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ECONOMIC GROWTH MODEL FOR BOSNIA AND HERZEGOVINA IN THE PERIOD 2007-2017 - OPPORTUNITIES FOR FUTURE RISKS REDUCTION -

МОДЕЛ ЕКОНОМСКОГ РАСТА ЗА БОСНУ И ХЕРЦЕГОВИНУ У ПЕРИОДУ 2007-2017 - ПРИЛИКЕ ЗА СМАЊЕЊЕ БУДУЋИХ РИЗИКА -

Summary: *The theory of the system indicates that the metastable state (state of the system described as a state which is close to the equilibrium state) will go into equilibrium if we wait long enough. The behavior of a particular system in the future depends on historical events, current and future shocks. In the equilibrium, all participants in economic life - economic agents are satisfied with their position, and economists call this a state of Nash equilibrium. The problem that we will deal with is the question of whether the economy of Bosnia and Herzegovina is in equilibrium, how to measure equilibrium, how to achieve stability and the balance of the system. The research will focus on productivity function for BiH, the concept of a potential gross domestic product, deviations in the nominal gross domestic product from the potential. We will analyze aggregate demand with the aim to define the model of economic growth of Bosnia and Herzegovina. We believe this knowledge will provide a basis that we believe can serve to create instruments, measures and policies that are needed to reduce future risks - deviations in economic growth.*
Keywords: *Econometrics, Capital, Modeling of Quantitative Policies, Simulation*
JEL classification: *N1, O4*

Резиме: *Теорија система указује да ће метастабилно стање (стање система описано као стање које је близу стању равнотеже) прећи у равнотежу ако чекамо довољно дуго. Понашање одређеног система у будућности зависи од историјских догађаја, тренутних и будућих шокова. У равнотежи, сви учесници у економском животу - економски чиниоци су задовољни својим положајем, а економисти то називају Нешовом равнотежом. Проблем којим ћемо се бавити је питање да ли је економија Босне и Херцеговине у равнотежи, како измјерити равнотежу, како постићи стабилност и уравнотеженост система. Истраживање ће се фокусирати на функцију продуктивности у БиХ, концепт потенцијалног бруто друштвеног производа, одступања номиналног бруто друштвеног производа од потенцијалног. Анализираћемо агрегатну тражњу са циљем дефинисања модела економског раста Босне и Херцеговине. Вјерујемо да ће ово знање пружити основе које по нашем мишљењу могу послужити за стварање инструмената, мјера и политика које су потребне за смањење будућих ризика - одступања у економском расту.*
Кључне речи: *економетрија, капитал, моделирање квантитативних политика, симулација*
ЈЕЛ класификација: *N1, O4*

1. INTRODUCTION

This research seeks to show the movement in the Bosnia and Herzegovina economic system for the period 2007-2017. We will integrate several different segments of the economy. The subject of observation will be: production function, potential GDP growth, and aggregate demand. The period to be monitored includes the period of availability of data and a period that is long enough to gain knowledge of the movement of given economic events, a

period that includes the cycle: contraction and expansion of the economy. Our goal is to create a model of economic growth and lay the foundation for further econometric, macroeconomic research, provide the basis for the adoption of measures, policies and decisions aimed at stabilizing the economy and mitigating the risks. By showing the production function, we determine the contribution of certain factors to the economic system. By introducing the concept of potential GDP and defining its movement, we identify the gap between actual and potential movement - output gap. Based on these deviations, we will determine the state of the economy and answer the question of whether the economic system is in the stage of contraction or expansion. System stability is achieved by reducing these deviations. After that we will analyze the aggregate demand and its components, since the implementation of short-term macroeconomic policies is most easily done through aggregate demand. On the basis of aggregate demand components, we will create Bosnia and Herzegovina's economic growth model for the period 2007-2017 in order to quantify relations and focus attention on the factors that contribute most to growth. We hope that this paper will generate new ideas and open new aspects for thinking about the economy of BiH.

