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Modelling of Fiscal and Monetary Policy Interactions in the Republic of Belarus

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ABSTRACT
The article discusses classical and modern macroeconomic models of interaction of fiscal and monetary policies in Belarus. The hypothesis of this research is that the interaction of fiscal and monetary policies has a synergistic effect on economic growth and that at certain stages, one of these policies prevails over the other. This hypothesis was tested with the help of an IS-LM model, which was used to investigate the joint effects of monetary and fiscal policies on business activity in Belarus. A Markov switching model was developed in Eviews software to analyze the interaction between these policies. Regression dependences of the average tax burden (including the burden imposed by social security contributions) and GDP, investment and the refinancing rate were built by using Excel software. To solve the IS-LM model, the value of autonomous consumption was computed with the help of the adjusted value of the average propensity to consume. It was found that autonomous consumption is comparable with the budget of subsistence minimum in Belarus. The share of government spending in the GDP structure was on average 35.01%. The comparison of gross savings and investment showed that in the majority of periods, gross savings insignificantly exceeded the amount of investment, that is, the available funds were used for consumer lending rather than for investment. Analysis of the Markov switching model has led us to the conclusion that from the first quarter 2005 until the fourth quarter of 2009, the fiscal policy in Belarus was in the active regime. The passive fiscal policy regime was observed in the period between the first quarter of 2010 and the first quarter of 2019. In this period, a rise in the public debt was accompanied by an increase in the budget surplus. In the second quarter of 2019, there was a transition to a more active fiscal policy, which points to the need to intensify tax reforms.

KEYWORDS
taxation system, tax reform, tax burden, fiscal policy, monetary policy, economic growth

JEL H20, H21, E62

УДК 336.221

Тестирование моделей взаимодействия налоговой и монетарной политики в Республике Беларусь

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АННОТАЦИЯ
Статья посвящена тестированию классических и современных макроэкономических моделей взаимодействия налоговой и монетарной политики в Республике Беларусь. Гипотезой исследования является предположение о том, что

взаимодействие фискальной и монетарной политик обеспечивает синергетическое воздействие на экономический рост, при этом на определенных этапах преимущества имеет фискальная либо монетарная политика. В качестве основной модели для исследования совокупного влияния монетарной и фискальной политики на деловую активность в республике Беларусь выбрана модель IS-LM. С помощью программного продукта Eviews построена модель с марковским переключением, анализирующая взаимодействие монетарной и фискальной политики. Средствами Excel построены регрессионные зависимости средней налоговой нагрузки (включая налоговую нагрузку по взносам на социальное страхование) и ВВП, инвестиций и ставки рефинансирования. В ходе решения модели IS-LM скорректированное значение средней склонности к потреблению позволило рассчитать значение автономного потребления, которое сопоставимо с бюджетом прожиточного минимума в Республике Беларусь. Доля государственных расходов в структуре ВВП в среднем составила 35,01%. Сопоставление валового сбережения и инвестиций показало, что в большинстве периодов валовое сбережение незначительно превышает размер инвестиций, то есть свободные средства используются для потребительского кредитования, а не для инвестиционных целей. Анализ модели с марковским переключением позволил установить, что режим активной фискальной политики в Республике Беларусь соответствовал периоду с 1 квартала 2005 г. по 4 квартал 2009 г. Режим пассивной фискальной политики соответствовал периоду с 1 квартала 2010 г. по 1 квартал 2019 г., когда параллельно с ростом государственного долга наращивался и профицит бюджета. Во 2 квартале 2019 г. наметился переход к активизации фискальной политики, что свидетельствует о необходимости активизации налоговых реформ.

КЛЮЧЕВЫЕ СЛОВА
налоговая система, налоговая реформ, налоговая нагрузка, фискальная политика, монетарная политика, экономический рост

1. Introduction

The tax system of Belarus emerged at the moment when the country acquired sovereignty and obtained the right to organize its own taxation, set priorities in the fiscal policy, and create taxation mechanisms providing the country's tax sovereignty [1].

The process of creation and development of the national tax system can be roughly divided into the following stages:

1. At the first stage, the tax system was oriented towards the formation of market relationships and ensuring stable budget revenues (1992–1995). At this stage, the fiscal function was the main priority of the tax system. The number of tax payments exceeded 30 and the level of the tax burden as a percentage of GDP was so high that it resulted in tax evasion.

2. At the second stage (1996–2000), the tax system developed and different regulatory instruments were tested. In this period, incentives to stimulate foreign investment were introduced, such as special tax schemes and systems.

3. The third stage (2001–2010) was characterized by codification and unification of the tax system, which was integrated into the system of international taxation. The government also sought ways to balance the fiscal and regulatory components of taxation. The general part of the Tax Code in Belarus came into force on 1 January 2004, while the special tax code has been in operation since 1 January 2010. From 2006 to 2009, 17 taxes were eliminated and 34 independent tax levies and charges were included into the single state tax.

4. At the fourth stage (since 2011 to present), the tax system was modernized and simplified, becoming oriented towards more advanced fiscal tools and methods. The government has also been searching for new ways to optimize the fiscal policy models in order to ensure economic growth. At this stage, the government also defined priorities of economic development and tried to stimulate innovation in business as well as economic growth and investment activity, create the infrastructure for e-government.

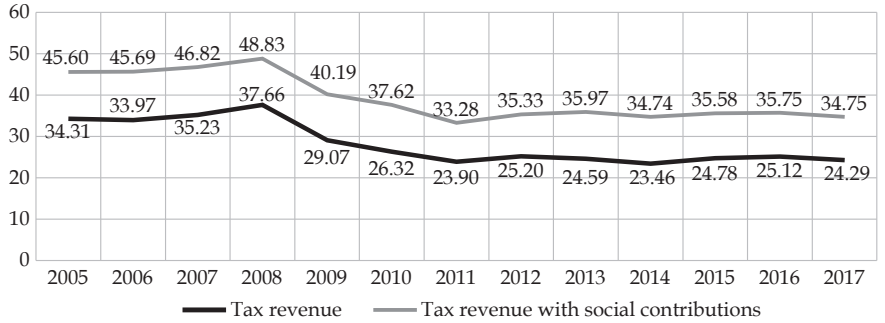

Figure 1. **Tax revenues as a percentage of GDP in Belarus in 2005–2017, %**

Source: built by the authors on the basis of the IMF data

The Belarusian government is now taking active steps to reduce the tax burden (Figure 1). The percentage of tax revenues in GDP in the given period was on average 39.24% (taking into account contributions to the National Social Security Fund), with the smallest share in 2011, and the largest, in 2008.

