ORIGINAL PAPER

DOI: 10.26794/2587-5671-2021-25-1-35-50
UDC 330.01(045)
JEL C51, C54, E22, E52, O11, O41

Investment Function of Economic Growth in Russia

O.S. Sukharev
Institute of Economics Russian Academy of Sciences, Moscow, Russia
https://orcid.org/0000-0002-3436-7703

ABSTRACT

The intensification of investment dynamics is a determining factor in the new growth model of the Russian economy. The Covid crisis has greatly limited the opportunities to use this factor and made restoring growth dynamics an urgent task. **The aim** of the study is to determine the investment function of the Russian economy before the Covid crisis in order to identify the main instruments of the investment policy of growth in the post-crisis period. **The research methods** are macroeconomic and regression analysis based on software Gretl 2020b, which helped to choose the investment function according to the instrument-factors. Solving the problem of collinearity of multiple regression factors makes it possible to select the best models for GDP and investment in fixed assets of the Russian economy. **The research result** is selected multivariate models of gross product and investment that allow considering the impact of the following instruments on the goal's function: monetization level, key interest rate, exchange rate, risk, profitability, oil prices, financial investments, inflation. The author **concludes** that an increase in the monetization of the economy, a decrease in the key interest rate, and a controlled devaluation generally had a positive effect on the amount of investment in fixed assets. The investment growth increased the risk of economic activity; the decrease in profitability relatively decreased investment and increased Russia's GDP with an increased risk over the considered time interval. When implementing investment policy, one should consider these features along with the specified macro-aggregates, the structure of investment distribution between sectors and types of investments, for example, in financial and non-financial assets. The paper shows the significance of this condition, which affects the effectiveness of the investment policy, when the shift in investment towards financial assets accompanies the slowdown in economic growth. **The prospect** of further research is an assessment of the equalization of sectoral risks affecting the distribution of investments and investment dynamics.

Keywords: investment; gross value added; risk; profitability; investment policy; economic sectors; resource allocation; regression analysis; sensitivity of target function; economic growth

For citation: **Sukharev O.S. Investment function of economic growth in Russia.** ***Finance: Theory and Practice.*** **2021;25(1):35-50. (In Russ.). DOI: 10.26794/2587-5671-2021-25-1-35-50**

INTRODUCTION

Many economists perceive investment [1–5] as the main engine of economic growth and structural change. As for Russia, this refers to investment in fixed assets and human capital [1, 4] or the creation of capital of different age generations, which individual models show within the reproduction theory [3]. However, the issue of the investment structure (for example, investments in financial and non-financial assets, transactional and non-transactional sectors [6–7]), i.e. their distribution by objects of use, both as a purely structural task and an assessment of efficiency, is not considered in all studies. The structural aspects of investments and their effectiveness are usually not considered when designing incentive measures for investment policies at the macroeconomic level. Sensitivity of the investment function to the instruments of economic policy is especially important. Most often, standard approaches reduce the problem of intensifying investment to increasing accumulation [2] and investment in education and human capital [1, 8, 9]. The distribution of investments depends on many conditions and factors and has a strong impact on the economic dynamics of not only sectors of the economy, but also on creating the future structure of demand, thereby determining current and future transformations of the economic structure [10–12]. Investments affect factor productivity, which determines the quality and rate of future economic growth [8, 11].

In terms of underinvestment rates, in a large sample of countries over a long period of time, some studies reveal the problem of allocating investment across countries. Underinvestment by different amounts took place in all considered countries, which increased the discrepancy in the development of these countries [13], including due to the difference in the total productivity of factors. The structure of investment in the public and private sectors also influenced to what extent public investment had a positive effect on growth and how it increased or slowed down private investment [14, 15]. The survey data do not consider all possible circumstances, for example, the crowding out effect of public and private investment with appropriate government policies in the open market. Financial strategy, the functioning of the financial market, labor market institutions can have a strong impact on growth by changing the structure of investment [16, 17]. The determining factors are closely related and define the change in each other (collinear). This limits the study of their influence using multiple regression and complicates the algorithm for choosing the appropriate model. The higher the demands on the labor market and the stronger the regulatory mechanisms are, and the market capacity is not chosen in the course of imperfect competition, the greater the need is to replace labor-intensive technologies with capital-intensive technologies. This creates the need to invest in fixed assets. Along with the need for personnel training, they provide an increase in investment in human capital, so that replacing labor with technology does not mean a decrease in investment in people. There is the connection and certain types of investments, mutually determining each other.

We should give our special attention to the state of the financial market and the relationship between financial and non-financial investments [6], when financial investments can crowd out or can stimulate non-financial investments. It depends on many factors: not only the financial market organization, but also the institutions that regulate the functioning and interaction of the real and financial sectors. This fact makes consider the sensitivity of the objective function — investment — to the parameters of macroeconomic policy, taking into account the connection of various economic elements. A decrease in the interest rate can stimulate investment in fixed assets, but can also lead to an increase in consumption, a decrease in savings, which will reduce the potential of

lending from the banking system of the real sector in a greater proportion of the relative financial sector than before. One should consider these possible outcomes, especially when currently absent factors appear and provoke crisis phenomena and a decrease in investment, in particular, the "virus attack" on the economy in 2020.

The Covid recession 2020, caused by the force majeure factor, a dangerous virus, and associated with countering it through quarantine and direct restrictive measures, differs from all previous recessions in modern times. They usually arose due to the destabilization of the financial and foreign exchange market, the devaluation of the national currency, a strong capital outflow, spreading its influence to other sectors of the economy and other countries. The present crisis is related to the fact that demand and specific types of activity in the economy are limited, while the production load on others increases (this disproportion causes a reaction of price increases). However, it is not able to withstand the multiplication of the volume reduction for other types of activity. Investments are curtailed first, and the financial market is also seriously affected [18]. At the same time, the financial sector is not a primary source for the crisis — it suffers simultaneously with other, initially transactional activities, since the fight against the virus requires limiting contacts and reducing travel (tourism, catering, restaurant business, hotel business, similar and related areas of activity). Considering that it is the transactional sector that makes a decisive contribution to the rate of economic growth of the Russian economy [5–7], the reduction in its activities in many areas affects the growth rate. The squeeze effect is also transmitted to the manufacturing sectors — as a result, a recession occurs, which is also indicated by a reduction in investment.

