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Solving Fiscal Problems through Monetary Policy Mechanisms: Case of Armenia

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ABSTRACT

The problem of fiscal dominance tends to be most pronounced in emerging markets. The research **subject** is the monetary policy of the Central Bank of the Republic of Armenia and its participation in solving fiscal problems. The **aim** of the article is to analyze and assess fiscal dominance in the macroeconomic regulation of Armenia. The **methodological basis** of the study is a review of theoretical and practical models of fiscal dominance known in the scientific literature, as well as applying the most optimal models to the Armenian economy. The authors conclude that the tasks of fiscal policy are the priority of macroeconomic management, and monetary policy aims to solve fiscal problems.

Keywords: monetary regulation; monetary policy; inflation; fiscal policy; fiscal dominance

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INTRODUCTION

The strategic goal of macroeconomic regulation is to achieve sustainable economic growth rate in terms of stable prices and national currency, low unemployment together with free capital flow. Thus, all of the above indicators characterizing macroeconomic stability are closely interrelated.

As a rule, the choice of priorities for macroeconomic regulation in the economy is adaptive. In particular, this approach is inherent in developing countries or countries with economies in transition, since the conditions of uncertainty and lack of macroeconomic stability are often chronic. At the same time, this approach does not provide a strategic direction for the development of the economy and largely hinders the achievement of sustainable economic growth.

A key challenge faced by developing societies is the high public debt and inability to pay off debt in the near future, which is very closely related to slow economic growth. In such conditions, macroeconomic policy tends to solve the fiscal problems associated with public debt and high public deficit by all possible means, including monetary mechanisms. For this reason, developing countries choose to opt for fiscal dominance in their macroeconomic policies. Armenia is a good example.

LITERATURE REVIEW: THEORETICAL PREMISES OF FISCAL DOMINANCE IN MACROECONOMIC POLICIES

Fiscal dominance takes place in the economy when all macroeconomic decisions are based on the priorities of fiscal policy. This means that with a conflict of interest between monetary and fiscal policies, the choice is made in favor of fiscal problems, and monetary instruments are inevitable to solve problems with public debt and budget deficits. One of the most famous theories of fiscal dominance in macroeconomic regulation is "The Fiscal Theory of the Price Level", first described by E. Leiper (1991), K. Sims (1994), M. Woodford (1994, 1995) [1–4].

The author of earlier studies M. Bassetto (2008) [5] prioritizes the role of public debt and fiscal policy in the pricing process in the economy, while monetary policy plays an indirect role. The author relied on data from the crisis and post-crisis periods, which clearly proved that monetary mechanisms are overshadowed by economic shocks. However, ten years later, M. Bassetto and W. Cui in their work "The Fiscal Theory of the Price Level in a World of Low Interest Rates" (2017) [6] showed that the fiscal theory of the price level is not a good balancing tool in a context when interest rates are not outstripping long-term growth. Taylor's equation (1993) [7] also sup-

ports this idea (*Equation 1*), based on the sensitivity of the interest rate level to changes in the price level and to the difference between real and potential GDP.

Equation 1

$$R = P + 0.5(Y - Y^*)/Y^* + 0.5(P - 0.02) + 0.02,$$

where R is the nominal interest rate, P is the prior period inflation, Y is the real GDP, Y^* is the potential GDP, and 0.02 is the most optimal inflation target according to Taylor — 2%.

The work by W.H. Buiter (2002) [8] is one of the critics of FTPL. As a counterargument, it suggests the thesis that this approach carries many contradictions and violations of the laws of economic theories, in particular, in achieving a balance only in the face of budget restrictions.

Many researchers attempted to build mathematical and econometric models to reveal fiscal dominance. In particular, the study by H. Bohn (1998) [9] (*Equation 2*):

Equation 2

$$PB_t = a + b * D_{t-1} + e_t,$$

where PB_t is the primary balance scaled by GDP for the current period, D_{t-1} is the public debt scaled by GDP of the previous period, a and b are the model parameters, and e_t is the errors.

This equation is based on the thesis that if the coefficient b is significant and positive, it indicates monetary dominance. However, FTPL proponents, who argued that positive rating b could also indicate fiscal dominance in certain circumstances, as it reflects government fiscal sustainability, criticized this theory.

Many studies measured fiscal dominance in sample countries. For example, Carlos de Resende (2007) [10] tried to estimate fiscal dominance and monetary independence by examining OECD countries as well as a group of developing countries that are part of the IMF group. The research by the author showed that fiscal dominance is inherent in many developing countries, while in developed countries monetary authorities are highly independent. The author singles out the institutional environment and its development as a reason for such dynamics.

From the experience of several European developing economies, I. Milenkovich (2018) [11] conducted an empirical analysis using the econometric VAR model. He found that, first, a prerequisite for inflationary expectations in these countries is fiscal management (which might be a valid argument for applying FTPL). Second, in these countries fiscal policy, rather than monetary policy, prevails. Based on the analysis of the quarterly data of the primary balance sheet and the consolidated gross public debt of five developing countries in Europe (Hungary, Romania, Bulgaria, Serbia and Macedonia), the author built two regression models (*Equation 3*) that describe fiscal or monetary dominance in the economy.

Equation 3

$$X_t = \sum_{j=1}^{k+d_{\max}} \alpha_j X_{t-j} + \sum_{j=1}^{k+d_{\max}} \beta_j Y_{t-j} + \varepsilon_t,$$

$$Y_t = \sum_{j=1}^{k+d_{\max}} \gamma_j X_{t-j} + \sum_{j=1}^{k+d_{\max}} \delta_j Y_{t-j} + \eta_t,$$

where Xt is the government budget deficit, Yt is the consolidated gross debt, $\alpha_j, \beta_j, \gamma_j$ *and* δ_j are model parameters, k is the optimal number of lags in the initial VAR model, d_{max} is the maximum sequence integration in the system, and ε_t and η_t are the errors of the first and second regressions respectively.

The key finding of the study was that the causal relationship between government debt and budget deficits reduces the ability of monetary authorities to effectively determine policies to achieve their own goals, and as a result, they lose autonomy in regulating the economy.

K. Sanusi and A. Akinlo (2015) [12] proposed their own approach to defining fiscal dominance in macroeconomic policy. Their research refers to the work by M. Fratianni and F. Spinelli (2001) [13], based on the assumption that the causal relationship between the budget deficit and the increase in the monetary base in the economy is direct. The focus of the research by K. Sanusi and A. Akinlo was to identify the fiscal dominance in Nigeria. The VAR model is as follows (*Equation 4*):

Equation 4

$$\begin{bmatrix} Y_t & X_t \end{bmatrix} = \begin{bmatrix} a_{10} & a_{20} \end{bmatrix} + \begin{bmatrix} a_{11} & a_{12} \\ a_{21} & a_{22} \end{bmatrix} \begin{bmatrix} Y_{t-1} & X_{t-1} \end{bmatrix} + \begin{bmatrix} e_{yt} & e_{xt} \end{bmatrix},$$

where Y_t is the budget deficit of the current period, X_t is the growth of money base, the first term and the first part of the second term are parameters of the regression model, and the last term is errors.

The study failed to prove the existence of fiscal dominance in Nigeria, because other mechanisms of fiscal dominance were used there.

The link between government spending and inflation is presented in the book by H. Khan, M. Marimuthu and F.-W. Lai (2020) [14]. It describes several stages of financing the budget deficit. Their research is based on the formula linking inflation and budget deficit described in the study by K. Ali and M. Khalid [15]. The relationship between inflation and budget deficits is as follows (*Equation 5*):

Equation 5

$$CPI_t = \alpha_0 + \beta_1 FD_t + \beta_2 GDP_t + \beta_3 M2_t + \varepsilon_t,$$

where *CPI* is the Consumer Price Index, *FD* is the Fiscal Deficit, *GDP* is the Gross Domestic Product, M2 is the money supply.

Since the model does consider the methods of financing the government deficit, the authors modified it as follows (*Equation 6*):

Equation 6

$$CPI_t = \alpha_0 + \beta_1 DB_t + \beta_2 EB_t + \beta_3 PS_t + \beta_4 M2_t + \beta_5 GDP_t + \varepsilon_t,$$

where *DB* is domestic borrowings, *EB* is external borrowings.

The third phase reveals the categories of internal and external borrowings (*Equation 7*):

Equation 7

$$CPI_t = \alpha_0 + \beta_1 CBB_t + \beta_2 BIB_t + \beta_4 M2_t + \beta_5 GDP_t + \beta_6 PS_t + \beta_7 MLT_t + \beta_8 STL_t + \varepsilon_t,$$

where *CBB* is Central Bank borrowings, *BIB* is bank borrowings, *PS* is political instability, *MLT* is medium and long term borrowings, *STL* is short term borrowings.

In their work, M. Mehrara, M.B. Soufiani and S. Rezael (2016) [16] consider government spending within expansionary and restrictive monetary regimes. They find that in the case of the former, an increase in government spending is not inflationary and may even contribute to economic development, but it is inflationary in the latter. Both may cause price changes, but the first regime can minimize the negative effects of inflationary pressures. The authors' findings are not entirely consistent with FTPL, as the latter suggests the impact of inflationary pressures on government spending. However, the opposite is also true, when prices are kept at a certain level in order to maintain optimal costs from the government budget.

We believe that this approach can be identified through the model described in the work by H. Khan, M. Marimuta and F.-W. Lai (2020) [14]. First, the following simple econometric model is as follows (*Equation 8*):

Equation 8

$$CPI_t = \alpha_0 + \beta_1 FD_t + \beta_2 GDP_t + \beta_3 M2_t + \xi_t.$$

The equation describes the direct relationship between inflation and the state budget deficit of the country without considering the internal and external sources of financing the budget deficit. The model with these parameters is as follows (*Equation 9*):

Equation 9

$$CPI_t = \alpha_0 + \beta_1 CBB_t + \beta_2 BIB_t + \beta_4 M2_t + \beta_5 GDP_t + \beta_6 PS_t + \beta_7 MLT_t + \beta_8 STL_t + \varepsilon_t.$$

The authors concluded that in the short term, government borrowing will not have a negative impact on the inflationary background in the economy, while in the long term, this impact will be significant.

Thus, the literature suggests three key mechanisms of fiscal dominance.

The first mechanism is to solve the problem of the budget deficit by increasing the money supply, contrary to the principles of monetary regulation. Thus, fiscal policy dominates macroeconomic management.