As it is illustrated by the data above, Belarus fits into the global trends in tax burden. Belarus can be described as a country with a moderate tax burden. Its level corresponds to the average tax burden in OECD states (in 2017 it was 34.48%[1]).

Overall, it can be concluded that the Belarusian tax system is affected by the key global trends such as globalization, international competition and search for investment, which have rendered introduction of new taxes virtually impossible. Moreover, the openness of Belarusian economy makes doubtful the possibility of the multiplier effect for tax change and government spending.

In Belarus, like in other countries, fiscal instruments are used to regulate socio-economic processes. Fiscal policy instruments are used along with those of monetary policy, which makes it particularly interesting to look at the joint effects of monetary and fiscal policies on the country's economy. The hypothesis we are going to test further in this research is that the interaction of fiscal and monetary policies has a synergistic effect on the national economic growth and that at certain stages, either one or the other prevails.

2. Literature review

The global financial crisis of 2008 spurred a renewed discussion about the role of fiscal and monetary policies in macroeconomic stabilization. Until the crisis, the majority of economists had been in agreement that the monetary policy should be playing the main role in the process of macroeconomic stabilization. It was, however, the fiscal policy that provided the main support for aggregate demand.

The fiscal policy played an active role during the crisis, which led to a massive increase in debt levels in developed countries and, as a result, raised a number of questions concerning fiscal stability in the future and potential risks for the monetary policy. The financial crisis of 2008 also triggered new trends in studies of the correlation between economic growth and fiscal regulation. There was a long period when governments resorted to unpopular measures such as tax raising in order to restore the former growth rates in the country. After the crisis, however, OECD experts, who analyzed tax reforms and prospects of fiscal policy implementation, voiced their doubts about the tax burden's ability to affect economic growth[2].

[1] OECD database. Available at: https://stats.oecd.org/viewhtml.aspx?datasetcode=REV&lang=en#

[2] OECD (2018), Tax Policy Reforms 2018: OECD and Selected Partner Economies, OECD Publishing, Paris. DOI: 10.1787/9789264304468-en; OECD (2010), Tax Policy Reform and Economic Growth, OECD Publishing. DOI: 10.1787/9789264091085-en

The analysis of empirical data no longer led scholars to definite conclusions regarding the impact of taxation on economic growth.

I. Mayburov, for example, pointed out that the lack of the empirical connection (or its weakness) between economic growth and the size of the state (provided that there is a theoretical justification for the existence of the optimal state size) shows that either economic growth is insensitive to the level of taxation or the real tax burden is on average close to the optimum [2, p. 33].

Contemporary studies have focused on general fiscal policy indicators and on its effects in combination with other instruments of state regulation such as monetary policy. For instance, T. Sargent and N. Wallace [3] have shown that depending on the way fiscal and monetary policies are coordinated, the latter may fail to control inflation. M. Woodford and E. Leeper [4; 5] have demonstrated the impact of fiscal policy on the level of prices. E. Cevik et al. [6] studied interactions between fiscal and monetary policies in emerging European states by using a Markov regime-switching model.

Game theory methodology enabled W. Nordhaus to study the 'fiscal-monetary mix' [7] and to describe the optimal monetary and fiscal policies. O. Blanchard studied fiscal dominance in Brazil and its implications [8].

Russian scholars [9] tested the interaction between monetary and fiscal policies by using the empirical data of the Russian Federation and demonstrated that in modern Russia the fiscal policy is quite restrictive while the monetary policy provides excessive stimulation, which means that such coordination of policies is far from optimal.

Contemporary studies use a variety of econometric models and tests to evaluate fiscal and monetary policy interactions [10–11]. The most widely used models are DSGE, SWAR and Markov switching models. The Markov switching model is one of the most popular nonlinear time series models. In this model, behaviours of time series switch between different regimes. The process of regime switching is controlled by the unobservable Markov chain.

The dynamic stochastic general equilibrium model (DSGE) is a modern instrument used in applied macroeconomics. These models are now widely used by central banks and other economic institutions. The National Bank of Belarus has been conducting studies in the sphere of DSGE-modelling since the mid-2000s [11]. DSGE-models are based on economic theory and have structural parameters describing behaviours of economic agents on the micro-level, which means that such models are not subject to the Lucas critique.

To work with such models, international scholars use the free Dynare package, which runs on MatLab. Dynare is a software platform for handling a wide class of economic models, in particular DSGE models [11].

Since the early 1980s, VAR-models have been used successfully in economic research. Vector-autoregressive models are quite easy to use and they generally provide more accurate forecasts than other complex macroeconomic models [13].

Thus, classical, Keynesian and modern models show that fiscal policy and monetary policy are interdependent and coordination of their goals and mechanisms are crucial for their implementation [14–18]. In our study, we chose the IS-LM model as the main model to investigate the joint effects of monetary and fiscal policies on business activity in Belarus.

3. Research methodology

The empirical part of the study focuses on the level of tax burden and its connection with economic growth by taking into account specific macroeconomic conditions and indicators.

Calculations were made with the help of Eviews software. Databases of OECD[3], World Bank[4], and the International Mon-

[3] OECD database. Available at: https://stats.oecd.org/viewhtml.aspx?datasetcode=REV&lang=en#

[4] World Bank database. Available at: https://data.worldbank.org/indicator/GC.TAX.YPKG.RV.ZS?view=chart

etary Fund[5] were used as a source of statistical data.

We built an **IS-LM** model to study the joint impact of monetary and fiscal policies on business activity in Belarus.

The main equations of the IS-LM model can be presented in the form of a system of identities (1):

Main macroeconomic identity	$Y = C + I + G + Xn$
Function of consumption	$C = a + b(Y - T)$
Function of taxation	$T = Ta + tY$
Function of investment	$I = e - dR$
Function of net export	$Xn = g - m'Y - n'R$
Function of demand for money	$\frac{M}{P} = kY - hR$

(1)

where Y is the income; C, consumption; I, investment; G, government spending; Xn, net exports; R, the interest rate; Ta, autonomous taxes; and t is the marginal tax rate. The empirical coefficients ($a, b, e, d, g, m', n, k, h$) are positive and relatively stable while k is the sensitivity of income to demand for money and h is the sensitivity of demand for money to the interest rate.