2. RESULTS OF ANALYSIS

2.1. Production function

The first step in the analysis is the presentation of the production function. We will define the relations between the factors of production: labor - employment, capital and total factor productivity. The production function itself can be expressed by a relationship:

$$Y = TFP * f(K, L)$$

Where Y is gross domestic product, K - represents capital, L - represents the labor while TFP is our total factor productivity. In order to determine the degree of contribution of these factors and the efficiency in combining them, it is first necessary to estimate the initial level of capital. As an initial assessment, we will use the IMF's January 2017 research and the country-based capital base. In 2006, the ratio between the total amount of private and public capital in relation to GDP was 1.84. As initial capital, we took 2006 year, because on the basis of capital growth model, we will create the total amount of capital according to years.

The capital growth model will be shown by the following relations:

$$Kt = Kt\text{-}1 + I_t \text{ - DEPt respectively,}$$
$$Kt = Kt\text{-}1 * (1 - \square) + It$$

Where Kt is our capital in the year t and equals the capital of the previous year - Kt-1 increased for investments in that year - I_t was corrected for depreciation costs of DEP_t and depreciation rate $\square$. As a depreciation rate we will assume 4%. Our assumption is based on the average depreciation rate in the EU, ranging between 4% and 5.5% (IMF 2017). The question arises why we took 4%. The answer to this question lies in the assumption that the largest part of the public sector property in BiH is in fixed assets, as indicated by the data that can be seen in the Balance Sheet of the Consolidated Report of the Budget Users of Republic of Srpska in 2017 (GSR RS 2017). We used this report to define it as a sample for BiH, because we assume a similar relationship in the FBiH and Brčko District entities, although data is not available. The assumption it uses relates to the fact that private sector assets are on average similarly distributed as in the public sector with 95% of the fixed assets. We used the time series on employment in BiH as a variable L-work. The ratio of labor and capital to GDP creation depends on the elasticity of labor and capital. We have now Cobb-Douglas production function given with relation:

$$Y = TFP * K^{\alpha} * L^{1-\alpha}$$

That is characteristic of the United States. Below we will present the result of the contribution to the economic growth of BiH for the period 2008-2017.

Chart 1 Contribution to economic growth in BiH, period 2008-2017[1]
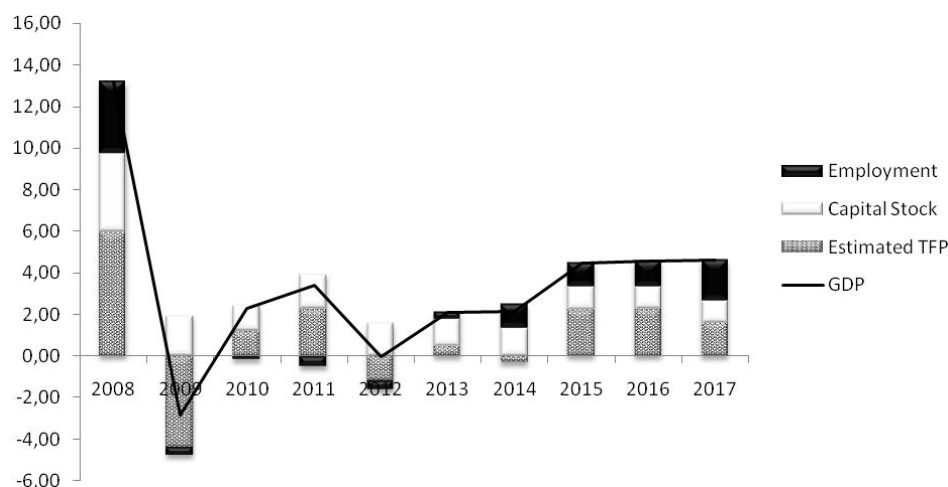
Source: Author's calculation

Based on the chart we can conclude that the greatest contribution is growth in investments, which increased the level of capital, the next component is the importance of the overall factor productivity and then the labor. In the period from 2009 to 2012, 10,500 jobs were lost in BiH. This period is the period in which job losses have adversely affected economic growth. The period 2014 to 2017 is the period in which 45,000 jobs were created in BiH, a period in which new jobs significantly influenced economic growth. The contribution of total factor productivity that represents efficiency in combining labor and capital in the observed period significantly oscillates (standard deviation is 3.06) as opposed to contribution to capital (standard deviation is 0.91) and contribution of labor (standard deviation is 1.16). Large oscillations in factor productivity can be the cause of external shocks (imports and exports) that have affected the employment and use of capital.