The second mechanism is based on the close relationship between domestic prices and government spending. In the case of fiscal dominance, the government prefers to keep prices at a certain level to reduce budget spending. At the same time, the target may damage economic growth. This approach is most pronounced in developing countries prone to inflation, where prices are chosen as the best target for the government budget, rather than for sustainable economic growth. The third mechanism is monetary regulation and its close link to the external debt. If the external liabilities cannot be met in the short term, countries often use monetary policy to maintain constant external debt. Fiscal dominance is also pronounced here.

In the real world, countries are not limited to one of the above mechanisms for solving fiscal problems through monetary policy mechanisms, but tend to use all these mechanisms of fiscal dominance. In this regard, we will further consider all three mechanisms of fiscal dominance using the case of the Armenian economy.

FISCAL DOMINANCE: CASE OF ARMENIA

In this study, we have assessed fiscal dominance in the macroeconomic regulation of Armenia, using the above monetary mechanisms for solving fiscal problems. The considered cases are as follows.

Fiscal dominance: monetizing government deficits

Budget deficits are common in most developing countries. Moreover, countries often use monetary instruments to deal with the default on government deficits. Monetizing the government deficit actually indicates the priority of fiscal policy in macroeconomic management. The deficit balance (*Fig. 1*) characterizes the state budget of the Republic of Armenia. Chronic state budget deficits have been observed over the past thirty years.

Since the monetization of the state deficit depends more on the structure and growth of the money supply, the structure of the money supply and the monetary base in Armenia was considered as indicators of the money supply.

Figure 2 shows that the growth of money supply over the last 10 year has been driven largely by the growth of term and foreign currency deposits. At the same time, the growth of cash turnover is almost non-existent, due to the decline of consumption in the economy, as well as the decrease in household income. There was a slight increase in demand deposits. Foreign currency deposits account for a large share in the overall structure of the money supply, which reflects the high dollarization of the country's money supply. The monetary base structure also indicates no significant growth in the money supply of the economy. The growth of the monetary base is due to the growth of correspondent accounts in national and foreign currency in the banking system.

The next step is to define a model that would determine the monetization of the state budget deficit in the Armenian economy. The model is as follows.

- *Methodology: Characteristics of the government deficit monetization model*

In the case of fiscal dominance, the government can use mechanisms for monetizing the state budget deficit, which will definitely affect the independence of the monetary authorities in macroeconomic management.

We went for the model by M. Fratianni and F. Spinelli [13] to describe the existence of fiscal dominance by monetizing the state budget deficit. The model is a step-by-step determination of fiscal dominance in the country's macroeconomic management.

First, it is necessary to assess the quantitative impact of the monetary component of the state budget. We start the calculations with the methodology for accounting for money supply growth.

To solve this problem, the authors initially use the money-supply formula and its derivatives (*Equation 10*):

Equation 10

$$M_t = m_t MB_t,$$
$$m_t = (1 + k_t)/(k_t + rr_t + re_t),$$
$$k_t = BP_t/D_t,$$
$$rr_t = BR_t/D_t,$$
$$re_t = BE_t/D_t,$$

where M_t is the money supply, m_t is the money multiplier, MB_t is the money base, rr_t is the reserve ration, re_t — deposit rate, BR_t is the reserve requirement, BE_t is the excess reserves, BR_t is the cash, D_t is the deposits.

These formulas do not describe the growth of monetary base, so *Equation* (10) was transformed into the following: (*Equation 11*):

Equation 11

$$\ln m_t - \ln m_{t-1} = c(k) + c(rr) + c(re) + c(com1),$$
$$c(k) = \ln(1 + k_t) - \ln(1 + k_{t-1}) - \ln(k_t + rr_{t-1} + re_{t-1}) + + \ln(k_{t-1} + rr_{t-1} + re_{t-1}),$$
$$c(rr) = -\ln(k_{t-1} + rr_t + re_{t-1}) + \ln(k_{t-1} + rr_{t-1} + re_{t-1}),$$
$$c(re) = -\ln(k_{t-1} + rr_{t-1} + re_t) + \ln(k_{t-1} + rr_{t-1} + re_{t-1}),$$
$$c(com1) = \ln m_t - \ln m_{t-1} - [c(k) + c(rr) + c(re)].$$

Then, it was transformed into *Equation 12*:

Equation 12

$$\ln MB_t - \ln MB_{t-1} = c(MBTR) + c(MBOT) + c(BF) + + c(com2),$$
$$c(MBTR) = \ln(MBTR_t + MBOT_{t-1} + BF_{t-1}) - \ln(MBTR_{t-1} + + MBOT_{t-1} + BF_{t-1}),$$
$$c(MBOT) = \ln(MBTR_{t-1} + MBOT_t + BF_{t-1}) - \ln(MBTR_{t-1} + + MBOT_{t-1} + BF_{t-1}),$$
$$c(BF) = \ln(MBTR_{t-1} + MBOT_{t-1} + BF_t) - \ln(MBTR_{t-1} + + MBOT_{t-1} + BF_{t-1}),$$
$$c(com2) = \ln MB_t - \ln MB_{t-1} - [c(MBTR) + c(MBOT) + + c(BF)],$$

where *MBTR* is the government bonds, *MBOT* is the non-governmental bonds, *BF* is the foreign component of securities, *com*1 an indicator that integrates the determinants of multiples, and *com*2 is an indica-

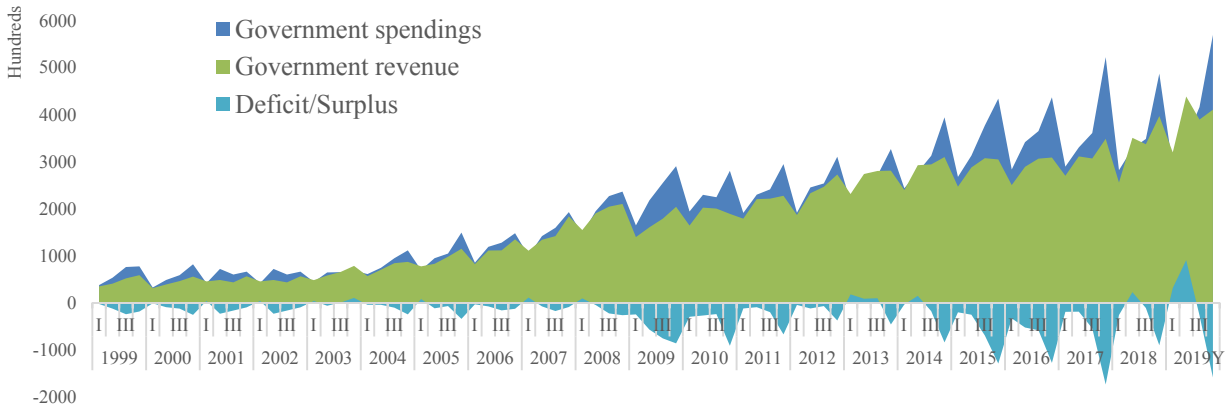

Fig. 1. **Government spending, revenue and deficit/surplus, quarterly, in billion AMD**

Source: database of the National Statistical Service of the Republic of Armenia. URL: www.armstat.am (accessed on 12.10.2020).

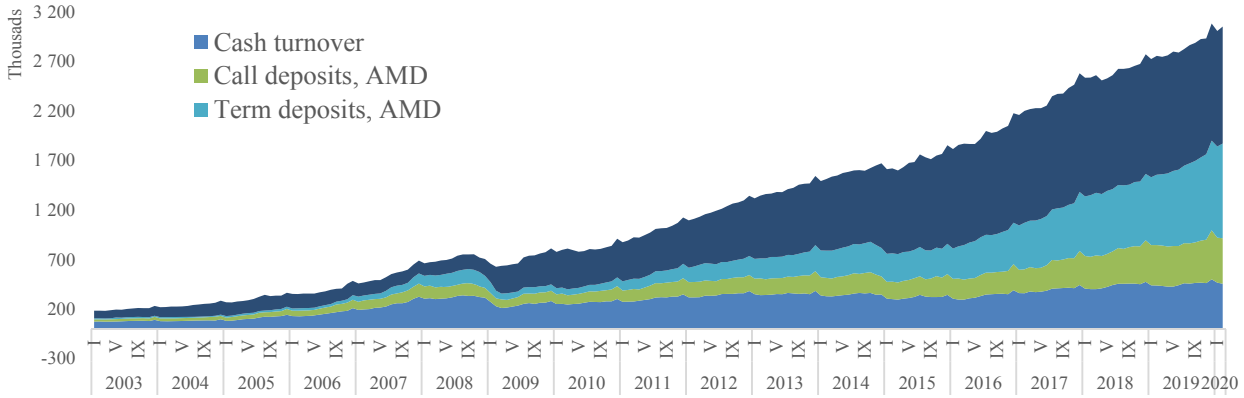

Fig. 2. **Monthly money supply, billion AMD**

Source: database of the Central Bank of the Republic of Armenia. URL: www.cba.am (accessed on 12.10.2020).

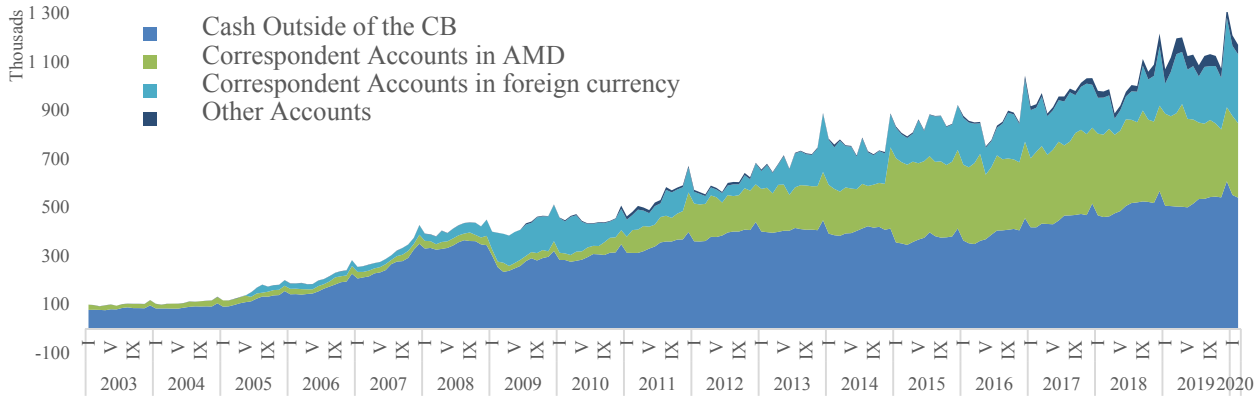

Fig. 3. **Monthly money base, billion AMD**

Source: database of the Central Bank of the Republic of Armenia. URL: www.cba.am (accessed on 12.10.2020).

tor that integrates the determinants of the monetary base.