Our analysis of the monetary policy regimes in Belarus is based on the Taylor equation, which models the dynamics of the interest rate's dependence on the inflation rate and the deviation of real output (GDP) from potential GDP.

The Taylor equation used to analyze the monetary policy regime in Belarus is estimated as a Markov switching model (dependence 1):

$$stavka_t = a_0(s_t) + a_1(s_t)\inf_t + \\ + a_2(s_t)cycle_t + \varepsilon_t, \quad (2)$$

where $stavka_t$ is the interbank interest rate, % per annum; inf_t, the inflation growth rate, %; $cycle_t$, deviation of real GDP from potential GDP; ε_t, error; s_t, unobservable variable characterizing the monetary policy regime; a_0, a_1 and a_2, parameter estimations.

For model (1) estimation, we used the quarterly data for 2005–2019.

In order to obtain variable $cycle_t$, we applied the Hodrick-Prescott filter to smooth the data of GDP variable. By applying this filter, we estimate the trend and cyclical component. When we subtract the trend and cyclical component from the real values of the initial time series, we obtain values of the initial time series devoid of the trend and cyclical component. The latter procedure is often used in applied macroeconometric research, for example, to obtain such variables as output gap or GDP (deviation of real GDP from potential GDP).

We estimated the fiscal policy regimes in Belarus in the given period with the help of the Markov switching model. The behaviour of fiscal authorities and their choice of the active or passive regime are primarily determined by the reaction of the tax burden to the changes of the public debt. In the previous periods, when the public debt was growing, it was stabilized by increasing the tax burden. In this case, the fiscal policy was passive. A decline in the tax burden accompanied by an increase in the public debt in the previous periods signify that the fiscal policy was active.

In this case, econometric modelling shows that estimation of the regression coefficient with a variable characterizing public debt should have a negative value for the active monetary policy regime and a positive value for the passive monetary policy regime.

Therefore, we propose to use the following equation to describe fiscal policy with the help of a Markov switching dependence (2):

$$tax_t = a_0(s_t) + a_1(s_t)debt_{t-1} + \\ + a_2(s_t)cycle_t + a_3(s_t)\cos t_t + \varepsilon_t, \quad (3)$$

where tax_t is the tax burden (consolidated budget revenue to GDP ratio), %; $debt_{t-1}$, gross external public debt, % of GDP; $cycle_t$, deviation of real GDP from potential GDP; cos t_t, total expenditures of consolidated budget, % of GDP; ε_t, error; s_t, unobservable variable characterizing the fiscal policy regime; a_0, a_1 and a_2, parameter estimations.

[5] IMF database. Available at: https://data.imf.org/regular.aspx?key=60991467

4. Results discussion

4.1. Analysis of monetary and fiscal policies in Belarus in the IS-LM model

To solve the IS-LM model, we need to conduct a trend analysis of the dynamics of specific macroeconomic indicators and build linear regression equations of their dependences upon the income level (*Y*) and the refinancing rate (*R*). Figure 2 illustrates the dynamics of nominal GDP, final consumption expenditures and investment in Belarus, according to the System of National Accounts.

The Belarusian System of National Accounts uses gross savings instead of investment. The equation does not include government spending as an indicator. It can be explained by the fact that final consumption expenditures include the corresponding amount of spending in the government sector. Therefore, in order to convert the equation of the national system of accounts into the main macroeconomic identity which the IS-LM model is based on, we used such indicators as total final consumption, final consumption net of government spending, investment and savings (Table 1).

As Table 1 illustrates, in the majority of cases, fixed investment is smaller than gross savings, which might mean that a part of gross savings is used through credit operations of banks for final consumption.

It should also be noted that final consumption expenditures include govern-

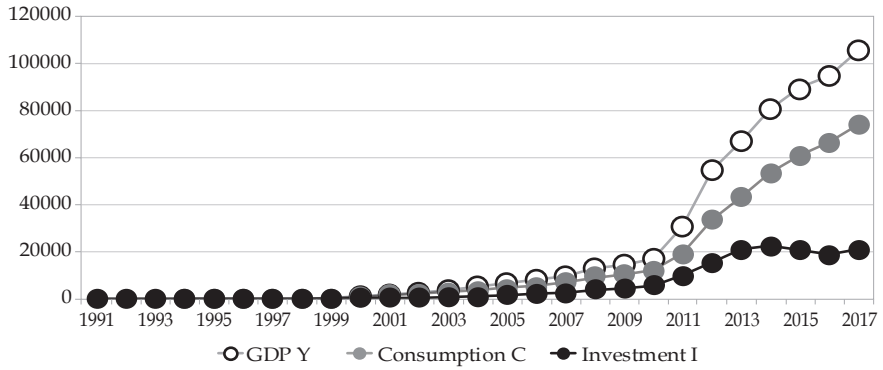

Figure 2. **Dynamics of GDP, final consumption and investment in Belarus, 1991–2017** (in nominal prices and by taking into account the denomination of 1995, 2000 and 2016)

Note: based on the data of statistical yearbooks 'System of National Accounts of the Republic of Belarus', 1995–2018

Table 1

Indicators of the system of national accounts, investment and consolidated budget expenditures in 2005–2017 (in nominal prices and by taking into account the denomination of 1995, 2000 and 2016), mln Belarusian roubles

Year	GDP	Gross savings	Final consumption	Net exports of goods and services	Fixed investment	Real government spending
2005	6506.71	1819.5	4735.14	46.283	1509.58	3125.7
2006	7926.7	2343.35	5602.82	–330.74	2037.41	3725.6
2007	9716.53	2835.01	6834.05	–609.01	2605.33	4762.7
2008	12979.08	3963.67	8888.36	–1002.5	3720.23	6381.1
2009	14209.1	7893.94	10274.55	–1546.34	4337.76	5111.739
2010	17046.6	4574.69	12216.68	–2245.41	5538.08	2500.64
2011	30724.5	9813.97	19096.47	–320.62	9866.49	2134.68
2012	54761.7	17108.28	33743.22	2447.05	15444.24	1463.15
2013	67068.8	19085.25	43384.27	–2111.87	20957.46	6711.15
2014	80579.3	22155.16	53650.85	–619.99	22526.97	5393.28
2015	89909.8	25627.34	60958.05	95.94	20715.25	3228.47
2016	94949	25057.9	66619	–181.00	18710	3453.1
2017	105748	29617.3	74138.8	223.6	21033.7	1768.3

ment spending. Furthermore, the System of National Accounts of the Republic of Belarus contains the indicator 'statistical discrepancies'. For example, when GDP is computed by applying the income approach, these statistical discrepancies make up from 0.85% to 3.1%, depending on the period. The conversion of the data from the System of National Accounts into the main macroeconomic identity leads to an increase in statistical discrepancies, which are now 3.3–10.6%. These discrepancies are still smaller than the real expenditures of the state budget. Thus, in order to solve the IS-LM model, we are going to introduce real final consumption expenditures of the consolidated budget into the formula through the statistical discrepancy and reduction of final consumption expenditures. In consideration of the above, the updated data for solving model (1) are shown in Table 2.

