MONEY SUPPLY, INFLATION AND ECONOMIC GROWTH IN BOSNIA AND HERZEGOVINA: AN EMPIRICAL ANALYSIS

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ABSTRACT

The analysis of monetary variables and their impact on the economic growth rate has always been in the focus of economic research. In the broadest sense, economic theory distinguishes two basic views defined by the views of monetarists and Keynesians. Although the basic difference is reflected in the determination of price rigidity and money neutrality, specifics of modern economic systems shift the focus towards the positive influence of monetary on real variables. The aim of our research is to identify and quantify the impact of monetary variables on economic growth in Bosnia and Herzegovina. The research was conducted using data from the period 2000-2020. The paper starts with the hypothesis that money supply and inflation ultimately have a positive impact on the real economic growth in BiH. The money supply M2 and the annual inflation rate are taken as explanatory (monetary) variables in the research, while real growth is a dependent variable. The long-term relationship between monetary variables and real growth rates was tested, taking into account the specificity of the BiH monetary arrangement established in the form of a currency board. In order to prove the hypothesis, we applied econometric techniques such as VEC model, cointegration analysis, innovation analysis based on the impulse-responsive function, decomposition variance as well as a causality test. The research results showed the connection between the money supply and the inflation rate with the economic growth in BiH, the relation being positive and statistically significant in the long run. With this, we confirmed the initial hypothesis of the work.

1. INTRODUCTION

Thinking about economic growth and what it represents (being the increase of the domestic product), the question of different determinants in its realization arises. Among other things, the variables that determine economic growth can be observed through real variables, such as investment, consumption, imports and exports. However, economic growth is not achieved only through real variables. The economic system of each country consists of a real sector that creates added value, but also of financial and monetary institutions that ensure the normal functioning of the entire economic system of a country.

Takahashi (1971) concludes that monetary and institutional variables, the money supply growth rate, the ratio of supply and monetary base, and the rate of required reserves on deposits affect the long-term equilibrium of real variables. Economic growth cannot be achieved without an adequate money supply, loans and adequate financial conditions in general. For some researchers, the degree of development in the financial sector is a key factor of economic growth (Levine, 1997; King & Levine, 1993; Demirguc-Kunt & Maksimovic, 1998). There are a number of relevant papers that have explored the relationship between money supply and its impact on growth rates in particular (Barro, 1977, 1978; Mishkin, 1982; Frydman & Rappoport, 1987). Most studies are focused on showing the long-term neutrality of money (Asongu, 2014), but the impact of monetary policy on real variables and primarily output remains at the center of research (Walsch, 2003). Lu et all. (2016) show that the connection between the fictitious and the real economy is getting closer.

When considering the effects that fictitious variables have on real variables, i.e. the growth rate, there are two opposing views. The first one comes from the supporters of monetarism and confirms the connection between the money supply and economic growth. This view is based on the quantitative theory of money. The view of monetarists says that nominal income is a function of the money supply (Friedman & Schwartz, 1963; Friedman, 1968). By observing it through Fisher's equation, one can see in perspective the theory of monetarists who point to the connection between money supply and economic growth. Monetarists' opinion, based on the quantitative theory of money, says that with constant turnover the money supply growth leads to higher prices and lower interest rates. At the same time, interest rates are lower than profit rates, which increases investment and consumption, leading ultimately to increased production. Fridman & Schwartz (1963) concluded that changes in the money supply lead to corresponding changes in output 2 quarters in advance.

Opposite the monetarists is the Keynesians' point of view, which begins with the assumption that the economy is in a state in which it does not employ factors of production, so it is necessary to intervene on the side of raising aggregate demand in order to achieve higher production. Keynesians assume that there is a neutrality in the money supply. Money neutrality implies that the money supply does not affect real output (Lewis & Mizen, 2000). The money supply in the long run is inflationary and neutral (Bernanke & Mihov, 1998; Bullard, 1999; Nogueira, 2009; Gali, 2008; Mankiw & Taylor, 2007). Evans (1996) reveals that money is neutral in the case of exogenous growth. In the absence of nominal price rigidity, a change in money supply leads to changes in prices without affecting real variables (Romer, 2012).

The aim of this research is to identify and quantify the impact of monetary variables on the economic growth in Bosnia and Herzegovina. The research was conducted on the basis of data from the database of the Central Bank of Bosnia and Herzegovina for the period from 2000 to 2020. The money supply M2 and the annual inflation rate are considered the explanatory (monetary) variables in the research, while real growth is dependent. This paper will test the long-term relationship between monetary variables and real growth rates. Along with that, the paper will review the specifics of the monetary system in Bosnia and Herzegovina, which operates on the monetary board basis. Using the relevant literature and research results, we try to confirm the hypothesis: ultimately there is a positive link between money supply, inflation and real economic growth in Bosnia and Herzegovina.