Thus, a return to economic growth, especially creating a certain new model, based on investment as a leading factor (until now, for a long period in Russia, the main contribution to the growth rate was made by gross consumption, but not investment spending) will require the design of the investment function of economic growth with the selection of instruments to influence it, which will form the directions of the investment policy of growth. Therefore, the aim of this study is to analyze the investment function of the Russian economy before the Covid crisis in order to identify the most relevant instruments to influence the revival of investments as one of the most significant growth factors. We used the methods of macroeconomic and regression analysis, which makes it possible to select an investment function and determine its sensitivity to various instruments of macroeconomic policy. We should discuss not only an increase in the accumulation rate, which is not a guarantee of economic growth, but can be considered as a condition affecting economic growth at a certain rate (but not to guarantee it), but also to ensure a certain investment dynamics.[1]

Lifting of restrictions on various types of activities will undoubtedly stimulate their dynamics and the development of related industries. However, the resulting risk can block investments and will inertially restrain the economic development of the prospective period. Thus, a rebound in growth rates like in 2010 relative to 2009 is hardly possible in an equivalent way in 2021 relative to 2020. In addition, designing the investment function of economic growth is useful for establishing permanent links between relevant parameters that affect on the process and structure of investments in the Russian economy. The relevant parameters considered in the next section had the strongest impact on the dynamics of investments and GDP,[2] since it

[1] The share of investments in the gross product and their growth rate together determine the contribution of the investment component of expenditures to the economic growth of the country (but not just one share — the accumulation rate).

[2] These parameters include: monetization level, key interest rate, risk, profitability, exchange rate, oil price, tax burden.

influenced its structure and the development of elements. We now designate the research methodology.

INVESTMENT FUNCTION OF ECONOMIC GROWTH. RESEARCH METHODS

Economic growth is estimated according to the country's GDP dynamics, and gross investment is a component of this product measured by expenditures. Economic policy instruments affect GDP components, including investment, which determines both the current and future dynamics of the economy [19–20]. J. Tinbergen demonstrated that the number of instruments should be no fewer than the number of policy goals [20]. However, the principle of "goals-instruments" can be changed due to the fact that one and the same instrument, when influencing differently the components of the objective function (GDP), can act in one direction for each of the components. For example, a change (decrease) in the interest rate increases investment and gross consumption, which enhances the positive impact on the dynamics of gross domestic product. Sometimes, the same policy instrument has a positive effect on one component, but the negative one on another, or does not affect it at all. Thus, determining the influence of investments on the country's economic growth should be reduced to determining the influence of investments on GDP over the past time interval, thereby establishing the fact of this determination, and also to build an investment function, highlighting the instruments that affect investments, removing the problem of their collinear relationship. The selected instruments will also have an impact on other components of GDP, so it will be necessary to assess their impact on the value of the product.

This approach definitely includes the economic policy measures that were taken during the considered time interval. The established links include the used instruments of economic policy. There is a non-typical problem of longer use of these instruments. Apparently, if the instruments are closely connected to the goal function and have a positive effect on the dynamics of its other components, including investments, one should continue using these instruments. Otherwise, if they negatively affect other components of GDP, so that they can slow down its growth, or the close connection with the goal function is not so significant, one should correct the use of these instruments when planning economic policy measures in the following time intervals.

Economic growth is determined by labor and capital, and investment [21]. We will study the influence of investments on growth by the algorithmic sequence in stages. It can be very important how investment is allocated between labor and capital and how they set certain prospects for economic growth. If the country has the most developed labor-intensive technologies, but it needs capital renewal, the transition to this renewal can significantly weaken economic growth in a certain initial period of time. It is possible that the ratio and state of technology will greatly affect the efficiency of investments and the economic dynamics that they provide. If the pace creates the most optimistic expectations for economic development, then it will probably be useful to invest in labor-intensive technologies at the initial stage. In this case, they will quickly provide a return, but it must be such as to create conditions for the regime of technological renewal and personnel training.[3] At the next stages, it will naturally look like a stake on capital-intensive technologies and the primary replacement of capital by its new forms.

Thus, it is appropriate to consider three stages to solve the analytical problem.

[3] Today, there are no effective methods of macroeconomic and investment policy, which would consider the structure of investments, technologies, funds and labor. Usually, a very complex set of systemic measures can be applied within the framework of a combined economic policy aimed at structural modification of the economy and its sectors.

First. We will consider the indicated basic growth factors (capital, labor, investment) in the constructed multiple regression model for the Russian economy, determining the reaction of gross value added to the value of the key interest rate, and money supply M_3.[4]

Second. We will build a multiple regression model of the gross value added (Y) of the Russian economy depending on the following instrument-factors: X_1 is the level of monetization, %; X_2 is the risk,[5] billion roubles, in the prices of 2011; X_3 is the key rate of the Central Bank of the Russian Federation, %; X_4 is the average nominal dollar rate, roubles; X_5 is the average annual price of Urals oil, USD; X_6 is the inflation, %.

The general view of the regression model is as follows:

$$Y = a_0 + a_1{*}X_1 + a_2{*}X_2 + a_3{*}X_3 + a_4{*}X_4 + a_5{*}X_5 + \\ + a_6{*}X_6 + \varepsilon,$$

where a_i is the regression coefficients; ε is the standard error of the model.

The regression is based on software Gretl 2020b using the least squares method. All possible models are built by the enumeration method, the multicollinearity of factors is revealed by the pairwise correlation method with further rejection of the corresponding variants of the models.

We used the Breusch–Pagan test to check the heteroscedasticity of the random errors of the regression model. It resulted in the homoscedasticity of the variances of random errors of the considered regressions for the best selected model. We used the Durbin-Watson (DW) test to check the hypothesis of the absence of autocorrelation of residuals. Comparing the DW statistics with the theoretical parameters d_1 and d_u, we found that the DW value in the selected regression models is in interval $d_u < DW < 4 - d_u$. This indicates the absence of autocorrelation. We applied a similar algorithm for the next step of the study, which directly concerns the design of the investment growth function.

Third. We will build a multiple regression model with a target investment function (investments in fixed assets — I) for the Russian economy from the following factors: Z_1 is the risk, billion roubles, in 2011 prices; Z_2 is the profitability, %; Z_3 is the key rate of the Central Bank of the Russian Federation, %; Z_4 is the average nominal dollar rate, roubles; Z_5 is the financial investments, billion roubles, in the prices of 2011. The regression equation is as follows: $I = b_0 + b_1{*}Z_1 + b_2{*}Z_2 + b_3{*}Z_3 + \\ + b_4{*}Z_4 + b_5{*}Z_5 + \varepsilon 1$, where b_i is the regression coefficients; ε1 is the standard error of the model. The models are selected by the least squares method, multicollinear factors are determined by the pairwise correlation method, and the best regression models are selected by screening.

The implementation of these three steps will help formulate a general conclusion about the impact of investments on economic growth in the period under review and the possibilities of investment policy to stimulate economic growth in Russia in the coming period.

INVESTMENT POLICY INSTRUMENTS FOR ECONOMIC GROWTH

We will carry out a step-by-step solution to the above analytical problem, which allows us to identify the impact of investments on the economic growth of the Russian economy. We will carry out a regression analysis of the gross domestic product, assessed by the value added, and highlight the factors influencing its dynamics, including investments in fixed assets. We will also build an investment function, ensuring its study from the point of view of relevant instruments and pursuing an investment growth policy.