Taking into account that we have significantly adjusted final consumption expenditures, it seems reasonable to estimate the new GDP structure formed to solve the IS-LM model according to sources of income. Final consumption with consideration of the adjustments that we made still accounts for the largest share in GDP. However, the adjusted average propensity to consume is 45.46% while before the adjustment, the average value of this indicator in 1994–2017 was 72.98%. There was a parallel increase in the share of government spending, which was on average rather high – 35.01% and can be interpreted as a sign of extensive state intervention in socio-economic processes.

Our analysis of the average propensity to save (Figure 3) shows that in this pe-

Table 2

Indicators of the System of National Accounts, investment and consolidated budget expenditures in 2005–2017 (mln Belarusian roubles, measured in 2016 prices)

Year	GDP	Final consumption	Fixed investment	Real government spending
2005	6506.71	1825.15	1509.58	3125.7
2006	7926.7	2494.43	2037.41	3725.6
2007	9716.53	2957.51	2605.33	4762.7
2008	12979.18	3880.25	3720.23	6381.1
2009	14209.1	6497.6	4337.76	4920.08
2010	17046.6	8455.95	5538.08	5297.98
2011	30724.5	13235.81	9866.49	7942.82
2012	54761.7	21353.49	15444.24	15516.92
2013	67068.8	29448.07	20957.46	18775.14
2014	80579.3	37556.92	22526.97	21115.4
2015	89909.8	44060.91	20715.25	25037.7
2016	94949	49098	18710	27322
2017	105748	55763.9	21033.7	28726.8
Average value	26368.12	12321.18	6600.81	7742.94

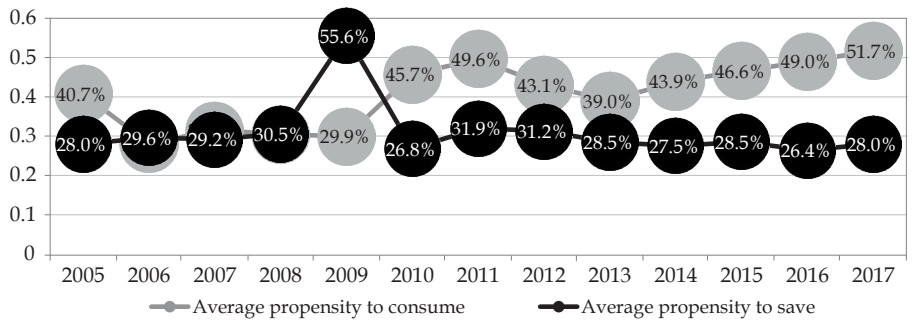

Figure 3. **Analysis of the average propensities to consume and save in Belarus in 2005–2017** (Consumption was adjusted to account for the sum of government spending)

riod, this indicator varied between 26.4% and 55.6% and the average propensity to consume, between 29.9% and 51.7%. Recently, the latter indicator has been rising steadily.

It should be noted that in a closed economy the average propensities to consume and save equal 1. In Belarus, net exports do not equal zero and in most periods are negative, which means that (APC+APS) can be different from 1 but in any case should be positive.

After the amount of final consumption is adjusted for the sum of government spending, let us calculate autonomous consumption and evaluate the adequacy of this result (Figure 4).

To confirm the adequacy of our results regarding autonomous consumption, it is necessary to take into account the following: the economic meaning of this indicator is that it allows us to estimate the amount of resources people need to consume to meet their basic needs. For easier comparison, Figure 4 shows the dynamics of real final consumption, calculated values of autonomous consumption and autonomous consumption. Autonomous consumption can be calculated in two ways:

1) as the annual budget of subsistence minimum multiplied by the average annual population of Belarus;

2) as the annual minimum wage multiplied by the average annual population of Belarus.

It should be noted that before the adjustment of final consumption for the expenditures of consolidated budget in 2013–2016, the calculated value of autonomous consumption was considerably below the budget of subsistence minimum, which contradicts the economic meaning of this indicator. After it was adjusted, the calculated value of autonomous consumption either corresponds to the budget of subsistence minimum or exceeds it, which looks quite normal from the economic point of view, since the data were calculated by using the average income and consumer demand of the population.

The function of consumption is included in model (1) and shows the dependence of the final consumption expenditures on GDP. We introduce two auxiliary factors a and b in the equation of final consumption, where b is the marginal propensity to consume. The economic meaning of factor a is that it reflects the so-called autonomous consumption, which does not depend on income. To build the function of consumption depending on the GDP level, we are going to apply correlation and regression analysis. As a result, we obtain the following equation of consumption:

$$C = -795.208 + 0.497Y$$
$$R^2 = 0.989 \quad (4)$$

Thus, the value of the marginal propensity to consume (b) equals 0.497, which is 0.0526 less than the average value obtained by direct estimation. We find such discrepancy acceptable. A cause for concern might be the value of parameter (a), characterizing autonomous consumption, since, according to the regression model we have obtained, its value is negative

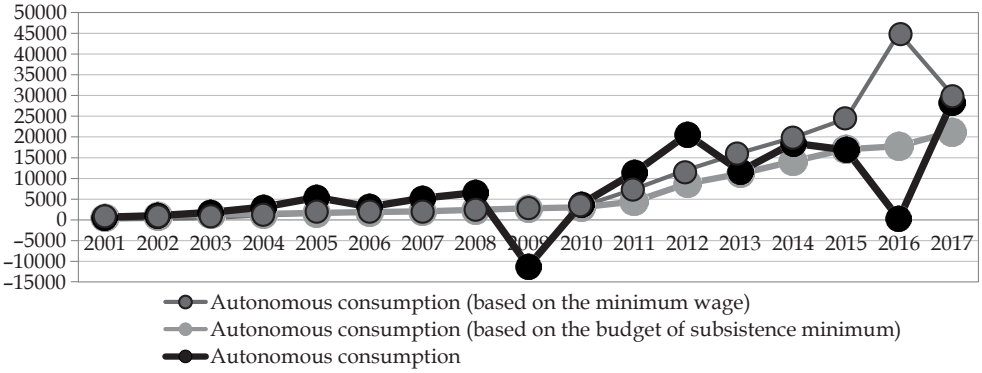

Figure 4. **Evaluation of the adequacy of the adjusted value of autonomous consumption**

and does not correspond to the average calculated value.