The first set of equations passed to the second one using *Equation 13*:

Equation 13

$$MB = MBTR + MBOT + BF.$$

With these equations, the authors identified the contribution of each indicator into the monetary growth.

Then goes the analysis of the impact of the budget deficit on the growth of the earlier component of the monetary base. It helps assess how the deficit has been solved through the monetization of the economy and to

identify the elements of fiscal dominance. To this end, the authors analyzed the impact of the budget on the state component of the money supply. They suggested that a positive relationship between indicators could be a prerequisite for fiscal dominance, while the absence of this relationship indicates that it does not exist.

The following type of regression analysis was used:

Equation 14

$$DMBTR = a_0 + a_1 DMBTR_{t-1} + \ldots + a_n DMBTR_{t-n} + b_0 DEFY_t + \ldots + b_n DEFY_{t-n} + cDEFY(CRE) + dDEFY(MAAS) + u_t,$$

where $DMBTR = (MBTR_t - MBTR_{t-1})/Y_{t-1}$, $DEFY = DEF/Y_{t-1}$,

Y is the net national income, CRE is the dummy variable (1 in the period 1981–1992, 0 in other cases), MAAS is the dummy variable (1 in the period 1993–1997, 0 in other cases).[1]

Finally, the authors assessed the relationship between the general monetary base growth and the budget deficit. It makes it possible to determine whether fiscal policy should be given priority in the country's macroeconomic management. To this end, the authors tested the relationship between the relative change in the total monetary base and the budget deficit by regression analysis of the type in *Equation (15)*. The model is as follows:

Equation 15

$$DMB = e_0 + f_1 DMB_{t-1} + \ldots + f_n DMB_{t-n} + g_0 DEFY + \ldots + g_n DEFY_{t-n} + hDEFY\,(CRE) + nDEFY(MAAS) + qDY + + si_{diff} + vCAB + z\,r_{diff} + \varepsilon,$$

where $DMB = (MB_t - MB_{t-1})/Y_{t-1}$, i_{diff} is the difference between the return on assets and the cost of borrowing from the Central Bank, r_{diff} is the difference between Italian and foreign interest rates, ε is the errors.

The researchers conclude that the monetization of the budget deficit decreases over time and may even be reversible, which indicates that solving fiscal problems by monetizing the state budget leads to an excessive increase in the money supply in the economy and, as a consequence, to additional inflationary pressure.

- *Testing the model of budget deficit monetization in the economy of Armenia*

The model described above is adapted to the specifics of the Armenian economy, considering the key features and factors between the budget deficit and the money supply. To build the model of the Armenian economy, we used the monetary base, the volume of government securities on the market and the state budget deficit (from the first quarter of 2008 to the fourth quarter of 2019). The percentage of foreign participation in the securities market was excluded from the indicators in the original model, since the capitalization of the stock market in Armenia is about 2% of GDP and is not significant in terms of money supply.

The data were cleared of seasonality, logarized, and the differences between the current and previous values were calculated. The data distribution was normalized. The data were tested for normality using the Shapiro-Wilk and Shapiro-Francia tests. The distribution of all data is normal (*Appendix, Table 1*), and the time series is stationary (*Appendix, Table 2*).

We built a VAR model (*Table 1*) to find the correlation between the growth of the monetary base and the growth of government securities. Before that, we tested its order criterion and chose the first order (*Appendix, Table 3*). There is a one lag correlation between government securities, meaning that an increase in government securities over one time period affects the monetary base and, therefore, the amount of money in circulation in Armenia.

The model was tested using the Granger causality test, where the null hypothesis is that a lagging variable (in this case, one lag) does not cause the dependent variable to change. *Table 2* presents the test result. The test result showed that the null hypothesis is accepted with a probability of 4.3% for the model with the monetary base as the dependent variable. This means that the null hypothesis is denied. In other words, changes in the monetary base are inversely affected by changes in the number of government securities.

The next step was to assess the impact of changes in the state budget deficit on changes in the volume of government securities. We calculated the order criterion for the model and chose lag-4 (*Appendix, Table 4*). We built the VAR model with these three variables. *Table 3* presents the result.

Table 3 shows that the changes in government deficits have no impact on the volume of government securities. The Granger causality test also proves this point (*Table 4*).

The last step was to identify the link between the monetary base and state budget deficit. For this purpose, the order of the VAR model (*Appendix, Table 5*) was analyzed and the fourth order was chosen. *Table 5* presents the

[1] CRE and MAAS are specific variables for the Italian economy.

Table 1

VAR analysis of the impact of changes in the state component of the monetary base and the monetary base

	Coef.	Std. Err.	z	P>|z|	[95% Conf.	Interval]
mb						
mb						
L1.	.1333205	.1417833	0.94	0.347	-.1445696	.4112107
govtb						
L1.	-.0115482	.0057165	-2.02	0.043	-.0227522	-.0003441
_cons	.0200455	.0062981	3.18	0.001	.0077014	.0323896
govtb						
mb						
L1.	-.3932807	2.717911	-0.14	0.885	-5.720289	4.933727
govtb						
L1.	-.6759048	.1095816	-6.17	0.000	-.8906808	-.4611287
_cons	.1597744	.1207317	1.32	0.186	-.0768553	.3964042

Note: mb is the money base, *govtb* is the government securities.

Source: calculated by the authors.

result. The relationship between the budget deficit and the monetary base was not found at the 5% significance level. However, at the 10% significance level, the budget deficit has a positive effect on the monetary base. This means that if the deficit grows in the next quarter, the monetary base will increase, and hence the money supply.

Granger causality test showed no connection between monetary base and deficit (*Table 6*).

The study also examined the effect of external and internal shocks on individual regressions and the responses to these impulses of the remaining regressions by the impulse response function (*Fig. 4*) and the orthogonal impulse response function (*Fig. 5*). Since the shocks identified by the impulse response function are intrinsic, it can be argued that these shocks are due to a sharp increase or decrease in the variable itself, which may be caused by unforeseen circumstances (the COVID-19 pandemic and the associated sharp increase in government spending). In this case, impulses for change will be based on the size of the government expenditure variable, and the response will be reflected on other variables.

The orthogonalized impulse-response function shows the external shock of the given factor. These are shocks, for example, related to innovation or technological progress, introduced in this area.

Figure 5 shows that the amount of government securities is the biggest for regression shocks.

In addition, *Fig. 6* shows the changes in government internal debt, which suggests that an increase in the ab-

Table 2

Granger causality test of the state component of the monetarv base and monetarv base

Granger causality Wald tests

Equation	Excluded	chi2	df	Prob > chi2
mb	govtb	4.081	1	0.043
mb	ALL	4.081	1	0.043
govtb	mb	.02094	1	0.885
govtb	ALL	.02094	1	0.885

Source: calculated by the authors.

Table 3

VAR analysis of state budget deficit and government securities

	Coef.	Std. Err.	z	P>|z|	[95% Conf.	Interval]
govtb						
govtb						
L1.	-.6140958	.1523082	-4.03	0.000	-.9126144	-.3155773
L2.	.1673323	.1786786	0.94	0.349	-.1828713	.5175358
L3.	.0167982	.1789218	0.09	0.925	-.333882	.3674785
L4.	-.1394247	.1520903	-0.92	0.359	-.4375319	.1586824
def						
L1.	-.2240432	.4535043	-0.50	0.620	-1.113695	.6640088
L2.	-.5644248	.4627076	-1.22	0.223	-1.471315	.3424654
L3.	-.5454681	.4871452	-1.12	0.263	-1.500255	.4093189
L4.	-.3900071	.4814185	-0.81	0.418	-1.33357	.5535558
_cons	.1408481	.1080592	1.30	0.192	-.070944	.3526402
def						
govtb						
L1.	-.0323687	.0446701	-0.72	0.469	-.1195205	.0551831
L2.	-.0251058	.0524042	-0.48	0.632	-.1278162	.0776046
L3.	.0316681	.0524756	0.60	0.546	-.0711821	.1345183
L4.	-.0033308	.0446086	-0.07	0.940	-.090762	.0841003
def						
L1.	-.4208134	.1330072	-3.16	0.002	-.6815028	-.160124
L2.	-.4593744	.1357064	-3.39	0.001	-.7253541	-.1933946
L3.	-.4133504	.1428737	-2.89	0.004	-.6933857	-.1333151
L4.	.5436343	.1411941	3.85	0.000	.2668989	.8203697
_cons	.0065590	.0316924	0.21	0.836	-.0555562	.0686759

Note: govtb is the government securities, *def* is the budget deficit.

Source: calculated by the authors.

solute values of government internal debt is not equal to an increase in the share of internal debt in GDP. This indicates that the total public debt is currently increasing mainly due to external borrowing.

In such a way:

1) there is a negative relationship between government securities and the monetary base, and hence the money supply;

2) there is no correlation between the government budget deficit and government securities;

3) there is a weak, but positive relationship between the fiscal deficit and the monetary base.

Thus, the mechanism for addressing fiscal deficit is rarely resolved through monetization mechanisms.

Fiscal dominance: government expenditure and inflation

The assessment of fiscal dominance through price control with a view to reducing the growth of public expenditure should begin with an analysis of monetary regulation in Armenia within the framework of inflation targeting. Since 2006, Armenia has officially adopted an inflation-targeting regime within monetary regulation. Base inflation was wet as a target and initially changed several times in value. The Central Bank of the Republic of Armenia has definitely set the inflation target of 4±1.5% since the end of 2007, which is still in force today.

Table 4

Granger causality test of the government securities and budget deficit

Granger causality Wald tests

Equation	Excluded	chi2	df	Prob > chi2
govtb	def	2.4961	4	0.645
govtb	ALL	2.4961	4	0.645
def	govtb	1.8384	4	0.765
def	ALL	1.8384	4	0.765

Source: calculated by the authors.

However, as a result of monetary regulation throughout the inflation targeting period, the Central Bank of Armenia rarely managed to achieve the set target (*Fig. 7*). Despite the fact that in most cases the monetary authorities failed to achieve the set goal, the Central Bank of Armenia never tried to change the target nominal anchor of monetary policy [19].

Neither core inflation nor the cumulative value of the price level falls within the definition of a central bank. The Armenian economy has been deflationary over the past four years, indicating rather tight monetary regulation, as well as a slowdown in economic growth due to a significant decrease in consumption in the economy.