2.2. Potential GDP

A long-term sustainable, inclusive and stable level of economic growth is one of the priorities of economic policies. Such growth is called a potential GDP growth. This growth is the growth followed by a stable level of inflation, the natural rate of unemployment, full employment of capital. Economic growth oscillates above and below the potential level. The difference in oscillations between realized GDP and potential GDP is called the output gap.

Output gap of GDP is represented by a relation:

$$\text{Output Gap}_t = \frac{Y_t - Y_t^*}{Y_t}$$

Where: Y_t - realized GDP, Y_t^* - potential GDP. The concept of potential economic growth is inherently controversial, but is often used in policy making. The fact is that at the moment there is no better concept or alternative, and this concept puts it to the forefront. The existence of information on the movement of economic variables such as: the real level and growth of GDP, employment, level of capital and inflation enable the use of econometric-statistical methods to calculate potential growth. There are univariate methods (Linear trend,

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[1] For more details on the contribution to economic growth see Appendix Table 4

Hodrick - Prescott Filter[2] and Bend Pas filter), multivariate methods (production-based method, multivariate filters and DSGE models - Dynamic-Stochastic Equilibrium Model). Each of the exposed approaches has certain advantages and disadvantages. The most commonly used method is Hodrick - Prescott filter. Without going into the discussion of advantages and disadvantages in the analysis, we will use the most commonly used method on the time series on the annual movement of GDP and with the parameter λ-100. Based on this method we can present the actual and potential level and GDP growth for Bosnia and Herzegovina in the period 2007-2017.

Chart 2 Nominal and potential GDP
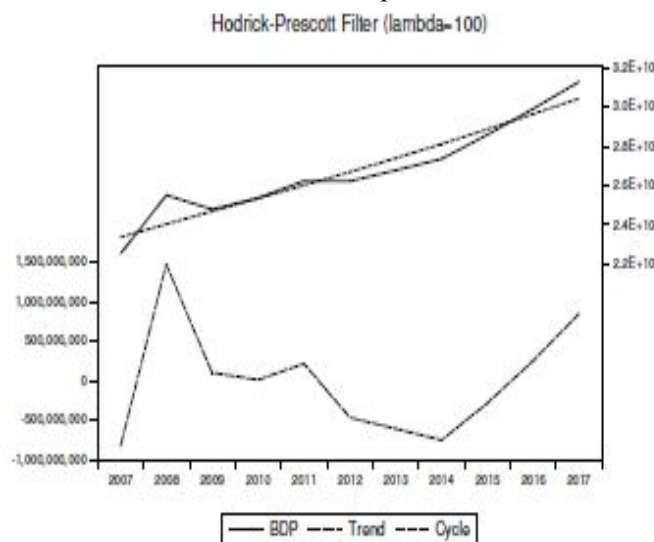
Chart 3 Growth rates of nominal and potential GDP
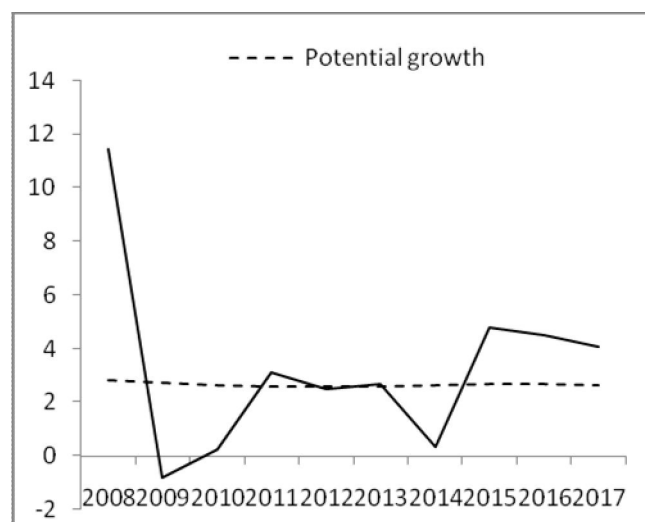
Source: Author's calculation

Based on the ratio of potential and actual GDP from the previous chart, we can conclude that the level of GDP from 2007 to 2009 was above the potential level. This is the period in which the economy was in the expansion, while the period from 2010 to 2012 is the period of GDP levels at the potential level. The period 2012 to 2015 is the period when GDP

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[2] More about the Hodrick-Prescott filter on the example of BiH can be found in the research: Bosnia and Herzegovina: calculation of the cyclically adjusted budget balance and assessment of fiscal policy stance

is below the potential level. This is a contraction period. From 2015 it can be argued that we are in the expansion. The nominal and potential growth rates are shown in Chart 3. The objective of these analyses and methods is to determine the position of the economic system in order to achieve stability and long-term sustainability. In the expansion stabilization policies involve restrictive measures and instruments aimed at destimulating further expansion, while in the contraction stage we need expansionary policies with the aim for stabilizing deviations from the expected values. The next subject of observation is the aggregate demand that we will analyze.