Therefore, we recalculated the marginal propensity to save and autonomous investment. The dynamics of the marginal propensity to save adjusted for government spending is shown in Figure 5. The adjusted marginal propensity to consume demonstrates that the rouble change of GDP leads to an increase in final consumption from –0.14 to 2.13 roubles. On average, the marginal propensity to consume is 0.55 roubles for every rouble change of GDP.

In order to build an IS-LM model, we will need a set of equilibrium points of savings and investment in relation to GDP and the refinancing rate. We are going to build a graph illustrating the dependence of savings and investment on the refinancing rate (Figure 6). The points of intersections of lines *S* and *I* show the equilibrium rate of investment and of savings.

Tax burden is one of the factors that influence investment. Since fiscal policy is implemented simultaneously with other policies, in our study of the interrelation between fiscal and monetary policies we are going to consider the dynamics of the average refinancing rate and tax burden in 1994–2017 (Figure 7).

Despite the change in the tax legislation, the level of tax burden measured as the tax revenue-to-GDP ratio, varied between 18.5% in 1995 and 36.1% in 2008. Interestingly, in the periods of 2004–2008 and 2015–2016, a fall in the refinancing rate was accompanied by an increase in the tax burden while in 2009–2012, a rise in the refinancing rate coincided with a decline in the tax burden. In other periods, the direction of the changes in the refinancing rate coincided with that of the changes in the tax burden. It should be noted that while the level of tax burden changed by 17.6 percentage points, the average refinancing rate in the given period dropped from 211.7% in 1994 to the minimum of 10.4% in 2008. As of the time of the study (July 2019), the refinancing rate

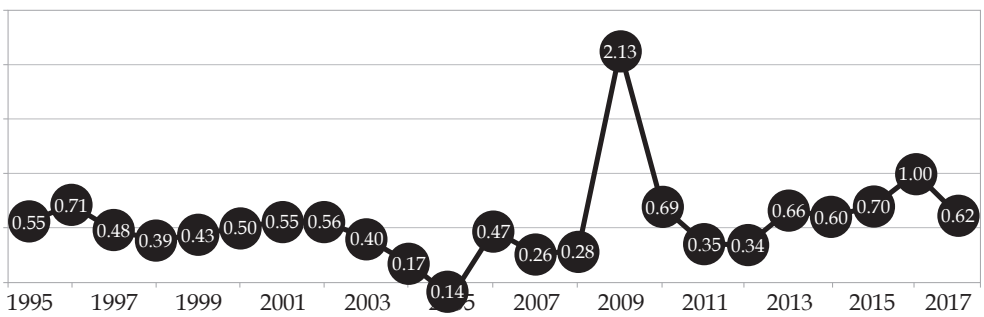

Figure 5. **Adjusted marginal propensity to consume**

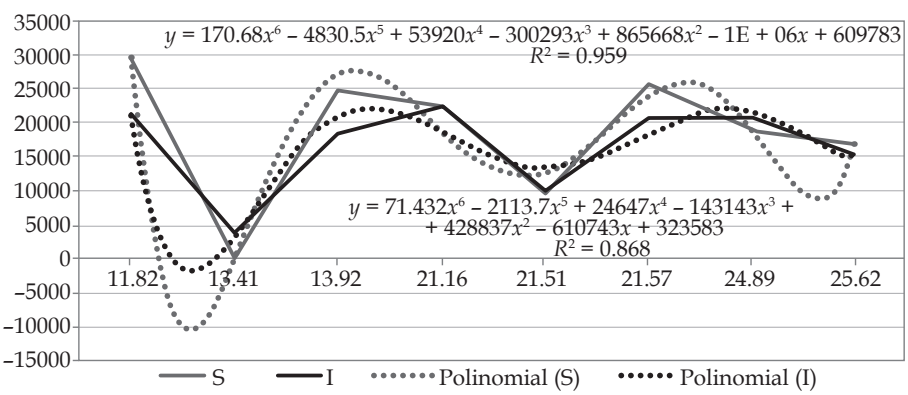

Figure 6. **Dependence of investment (I) and gross savings (S) on the average refinancing rate (horizontal axis) in 2005–2017**

in Belarus was 10% and it did not change since 27 June 2018.

The next set of tasks that need to be addressed to solve the IS-LM model is to build the function of taxation, in which tax revenues depend on GDP. The initial data and the results of our study for building a taxation function are shown in Table 3. Although GDP growth is usually accompanied by rising tax revenues of the consolidated budget, there are periods when tax sensitivity to GDP growth is negative.

For example, the negative value of the tax burden's sensitivity to GDP changes was observed in 1995, 1996, 2001, 2002, 2004, 2009–2011, 2013–2014, and 2016. This dynamics requires further investigation and may be connected to changes in the taxation legislation, expanded use of tax preferences, and so on. The data shown in Table 3 demonstrate that on average, for every one rouble increase in GDP, we observe a 0.023% decrease in the tax burden.