2. EMPIRICAL RESEARCH

There have been numerous written works showing a wide range of research related to the impact and effects of monetary variables on economic growth. Thus Cover (1992) shows that the positive effects in the money supply have no effects on output, while the negative ones do. McCandless & Weber (1995) confirm the link between monetary base growth and inflation. Based on quarterly data from 1999 to 2012 related to Turkey, Bozkurt (2014) showed that inflation depends on the money supply and the turnover cycle. Blinov (2017) concludes that economic growth depends on the growth rate of money supply and the inflation rate. Barro (2013) comes to the results according to which the growth of inflation means a decrease in domestic product per capita and a decrease in the share of investments, with other factors unchanged. Amiri & Gang (2018) used the example of the USA to investigate the impact of monetary policy on economic growth based on available data from 1970 to 2016. This research showed that

inflation has a positive effect on the growth rate in the short, medium and long term.

Agbonlahor (2014) investigated the long-term impact of monetary variables on economic growth on the example of Great Britain in the period from 1940 to 2012. The research confirmed the long-term link between monetary variables and economic growth. George (2018), based on research conducted for the period from 1985 to 2016 on the example of Nigeria, concludes that inflation has an inverse effect on economic growth. Sequeira (2021) confirms that inflation has a negative impact on economic growth. Hu et al. (2021) confirmed the negative effects of inflation on economic growth. Precious & Palesa (2014) confirm the long-term link between monetary variables and real growth on the example of South Africa, based on research conducted for the period 2000-2010. Mahara (2021) investigated the relationship between money supply, capital expenditures and economic growth on the example of Nepal. Research has shown that there is a long-term stable relationship between money supply, capital expenditures and growth. Also, the paper confirms the causal impact of money supply and capital expenditures on economic growth.

Kausar et al. (2020) investigated the impact of money supply on domestic product on the example of Pakistan. Their dynamic ARDL model was set up to examine the regularity between the observed variables based on time series spanning from 1972 to 2018. This research showed that the money supply, capital investments and labor supply have a positive impact on the movement of the domestic product. Srithilat & Sun (2017) conclude that changes in the money supply can have negative consequences for the economic development of a country. Adaramola (2020), based on research conducted on Nigeria's example, shows that inflation and the exchange rate have a negative impact on domestic product movements, while money supply and interest rates have a positive impact. Dingela & Khobai (2017) confirmed the impact of money supply on long- and short-term economic growth according to research conducted on series from 1980 to 2016 in South Africa.

2.1. Monetary system in Bosnia and Herzegovina

The monetary system in Bosnia and Herzegovina was established on the basis of the Dayton Peace Agreement, which also regulated the political structure of the state itself. On the basis of this agreement, the Central Bank of Bosnia and Herzegovina (CBBH) was established, and it operates on the principles of the classical currency board. A key role in the formation of the CBBH was played by the International Monetary Fund, which advocated the view that emerging

markets should have such an exchange rate regime that will allow predictability of the exchange rate (Doyle et al., 2005). The CBBH possess the three most important characteristics of the currency board, namely a fixed exchange rate against the replacement currency, full coverage of domestic money with reserves, and free convertibility of domestic money into the replacement currency at a fixed exchange rate. The country in which the currency board arrangement is established chooses one of the leading currencies to ensure the stability of the domestic currency, while it is also the currency of the country that is the most important trading partner (Frank, 2004). In Bosnia and Herzegovina, the national currency convertible mark BAM) is firmly pegged to the euro, with an exchange rate of 1.95583 BAM to 1 euro. The currency board arrangement implies that there is full coverage of the domestic currency (BAM) with the reserve currency, while in the case of Bosnia and Herzegovina there is an obligation to hold an additional reserve of foreign currency. Therefore, the functions of the CBBH as a classic currency board differ from "normal" central banks that have independence in conducting the country's monetary policy. The only monetary policy instrument available to the CBBH is the required reserve, by which the bank regulates the rate of banks on deposits that they must keep in reserves.

The main advantages and benefits of monetary committees are monetary discipline and the reduction of inflation, given that the discretion of monetary authorities is limited by the rule which makes it impossible to expand the monetary base beyond the level of foreign exchange reserves. Monetary discipline is also related to fiscal discipline, as deficit financing of budget spending is not allowed, which implies macroeconomic stability as a result of a sound economic policy. The currency board is considered to signal great credibility to market participants, thus attracting foreign capital and being immune to speculative attacks (Becker, 2006). The fixed exchange rate and disabling of speculations, cancel foreign exchange risk and thus enhance the effect of direct foreign investment and a favorable climate for new capital investment. Another view which is in defence of the fixed exchange rate regime is its usefulness for developing countries, assuming that monetary and fiscal stability bring the credibility they need, given their dependence on international trade and international capital markets (Calvo & Reinhart, 2000).