[4] The amount of money supply M3 is understood as the amount of currency outside the banks; demand deposits; temporary, savings and foreign currency deposits; bank and travel checks; other securities such as certificates of deposit and commercial paper. The World Bank. URL: https://data.worldbank.org/indicator/FM.LBL.BMNY.GD.ZS?view=chart (accessed on 25.11.2020).

[5] Risk refers to the standard deviation of gross profit.

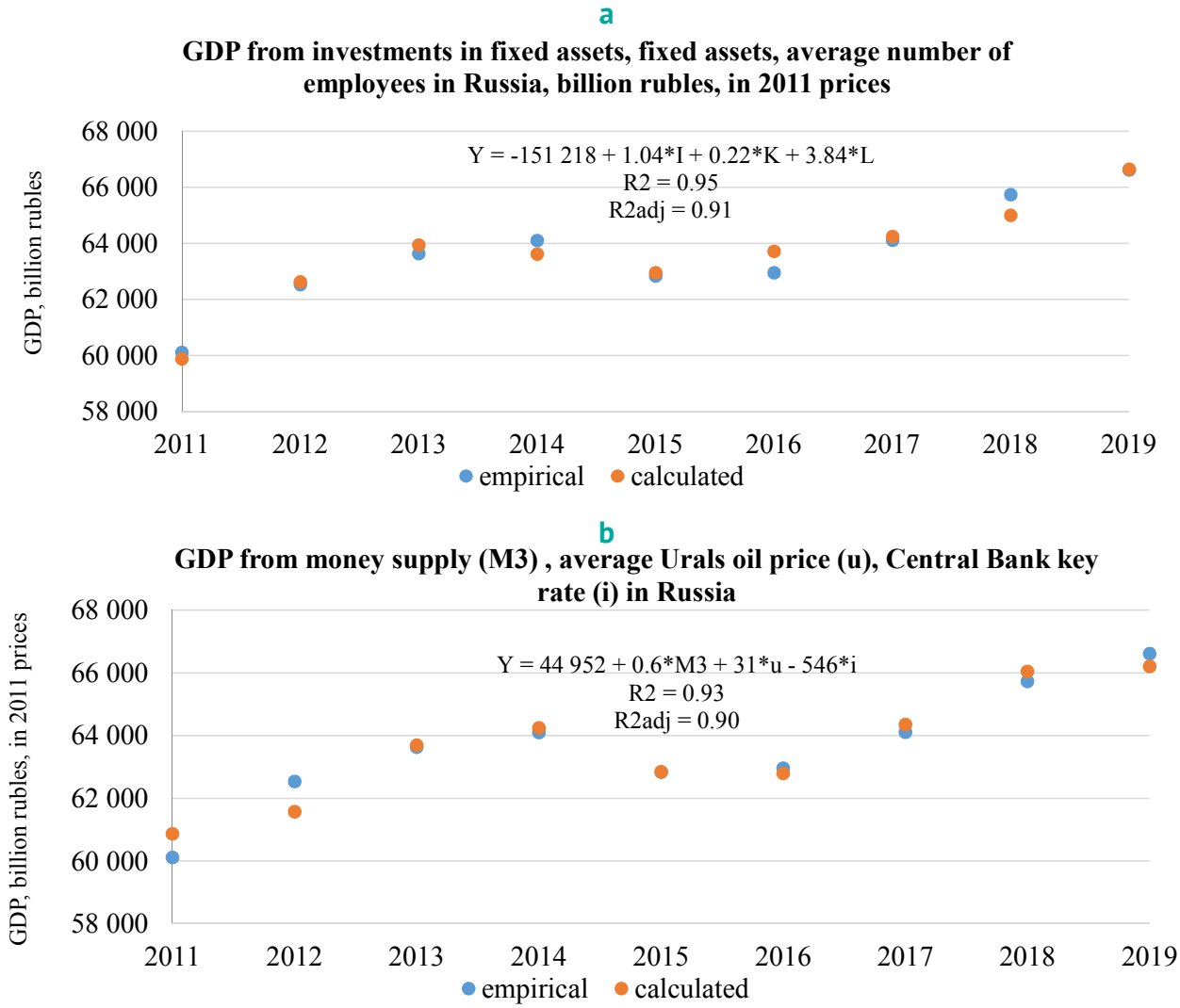

Fig 1. **Models of Russia's GDP from capital, labour and investment* (a), money supply, oil price and key interest rate** (b), 2011–2019**

Source: compiled by the author based on data from the World Bank. URL: https://data.worldbank.org/indicator/FM.LBL.BMNY.GD.ZS?view=chart; https://data.worldbank.org/indicator/FP.CPI.TOTL.ZG?view=chart; https://data.worldbank.org/indicator/FR.INR.DPST?view=chart; https://data.worldbank.org/indicator/FR.INR.LEND?view=chart; Росстата. https://www.gks.ru/accounts; ЕМИСС. URL: https://www.fedstat.ru/indicator/43007; https://www.fedstat.ru/indicator/58699; https://fedstat.ru/indicator/58538; https://fedstat.ru/indicator/40442. (accessed on 04.10.2020).

* Model statistics: F-test = 29.2; D-W-calculation = 2.1 ∈ [1.32; 2.68]; White's test: χ^2 calculation = 1.12; χ^2 index = 15.5. Regression statistics: Multiple R = 0.97264932609489; R^2 = 0.946046711552844; Normalized R^2 = 0.913674738484551; Standard error 553.772831037142 (9 observations).

** Model statistics: F-test = 23.8; D-W calculation = 2.5 ∈ [1.32; 2.68]; White's test: χ^2 calculation = 0.45; χ^2 index = 15.5. Regression statistics: Multiple R = 0.966665269362855; R^2 = 0.934441742992362; Normalized R^2 = 0.895106788787779; Standard error 610.430723626548 (9 observations).

Fig. 1 presents the results. The GDP models are built regarding investments in fixed assets (*I*), fixed assets (*K*), average number of employees (*L*) in the prices of 2011 (left). In addition, we built a model that connects GDP and the following instruments-factors as money supply (M_3), oil price (*u*), key interest rate (*Fig. 1*, right). Based on the constructed graphs in *Fig. 1*, reflecting the above models, we see that the same change in labor,