However, the inflation rate set by the Central Bank is significant for the government spending, since the latter requires mandatory annual indexation of price changes. From this perspective, keeping the prices as low as pos-

Table 5

VAR analysis of the impact of the state budget deficit on the state securities

		Coef.	Std. Err.	z	P>|z|	[95% Conf.	Interval]
mb							
	mb						
	L1.	-.0702561	.1417934	-0.50	0.620	-.3481661	.2076539
	L2.	-.0596247	.1335285	-0.45	0.655	-.3213357	.2020864
	L3.	-.3599978	.1307913	-2.75	0.006	-.616344	-.1036516
	L4.	-.3640742	.1413079	-2.58	0.010	-.6410327	-.0871158
	def						
	L1.	.0391473	.0217276	1.80	0.072	-.0034379	.0817326
	L2.	.0359355	.021998	1.63	0.102	-.0071798	.0790507
	L3.	.0361583	.0235236	1.54	0.124	-.0099472	.0822638
	L4.	.0259636	.0230099	1.13	0.259	-.019135	.0710622
	_cons	.0439094	.008331	5.27	0.000	.0275808	.0602379
def							
	mb						
	L1.	1.021696	.8711134	1.17	0.241	-.6856545	2.729047
	L2.	-.4052407	.8203375	-0.49	0.621	-2.013073	1.202591
	L3.	.5030956	.8035211	0.63	0.531	-1.071777	2.077968
	L4.	.520096	.8681307	0.60	0.549	-1.181409	2.221601
	def						
	L1.	-.4347283	.1334842	-3.26	0.001	-.6963525	-.1731041
	L2.	-.4918619	.1351454	-3.64	0.000	-.756742	-.2269818
	L3.	-.4173965	.1445184	-2.89	0.004	-.7006474	-.1341457
	L4.	.5293657	.1413622	3.74	0.000	.2523008	.8064306
	_cons	-.0349252	.051182	-0.68	0.495	-.13524	.0653896

Note: mb is the monetary base, def is the deficit. *Source:* calculated by the authors.

sible allows monetary regulation to solve fiscal problems.

As mentioned above, the state budget of Armenia is characterized by chronic budget deficits (*Fig. 1*). Let's consider these indicators for GDP (*Fig. 8*). The share of expenditures of the state budget of the Republic of Armenia in relation to the gross product has significantly increased since 2008. This is offset by an increase in the budget deficit due to the contraction of the economy as a whole as a result of fiscal revenues. Thus, the problem of increasing government revenues is quite obvious.

The reduction of budget expenditure is not an easy task, especially in developing economies. *Fig. 9* shows the structure of government spending in Armenia. As you can see, the largest share of spending falls on social spending, defense and the state apparatus. These sections are difficult to cut down.

As a result, macroeconomic regulation urgently requires control of public spending. In the absence of stronger institutions, it is forced to address the problem through monetary intervention.

- *Methodology: Characteristics of the relationship model between government spending and inflation*

To determine the relationship between government spending and inflation, we used the model described in the work by S. Olubokun, E. Ayooluwade and F.O. Fawehinmi (2016) [20]. *Equation 16* is a brief description of this model:

Table 6

Granger causality test of the monetary base and budget deficit

vargranger

Granger causality Wald tests

Equation	Excluded	chi2	df	Prob > chi2
mb	def	3.8699	4	0.424
mb	ALL	3.8699	4	0.424
def	mb	1.9073	4	0.753
def	ALL	1.9073	4	0.753

Source: calculated by the authors.

Equation 16

$$\alpha_t = \sum_{i=1}^{k} A_i \times \alpha_{t-1} + \mu_t,$$

where α_t is a column vector of observations of all variables in a model at t, $\mu_t = V_1 - V_5$ — are impulses, innovations and other shocks.

In particular, in the model presented in the above-mentioned paper variables Real GDP (RGDP), Total Government Expenditure (TGEP), Inflation (INFR), Money Supply (MSPL) and Exchange Rate (EXCH) (α_t= $RGDP_t$, $TGEP_t$, $INFR_t$, $EXCH_t$, $MSPL_t$) were used.

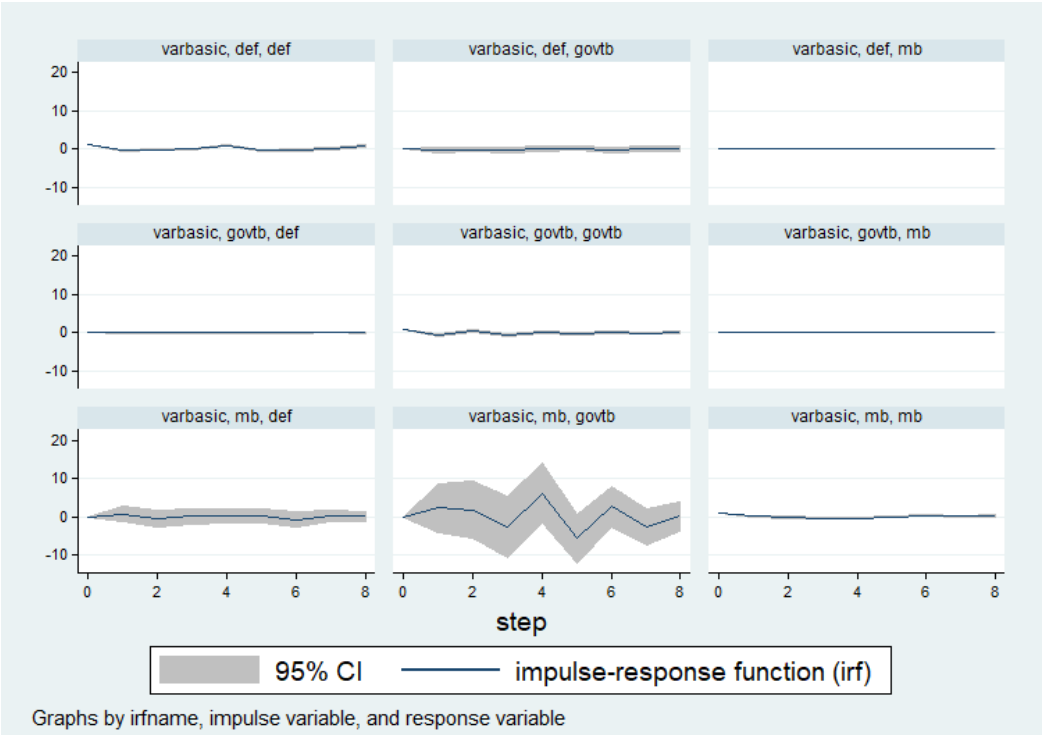

Fig. 4. **Impulse-response function for following variables: budget deficit, government securities, monetary base**

Source: calculated by the authors.

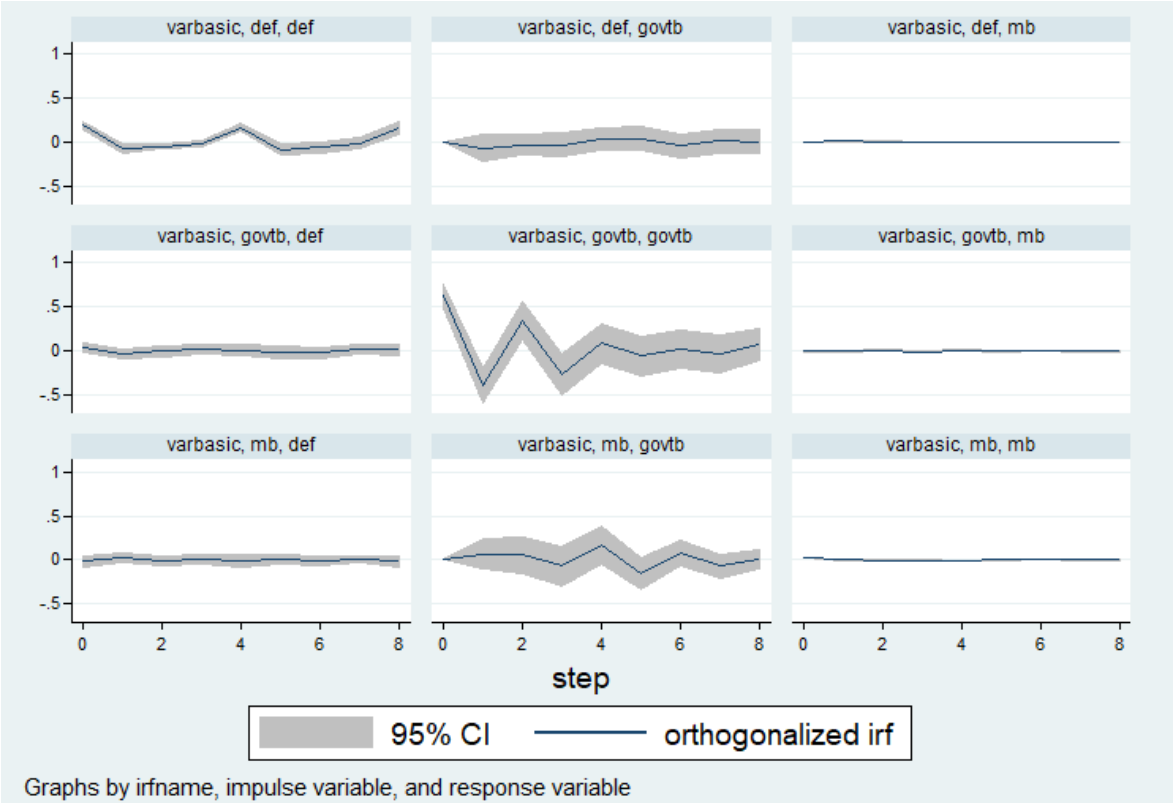

Fig. 5. **Orthogonalized impulse-response function for the following variables: budget deficit, government securities, monetary base**

Source: calculated by the authors.

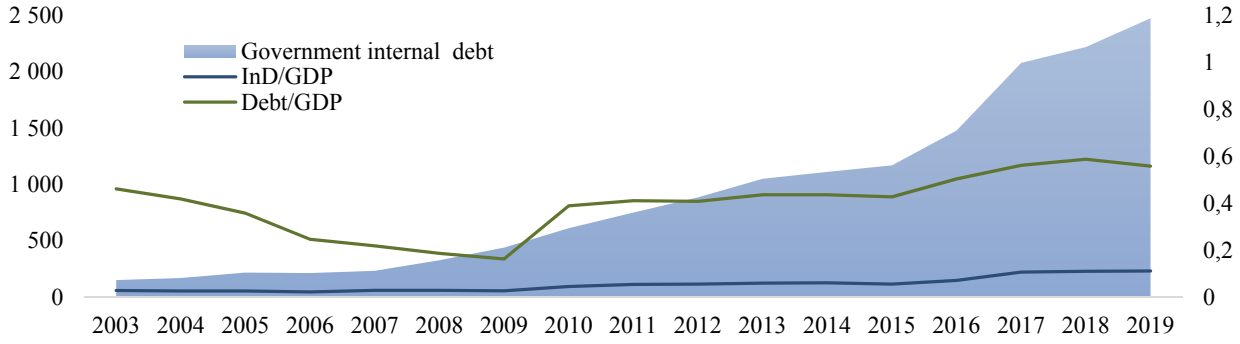

Fig. 6. **Government internal debt of the Republic of Armenia, billion AMD**

Source: database of the National Statistical Service of the Republic of Armenia. URL: www.armstat.am (accessed on 12.10.2020) and also calculated by the authors.