In addition to the above advantages, the currency board arrangement has all the shortcomings that are consciously accepted with the choice of this model of monetary policy management as the imperfections that the fixed exchange rate undoubtedly has. The absence of discretionary monetary policy through the fixed exchange rate which the monetary board rests on, further reduces the room

for maneuvering in any macroeconomic adjustments, because there is no change in the exchange rate (Topić-Pavković, 2014).

In the conditions of the monetary board, there may be a need to change the established exchange rate, which can realistically become overestimated. This is due to inflationary inertia, as a rule, but also due to the fact that domestic prices, even in a fixed exchange rate, are rising and trying to gradually adjust to prices in reserve currency countries. The overestimated exchange rate will result in a decrease in the country's international competitiveness with the monetary board and will cause significant foreign trade problems and slow economic growth. (Dušanić & Špirić, 2009). According to Roubini (1998), fixed exchange rates, and in particular currency board arrangements, are associated with real currency appreciation, loss of competitiveness, and deterioration of trade balance and current accounts.

2.2. Overview of macroeconomic indicators in Bosnia and Herzegovina

Bosnia and Herzegovina is a small country with a transition economy that operates on the basis of a complex political organization with significant constraints on the economic system and its prosperity, and as such it is far below the average economic growth of European countries. Political instability and the complex political and ethnic structure are in conflict with the realization of economic development of this area. The following table shows the development of certain macroeconomic indicators in Bosnia and Herzegovina for the period from 2000 to 2020:

Table 1: Gross domestic product, money supply and inflation rates from 2000 to 2020

Year	Real GDP growth	GDP per capita at constant prices	GDP amount in billions of BAM	Money supply - M2 in millions of BAM	CPI with base in 2015	CPI percentage changes
2000	4.442	4874.44	18.284	2467.3	75.534	4.973
2001	2.362	4984.268	18.716	4669.3	77.96	3.212
2002	5.053	5230.566	19.662	5071.3	78.204	0.313
2003	3.858	5430.938	20.42	5496.1	78.632	0.547
2004	6.257	5766.16	21.698	6831.6	78.853	0.282
2005	4.236	6005.605	22.617	8075.1	81.678	3.582
2006	5.691	6344.025	23.904	9901.8	86.681	6.125
2007	5.979	6734.067	25.334	11953.2	87.982	1.501
2008	5.594	7125.9	26.751	12439.3	94.516	7.427
2009	-0.816	7101.815	26.532	12709.1	94.156	-0.381
2010	0.767	7218.129	26.736	13627.1	96.155	2.124
2011	0.908	7371.251	26.979	14417.4	99.991	3.989

Year	Real GDP growth	GDP per capita at constant prices	GDP amount in billions of BAM	Money supply - M2 in millions of BAM	CPI with base in 2015	CPI percentage changes
2012	-0.707	7430.803	26.788	14909.7	102.044	2.053
2013	2.351	7740.779	27.418	16093.6	101.949	-0.093
2014	1.148	7964.563	27.733	17268.9	101.034	-0.897
2015	3.088	8337.432	28.589	18647.2	100	-1.023
2016	3.146	8708.909	29.488	20197.6	98.416	-1.584
2017	3.176	9073.903	30.425	22116.3	99.213	0.81
2018	3.740	9498.257	31.563	24191.1	100.619	1.417
2019	2.831	9832.247	32.456	26332.7	101.182	0.559
2020	-4.327	9469.885	31.052	28249.0	100.117	-1.052

Source: The Central Bank of Bosnia and Herzegovina and the International Monetary Fund

From the table above we can see that over the last 20 years the value of domestic product per capita in Bosnia and Herzegovina has doubled. With 4.8 thousand BAM of GDP in 2000, the value of domestic product per capita in 2019 was 9.8 thousand BAM, while in 2020 this level was reduced as expected. It can also be seen that the total domestic product value has grown from around 18 billion BAM since the beginning of the observed period, reaching a level of over 32 billion BAM in 2019. The GDP growth was accompanied by the growth of money supply, which is clearly visible in the money supply M2 increasing by seven times in 2020 compared to 2000, while the inflation rate remained relatively low over the observed period. Specifically, the average inflation rate during the observed period was 1.6%, and if the crisis years were to be put aside, this average inflation rate would be even lower.

3. MATERIALS AND METHODS

Starting from the subject and goal of the research, which is quantifying the impact of money supply (M2) and inflation rates on the real growth rate, the basic model that will be used in the empirical research is given in the following form:

$$GDP = f\left(MS, INF\right) \tag{1}$$

where is the real growth rate of the gross domestic product, is the money supply M2 and *INF* is the annual inflation rate. The impact of inflation and money supply on the real growth rate in Bosnia and Herzegovina in the period from 2000 to 2020 is analyzed on the basis of the Vector Autoregressive Model (VAR).