2.3. Analysis of aggregate demand

By analyzing aggregate demand as an important area of macroeconomic analysis, we strive to make the decomposition of its components. Managing short-term macroeconomic policies relies mainly on stimulating or destimulating its components. By analyzing the aggregate demand, we will acquire knowledge and create the prerequisite for influencing the oscillations of the economic system and the possibility of its stabilization. Starting from the basic formula of aggregate demand expressed by a relation:

$$AD = C + I + G + NX$$

where C - private consumption, I - investments, G – government consumption NX - net export (import - export) we will define the participation of individual components in aggregate demand. Then we will determine their relative growth by a relation:

$$\Delta AD = \Delta C + \Delta I + \Delta G + \Delta NX$$

$$\Delta - \text{component growth.}$$

Total private consumption in BiH in the observed period 2007-2017 ranged from 75.4% to 83% of GDP. Investments ranged from 15.9% to 22.6%, while government spending ranged from 19.7% to 22.6%. Private consumption has a declining trend as well as government spending as share in GDP. Below we will show the growth factor share table in the observed period.

Table 1 Sources of growth and share of individual components[3]

Average	Private consumption	Government consumption	Invest-ments	NPISD consumption	Net Export	Import	Export	Economy openness
2010-2007	81.8	22.2	20.4	0.8	-25.1	51.4	26.3	77.8
2011-2014	80.8	22.1	18.1	0.8	-21.8	53.5	31.7	81.6
2015-2017	76.5	20.4	19.1	0.8	-16.8	51.9	35.1	87.0
2007-2017	80.0	21.5	19.6	0.8	-21.9	52.5	30.6	83.2

Source: BiH Agency for Statistics, author's calculation

Private consumption gives the greatest contribution to economic growth - aggregate demand, which declined in the period of 2005-2017, followed by government consumption. Although investments in the period 2015-2017 increased in relation to the period 2011-2014, they are still below the long-term trend. The greatest contribution in the last three years is on the external position, export and import. Consequently, the openness of the economy has increased. Greater openness of the economic system implies a greater effect of external shocks on the domestic economic system.

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[3] For a more detailed individual component see Appendix Table 6

Chart 4 Graphic presentation of the sources of economic growth of Bosnia and Herzegovina
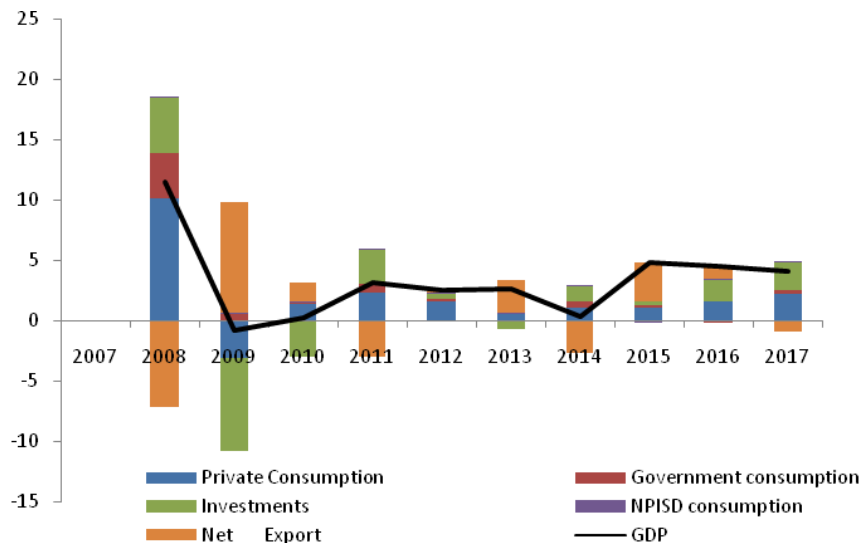
Source: BiH Agency for Statistics, author's calculation

From the previous chart we see the positive influence of private consumption on aggregate demand and, consequently, economic growth, and then the government consumption is important, after which there is a positive impact of net exports and investments. The most stable component is government spending, followed by private consumption, investments and net exports, which has the largest oscillations in the contribution of economic growth.