Equation 17 is disclosed in *Equation 17*:

Equation 17

$$RGDP_t = \gamma_1 + \gamma_2 TGEP_{t-1} + \gamma_3 INFR_{t-1} + \gamma_4 EXCH_{t-1} + \\ + \gamma_5 MSPL_{t-1} + \gamma_6 RGDP_{t-1} + V_1,$$

$$TGEP_t = \theta_1 + \theta_2 TGEP_{t-1} + \theta_3 INFR_{t-1} + \theta_4 EXCH_{t-1} + \\ + \theta_5 MSPL_{t-1} + \theta_6 RGDP_{t-}1 + V_2,$$

$$INFR_t = \alpha_1 + \alpha_2 TGEP_{t-1} + \alpha_3 INFR_{t-1} + \alpha_4 EXCH_{t-1} + \\ + \alpha_5 MSPL_{t-1} + \alpha_6 RGDP_{t-1} + V_3,$$

$$EXCH_t = \beta_1 + \beta_2 TGEP_{t-1} + \beta_3 INFR_{t-1} + \beta_4 EXCH_{t-1} + \\ + \beta_5 MSPL_{t-1} + \beta_6 RGDP_{t-1} + V_4,$$

$$MSPL_t = \sigma_1 + \sigma_2 TGEP_{t-1} + \sigma_3 INFR_{t-1} + \sigma_4 EXCH_{t-1} + \\ + \sigma_5 MSPL_{t-1} + \sigma_6 RGDP_{t-1} + V_5,$$

where $\gamma_1 - \gamma_5$, $\theta_1 - \theta_5$, $\alpha_1 - \alpha_5$, $\beta_1 - \beta_5$ and $\sigma_1 - \sigma_5$ are the parameters to be estimated.

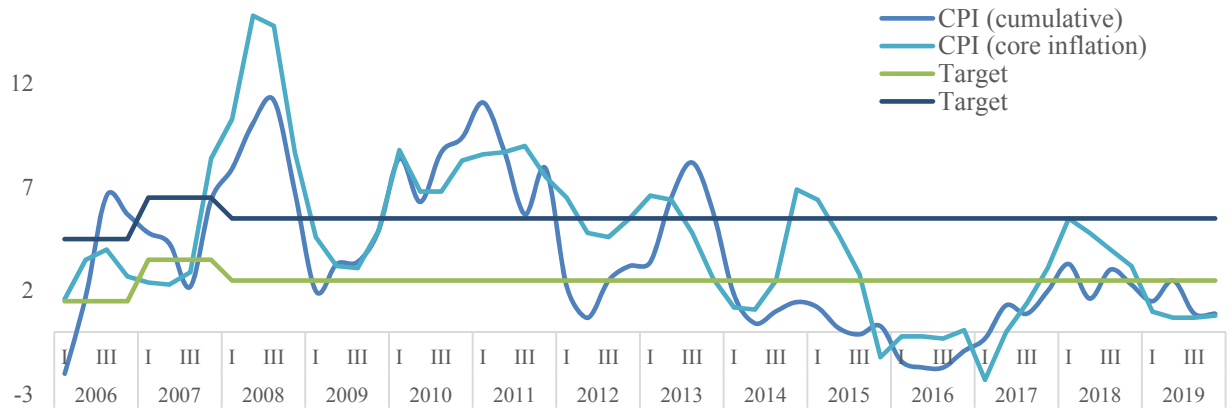

Fig. 7. **CPI and Central Bank of Armenia monetary policy target, quarterly, %**

Source: database of the Central Bank of the Republic of Armenia. URL: www.cba.am (accessed on 12.10.2020).

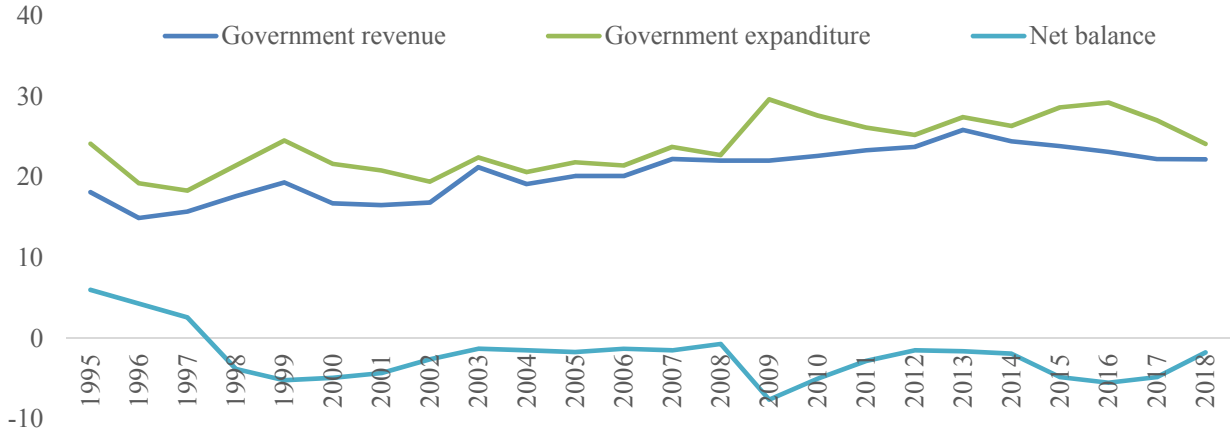

Fig. 8. **State budget of the Republic of Armenia, % of GDP**

Source: database of the National Statistical Service of the Republic of Armenia. URL: www.armstat.am (accessed on 12.10.2020).

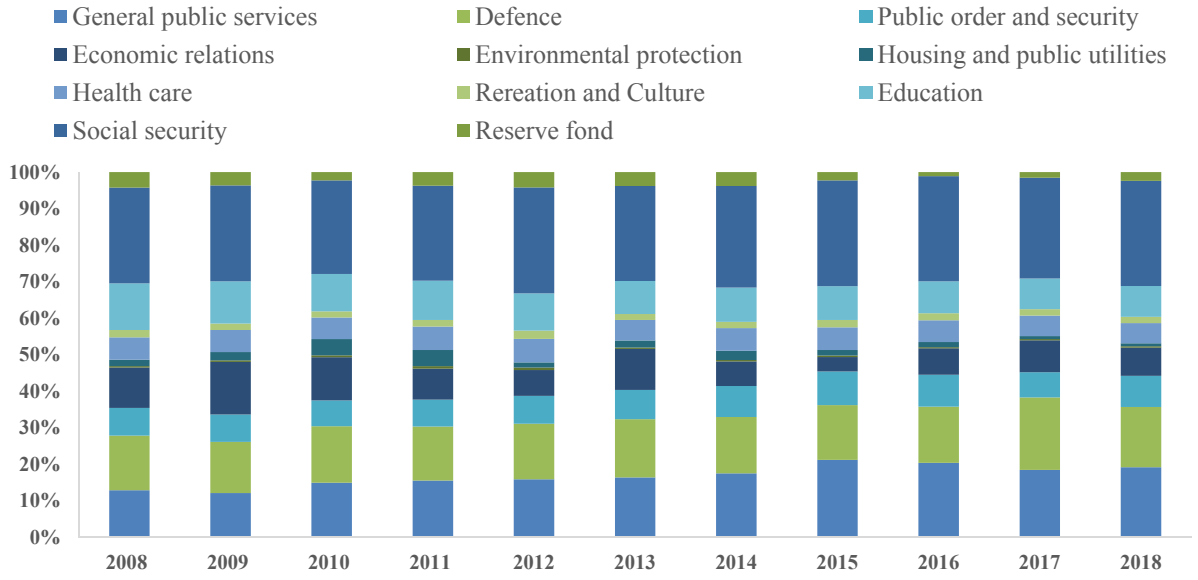

Fig. 9. **State budget expenditure structure of Armenia**

Source: database of the National Statistical Service of the Republic of Armenia. URL: www.armstat.am (accessed on 12.10.2020).

The data were converted to stationary and normal distributions and a VAR model was built. The resulting model was considered by the authors both holistically and by individual regressions. Finally, the authors built a table of the impulse-response function, which made it possible to assess the influence of two separate indicators on each other.

• *Testing the model of connection between public expenditure and inflation for Armenia*

We used the following data to build the model for Armenian economy: quarterly data on the exchange rate (exr), government expenditure (exp), inflation in the form of CPI (inf), money supply (m2) and real GDP (rgdp) from the first quarter of 2003 to the third quarter of 2019. Then, we calculated the differences between logarithms of this data, and checked them for stationarity by means of Dickie-Fuller test (*Appendix, Table 6*). We normalized time series (*Appendix, Table 7*). We then calculated the order criterion for the model (*Appendix, Table 8*). Thus, the third order was concluded to be the best choice for the model. The model produced the following points:

- government expenditure is affected by government expenditure itself with lags of 1, 2 and 3, and is affected negatively, which is logical, because if in one quarter the authorities spend more money from the state budget, then in the next quarter they should cut their spending;
- the impact of exchange-rate volatility on government expenditure is also negative, if the dram to the dollar becomes more expensive, then government expenditure increases with the first lag;
- inflation is influenced positively by inflation itself, exchange rate volatility and changes in the money supply with the third lag;
- exchange rate volatility is affected positively, only by the exchange rate itself, with the first lag. The money supply is also affected by exchange-rate volatility with one lag, but negatively;
- real GDP is affected negatively, only by the real GDP itself through one lag (quarter).

The analysis of the impulse-response function (*Fig. 10*) and the orthogonalized impulse-response function (*Fig. 11*) showed that internal shocks are strongly responded by government expenditure (they respond to shock from government expenditure itself, exchange rates, inflation and money supply), real GDP (responds to shocks from exchange rate, inflation, money supply and real GDP itself), but the inflation response to changes in government expenditure is rather small. The response of the indicators to external shocks almost coincides with the response to internal shocks, except government expenditure, which responds more to changes in real GDP than to changes in prices. The most significant factors for real GDP were exchange rate volatility inflation and exogenous changes in GDP itself.