The specification and description of the variables in the model are given in the following table:

Table 2: Specification of research variables

Variable	Type	Label	Source	Description
Real GDP growth rate	Dependent	GDP	International Monetary Fund	The real GDP growth rate is given as a percentage
Money supply M2	Independent	MS	Central Bank of Bosnia and Herzegovina	The money supply uses the logarithmic transformation of the original data in millions of BAM
Annual inflation rate	Independent	INF	International Monetary Fund	The annual inflation rate is given in levels

Source: Authors' review

The application of the VAR model in economics has gained particular importance since the appearance of the works of Granger and Newbold (1974) who pointed to the problem of false regression. The conclusion is that the similar nature of a trend in an observed time series cannot predict a long-term relationship between the observed phenomena (Granger & Newbold, 1976). With the VAR model, we create a vector of endogenous variables that will enable the regression of each of the variables, i.e. the regression to the current and previous values of the explanatory variables in the model. Mathematically, we write the VAR model of order as:

$$y_{kt} = \phi_0 + \phi_1 y_{1t-1} + \phi_2 y_{2t-2} \ldots + \phi_k y_{kt-p} + \varepsilon_t \qquad (2)$$

where the is a vector of endogenous variables , or otherwise , is the matrix vector of dimensional constants , to matrices of the dimensions coefficients , and is the vector of the white noise process with which the expected value of variance is and whose variance and covariance are constant .

If the time series are not stationary in levels, then the VAR model is not applied. Instead, the Vector Error Correction Model (VECM) is used. This model observes the existence of a long-term cointegration relationship between the observed variables. If there is a cointegration relationship between the variables then we form a vector model of error correction (VECM) which is represented in the following form:

$$\Delta Y_t = \Pi Y_{t-1} + \sum_{i=1}^{p-1} \Gamma_i^* \Delta Y_{t-i} + \varepsilon_t \qquad (3)$$

According to the above relation, the Π matrix consists of the matrix of the adjustment parameter α and the matrix of cointegration vectors β. From relation (2) it can be seen that the formation of a linear process based on these vectors implies that the first difference of vector Y_t is stationary, i.e. I(1). These cointegration vectors form the basis for forming a long-term relationship between the observed variables. It is the testing of the coefficients that is the subject of Johansen's cointegration test. This cointegration test assumes testing of variables in levels, not in differences.

4. RESULTS AND DISCUSSIONS

As previously emphasized, the condition for applying the VAR model is that all time series are stationary in levels, otherwise we test only the existence of a cointegration relationship between variables that can be treated as long-term and create a model with error correction. In this paper, we apply the extended Dickey-Fuller test and the Philips-Perron test to check the stationarity of time series in levels and after the first derivation. The results of the ADF test are given in the following table:

Table 3: Results of the Dickey-Fuller stationarity test

Series		Critical values of the ADF test	p-value
GDP	Levels	-2.463	0.340
	The first difference	-4.800	0.006
MS	Levels	-6.772	0,000
	The first difference	-2.425	0.353
INF	Levels	-3.919	0.030
	The first difference	-6.946	0.000

Source: Authors' calculations

As shown in the previous table, the results of the ADF test say that the GDP variable is non-stationary in levels, while it becomes stationary after the first derivation, i.e. it is I(1) at the significance level of 1%. The variables M2 and INF are stationary in levels, i.e. I(0) at the significance level of 1%, MS is non-stationary after the first derivative, while the INF variable is stationary even after differentiation. Constant and trend were used in the analysis of stationarity. The results of the PP stationarity test do not deviate greatly from the previously obtained results of the ADF stationarity test:

Table 4: Results of PP stationarity test

Series		Custom t-statistics	p-value
GDP	Levels	-1.757	0.389
	The first difference	-4.816	0.001
MS	Levels	-4.067	0.005
	The first difference	-7.591	0.000
INF	Levels	-3.468	0.020
	The first difference	-7.986	0.000

Source: Authors' calculations

The results of stationarity tests indicate that due to the lack of stationarity in the levels of the GDP variable it is impossible to use the VAR model, therefore the existence of cointegration relationship between the observed variables must be examined to further inspect the possibility of developing error-correcting models. Before testing the existence of a cointegration relationship, the optimal number of previous values on the basis of which the cointegration between variables is tested must be determined. AIC, HQ, FPE, LR and SC were used as information criteria for selecting the optimal shift length. The following table shows the results of testing the optimal number of previous values based on the observed criteria for a maximum of three shifts:

Table 5: Selection of the optimal number of previous values

Lag	LogL	LR	FPE	AIC	SC	HQ
0	-91.25168	NA	7.093094	10.47241	10.6208	10.49287
1	-45.42574	71.28481	0.121193	6.380637	6.974219	6.462484
2	-26.89862	22.64426*	0.046796*	5.322069*	6.360836*	5.465301*
3	-23.21449	3.274779	0.1135	5.912721	7.396674	6.117338