We are going to use the above-described data and correlation and regression analysis to derive the following equation of the dependence of budget revenues on GDP change:

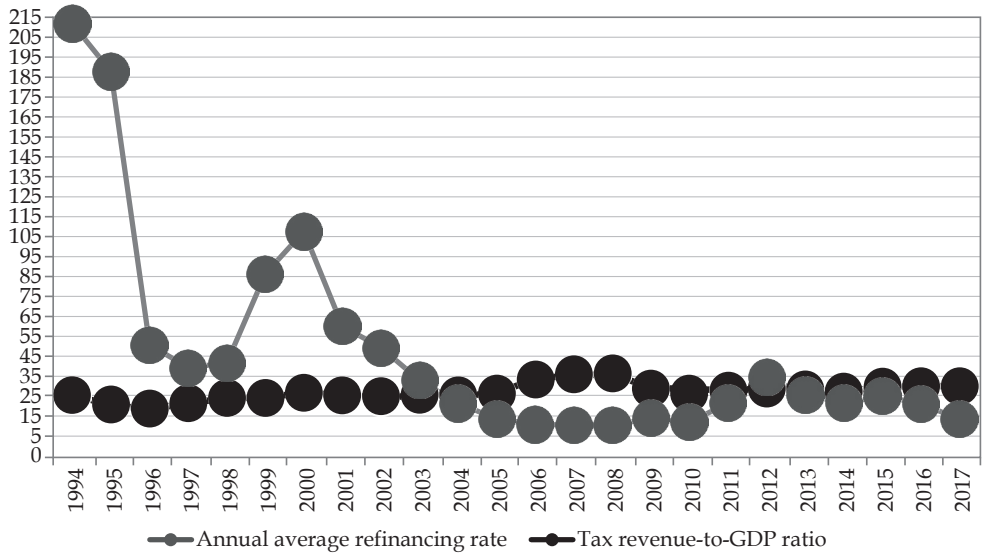

Figure 7. **Dynamics of the average refinancing rate and tax burden in 1994–2017**

Table 3

Initial data for constructing the taxation function (mln Belarusian roubles measured in 2016 prices)

Year	GDP	Tax revenues of the consolidated budget	Autonomous taxes	Sensitivity of tax burden to GDP changes (coefficient)
2005	7926.7	1706.3	1706.27	0.0000060
2006	9716.53	2692.9	2692.54	0.0000546
2007	12979.08	3423.6	3423.54	0.0000071
2008	14209.1	4680.8	4680.78	0.0000025
2009	17046.6	4130.47	4131.21	–0.0000569
2010	30724.5	4875.42	4875.44	–0.0000017
2011	54761.7	8560.83	8560.84	–0.0000005
2012	67068.8	15795.6	15795.59	0.0000004
2013	80579.3	18923.22	18923.25	–0.0000005
2014	89909.8	21928.06	21928.11	–0.0000007
2015	94949.0	26632.1	26631.89	0.0000026
2016	105748.0	28526.3	28526.22	0.0000008
2017	26368.12	31651.4	24915.08	–0.0000001

$$T = -6.439 + 0.292Y$$
$$R^2 = 0.997 \quad (5)$$

We will use the data shown in Table 3 and in Figure 6 and apply correlation and regression analysis to derive the following equation of the investment function depending on the changes in the refinancing rate:

$$I = 10962.441 - 123.716R$$
$$R^2 = 0.135 \quad (6)$$

Even though the value of R^2 is quite low, we find it acceptable for the solution of the IS-LM model since our aim was to find the dependence of investment on the refinancing rate.

The equation we have thus obtained shows a 13.5% dependence of investment on the refinancing rate. Autonomous investment is used to take into account the influence of other factors. It seems reasonable at this point to compare the values of investment sensitivity to changes in the refinancing rate and autonomous investment obtained in equation 6 with the calculated data (see Table 4). As the table illustrates, the values of the coefficient of investment's sensitivity to changes in the refinancing rate do not fully comply with the laws of economics. For instance, if we decrease the refinancing rate, the sensitivity of investment becomes negative and vice versa, which demonstrates feasibility of autonomous investment.

As a part of our study, we also built a regression model of the net export function, which allows us to estimate the dependence of net exports on GDP and the refinancing rate:

$$Xn = -885.332 + 0.005Y + 13.167R \quad (7)$$
$$R^2 = 0.120$$

The net export function necessary for the solution of the IS-LM model reflects the dependence of the resulting indicator on the two factors, whose joint impact is weak, according to regression analysis. One of these factors (refinancing rate) is not typical of net exports, which makes it impossible to check the coefficients in formula (7).

The last function we need to consider in order to build the IS-LM model is the function of demand for money. Demand for money is usually estimated with the help of monetary aggregates M0, M1, M2 and M3, which are also used to measure money supply. There should be enough money in the economy for GDP. Therefore, we are going to compare GDP, M0 and M2 (Table 5).

M0 shows the balance of currency in circulation. The data in Table 5 show that the level of the average yearly balances of currency in circulation is not sufficient to pay for the real output in the corresponding period. M1 is larger than M0 because, apart from currency and coins, it also includes transferable deposits of physical persons and legal entities. M2 is the sum of M1 and savings and other deposits in national currency. M3 comprises the sum

Table 4

Initial data for constructing the investment function (mln Belarussian roubles measured in 2016 prices)

Year	Investment	Autonomous investment	Sensitivity of investment to changes in the refinancing rate (coefficient)
2005	1509.58	1706.27	–56.005
2006	2037.41	2692.54	–182.010
2007	2605.33	3423.54	–3549.500
2008	3720.23	4680.78	–5867.895
2009	4337.76	4131.21	172.978
2010	5538.08	4875.44	–571.581
2011	9866.49	8560.84	443.939
2012	15444.24	15795.59	433.055
2013	20957.46	18923.25	–624.374
2014	22526.97	21928.11	–381.876
2015	20715.25	26631.89	–536.012
2016	18710	28526.22	537.601
2017	21033.70	31651.41	–299.832

of M2 and money market instruments issued by banks in national currency.

To justify the choice of this or that indicator to estimate the demand for money, we are going to build three equations for the real demand for money depending on GDP and the refinancing rate (Table 6).

Securities are not a legal monetary circulation medium while cash constitutes only one of the many payment instruments used in Belarus. Therefore, for the purpose of this study, we are going to use M2 as an indicator of supply and demand for money. It is also necessary to take into account the effect of the bank multiplier and other instruments for regulating the balance of the money supply in cash and non-cash.

Let us now consider the results of the correlation and regression analysis (see Table 8). By using the average values of government spending and real demand for money and substituting any values from –100 to =100 for R, we obtain the following graphical representations of the IS-LM model (see Figure 7). For each curve we derived linear equations with the help of 'Trendline' tool. The equilibrium rate of refinancing will be achieved if the right-hand side of the simplified equation of the IS curve will be equal to the right-hand side of the LM equation.