2.4. Economic Growth Model for Bosnia and Herzegovina

Based on the collected variables we used in the previous analysis we will approach the estimation of the models of economic growth. The model will be based on the variables we used in the analysis of aggregate demand. Although time series are short because they span a period of ten years, we will not test the time series on stationarity and we will not be able to test residual deviations. The best test of these models and predictions on the basis of them will give the time. Despite the limitations, we will strive to present, popularize and give the opportunity to its positive and negative criticism. As a dependent variable, we will observe a time series of GDP, and as independent variables we will observe time series of private consumption, government spending, investment, import and export. Time series will be presented as logarithms, and we can argue that the relations between variables are elasticity. Positive coefficients imply a positive influence (the growth of an independent variable causes the growth of the dependent and vice versa) given independent variables on the dependent variable, while the negative coefficients indicate the opposite movement, that is, the growth of a variable having a negative coefficient causes the fall of the dependent variable for the amount of the coefficient. We will display the results of the model in Figure 1. The model is represented by a relation:

$$y = b + b_1 x_1 + b_2 x_2 + b_3 x_3 + b_4 x_4 + b_5 x_5$$

Where y is dependent variable GDP, b - coefficients, x1 ...... x5 independent variables private consumption, government spending, investment, import and export.

Figure 1 Regression model using the OLS for Bosnia and Herzegovina in the period 2007-2017

Dependent Variable: BDP Method: Least Squares Date: 02/05/19 Time: 19:07 Sample: 2007 2017 Included observations: 11				
Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	0.155803	1.176907	0.132383	0.8998
PRIVATNAPOTROSNJA	0.945407	0.182199	5.188874	0.0035
POTROSNJA_DRZAVE	0.133027	0.088871	1.496849	0.1947
INVESTICIJE	0.205392	0.023315	8.809621	0.0003
UVOZ	-0.543038	0.029764	-18.24470	0.0000
IZVOZ	0.294037	0.025435	11.56022	0.0001
R-squared	0.999529	Mean dependent var		17.13633
Adjusted R-squared	0.999057	S.D. dependent var		0.090280
S.E. of regression	0.002772	Akaike info criterion		-8.635887
Sum squared resid	3.84E-05	Schwarz criterion		-8.418853
Log likelihood	53.49738	Hannan-Quinn criter.		-8.772696
F-statistic	2120.087	Durbin-Watson stat		1.700513
Prob(F-statistic)	0.000000			

Forecast: BDPF Actual: BDP Forecast sample: 2007 2017 Included observations: 11	
Root Mean Squared Error	0.001869
Mean Absolute Error	0.001484
Mean Abs. Percent Error	0.008644
Theil Inequality Coef.	5.45E-05
Bias Proportion	0.000000
Variance Proportion	0.000118
Covariance Proportion	0.999884
Theil U2 Coefficient	0.043494
Symmetric MAPE	0.008644

Source: Author's calculation

On the basis of the model by which we tried to explain the analyzed aggregate demand, we can conclude that the defined model describes the economic phenomenon very well because R^2 is 0,999. Statistically significant p-value variables are less than 1% for private consumption, investments, imports and exports. When comparing actual developments with the model, the conclusion that arises is that the economic movement described by the model coincides with the actual motion (comparing Actual - actual motion and Engaged Fitted - the movement described by the model.) We can also be satisfied that the average error of predicting the value of the variable is of the average real variable (Bias proportion) and what variations between predictions are far from variation in the actual time series (Variance proportion) at an exceptionally low level. While the parameter that measures the remaining non-systemic errors in the prediction (Covariance proportion) is close to 1. For each model, the tendency is that this parameter is as close as possible to the one. The findings we have come to indicate that the greatest effect on economic growth is private consumption where the coefficient is 0,94, followed by import by the coefficient -0,54, followed by exports with a coefficient of 0,29, investments with a coefficient of 0,21 and government consumption with a coefficient of 0,13.