Source: Authors' calculations

Five information criteria suggest that for the optimal number of shifts for the observed time series, two previous values should be taken. Implicitly, based on these results, Johansen's cointegration technique is used to determine the existence of a cointegration relationship between the observed variables, and in testing this relationship, we use two previous values of the variables. Johansen's cointegration test uses the trace test and the largest characteristic root test to determine the cointegration relationship between variables. The results of the Johansen cointegration test are shown in the following table:

Table 6: Results of the Johansen cointegration test

Zero hypothesis	Alternative hypothesis	Test statistics	Critical values	p-value
Trace test				
r = 0	r ≤ 1	38.86684	29.79707	0.0035
r = 1	r ≤ 2	10.75995	15.49471	0.2267
r = 2	r ≤ 3	4.96848	3.841466	0.0258
Test of the largest characteristic root				
r = 0	r = 1	28.10689	21.13162	0.0044
r = 1	r = 2	5.791473	14.2646	0.6401
r = 2	r = 3	4.96848	3.841466	0.0258

Source: Authors' calculations

Based on the previously presented results of Johansen's cointegration technique, or rather, based on the trace test and the test of the largest characteristic root, we reject the null hypothesis (r=0) which suggests that a cointegration relationship between the observed variables doesn't exist, and we conclude that at 1% level of significance, there exists a long-term link between real growth, money supply (M2) and inflation rates.

According to what was found through previously performed cointegration tests, we can conclude that there is one cointegration equation that testifies to the long-running relationship between real growth rate (GDP), money supply M2 (MS) and inflation rates (INF). The normalized cointegration equation that shapes this long-term relationship based on the VECM model and previously calculated coefficients using the E-Views 10 statistical software is given in the following equation:

$$GDP_{t-1} = 11{,}513 + 1{,}426\,MS_{t-1} + 0{,}739\,INF_{t-1} \tag{4}$$

The previously defined cointegration equation shows that the long-term relationship between inflation and money supply, on one hand, and the real growth rate, on the other hand, is positive. In other words, the results suggest that an increase of 1% in the money supply will increase the real growth rate by 1.43% in the long run, while an increase of 1% in inflation implies an increase of 0.74% in the growth rate.

The cointegration equation can be observed in a system with three previously defined variables that are the subject of research:

$$\begin{aligned}\Delta GDP = {} & -0{,}07 * [GDP_{t-1} - 1{,}43\,MS_{t-1} - 0{,}74\,INF_{t-1} - 11{,}51] \\ & - 0{,}22\,\Delta GDP_{t-1} + 4{,}73\,\Delta MS_{t-1} - 0{,}21\,\Delta INF_{t-1} - 1{,}01\end{aligned} \tag{5}$$

If we look at the previous system, we see that the degree of adjustment of the system at equilibrium is 7%. If the system is imbalanced when the GDP variable is above equilibrium in the current period, this implies that the independent variables MS and INF must be increased in the coming period in order for the system to return to the equilibrium. Coefficients that speak of the short-term effects of independent variables on the dependent one say that the impact of money supply is positive in the short run, meaning an increase in money supply M2 of 1% in the short term will imply a 4.73% increase in the GDP. The impact of inflation on the movement of the real growth rate is negative, evident in how in the short term an increase in inflation of 1% will mean a decrease in the real growth rate by 0.21%.

In the continuation of the research, we will test the causal relationship between the previously described variables in the system. The existence of a causal relationship between the observed variables will be examined on the basis of the causality test proposed by Granger (1969). This test reveals the existence of a short-term causal relationship between observed variables. One of the anomalies of this causality test is its inability to observe a long-term relationship (Toda & Philips, 1993; Toda & Yamamoto, 1995). When there is a cointegration relationship between variables, it is recommended that causality be tested on the VECM model (Granger, 1988). Therefore, the block test is most often used to detect a causal relationship in the model already described. The following table shows the results of Granger causality testing in our model:

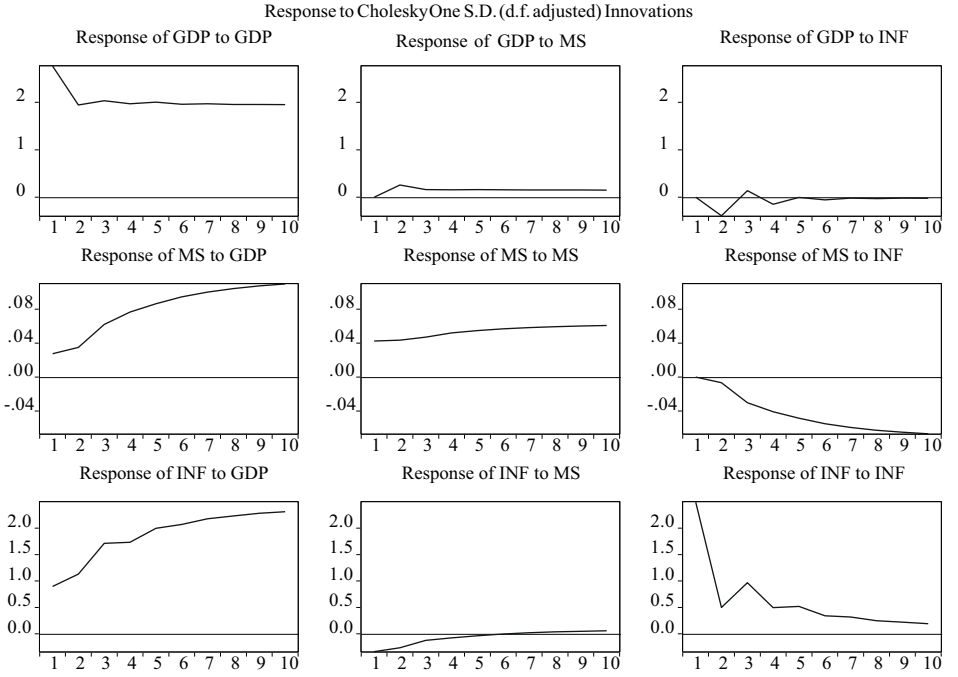
Table 7: Results of the Granger causality test