Table 5

Initial data for building the function of demand for money (mln Belarusian roubles measured in 2016 prices)

Year	M0	M2	Average annual refinancing rate, %	Inflation level, %
2009	364.72	1718.71	13.92	107.8
2010	449.39	2189.92	11.82	153.2
2011	671.18	3140.06	21.57	159.2
2012	1130.73	5202.03	34.45	118.3
2013	1230.20	7250.80	25.62	118.1
2014	1392.38	8586.39	21.51	113.5
2015	1423.61	8913.56	24.89	106.0
2016	1692.76	9099.18	21.16	104.9
2017	234.66	1368.66	13.41	104.9

Table 6

Matrix of the demand-for-money equations obtained through correlation and regression analysis

Demand for money = M0	Demand for money = M2	Demand for money = GDP
$M/P = 0.01792Y - 4.7924R$	$M/P = 0.092254Y - 2.49317R$	$M/P = 0.887407Y - 19.2708R$
$R^2 = 0.993198$	$R^2 = 0.983345$	$R^2 = 0.983345$

Table 7

Coefficient values for the system of equations (1) obtained through correlation and regression analysis

Indicator	Notation	Value
Autonomous consumption	a	–795.208
Marginal propensity to consume	b	0.497
Sensitivity of tax burden to GDP change	t	0.292
Autonomous tax revenues to the consolidated budget	Ta	-6.439
Autonomous investment	e	10962.440
Sensitivity of investment to changes in the refinancing rate	d	–123.716
Free balance in the net export function	g	–885.332
Import coefficient (M/GDP) for the net export function	m	0.005
Coefficient on the refinancing rate for the net export function	n	13.167
Sensitivity of income demand for money	k_{M2}	0.092
Sensitivity of demand for money to changes in the refinancing rate	h_{M2}	–2.493

Table 8

Equilibrium refinancing rate and GDP in the IS-LM model, taking into account different ways of measuring the demand for money (results of correlation and regression analysis)

Indicator	Demand for money = M0	Demand for money = M2	Demand for money = GDP
Equilibrium refinancing rate, %	82.140	–1.258	–2.744
Equilibrium GDP, mln Belarusian roubles	39972.236	25857.009	25605.588
Tax burden corresponding to the equilibrium point	29.216	29.207	29.207

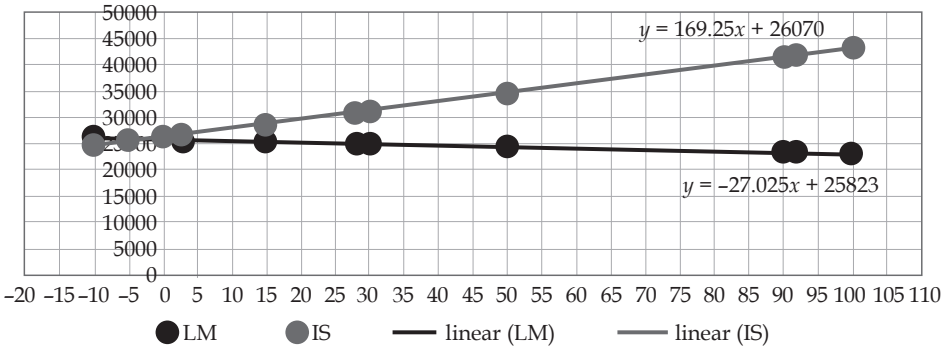

Figure 8. **IS-LM model with the demand for money measured as M2** (according to the results of correlation and regression analysis)

If the demand for money is measured as M2 and GDP, the equilibrium refinancing rate is negative, which contradicts the laws of economics. On the other hand, the negative equilibrium rate means that the National Bank does not use the refinancing rate as an instrument to regulate investment. If the demand for money is measured as M0, then the equilibrium of investment, savings, supply and demand for money will be achieved when the refinancing rate is 82.14% and GDP, 39 972.235 mln roubles. At the same time, taking into account the average inflation level in Belarus, such rate will not be justified as it is likely to impede stable economic growth in the country.

Since the IS-LM model reflects the equilibrium of the monetary market, savings and investment in the short term influenced by monetary and fiscal policies, we are going to estimate equilibrium in short periods corresponding to 1995, 2000, 2005, 2009–2017. The results of the correlation and regression analysis demostrate a considerable discrepancy between the equilibrium rate and the annual average refinancing rate. It is remarkable that for those periods when the National Bank decreased the refinancing rate, the model shows that a sharp increase of the rate was necessary to ensure the equilibrium of the monetary market, savings and investment.

4.2. Analysis of the interaction between fiscal and monetary policies in the Markov switching model

Table 9 shows the results of equation (2) estimation by using Markov switching models.

Table 9

Estimation of the Markov models of switching monetary policy regimes in Belarus in 2005–2019

Coefficient	Estimated parameter	
	regime 1	regime 2
a_1	0.525 *(0.001)*	1.941 *(0.000)*
a_2	–0.001 *(0.757)*	–0.002 *(0.577)*

The empirical verification of the Markov switching model (1) has enabled us to identify *regime 2* as corresponding to active monetary policy. This conclusion is based on our estimation of parameter a_1.

Its value exceeds 1, that is, the interbank market rate grows faster than inflation. *Regime 1* corresponds to passive monetary policy, which can be explained by the parameter estimation value.

The advantage of Markov switching models is that they allow us to estimate the transition probability matrix, which shows the probability of regime change at the time $t + 1$ (see Table 10).

Table 10

Matrix of the transition probabilities of monetary policy regimes in Belarus in 2005–2019

	Regime 1, *t*	**Regime 2, *t***
Regime 1, t + 1	0.965	0.035
Regime 2, t + 1	0.086	0.914

The transition probability matrix shows that the regimes of active and passive monetary policy are quite stable.

The periods of active (*regime 2*) and passive (*regime 1*) monetary policy in Belarus are illustrated by Table 11.

Table 11

Model duration of active and passive monetary policy in Belarus in 2005–2019

	Regime 1 (passive monetary policy)	**Regime 2 (active monetary policy)**
Periods	1st quarter, 2005 – 3rd quarter, 2011; 3rd quarter, 2016 – 1st quarter, 2019	4th quarter, 2011 – 2nd quarter, 2016

The results of equation (3) estimation by applying the Markov switching models are shown in Table 12.