The analysis showed that inflation does not react to internal and external shocks, which means that it is not subject to market mechanisms, but the high concentration in the market of goods in Armenia, as well as the active intervention of the Central Bank of Armenia in the currency market, as detailed in our previous studies. The analysis also supports this point, evidently indicating that the exchange rate of the national currency did not respond to any internal or external shocks included in the regression analysis, which may be due to non-market mechanisms of exchange rate formation of the dram and active currency regulation by monetary authorities of Armenia.

Finally, when examining GDP growth, GDP deflator and CPI, it can be seen that GDP growth is in most cases higher than GDP deflator growth, which in fact does not reflect either inflationary GDP growth or low consumption growth, where supply exceeds demand (*Fig. 12*). This dynamics reflects the lack of economic efficiency.

The developed model points to the ineffectiveness of monetary regulation within inflation targeting in Armenia, since monetary regulation aims at the fiscal objective of controlling the growth of state budget expenditures along with price level instability.

Fiscal dominance: public debt and exchange rate

Finally, the most notorious stumbling block between fiscal and monetary policy is the problem of public debt. While in theory this problem is being addressed by the Central Bank lending money to the government, in practice many countries use exchange-rate mechanisms.

As mentioned above, Armenia is pursuing an inflation targeting policy that assumes a freely floating exchange rate of the national currency. According to the Law of RA "On Currency Regulation and Currency Control",[2] as well as the IMF[3] classification, Armenia is included in the group

[2] Cf The Law of RA on Currency Regulation and Currency Control. URL: http://www.parliament.am/legislation.php?sel=show&ID=2140&lang=eng (accessed on 05.05.2020).

[3] CF Annual Report on Exchange Arrangements and Exchange Restrictions 2018; International Monetary Fund. Monetary and

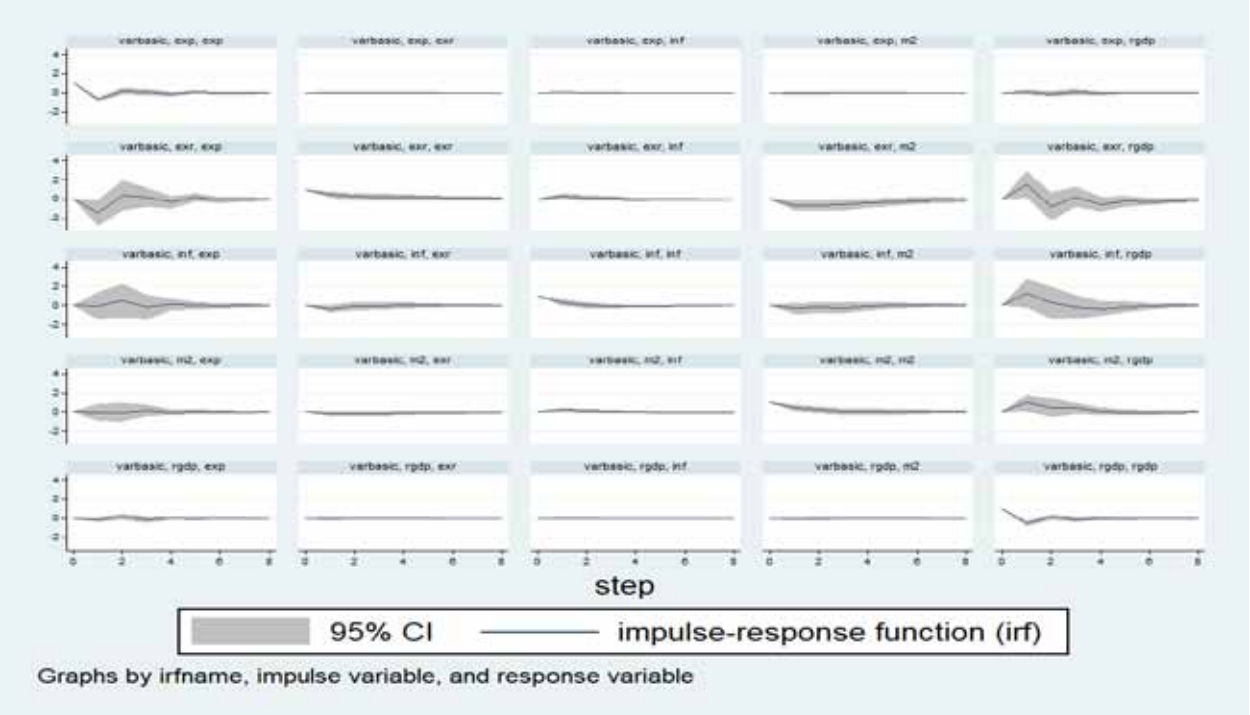

Fig. 10. **Impulse-response function for the following variables: government expenditure, exchange rate, inflation, money supply, real GDP**

Source: calculated by the authors.

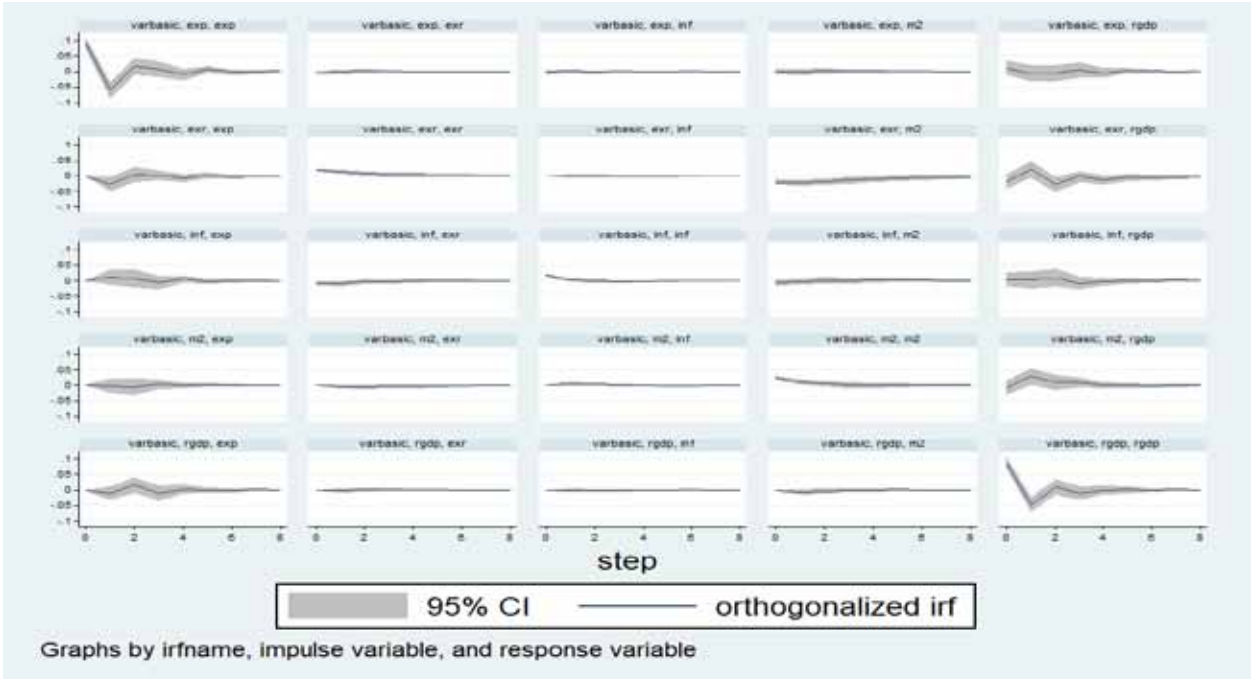

Fig. 11. **Orthogonalized impulse-response function for the following variables: government expenditure, exchange rate, inflation, money supply, real GDP**

Source: calculated by the authors.

Fig. 12. **Growth of GDP, CPI and GDP deflator, annual, in %**

Source: database of the National Statistical Service of the Republic of Armenia. URL: www.armstat.am (accessed on 12.10.2020) and also calculated by the authors.

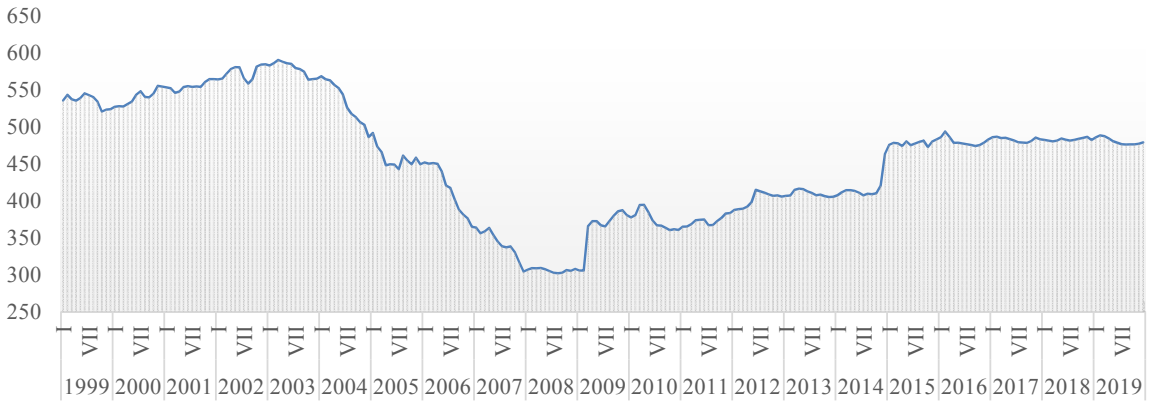

Fig. 13. **Dynamics of USD\AMD rate in Armenia, monthly**

Source: database of the Central Bank of the Republic of Armenia. URL: www.cba.am (accessed on 12.10.2020).

with a regulated free floating rate. In addition, the Law notes the possibility of the Central Bank's intervention in the foreign exchange market, in case it is necessary to achieve the goals of monetary regulation.

The assessment of foreign exchange regulation in Armenia testifies to the active intervention of the Central Bank in the foreign exchange market and in the formation of the dram exchange rate. *Figure 13* shows the dynamics of the exchange rate by month. Despite significant external and internal shocks for the economy, the AMD exchange rate has demonstrated stable volatility over the past few years [19]. Many of our researches prove that such stability has been and is currently ensured by efforts of monetary authorities [20]. The analysis of the formation factors of the exchange rate indicates a rather low participation of market factors in this process, while the role of monetary authorities is big [21, 22].

Maintaining the exchange rate at a certain point aims at several objectives. Among the most significant are the maintenance of prices and the resolution of the public debt problem.

As we can see in *Fig. 14*, Armenia's external debt amounts to almost $ 12 billion and is equivalent to above 85% of GDP. More than half of the debt is in the government sector.