Zero hypothesis		p-value	Causality test result
MS does not cause GDP	0.920445	0.3374	The money supply does not cause a growth rate
INF does not cause GDP	0.764387	0.382	The inflation rate does not cause a growth rate
MS and INF do not cause GDP	1.605347	0.4481	The money supply and the inflation rate together do not cause a growth rate
GDP does not cause MS	2.724797	0.0988	The growth rate does not cause a money supply
INF does not cause MS	3.510746	0.061	Inflation does not cause money supply
GDP and INF do not cause MS	4.301937	0.1164	Growth rate and inflation rate do not cause money supply
GDP does not cause INF	0.185281	0.6669	The growth rate does not cause the inflation rate
MS does not cause INF	0.647427	0.421	The money supply does not cause the inflation rate
GDP and MS do not cause INF	0.741891	0.6901	Growth rate and money supply do not cause inflation rate

Source: Authors' calculations

The results of the Granger causality test applied to the previously described VECM model suggest that there is no causal relationship between the observed variables in the system. The causal relationship was not confirmed in any of the previously described cases. The closest result that could confirm causality is the testing of the causal effect of the inflation rate on the money supply, where the probability was 0.06.

The impulse response function (IRF) analysis used to determine the relationship between M2 money supply and the inflation rate, i.e. the real growth rate of GPD, also shows the results caused by the "shock" of one standard deviation in an individual series to the "shock" in the endogenous system variable. The following charts show the results obtained based on an IRF analysis:



Graph 1: Results of impulse responsive analysis

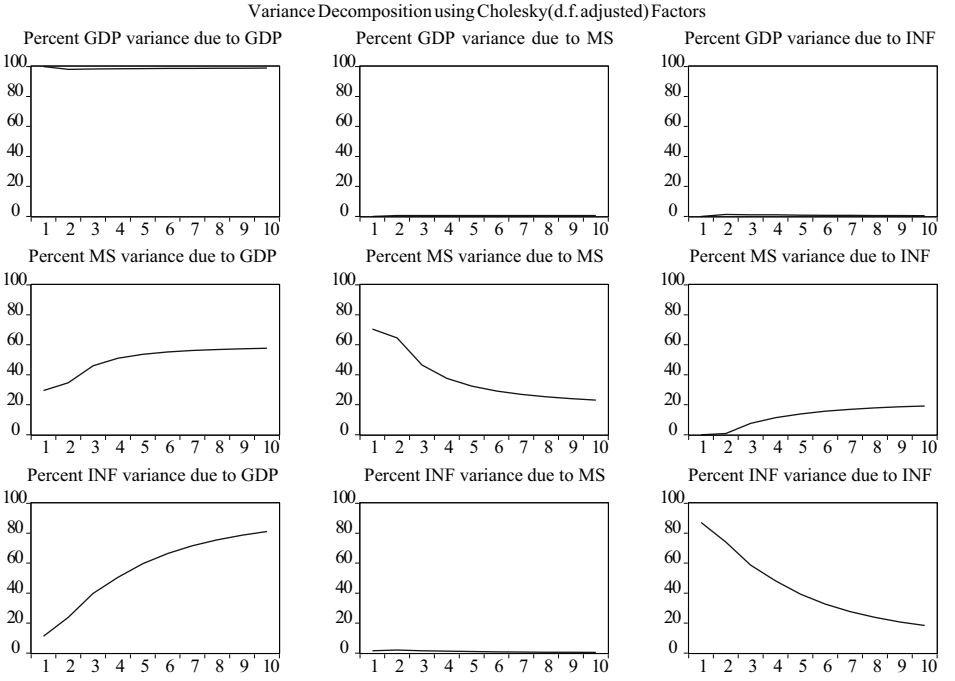
Source: Authors' calculations

IRF analysis shows the projected "shocks" over the next 10 years in one variable observed through the standard deviation and their impact on the movement of other variables in the system. As shown in the previous graph, the shock of one standard deviation in the GDP variable will have a negative impact on the growth rate in the two years of the projected period, after which the growth rate will