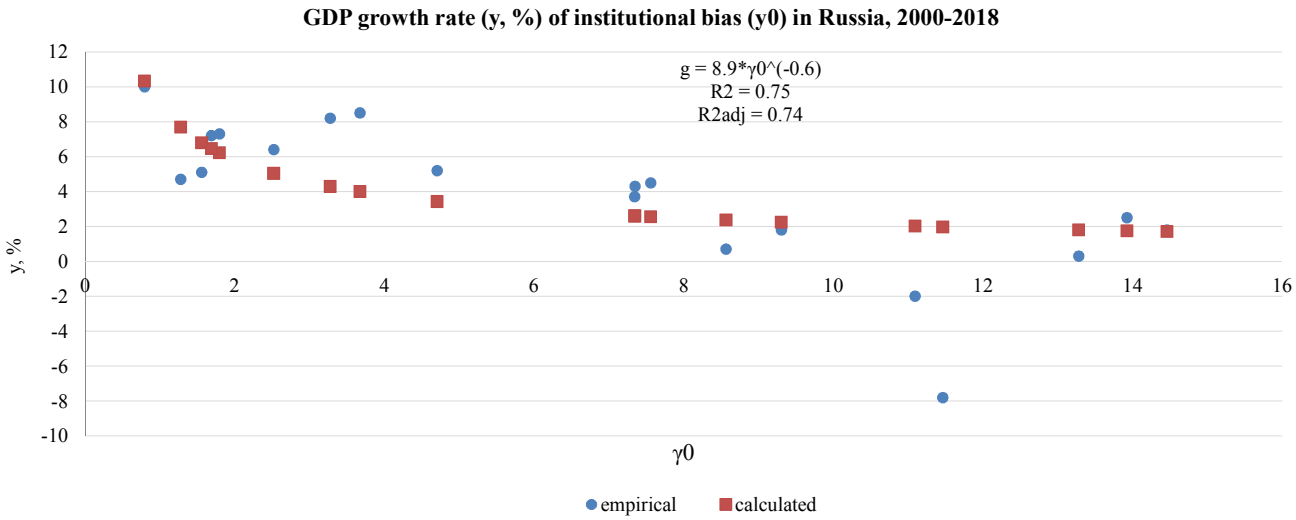

Fig 2. **Institutional displacement of the financial market (γ_0) and the growth rate of the Russian economy*, 2000–2018**

Source: compiled by the author based on Rosstat data. URL: https://www.gks.ru/investment_nonfinancial; https://www.gks.ru/folder/14476; https://www.gks.ru/storage/mediabank/tab1(2).htm; https://www.gks.ru/investment_nonfinancial; https://www.gks.ru/folder/14476; https://www.gks.ru/storage/mediabank/tab1(2). htm (accessed on 04.10.2020).

* Model statistics: F-test = 11; D-W-calculation = 1.8 ∈ [1.4; 2.6]; White's test: χ^2 calculation = 11.3; χ^2 index = 28.9.

investment and fixed capital affects GDP in terms of strength in the specified order (labor, investment, capital). This suggests that in the interval under consideration, an equivalent relative increase in each component provided a stronger impact on GDP (increase) from labor, then investment and fixed capital. Thus, we can talk about the predominance of labor-intensive technologies. Even proceeding from the collinearity of investments in fixed assets and funds (in this model, we intentionally did not omit the issue of collinearity to show a separate influence, and the statistics of the model are very significant), the labor factor turns out to be more significant in influencing the change in GDP, also, in this case (with a two-factor model).

In the GDP model (*Fig. 1*, left), investments, capital and labor are not visible investments in human capital, which can play an important role for long-term economic growth. However, given the high importance of labor in economic growth and the very limited opportunities for funds (technologies), given the limitations on investment dynamics, the Russian economy seems to be in great need of technological and stock modernization. Further training and retraining of personnel will need to be adjusted correspondingly. *Fig. 1* (right) clearly shows that an increase in the money supply, and especially in oil prices, has a positive effect on the gross domestic product — it affects its increase. The growth of the key interest rate reduces the value of the gross domestic product.

Over the considered time interval, within the macroeconomic policy of stabilizing and stimulating growth, despite the low growth rate of the Russian economy, almost accurate ratios have formed. They show that monetization as a whole contributes to GDP growth, as does the use of the labor factor, as well as investment in fixed assets. Alongside, the models show the need to reduce the key interest rate, which was observed after the recession of 2015–2016, as well as the need for further efforts to increase the impact of investments on economic dynamics.

What should these efforts consist of? A structural problem that is usually overlooked in standard macroeconomic and investment policies is the increasing bias of the financial

Fig. 3. **Russian GDP growth rate and M3 growth rate (a*), key interest rate (b)**, 2012–2019**

Source: compiled by the author according to the World Bank, Rosstat, Central Bank of the Russian Federation. URL: https://data.worldbank.org/indicator/FM.LBL.BMNY.GD.ZS?view=chart; https://www.gks.ru/accounts; https://www.gks.ru/accounts; https://cbr.ru/hd_base/keyrate/ (accessed on 04.10.2020).

* Model statistics: F-test = 27.0; D-W calculation = 1.4 Є [1.33; 2.67]; White's test: χ^2 calculation = 8.6; χ^2 index = 14.1

** Model statistics: F-test = 39.2; D-W calculation = 1.34 Є [1.33; 2.67]; White's test: χ^2 calculation = 2.9; χ^2 inde. = 14.1

market relative to other economic activities. This circumstance is expressed in the growth of the institutional bias parameter γ_0 [7, p. 74–76] due to a disproportionate increase in financial investments relative to investments in non-financial assets with a decrease in interest rates.[6] Due to this effect, stimulating growth, like investment, and lowering interest rates may not be obvious, since the growth of institutional displacement will slow down economic growth observed in Russia, when the decrease in the interest rate no longer had a strong effect on the rate of economic growth (*Fig. 2*). However, on the whole, this decrease in interest rates stimulated an increase in GDP, which is confirmed by the presented models. With a decrease in the key interest rate, financial investments in Russia increased several times more than investments in non-financial assets, which sharply increased the shift γ_0. The increase in the institutional bias of the financial market was accompanied in Russia, on average, by a decrease in the growth rate over the considered time interval (*Fig. 2*).

[6] Financial and non-financial investments were estimated at the prices of 2005 to calculate γ0.

Table 1

Comparative characteristics of models for Russia's GDP

Index	1	2	3	4	5
R^2	0.86	0.82	0.8	0.8	0.8
R^2_{adj}	0.78	0.71	0.69	0.68	0.7
F-test	10.5	7.6	6.9	6.7	6.9
P-value (F)	0.014	0.026	0.032	0.033	0.032
Durbin-Watson statistics	1.8	1.3	1.3	1.4	1.3
Significant / regression coefficients before factors	– /X_1, X_2, X_3	X_2 /X_1, X_6	X_2 /X_4, X_6	X_2 /X_3, X_5	X_2 /X_5, X_6

Source: compiled by the author based on the models built in Gretl 2020b.

Fig. 3 shows empirical points. The selected models are based on them and reflect the relationship between the growth rate of Russia's GDP and that of the money supply M_3 and the change in the key interest rate in the period 2012–2019. The decrease in the key interest rate was accompanied by an increase in the growth rate. The change in the dynamics of the money supply has a connection with the growth rate that is more complicated for the Russian economy. Namely, with an increase in the growth rate of the money supply from negative values to + 4%, the growth rate of Russia's GDP increased, with a higher dynamics of the money supply (above 4%), it decreased. In the considered time interval, there was an explicit restriction on the money supply growth resulting from the influence of the money supply dynamics on the economic growth rate. This influence may be due to other factors that are no less, and even more relevant in their influence on the growth rate in some periods than the money supply dynamics. The influence of the growth rate of the money supply on the economic growth rate will vary according to the current monetization. With a relatively low monetization (40–60%), this influence may turn out to be more significant, and with a higher level of monetization, it may be much smaller. This influence being determined for some time interval, does not mean that it can be transferred to the next period, when a different combination of factors may appear that influence economic growth and become more significant.