3. CONCLUSION

The analysis we have implemented, the model we have created, should open the discussion and generate new ideas in managing the economy of Bosnia and Herzegovina. The conduct of economic policies should, as a rule, be the opposite of the phase of the cycle in which the economic system is located, i.e. it is necessary to conduct a countercyclical policy. In the contraction, it is necessary to lead an expansion, while in the expansion it is necessary to conduct a restrictive economic policy. Expansion involves raising the level of GDP above the potential level, while contraction increases the level of GDP below the potential level. However, previous research did not put the notion of potential GDP at the forefront. Although the notion of potential growth in a certain way is controversial, it will increasingly be the subject of observation. Although this is an assessment, as any assessment it is subject to criticism. However, at present, this is, according to the author of this paper, the greatest extent of economic thought on this issue. The fact is that the risk represents a deviation of the actual from the expected and risk management is to develop policies, instruments and measures that should reduce these deviations. For this purpose, the aggregate demand was analyzed and the economic growth model of BiH was created. Like any model, it is susceptible to forecasting errors, but based on available data, the number of deviations has decreased, and the accuracy measurements of the models are at a satisfactory level. According to the author's knowledge, this type of model is the first and unique in BiH, but certainly the development of other models and the comparison of several different models of economic growth in the future is needed for this society. It is encouraging that the number of jobs created at a record level was in 2017 with 746,332 workers, but the openness of the BiH economy is also at a record level of 91.7% of GDP. Openness of the economy implies openness to external shocks. Therefore, we believe that the above model can serve as an eventual response to possible external shock. Namely, in the last 10 years, the greatest contribution to economic growth is in private consumption where KM 1 in private consumption results in KM 0,94 of economic growth, then comes the slower growth of imports where KM 1 of export reduction increases economic growth by KM 0,54, then export with a coefficient from 0,29, investments with a coefficient of 0,21 and government consumption with a coefficient of 0,13. The fact that personal consumption expressed as a share of GDP is declining in some way is worrying because it is the biggest source of economic growth so far, the fact that investments and government spending have little effect leaves the possibility of analyzing the effects of these factors on economic growth. Because with the development of the economy, the share of personal consumption in GDP will decline, while growth factors will increasingly be on the side of investment, government consumption, imports and exports. In the case of external shock, stimulating consumption will rapidly stabilize the economy and stimulate its growth. Whether the stimulation of consumption is possible and in what way was not the object of observation in this research, but we believe that this research will awaken the interest in analyzing all these factors of economic growth and that the presented model will provide a good basis for the creation of future economic growth policies and the development of stabilization policies in economic growth, thinking in a new way and reducing future risks in the economy of Bosnia and Herzegovina.

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APPENDIX

Table 2 Production function components

Production function components			
Year	GDP	Capital stock	Investments	Employment
2007	22,548,000,000	40,997,115,955	5,760,978,355	668313
2008	25,519,000,000	46,181,035,087	6,823,803,770	701211
2009	24,799,000,000	49,160,028,098	4,826,234,414	697441
2010	25,365,000,000	51,242,792,666	4,049,165,693	695780
2011	26,231,000,000	54,064,008,227	4,870,927,267	690797
2012	26,222,710,000	56,892,540,389	4,991,092,491	686852
2013	26,778,753,000	59,412,081,956	4,795,243,183	690088
2014	27,358,710,000	62,079,428,541	5,043,829,863	701254
2015	28,585,811,000	64,328,516,718	4,732,265,318	713098
2016	29,900,000,000	66,691,881,893	4,936,505,844	725872
2017	31,283,000,000	69,127,411,487	5,103,204,870	746332

Source: Bosnia and Herzegovina Statistics Agency, author's calculation

Table 3 Growth of components of production function

Components growth			
Year	GDP	Capital stock	Employment
2007	12.42	11.70	2.02
2008	13.18	12.64	4.92
2009	-2.82	6.45	-0.54
2010	2.28	4.24	-0.24
2011	3.41	5.51	-0.72
2012	-0.03	5.23	-0.57
2013	2.12	4.43	0.47
2014	2.17	4.49	1.62
2015	4.49	3.62	1.69
2016	4.60	3.67	1.79
2017	4.63	3.65	2.82

Source: author's calculation

Table 4 Contribution to economic growth in BiH of total factor productivity, capital and labor