be balanced. A shock of one standard deviation in the MS variable will have a positive impact on the movement of the GDP variable, followed by a stagnant impact in the MS shocks on the movement of GDP. The shock of one standard deviation in the inflation rate in the first two years will have a negative impact on GDP, in the third year this impact will be positive, then in the fourth it will be negative, and after the fifth year of the projected period this effect will decrease significantly. A shock of one standard deviation in the movement of GDP will mean a positive impact on the movement of MS in the first ten projected periods. The shock of one standard deviation of MS has a positive impact on the growth of MS from the third year to the end of the projected period. One standard deviation in the INF variable means a slight decrease in MS in the second year of the projected period, while the decrease from the third year to the end of the period is significantly pronounced. One standard deviation in the GDP variable has a positive effect on the movement of the INF variable over the projected period. A shock of one standard deviation in the INF variable negatively affects the MS variable in the first four years of the projected period, while from the fifth year the impact is positive. The shock of one standard deviation in INF has a positive effect on the movement of the INF variable in the first year of the period, in the second year this impact is smaller but positive, and after the third year the INF impact on INF itself is positive but tends to zero.

In the analysis, we also applied the analysis of the decomposition variance in order to examine the proportion in which the variables participate in the variations of other variables from the system over a period of 10 years. The results of the variance analysis are shown in the Graph 2.

By decomposing the variance of the VAR model, we came to the results according to which a small percentage of the explanation for the GDP variable is described by changes in the MS and INF variables, the results of the decomposition of variance show that changes in growth are explained at the level of 1% changes in the movements of inflation and money supply. On the other hand, the percentage of explanations of money supply movements was explained at the level of 60% by the GDP growth rate, and was explained at the level of almost 20% by variations in inflation trends in the first ten years of the projected period. In addition, the decomposition of variance shows that the significance of changes in the money supply is less important when explaining the prediction of the same variable in the future. Variations in the inflation rate are explained at the level of 80% by variations in the real growth rate. This ratio is characterized by an upward trend, while variations in the inflation rate are explained at the level of about 20% at the end of the projected period with the observation of a declining trend when we talk about the relationship between these variations.



Graph 2: Variance decomposition analysis

Source: Authors' calculations

5. CONCLUSIONS

The relation of monetary variables, especially the phenomenon of inflation and money supply, in relation to economic growth has always been the focus of public attention. Whether it is the Keynesian view on price rigidity or money neutrality of the neoclassical school of monetarists, the basic goals of all economic policies are uniquely reflected in achieving high rates of economic growth and price stability of the national economy. These parameters gain even more importance in countries such as Bosnia and Herzegovina. The specificity of Bosnia and Herzegovina as a small transition country is reflected in the functioning of a complex political organization with significant restrictions on the economic system, which with passive monetary policy in the currency board arrangement, further worsens significant economic growth and development. On the other hand, the main advantage of currency boards is monetary discipline and the reduction of inflation, since the discretion of monetary authorities is limited by a rule that prevents the spread of the monetary base outside the level of foreign exchange reserves.

The aim of this paper is to quantify the impact of money supply (M2) and inflation rates on the real economic growth rate of Bosnia and Herzegovina. In the paper, we applied econometric techniques such as VEC model, cointegration analysis, innovation analysis based on impulse response function, variance decomposition as well as a causality test. By applying the mentioned methods, the obtained results indicate a long-term connection between monetary variables and economic growth, and it has been proven in the model. Since the analyzed variables are of the first order of integration, their cointegration was established by appropriate cointegration tests. Based on the presented results of Johansen's cointegration technique, that is to say, based on the trace test and the test of the largest characteristic root, we rejected the null hypothesis of there not being a cointegration relationship between the observed variables and conclude that at the 1% significance level there is a maximum of one cointegration equation representing the relationship between real growth, money supply (M2) and inflation rates. The results suggest that a 1% increase in the money supply will increase the real growth rate by 1.43% in the long run, while a 1% increase in inflation will imply a 0.74% increase in the growth rate.

The Implementation of the VEC model for the observed period from 2000 to 2020, confirms the positive impact of monetary variables on economic growth in Bosnia and Herzegovina. The results showed a link between money supply, inflation rates and economic growth, which is positive and statistically significant in the long run. We have confirmed the initial hypothesis of the paper, which states that there is ultimately a positive impact of money supply and inflation on the real economic growth of Bosnia and Herzegovina.

The innovation analysis based on the impulse response function (IRF) and used to determine the relationship between the money supply M2 and the inflation rate, i.e. the real growth rate of BPD, as well as the decomposition of variance show the intensity of the above-explained relationships. It can be noted that this relationship in regression is not at a high level, it cannot be described with complex explanations, which is acceptable given the fact that in addition to monetary variables we analyzed, economic growth is conditioned by a number of other factors and determinants, real and monetary variables that are not included in this analysis.