If we assess the impact lags, after a certain connection is identified, it is possible to transfer it to the next period. Thereby we present the monetary policy of the next stage depending on the results of the previous one and adjust it considering the incremental effect, and predict a possible change in the established communication. A scenario design technique will be useful, when one scenario can be replaced during implementation with another evaluated option.

The analysis shows that in the period under review for the Russian economy both the decrease in the key interest rate, which entailed a decrease in other interest rates, and an increase in the growth rate of the money supply by no more than 4%, in general, contributed to an increase in the economic growth rate. Although the decrease in the interest rate did not obviously affect the rate, it rather influenced the possibility of increasing GDP, but at a lower rate. Most likely, other factors had an impact that slowed down growth, did not allow an increase in the rate, so that a

Table 2

Comparative characteristics of models for investment in fixed assets in Russia

Index	M1	M2	M3	M4
R^2	0.745	0.665	0.679	0.431
R^2_{adj}	0.592	0.464	0.572	0.241
F-test	4.9	3.3	6.4	2.3
P-value (F)	0.06	0.12	0.03	0.18
Durbin-Watson statistics	2.4	2.2	2.2	1.9
Significant / regression coefficients before factors	const. Z_3 / Z_2. Z_4	const / Z_1. Z_3. Z_4	const. Z_3 / Z_5	const. Z_4 / Z_5

Source: compiled by the author based on the models built in Gretl 2020b.

decrease in the key interest rate did not ensure the rate acceleration, but performed a positive function of stimulating growth. An interesting effect took place in the Russian economy in 2000–2018, when savings did not decrease with a decrease in the interest rate, but almost doubled [22, p. 22, 23]. It seems that classical connections and patterns are refuted by developing a specific economy, which requires clarifying not only the reasons for changing these parameters, but also their connections, which seems to be a more difficult task.

Our assessment of the influence on growth immediately includes the implemented policy measures for the indicated period, no matter how criticized the policy being pursued and proposals for more significant monetization are put forward. Currently, with this monetization at a higher rate, it would be possible to reduce the growth rate, and by transferring the economy to a new higher level of monetization, to change the law of the relationship between the economic growth rate and the growth rate of the money supply. This would have to be determined and considered in the further formation of monetary policy.

Now we will implement the next stage of the study, reduced to building GDP multiple regression (Y is determined by gross value added). It depends on the change in the set of these instruments. According to the pairwise correlation method, the following pairs of factors for multiple regression of the gross value added of the Russian economy are multicollinear: X_1-X_4; X_1-X_5; X_3-X_6; X_4-X_5 (the designation of factors is in the previous paragraph).

By the method of sequential exclusion of multicollinear factors, we select the best ones according to the calculated statistics — the most significant models:

1) $Y = 53997 + 255*X_1 + 6*X_2 - 675*X_3$;
2) $Y = 56883 + 64*X_1 + 16*X_2 - 87*X_6$;
3) $Y = 59264 + 19*X_2 - 3*X_4 - 33*X_6$;
4) $Y = 58815 + 20*X_2 - 18*X_3 + 2*X_5$;
5) $Y = 59131 + 19*X_2 + 0.9*X_5 - 35*X_6$.

Model statistics are presented in *Table 1*.[7]

Based on *Table 1*, the best of the built regression models for the gross value added of the Russian economy is as follows:

$$Y = 53997 + 255*X1 + 6*X2 - 675*X3.$$

[7] Hereinafter, the tables show the most frequently compared statistical indicators. The Breusch — Pagan test, Akaike, Hannan — Quinn, Schwarz tests, etc. were also calculated. All criteria are met and are statistically satisfactory. Software Gretl 2020b is used.

From the model, cleared of collinear factor instruments, we see that monetization allowed an increase in gross value added (an increase in monetization was accompanied by an increase in value added). The increasing key interest rate reduced the possibility of growth in value added. Over the considered time interval, an increase in value added took place together with an increase in the risk of doing business (in terms of profit dispersion). This means unstable dynamics and economic development with exhausting potential.

The final stage of the study involves assessing multiple regression for investment in fixed assets. The pairwise correlation method reveals multicollinear pairs of factors: Z_1-Z_2; Z_1-Z_5; Z_2-Z_5; Z_4-Z_5. Excluding collinear factors, we come to the most significant four models: M1-M4. The most frequently used statistics are given (for the period 2011–2019, nine points) as comparative characteristics of the models in *Table 2*.[8]

M1: $I = 14441 - 103*Z_2 - 270*Z_3 + 2{,}3*Z_4$;
M2: $I = 12946 + 1{,}6*Z_1 - 155*Z_3 - 12{,}3*Z_4$;
M3: $I = 13546 - 226*Z_3 - 0{,}006*Z_5$;
M4: $I = 11986 - 35*Z_4 + 0{,}02*Z_5$.

Based on *Table 2*, M1 model is the most significant of those considered: $I = 14441 - 103*Z_2 - 270*Z_3 + 2.3*Z_4$. This model shows that the rise in interest rates slowed down investment. The depreciation of the rouble encouraged investment. Profitability declined on average along with investment, which caused its influence within the selected model on the total amount of investments. The structural aspect of investment allocation by sector is strongly connected to the difference in profitability of these sectors (as shown in the next section). Higher profits did not lead to an increase in investment in the considered segment of the development of the Russian economy. This circumstance is reflected in the resulting regression model, which embodies the investment function. An increase in risk has accompanied an increase in investment and financial investments restrained investments in fixed assets (model M3) [6, 7].

The use of investment policy instruments for growth in Russia requires a systemic measurement. Changes in the well-known macroeconomic aggregates (money supply, interest rate or exchange rate) can have a significant impact on investment and growth. To be targeted and systematic, the structural parameters of the economy and basic institutions require a change enhancing this influence.

RESOURCES OF ECONOMIC SECTORS AND INVESTMENT POLICIES

The modern discussion about the economic growth of Russia [1, 2, 5] touches upon the issue of investment sources.[9] However, two important aspects are usually left out: those concerning both the agents who are able to dispose of these resources from known sources, and the agents who are able to accept and implement investments with a given efficiency. There is also no assessment of the available resources concentrated in the sectors of the Russian economy. It is about those sectors (transactional and raw materials), whose well-being increased due to the curtailment of other activities (manufacturing sectors) in the previous period. Most likely, they received an overestimated or surplus resource, which can also be used to level the situation in the sectoral context. This may create a scenario of a structural policy that can change the model of economic growth in Russia. This structural transformation would allow for additional investment in the areas that need to be developed, for example, setting the task of industrialization [23]. Thus, effective structural changes [24] can have a very significant effect on total productivity and support economic

[8] The Breusch — Pagan test, Akaike, Hannan — Quinn, Schwarz and others were also calculated using the Gretl 2020b program. All criteria are met.