Table 12

Estimation of the Markov models of switching fiscal policy regimes in Belarus in 2005–2019

Coefficient	**Estimated parameter**	
	regime 1	**regime 2**
a_1	–0.237 *(0.001)*	0.075 *(0.000)*
a_2	–0.001 *(0.412)*	–0.000 *(0.138)*
a_3	–0.303 *(0.013)*	0.446 *(0.000)*

The results of the empirical verification of the Markov switching model (1) shown in Table 10 have enabled us to identify *regime 1* as a regime of active fiscal policy. This conclusion is based on our estimation of parameter a_1. Its value is below zero, that is, the growth of external public debt in the previous periods does not affect the tax burden and even reduces it. *Regime 2* corresponds to passive fiscal policy, which is explained by the parameter estimation value. Such regime signifies an increase in the tax burden in response to the growing public debt in the previous periods (in this study the time lag is one quarter).

Our estimation of the parameters of the Markov model of switching fiscal policy regimes enables us to construct the transition probabilities matrix. The results of the matrix estimation are shown in Table 13.

Table 13

Matrix of the transition probabilities of fiscal policy regimes in Belarus in 2005–2019

	Regime 1, *t*	**Regime 2, *t***
Regime 1, t + 1	0.974	0.026
Regime 2, t + 1	0.023	0.977

The transition probability matrix shows that the regimes of active and passive fiscal policy are quite stable.

5. Conclusion

To solve the IS-LM model, we calculated autonomous consumption with the help of the adjusted value of the average propensity to consume. It was found that autonomous consumption is comparable with the budget of subsistence minimum in Belarus. The share of government spending in the GDP structure was on average 35.01%.

When we compared gross savings and investment, we found that in most periods, gross savings insignificantly exceeded investment, that is, the available funds were used for consumer lending rather than for investment.

Instruments of monetary policy are more dynamic in comparison with instruments of fiscal policy and can be changed multiple times within a year if the circumstances require state interference. For instance, if the National Bank of Belarus

chooses inflation targeting as a monetary policy regime and sets clear inflation targets and if the monetary policy is tailored to the national circumstances through institutional transformations, the government will be able to activate and modernize the fiscal policy.

Analysis of the Markov switching model has led us to the conclusion that from the first quarter 2005 until the fourth quarter of 2009, the fiscal policy in Belarus was in its active regime. Thus, the growth in the gross external debt in these periods (the lag equals 1) led to a fall in the revenues of the consolidated budget as percentage of GDP. From the first quarter of 2010 to the first quarter of 2019, the fiscal policy regime could be described as passive, that is, the growth of the public debt was accompanied by an increase in the budget surplus. In the second quarter of 2019, there were signs of transition to a more active fiscal policy, which means that tax reforms should be intensified.

The choice between the active and passive regimes was determined primarily by the response of the tax burden to the changes in the public debt. In the previous periods, an increase in the tax burden aimed at neutralizing the growing public debt meant a passive fiscal policy regime while the declining tax burden together with the increasing public debt, an active fiscal policy regime.

At the moment, the National Bank of the Republic of Belarus has chosen inflation targeting as a regime of monetary policy, which provides more opportunities for activating fiscal policy instruments to regulate socio-economic processes.

References

1. Kireeva E. F. Tax Reform: Necessity, Main Directions and Measures of their Implementation. *Belarusian Economic Journal*. 2018;(4):77–88. (In Russ.)

2. Mayburov I. A., Ivanov Y. B. (eds) *Tax Reforms. Theory and Practice. Textbook for Master's Students*. Moscow: UNITA-DANA; 2015. (In Russ.)

3. Sargent T., Wallace N. Some Unpleasant Monetarist Arithmetic. *Federal Reserve Bank of Minneapolis Quarterly Review*. 1981;(5):1–17.

4. Woodford M. Monetary Policy and Price Level Determinacy in a Cash-in-Advance Economy. *Economic Theory*. 1994;4(3):345–380.

5. Leeper E. Equilibria under 'Active' and 'Passive' Monetary and Fiscal Policies. *Journal of Monetary Economics*. 1991;27(1):129–147.

6. Cevik E. I., Dibooglu S., Kutan A. M. Monetary and Fiscal Policy Interactions: Evidence from Emerging European Economies. *Journal of Comparative Economics*. 2012;42(4):1–20.

7. Nordhaus W., Schulze C., Fisher S. Policy Games: Coordination and Independence in Monetary and Fiscal Policies. *Brookings Papers on Economic Activity*. 1994;(2):139–216.

8. Blanchard O. Fiscal Dominance and Inflation Targeting: Lessons from Brazil. *NBER Working Paper*, 10389. Available at: http://www.nber.org/papers/w10389.pdf

9. Pekarsky S. E., Atamanchuk M. A., Merzlyakov S. A. *Interaction of Fiscal and Monetary Policies in Export-Oriented Economy*. Preprint WP12/2007/02. Moscow: Higher School of Economics; 2007. (In Russ.)

10. Zaretsky A. *Methodology of Building, Solution and Parameter Estimation of DSGE Models*. Preprint WP/12/05. Minsk: IPM Research Centre; 2012. Available at: http://www.research.by/webroot/delivery/files/wp2012r05.pdf (In Russ.)

11. Bezborodova A. V. SVAR: Analysis and Forecasting of the Main Macroeconomic Indicators. *Bankovsky vestnik: issledovania banka*. 2017;(11):1–30. (In Russ.)

12. Ferede E., Dahlby B. The Impact of Tax Cuts on Economic Growth: Evidence from the Canadian Provinces. *National Tax Journal*. 2012;65(3):563–594.

13. Lee Y., Gordon R. Tax Structure and Economic Growth. *Journal of Public Economics*. 2005;89(5–6):1027–1043.

14. Barro R. J., Redlick C. J. Macroeconomic Effects of Government Purchases and Taxes. *The Quarterly Journal of Economics*. 2011;126(1):51–102.

15. Arnold J. M., Brys B., Heady C., Johansson A., Schwellnus C., Vartia L. Tax Policy for Economic Recovery and Growth. *The Economic Journal*. 2011;121(550):59–80. DOI: 10.1111/j.1468-0297.2010.02415.x

16. Alberto F. Alesina S. A. Large Changes in Fiscal Policy: Taxes Versus Spending. *NBER Working Paper No. 15438*. Cambridge: National Bureau of Economic Research; 2009. Available at: https://www.nber.org/papers/w15438

17. Romer C., Romer D. The Macroeconomic Effects of Tax Changes: Estimates Based on a New Measure of Fiscal Shocks. *American Economic Review*. 2010;(100):763–801.

18. Gale W. G., Samwick A. A. Effects of Income Tax Changes on Economic Growth. *Economic studies at Brookings*. 2014;(1):1–15.

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