As of 2018, the share of total government debt in GDP was 55.7%, including 44.5% of external debt and 11.2% of domestic debt (*Fig. 15*). According to the Fig., over the past 10 years, Armenia's total public debt has increased

Capital Markets Department, April, 2019. URL: https://www.imf.org/en/Publications/Annual-Report-on-Exchange-Arrangements-and-Exchange-Restrictions/Issues/2019/04/24/Annual-Report-on-Exchange-Arrangements-and-Exchange-Restrictions-2018–46162 (accessed on 12.05.2020).

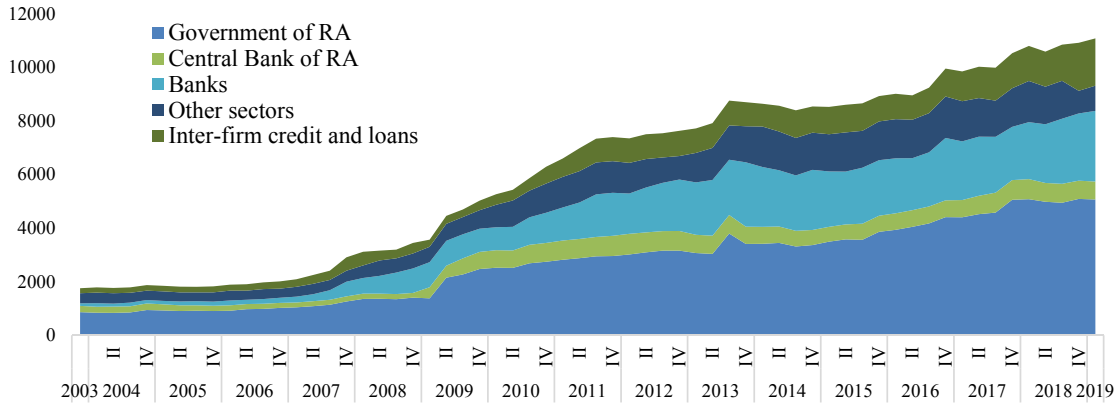

Fig. 14. **Gross external debt of RA, million USD**

Source: database of the National Statistical Service of the Republic of Armenia. URL: www.armstat.am (accessed on 12.10.2020).

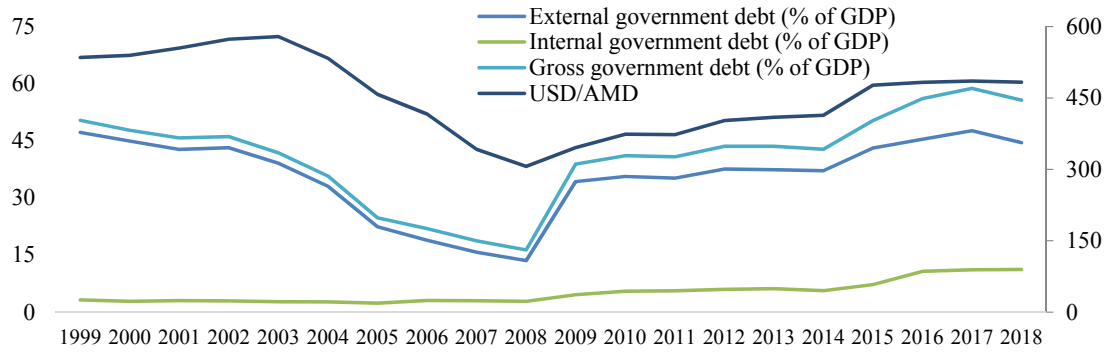

Fig. 15. **Government debt of RA (in % of GDP) and exchange rate of AMD**

Source: database of the National Statistical Service of the Republic of Armenia. URL: www.armstat.am (accessed on 12.10.2020).

twice: after 2008 and 2014. Both periods were caused by external shocks, which had a negative impact on the macroeconomic situation in Armenia and demanded an increase in the country's external debt to offset the loss of economic growth. Since the end of 2014, the Armenian government has been actively raising domestic debt obligations.

The problem of Armenia's high government debt is obvious and certainly requires both regulation and solution. Monetary policy is actively involved in solving this problem now. If the Central Bank of Armenia stimulated the investment of the financial system in government securities by the Armenian government, using supervisory functions on the part of the internal debt, then, in our opinion, it is pursuing a policy of gimmicks on the external debt to maintain the exchange rate at a stable level, conceived to the detriment of the country's export positions and the competitiveness of the domestic product in foreign markets, including the EAEU market. In this regard, a model of the relationship between the public debt and the exchange rate of the national currency in order to identify this relationship in the Armenian economy is presented below.

- *Methodology: Characteristics of the model of the relationship between public debt and the exchange rate*

In order to identify the dependence of exchange rate volatility in a country's government debt, we propose the following model: a country with a similar structure and internal and external shock to the economy was selected as a benchmark. The choice was also based on the implementation of inflation targeting policies in the context of a regulated floating exchange rate. In addition, the country's trade route options as well as the structure of GDP were included in the country's selection criteria. Based on the above criteria, we chose the Hungarian economy to build the basic model, which applies inflation targeting in a floating exchange rate framework,[4] has no access to the

[4] Cf. Annual Report on Exchange Arrangements and Exchange Restrictions 2018; International Monetary Fund. Monetary and Capital Markets Department. April, 2019. URL: https://www.imf.org/en/Publications/Annual-Report-on-Exchange-Arrangements-and-Exchange-Restrictions/Issues/2019/04/24/

Table 7

Correlation between variables

```
. corr exr ml cpi exp imp gdp debt
(obs=86)
```

	exr	ml	cpi	exp	imp	gdp	debt
exr	1.0000						
ml	-0.0480	1.0000					
cpi	-0.1722	-0.2795	1.0000				
exp	0.2262	-0.0077	0.0594	1.0000			
imp	0.2586	-0.0375	0.0654	0.8410	1.0000		
gdp	0.1382	0.0509	-0.0398	0.2172	0.2775	1.0000	
debt	-0.6851	0.1393	0.0794	-0.0060	0.0019	-0.1565	1.0000

Table 8

Regression model with the dependent variable of exchange rate

```
. reg exr cpi imp debt
```

Source	SS	df	MS		
				Number of obs	= 86
				F(3, 82)	= 34.13
Model	.131414091	3	.043804697	Prob > F	= 0.0000
Residual	.105242774	82	.001283448	R-squared	= 0.5553
				Adj R-squared	= 0.5390
Total	.236656865	85	.002784198	Root MSE	= .03583

exr	Coef.	Std. Err.	t	P>|t|	[95% Conf.	Interval]
cpi	-.0073885	.0040153	-1.84	0.069	-.0153762	.0005991
imp	.3160456	.0867879	3.64	0.000	.1433969	.4886944
debt	-.5016812	.0549219	-9.13	0.000	-.6109383	-.3924241
_cons	.0071809	.0046241	1.55	0.124	-.0020178	.0163797

Table 9

Heteroskedasticity and omitted variables test

```
. estat hettest

Breusch-Pagan / Cook-Weisberg test for heteroskedasticity
         Ho: Constant variance
         Variables: fitted values of exr

         chi2(1)      =     0.15
         Prob > chi2  =   0.7007

. estat ovtest

Ramsey RESET test using powers of the fitted values of exr
       Ho:  model has no omitted variables
                  F(3, 79) =      1.02
                  Prob > F =      0.3886
```

sea and two major industries are metallurgy and textiles. Based on the analysis of monetary and exchange rate policy in Hungary, a model was built that describes the relationship between the country's public debt and the volatility of exchange rates of national units.

To build the currency volatility, we used quarterly data from the first quarter of 1998 to the third quarter of 2019 on the following indicators: GDP, M1 cash aggregate (cash + demand deposits), inflation (CPI), exchange rate, export and import, and government debt. The data have been seasonally cleared, differences between logarithms of current and previous periods have been calculated and then the data have been normalized (*Appendix, Table 9*).

First, we tested the correlation between variables to avoid the multicollinearity. The highest correlation is between imports and GDP, imports and exports, inflation and money supply (*Table 7*). Since the exchange rate is more closely correlated with imports than with export or GDP, we decided to keep imports, monetary inflation and inflation rate in the model along the same lines.

We built a regression model with the remaining variables (*Table 8*).

Annual-Report-on-Exchange-Arrangements-and-Exchange-Restrictions-2018–46162 (accessed on 18.03.2020).

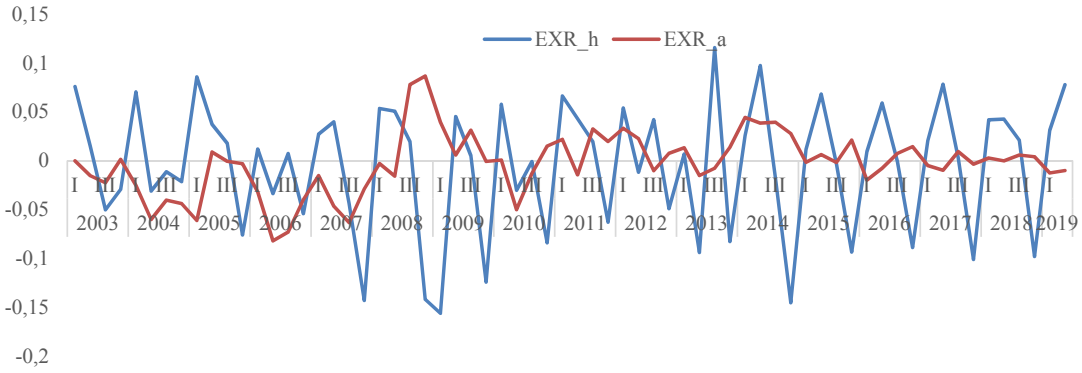

Fig. 16. **Volatility of real exchange rate of the dram and exchange rate of the dram on the model examined**

Source: database of the Central Bank of the Republic of Armenia. URL: www.cba.am (accessed on 12.10.2020) and also calculated by the authors.

The model is acceptable ($R^2 = 0.5552$), which means that exchange rate volatility is explained by data variables with probability more than 50%. To validate the model, we tested the model for heteroscedasticity (Breusch-Pagan test) and lack of significant variables (Ramsey test) in addition to lack of multicollinearity. The test results made us conclude that there is no heteroskedasticity and that there are no significant variables omitted (*Table 9*).

The model was adopted for testing in the Armenian economy.

- *Testing the model of connection between government debt and exchange rate for Armenia*

Exchange rate volatility equation for the Hungarian economy:

Equation 19

$$ExR = -0.0073885 * CPI + 0.3160456 * Imp - \\ - 0.5016812 * Debt.$$

Using *Equation 19*, we analyzed and assessed the impact of government debt on the exchange rate of the dram.