The obtained results are in line with previous research which has shown that stable economic growth implies price stability, but also that a moderate inflation rate is in a positive feedback loop with economic growth. Based on the previously presented results, we can conclude that the basic characteristic of the monetary board, which is reflected in maintaining price stability and flexible adjustments

of money supply in conditions that are present in BiH, positively affects economic growth. The task to be achieved by increasing economic activity while maintaining a stable and low inflation rate in the country, is a prerequisite for achieving long-term sustainable development of Bosnia and Herzegovina.

Conflict of interests

The authors declare there is no conflict of interest.

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APPENDICES

Appendix 1. Results of the autocorrelation test

As can be seen in the following account, by testing the serial correlation on two shifted values of the model's time series, based on F-statistics and p-values, it can be concluded that the model used in this study is free of serial correlation.

VEC Residual Serial Correlation LM Tests						
Date: 02/07/22 Time: 22:56						
Sample: 2000 2020						
Included observations: 19						
Null hypothesis: No serial correlation at lag h						
Lag	LRE* stat	df	Prob.	Rao F-stat	df	Prob.
1	5.881321	9	0.7517	0.634156	(9, 22.1)	0.7561
2	6.569435	9	0.6818	0.718346	(9, 22.1)	0.6872
Null hypothesis: No serial correlation at lags 1 to h						
Lag	LRE* stat	df	Prob.	Rao F-stat	df	Prob.
1	5.881321	9	0.7517	0.634156	(9, 22.1)	0.7561
2	18.56789	18	0.4189	1.041405	(18, 17.5)	0.4674

*Edgeworth expansion corrected likelihood ratio statistic.

Appendix 2. Residual normality test

To test the normality of the model residuals Skewness, Kurtosis and Jarque-Bera tests were used. Based on the p-value, we conclude that the model residues are normally distributed.

VEC Residual Normality Tests					
	Orthogonalization: Cholesky (Lutkepohl)				
	Null Hypothesis: Residuals are multivariate normal				
Date: 02/07/22 Time: 22:59					
Sample: 2000 2020					
Included observations: 19					
Component	Skewness	Chi-sq	df		Prob.*
1	-1.421227	6.396310	1		0.0114
2	0.411055	0.535059	1		0.4645
Joint		7.303727	3		0.0628
Component	Kurtosis	Chi-sq	df		Prob.
1	5.004689	3.181533	1		0.0745
2	2.257957	0.435914	1		0.5091
3	2.100190	0.640979	1		0.4234
Joint		4.258426	3		0.2349
Component	Jarque-Bera	df	Prob.		
1	9.577843	2	0.0083		
2	0.970973	2	0.6154		
3	1.013337	2	0.6025		
Joint	11.56215	6	0.0725		

*Approximate p-values do not account for coefficient estimation

ПОНУДА НОВЦА, ИНФЛАЦИЈА И ЕКОНОМСКИ РАСТ У БОСНИ И ХЕРЦЕГОВИНИ: ЕМПИРИЈСКА АНАЛИЗА

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САЖЕТАК

Анализа монетарних варијабли и њихов утицај на стопу економског раста дуги низ година се налази у фокусу економских истраживања. Најшире посматрано, економска теорија разликује два основна гледишта дефинисана становиштима монетариста и кејнзијанаца. Иако се основна разлика огледа у детерминисању ригидности цијена и неутралности новца коју истичу већина наведених студија, специфичности савремених економских система фокус помјерају ка позитивном утицају монетарних на реалне варијабле. Циљ нашег истраживања јесте идентификовати и квантификовати утицај монетарних варијабли на економски раст у Босни и Херцеговини. Истраживање је спроведено на основу података за временски период од 2000. до 2020. године. У раду полазимо од хипотезе да у дугом року постоји позитиван утицај понуде новца и инфлације на реални економски раст Босне и Херцеговине. Као објашњавајуће варијабле (монетарне варијабле) у истраживању се посматрају понуда новца М2 и годишња стопа инфлације, док је реални раст зависна варијабла. Тестирана је дугорочна веза између монетарних варијабли и стопе реалног раста, узимајући у обзир специфичност монетарног аранжмана БиХ који је успостављен у облику валутног одбора. Како би се доказала хипотеза, у истраживању смо примијенили економетријске технике као што су ВЕЦ модел, коинтеграциона анализа, иновациона анализа на основу импулсно-респонсивне функције, декомпозиција варијансе, као и тест каузалности. Резултати истраживања су показали везу понуде новца и стопе инфлације са економским растом Босне и Херцеговине, која је позитивног знака и статистички је значајна у дугом року. Овим смо потврдили и почетну хипотезу рада.

Кључне ријечи: *понуда новца, М2, инфлација, економски раст, валутни одбор, Босна и Херцеговина.*