[9] This refers to the volume of the invested resource and its location. For example, the country's foreign exchange reserves or the accumulated resource (National Welfare Fund), the savings of citizens concentrated in the banking system with potential for investment, the increase in public debt, etc. [1].

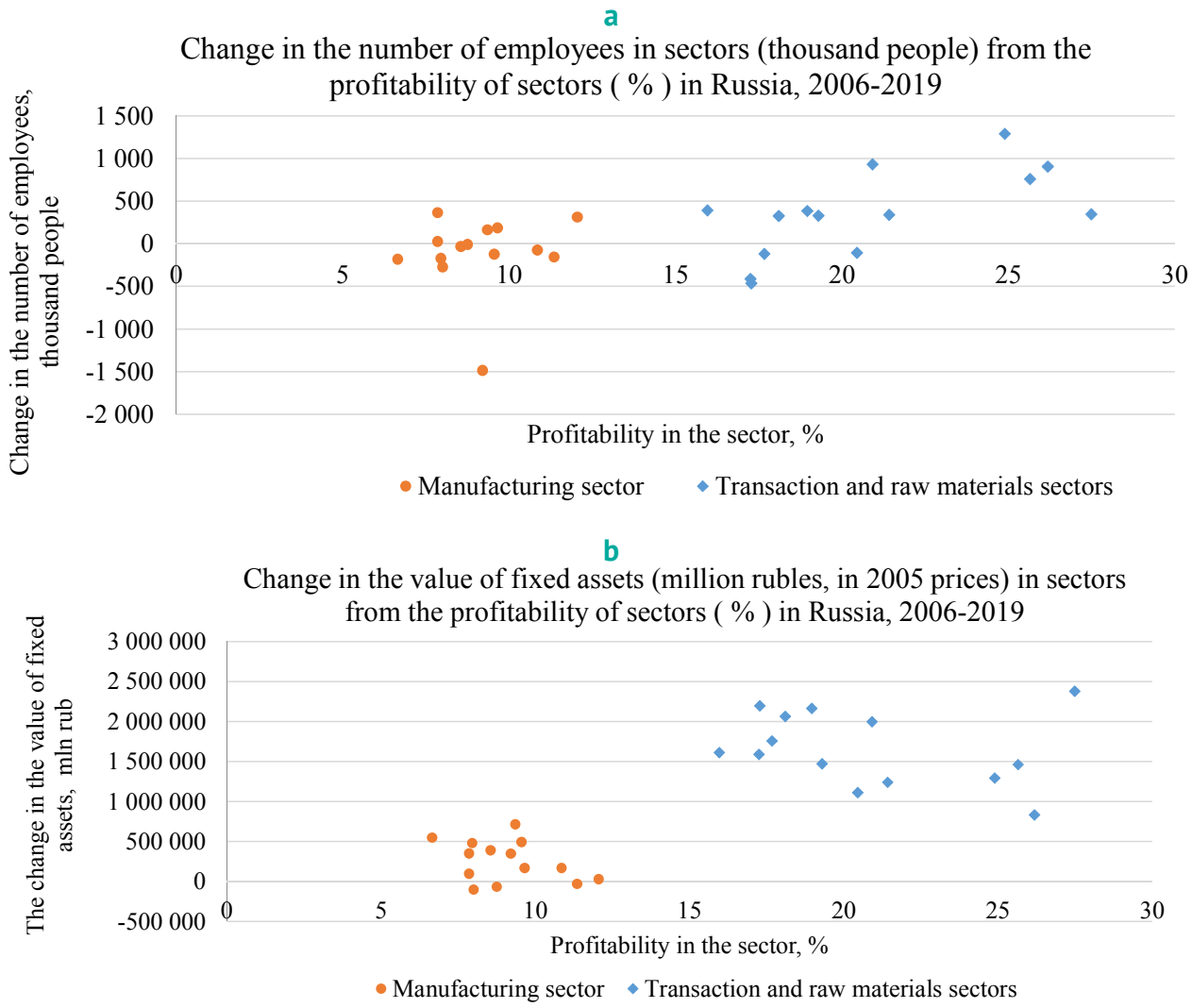

Fig 4. **Change in the number of employed (a) and fixed assets (b) in the sectors (manufacturing and transactional raw materials) of the Russian economy, 2006–2019**

Source: compiled by the author based on data: Rosstat. URL: https://rosstat.gov.ru/labour_force; https://rosstat.gov.ru/free_doc/new_site/finans/fin12_bd.htm.; https://rosstat.gov.ru/free_doc/new_site/business/osnfond/nal_ved2.htm (accessed on 04.10.2020).

growth. As for foreign investments [25], they did not constitute a significant investment resource for the Russian economy and will not represent it due to the existing set of limitations.

At the end of the study, we will consider the structural and investment problem of the development of the Russian economy (*Fig. 4, 5*). The figures show the change in the number of employees and the value of fixed assets in the prices of 2005 for the period 2006–2019 in the manufacturing and transactional raw materials sectors[10] of the Russian economy.

[10] The manufacturing sector includes the following types of activities: manufacturing; construction (according to the OKVED Rosstat). The transactional raw materials sector includes the following types of activities: agriculture, forestry, hunting, fishing and fish farming; mining; provision of electrical energy, gas and steam; air conditioning; water supply; water disposal, organization of waste collection and disposal, activities to eliminate pollution; wholesale and retail trade; repair of motor vehicles and motorcycles; transportation and storage; activities of hotels and catering establishments; activities in the field of information and communication; financial and insurance activities; activity on operations with real estate; professional, scientific and technical activities; administrative activities and related additional services; public administration and military security; social Security; education; activities in the field of health and social services; activities in the field of culture, sports, leisure and entertainment; provision of other types of services. Profitability of sold goods, products (works, services) as an arithmetic mean for the types of activities included in the sector. Rosstat. URL: https://rosstat.gov.ru/bgd/regl/b20_11/IssWWW.exe/Stg/d01/15–09.doc (accessed on 01.10.2020).