Contribution of TFP, K, L to economic growth				
Year	GDP	TFP	Capital stock	Employment
2007	12.42	7.50	3.51	1.42
2008	13.18	5.94	3.79	3.45
2009	-2.82	-4.38	1.94	-0.38
2010	2.28	1.18	1.27	-0.17
2011	3.41	2.26	1.65	-0.50
2012	-0.03	-1.20	1.57	-0.40
2013	2.12	0.46	1.33	0.33
2014	2.17	-0.31	1.35	1.13
2015	4.49	2.22	1.09	1.18
2016	4.60	2.24	1.10	1.25
2017	4.63	1.56	1.10	1.97

Source: author's calculation

Table 5 Components of aggregate demand in Bosnia and Herzegovina

GDP – expenditure level								
Year	GDP	Private consumption	Government consumption	Investments	NPISD consumption	Net export	Import	Export
2007	23,495,976	19,348,542	4,753,195	5,812,936	198,818	-6,617,515	12,728,335	6,110,820
2008	26,186,982	21,728,002	5,635,027	6,908,991	200,257	-8,285,295	15,136,742	6,851,447
2009	25,971,234	20,928,130	5,818,111	4,905,673	203,696	-5,884,376	12,086,332	6,201,956
2010	26,034,628	21,293,852	5,866,177	4,143,473	204,155	-5,473,029	13,005,289	7,532,260
2011	26,844,460	21,901,010	6,056,796	4,915,744	204,613	-6,233,703	14,637,143	8,403,440
2012	27,509,742	22,334,243	6,127,049	5,039,414	211,177	-6,202,141	14,630,848	8,428,707
2013	28,240,537	22,520,639	6,112,459	4,864,652	217,742	-5,474,955	14,510,923	9,035,968
2014	28,334,531	22,829,722	6,254,487	5,229,688	227,306	-6,206,672	15,504,193	9,297,521
2015	29,695,440	23,156,597	6,289,043	5,332,896	225,000	-5,308,096	15,244,294	9,936,198
2016	31,033,544	23,653,395	6,268,900	5,867,947	237,639	-4,994,337	15,617,766	10,623,429
2017	32,298,765	24,346,887	6,369,328	6,601,219	251,159	-5,269,828	17,449,926	12,180,098

Source: Bosnia and Herzegovina Statistics Agency

Table 6 Percentage share of components contribution to aggregate demand in Bosnia and Herzegovina

Percentage share of components in GDP								
Year	GDP	Private consumption	Government consumption	Investm-ents	NPISD consumption	Net export	Import	Export
2007	100	82.3	20.2	24.7	0.85	-28.2	54.2	26.0
2008	100	83.0	21.5	26.4	0.76	-31.6	57.8	26.2
2009	100	80.6	22.4	18.9	0.78	-22.7	46.5	23.9
2010	100	81.8	22.5	15.9	0.78	-21.0	50.0	28.9
2011	100	81.6	22.6	18.3	0.76	-23.2	54.5	31.3
2012	100	81.2	22.3	18.3	0.77	-22.5	53.2	30.6
2013	100	79.7	21.6	17.2	0.77	-19.4	51.4	32.0
2014	100	80.6	22.1	18.5	0.80	-21.9	54.7	32.8
2015	100	78.0	21.2	18.0	0.76	-17.9	51.3	33.5
2016	100	76.2	20.2	18.9	0.77	-16.1	50.3	34.2
2017	100	75.4	19.7	20.4	0.78	-16.3	54.0	37.7

Source: author's calculation

Table 7 Components growth of aggregate demand in Bosnia and Herzegovina

Components growth					
Year	GDP	Private consumption	Government consumption	Investments	Net export
2008	11.5	10.1	3.8	4.7	-7.1
2009	-0.8	-3.1	0.7	-7.7	9.2
2010	0.2	1.4	0.2	-2.9	1.6
2011	3.1	2.3	0.7	3.0	-2.9
2012	2.5	1.6	0.3	0.5	0.1
2013	2.7	0.7	-0.1	-0.6	2.6
2014	0.3	1.1	0.5	1.3	-2.6
2015	4.8	1.2	0.1	0.4	3.2
2016	4.5	1.7	-0.1	1.8	1.1
2017	4.1	2.2	0.3	2.4	-0.9

Source: author's calculation