Figure 16 shows the analysis of the movement of the exchange rate using the formula and the real exchange rate. The data used in the model does not have a seasonality factor, and each variable is the difference between the current and the previous period of the logarithms (all variables except the CPI) of the variable values. The volatility of the dram exchange rate is also seasonally adjusted. We conclude that the exchange rate volatility of the Hungarian forint against the US dollar (Exr_h) is not similar to the exchange rate volatility of the dram against the US dollar (Exr_a). Thus, the Armenian exchange rate is not regulated by the same regime as the Hungarian exchange rate, even if both Armenia and Hungary have a floating exchange rate regime. Thus, the volatility of the dram is due to non-market factors, which indicates the intervention of the Central Bank of Armenia in the foreign exchange market of Armenia.

In addition to meeting the targets, non-market interference shows that monetary authorities also indirectly engage in fiscal regulation to keep external debt at a certain level.

CONCLUSION

Fiscal dominance in the Armenian economy is clearly present to some extent. For sure, monetary policy aims to achieve stable prices in the country. However, the target chosen greatly facilitates the adoption of regulatory instruments, and the intended target directly solves the problems of fiscal policy.

The developed models have proved that all three mechanisms of fiscal dominance are used in monetary regulation by the Central Bank of Armenia. The most pronounced are fiscal expenditure, as well as external government debt. Clearly, the priority of these objectives in macroeconomic regulation requires fiscal dominance. However, given the negative consequences for economic growth and well-being of the population in the long term, we believe that the chosen approach in the country's macroeconomic policy should be revised.

ACKNOWLEDGEMENTS

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APPENDIX

Table 1

Test of the data distributions

```
. swilk def govtb mb

                    Shapiro-Wilk W test for normal data

    Variable |   Obs        W         V         z       Prob>z
-------------+--------------------------------------------------
         def |    46    0.95378    2.036     1.509    0.06566
       govtb |    46    0.97535    1.086     0.175    0.43060
          mb |    46    0.95687    1.900     1.362    0.08661

. sfrancia def govtb mb

                   Shapiro-Francia W' test for normal data

    Variable |   Obs       W'        V'        z       Prob>z
-------------+--------------------------------------------------
         def |    46    0.95331    2.279     1.549    0.06067
       govtb |    46    0.98382    0.790    -0.443    0.67128
          mb |    46    0.96528    1.695     0.992    0.16058
```

Table 2

Test of stationarity

```
. dfuller def

Dickey-Fuller test for unit root                   Number of obs   =        45

                         ------------ Interpolated Dickey-Fuller ------------
                 Test         1% Critical       5% Critical      10% Critical
               Statistic         Value             Value            Value
------------------------------------------------------------------------------
 Z(t)            -9.273           -3.614            -2.944           -2.606
------------------------------------------------------------------------------
MacKinnon approximate p-value for Z(t) = 0.0000

. dfuller govtb

Dickey-Fuller test for unit root                   Number of obs   =        45

                         ------------ Interpolated Dickey-Fuller ------------
                 Test         1% Critical       5% Critical      10% Critical
               Statistic         Value             Value            Value
------------------------------------------------------------------------------
 Z(t)           -14.971           -3.614            -2.944           -2.606
------------------------------------------------------------------------------
MacKinnon approximate p-value for Z(t) = 0.0000

. dfuller mb

Dickey-Fuller test for unit root                   Number of obs   =        45

                         ------------ Interpolated Dickey-Fuller ------------
                 Test         1% Critical       5% Critical      10% Critical
               Statistic         Value             Value            Value
------------------------------------------------------------------------------
 Z(t)            -5.821           -3.614            -2.944           -2.606
------------------------------------------------------------------------------
MacKinnon approximate p-value for Z(t) = 0.0000
```

Table 3

Selection-order criteria test

```
. varsoc mb gov

Selection-order criteria
Sample:  2009q1 - 2019q2                        Number of obs      =        42

+---------------------------------------------------------------------------+
| lag |    LL      LR      df    p      FPE       AIC      HQIC      SBIC   |
|-----+---------------------------------------------------------------------|
|  0  |  20.454                        .001424  -.87876  -.84843  -.796013  |
|  1  | 37.6232  34.339    4  0.000   .000761* -1.50587* -1.41488* -1.25763* |
|  2  | 39.1357  3.0249    4  0.554   .000858  -1.38741  -1.23576  -.973682  |
|  3  | 44.3148  10.358*   4  0.035   .000814  -1.44356  -1.23126  -.864341  |
|  4  | 48.4244  8.2191    4  0.084   .000816  -1.44878  -1.17581  -.704065  |
+---------------------------------------------------------------------------+
Endogenous:  mb govtb
 Exogenous:  _cons
```

Table 4

Selection-order criteria test

```
. varsoc gov def

Selection-order criteria
Sample:  2009q1 - 2019q2                        Number of obs      =        42
```

lag	LL	LR	df	p	FPE	AIC	HQIC	SBIC
0	-82.9472				.195806	4.0451	4.07543	4.12785
1	-66.5337	32.827	4	0.000	.10847	3.45398	3.54497	3.70222
2	-61.4151	10.237	4	0.037	.103027	3.40072	3.55237	3.81445
3	-39.6354	43.56	4	0.000	.04436	2.55406	2.76637	3.13329
4	-31.9047	15.461*	4	0.004	.037409*	2.37641*	2.64938*	3.12113*

Table 5

Selection-order criteria test

```
. varsoc mb def

Selection-order criteria
Sample:  2009q1 - 2019q2                        Number of obs      =        42
```

lag	LL	LR	df	p	FPE	AIC	HQIC	SBIC
0	52.1963				.000314	-2.3903	-2.35997	-2.30755
1	55.2431	6.0937	4	0.192	.000329	-2.34491	-2.25392	-2.09667
2	60.3691	10.252	4	0.036	.000312	-2.39853	-2.24688	-1.9848
3	85.427	50.116	4	0.000	.000115	-3.40129	-3.18898	-2.82206
4	95.5631	20.272*	4	0.000	.000086*	-3.69348*	-3.42052*	-2.94877*

Table 6

Testing variables for stationarity

```
. dfuller exp

Dickey-Fuller test for unit root                    Number of obs   =        65

                     ---------- Interpolated Dickey-Fuller ----------
         Test         1% Critical       5% Critical      10% Critical
       Statistic         Value             Value            Value
------------------------------------------------------------------------------
 Z(t)     -14.171           -3.559           -2.918           -2.594
------------------------------------------------------------------------------
MacKinnon approximate p-value for Z(t) = 0.0000

. dfuller inf

Dickey-Fuller test for unit root                    Number of obs   =        65

                     ---------- Interpolated Dickey-Fuller ----------
         Test         1% Critical       5% Critical      10% Critical
       Statistic         Value             Value            Value
------------------------------------------------------------------------------
 Z(t)     -6.820           -3.559           -2.918           -2.594
------------------------------------------------------------------------------
MacKinnon approximate p-value for Z(t) = 0.0000

. dfuller exr

Dickey-Fuller test for unit root                    Number of obs   =        65

                     ---------- Interpolated Dickey-Fuller ----------
         Test         1% Critical       5% Critical      10% Critical
       Statistic         Value             Value            Value
------------------------------------------------------------------------------
 Z(t)     -3.547           -3.559           -2.918           -2.594
------------------------------------------------------------------------------
MacKinnon approximate p-value for Z(t) = 0.0069

. dfuller m2

Dickey-Fuller test for unit root                    Number of obs   =        65

                     ---------- Interpolated Dickey-Fuller ----------
         Test         1% Critical       5% Critical      10% Critical
       Statistic         Value             Value            Value
------------------------------------------------------------------------------
 Z(t)     -3.448           -3.559           -2.918           -2.594
------------------------------------------------------------------------------
MacKinnon approximate p-value for Z(t) = 0.0094

. dfuller rgdp

Dickey-Fuller test for unit root                    Number of obs   =        65

                     ---------- Interpolated Dickey-Fuller ----------
         Test         1% Critical       5% Critical      10% Critical
       Statistic         Value             Value            Value
------------------------------------------------------------------------------
 Z(t)     -11.780           -3.559           -2.918           -2.594
------------------------------------------------------------------------------
MacKinnon approximate p-value for Z(t) = 0.0000
```

Table 7

Test of the data distribution

```
. swilk exp inf exr m2 rgdp

                    Shapiro-Wilk W test for normal data
```

Variable	Obs	W	V	z	Prob>z
exp	66	0.98052	1.144	0.291	0.38566
inf	66	0.98633	0.802	-0.478	0.68368
exr	66	0.96917	1.809	1.285	0.09940
m2	66	0.96852	1.847	1.330	0.09174
rgdp	66	0.96579	2.007	1.510	0.06547

```
. sfrancia exp inf exr m2 rgdp

                  Shapiro-Francia W' test for normal data
```

Variable	Obs	W'	V'	z	Prob>z
exp	66	0.97334	1.731	1.056	0.14558
inf	66	0.99057	0.612	-0.944	0.82744
exr	66	0.96799	2.078	1.408	0.07962
m2	66	0.96735	2.120	1.446	0.07412
rgdp	66	0.97219	1.805	1.137	0.12784

Table 8

Selection-order criteria test

```
. varsoc exp inf exr m2 rgdp

Selection-order criteria
Sample:  2004q1 - 2019q2                        Number of obs      =        62
```

lag	LL	LR	df	p	FPE	AIC	HQIC	SBIC
0	496.932				8.0e-14	-15.8688	-15.8014	-15.6972
1	563.724	133.59	25	0.000	2.3e-14*	-17.2169*	-16.8128*	-16.1876*
2	577.237	27.026	25	0.355	3.4e-14	-16.8464	-16.1055	-14.9594
3	593.031	31.588	25	0.170	4.7e-14	-16.5494	-15.4717	-13.8047
4	619.027	51.992*	25	0.001	5.0e-14	-16.5815	-15.1671	-12.9791

```
Endogenous:  exp inf exr m2 rgdp
 Exogenous:  _cons
```

Table 9

Test of the data distribution

```
. swilk ml cpi exr exp imp gdp debt

                    Shapiro-Wilk W test for normal data
```

Variable	Obs	W	V	z	Prob>z
ml	86	0.97358	1.924	1.440	0.07491
cpi	86	0.98465	1.118	0.246	0.40294
exr	86	0.99031	0.706	-0.766	0.77816
exp	86	0.97602	1.747	1.227	0.10984
imp	86	0.98240	1.282	0.546	0.29242
gdp	86	0.97735	1.650	1.101	0.13535
debt	86	0.97960	1.486	0.871	0.19182

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