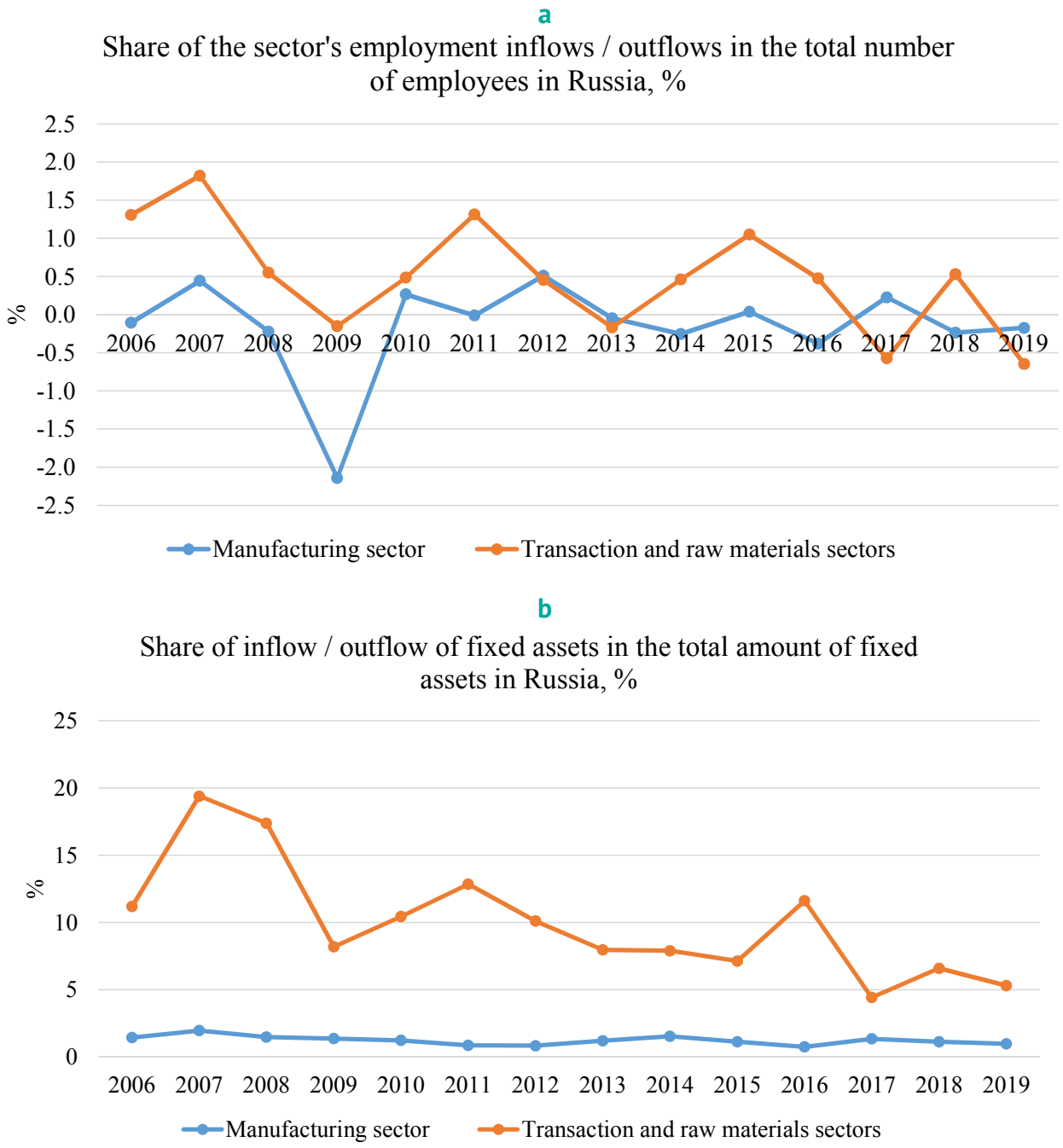

Fig 5. **The share of inflow / outflow of employed (a) and fixed capital (b) in the total amount of employed and funds in the sectors of the Russian economy, 2006–2019**

Source: compiled by the author based on Rosstat data. URL: https://rosstat.gov.ru/labour_force; https://rosstat.gov.ru/free_doc/new_site/business/osnfond/nal_ved2.htm (accessed on 04.10.2020).

Fig. 4, 5 demonstrate that the manufacturing sector showed lower profitability compared to the raw materials transaction, which ensured the difference in investments and a significantly different inflow of fixed assets with a clear predominance towards the transactional raw materials sector. This was a consequence of the distribution of investment between these two basic economic sectors. Moreover, there was mainly an outflow of

employed personnel from processing, and the inflow of personnel into the transactional raw materials sector (*Fig. 5*, left).

During the considered period, the inflow of fixed assets in two sectors decreased (*Fig. 5*, right), but the number of employees moving from one sector to another also decreased (*Fig. 5*, left). This circumstance indicates the curtailment of economic dynamics due to negative investment dynamics, especially in 2013–2016. The 2020 crisis will not change the situation, but on the contrary, it will exacerbate the problem of underinvestment in the Russian economy, especially in the sectoral context.

The manufacturing sector is on average twice more risky regarding economic activity in relation to the transactional raw materials sector [7], and it permanently lacks resources for development. Low profitability and high risk (in terms of the standard deviation of gross profit) confirm the actual blocking of the investment dynamics necessary for the development explain the shift of labor resources to the transactional and raw materials sectors. A significantly higher inflow of fixed assets is due to the work of the raw materials sector within the considered aggregate in the form of the transactional raw materials sector of the Russian economy. The reduction in risk in the transactional sector was accompanied by an increase in investment and in the non-transactional sector,[11] investment growth occurred with an increase in risk [22, p. 21]. As a result, the total amount of investments showed a very complex dependence on the risk of conducting economic activity. The connection that large investments correspond to a lower risk was not so unambiguous, especially since the overall risk in the Russian economy increased over the considered period, while investments, on average, decreased.

Consequently, in addition to the macroeconomic investment function, which helps study the general parameters of the investment influence on growth, it is necessary to consider a systemic perspective of investment policy tasks, including the use of resources concentrated in the economic sectors. Thus, it will be possible to make the structural investment policy the central instrument of the new economic growth policy and to overcome the emerging crisis regardless of its causes.

CONCLUSIONS

To sum up, we will formulate the main conclusions regarding the activation of investments as the future growth drive of the Russian economy.

First, a general macroeconomic policy oriented towards aggregate indicators (as an accumulation rate) requires a general vector to increase investments in the gross product and increase their dynamism, which will ensure an increase in the contribution of investments to the economic growth rate. However, this policy will not bring long-term benefits to the Russian economy if the structure of investment distribution is not considered.

Second, it is necessary to reduce the overall risk of doing business, especially in the manufacturing sectors and in the economy as a whole, as well as further use of such instruments as monetization (at a rate of no higher than 4% to increase M_3), lowering interest rates (this measure is already being applied), even with the ambiguous influence of the last instrument on the dynamics of investments, since other factors and structural and institutional conditions turn out to be significant. A useful instrument will be a controlled depreciation of the national currency, which has a positive effect on the investment function, and implementing the import substitution policy, which will also help to boost investment.

[11] One can also use this macroaggregate breakdown into two sectors. The risk for aggregated sectors is calculated as the standard deviation of profit in the prices of 2005. Profit is summed up by the types of activities included in the sector. Rosstat https://rosstat.gov.ru/bgd/regl/b20_11/IssWWW.exe/Stg/d01/15–04.doc (accessed on 01.10.2020).

