2% can be explained by the influence of independent variables: FDI, Import, Export, Growth rate, Unemployment, Inflation. Other factors negligibly (6.8%) explain the most important indicator of economic activities of a country.

Out of all the analysed independent variables, Import has major effect on GDP, followed by FDI and Export.

From the abovementioned we can confirm the set hypothesis of this paper that the selection of predictors defined in the multiple linear regression model is significant, in terms of Bosnia and Herzegovina GDP development over the observed period.

The research results may be useful to developers of economic policies for bringing the right decisions in solving external shocks and crisis, in order to focus their activities more precisely in the direction of economic growth and overall progress of Bosnia and Herzegovina economy.

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