Third, straightening of the structural imbalances of the Russian economy is a special direction of investment policy. In particular, the strong superiority that requires elimination, investments in financial assets over investments in non-financial assets, and the transactional and raw materials sectors over the manufacturing sector, which is expressed in the dynamics of fund renewal and labor resource movement. This dynamics also slows down investments and deforms their structure. The distribution of investments between new and obsolete technologies is such that it does not contribute to an increase in the general manufacturability [22]. This indicates the importance of structural and institutional factors in the investment function. If they are not considered, the classic macroeconomic form of the investment function built on aggregates is unlikely to lead to the successful implementation of investment policy.

The possibilities of using the investment function of the economic growth in Russia go beyond the purely macroeconomic framework of the aggregate approach to its design, although the usefulness of this approach used in this article is beyond doubt. In the long term, it should be accompanied by a structural analysis, and the investment function should include the risk and profitability factor determining the distribution of investments in the economy between the directions of use, which was done here at the aggregated level of analysis for the total amount of investments in fixed assets.

ACKNOWLEDGEMENT

I express my deep gratitude to E.N. Voronchikhina, Candidate of Economics, for her help in carrying out calculations using the software module Gretl 2020b.

REFERENCES

1. Aganbegyan A. G. Reduction of investments is destruction for the economy, growth of investments is its salvation. *Ekonomicheskie strategii = Economic Strategies*. 2016;18(4):74–83. (In Russ.).
2. Glaz'ev S. Yu. Thoughts about the ways to ensure economic growth of Russia. *Nauchnye trudy Vol'nogo ekonomicheskogo obshchestva Rossii = Scientific Works of the Free Economic Society of Russia.* 2017;203(1):229–242. (In Russ.).
3. Maevsky V.I., Malkov S. Yu., Rubinstein A.A. Analysis of the economic dynamics of the US, the USSR and Russia using the SMR-model. *Voprosy ekonomiki*. 2018;(7):82–95. (In Russ.). DOI: 10.32609/0042–8736–2018–7–82–95
4. Teixeira A.A., Queirós A.S. Economic growth, human capital and structural change: A dynamic panel data analysis. *Research Policy*. 2016;45(8):1636–1648. DOI: 10.1016/j.respol.2016.04.006
5. Sukharev O.S. Economic growth, institutions and technologies. Moscow: Finansy i statistika; 2014. 464 p. (In Russ.).
6. Sukharev O.S., Voronchikhina E.N. Financial and non-financial investments: Comparative econometric analysis of the impact on economic dynamics. *Quantitative Finance and Economics*. 2020;4(3):382–411. DOI: 10.3934/QFE.2020018
7. Sukharev O.S. Investments in the transactional sector and in financial assets: Impact on economic growth. *Finansy: teoriya i praktika = Finance: Theory and Practice*. 2020;24(3):60–80. (In Russ.). DOI: 10.26794/2587–5671–2020–24–3–60–80
8. Helpman E. The mystery of economic growth. Cambridge, MA: Belknap Press; 2010. 240 p. (Russ. ed.: Helpman E. Zagadka ekonomicheskogo rosta. Moscow: Gaydar Institute Publ.; 2011. 240 p.).
9. Saviotti P.P., Pyka A., Jun B. Education, structural change and economic development. *Structural Change and Economic Dynamics*. 2016;38:55–68. DOI: 10.1016/j.strueco.2016.04.002
10. Alonso-Carrera J., Raurich X. Demand-based structural change and balanced economic growth. *Journal of Macroeconomics*. 2015;46:359–374. DOI: 10.1016/j.jmacro.2015.10.005

11. Samaniego R.M., Sun J.Y. Productivity growth and structural transformation. *Review of Economic Dynamics*. 2016;21:266–285. DOI: 10.1016/j.red.2015.06.003
12. Zeira J., Zoabi H. Economic growth and sector dynamics. *European Economic Review*. 2015;79:1–15. DOI: 10.1016/j.euroecorev.2015.06.007
13. Perelman S., Walheer B. Economic growth and under-investment: A nonparametric approach. *Economics Letters*. 2020;186:108824. DOI: 10.1016/j.econlet.2019.108824
14. Afonso A., St. Aubyn M. Economic growth, public, and private investment returns in 17 OECD economies. *Portuguese Economic Journal*. 2019;18(1):47–65. DOI: 10.1007/s10258–018–0143–7
15. Afonso A., Jalles J. How does fiscal policy affect investment? Evidence from a large panel. *International Journal of Finance and Economics*. 2015;20(4):310–327. DOI: 10.1002/ijfe.1518
16. Calcagnini G., Giombini G., Travaglini G. A theoretical model of imperfect markets and investment. *Structural Change and Economic Dynamics*. 2019;50:237–244. DOI: 10.1016/j.strueco.2019.07.005
17. Swamy V., Dharani M. The dynamics of finance-growth nexus in advanced economies. *International Review of Economics & Finance*. 2019;64:122–146. DOI: 10.1016/j.iref.2019.06.001
18. Sukharev O.S. Economic crisis as a consequence COVID-19 virus attack: Risk and damage assessment. *Quantitative Finance and Economics*. 2020;4(2):274–293. DOI: 10.3934/QFE.2020013
19. Tinbergen J. The duration of development. *Journal of Evolutionary Economics*. 1995;5(3):333–339. DOI: 10.1007/BF01198312
20. Tinbergen J. Economic policy: Principles and design. Amsterdam: North-Holland; 1956. 276 p.
21. Anchishkin A.I. Forecasting the rates and factors of economic growth. Moscow: MAKS Press; 2003. 300 p. (In Russ.).
22. Sukharev O.S. Investment policy of economic growth. *Vestnik Yuzhno-Rossiiskogo gosudarstvennogo tekhnicheskogo universiteta (Novocherkasskogo politekhnicheskogo instituta). Seriya: Sotsial'no-ekonomicheskie nauki = The Bulletin of the South-Russian State Technical University (NPI). Social and Economic Science*. 2020;13(2):7–27. (In Russ.). DOI: 10.17213/2075–2067–2020–2–7–27
23. Romano L., Traù F. The nature of industrial development and the speed of structural change. *Structural Change and Economic Dynamics*. 2017;42:26–37. DOI: 10.1016/j.strueco.2017.05.003
24. Vu K.M. Structural change and economic growth: Empirical evidence and policy insights from Asian economies. *Structural Change and Economic Dynamics*. 2017;41:64–77. DOI: 10.1016/j.strueco.2017.04.002
25. Iamsiraroj S. The foreign direct investment — economic growth nexus. *International Review of Economics & Finance*. 2016;42:116–133. DOI: 10.1016/j.iref.2015.10.044

ABOUT THE AUTHOR

Oleg S. Sukharev — Dr. Sci. (Econ.), Prof., Chief Researcher, Institute of Economics, Russian Academy of Sciences, Moscow, Russia
o_sukharev@list.ru

The article was submitted on 18.10.2020; revised on 02.11.2020 and accepted for publication on 07.12.2020. The author read and approved the final version of the manuscript.