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Distribution of the Impact of Monetary and Fiscal Policy Instruments by Technological Modes and Economic Sectors

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ABSTRACT

The subject of the study is the impact of monetary and fiscal policy instruments on the functioning of the structural elements of the economy, represented by sectors and technological structures. **The purpose** of the paper is to establish how the monetary and individual fiscal policy instruments influenced the structure of the Russian economy. **The methodology** consists of the "distributed control" doctrine, which modifies Tinbergen's principle of "goals-instruments" of macroeconomic policy, since it allows to reveal the unequal power of the instrument by objects of economy, structural and empirical analysis, correlation-regression analysis, with which it is possible to show a picture of the distributed influence of monetary and fiscal policy instruments. A general algorithm of research and application of the doctrine of "distributed management" at the macroeconomic level are developed — by technological structures and economic sectors, which made it possible to obtain a picture of the distribution of the influence of monetary policy on economic objects, to identify the significance of individual fiscal policy instruments. **The general result** of the research is that the doctrine of "distributed management" used not only modifies the classical theory of economic policy, but also confirms that, in addition to the economic structure, the impact structure of standard monetary and fiscal policy instruments arises. The distribution of the most significant instruments of monetary and fiscal policy by technology and three sectors of the Russian economy to ensure its growth in the period 2011–2021 are obtained. It was found that the development of high-level processing and technological modes were more influenced by monetary than budgetary instruments, and the transfer of resources to the national welfare fund hindered their development. Fiscal policy measures — revenues, expenditures, budget deficit/surplus — did not have an equal impact on the development of the considered sectors of the economy. **The prospect** of further research is to develop a software module that includes ongoing analysis and automates calculations based on available statistics to change of monetary and fiscal policy measures in Russia aimed at developing the manufacturing sector and high-tech.

Keywords: monetary policy; economic sectors; technological paradigms; fiscal policy; economic growth; distributed control; Tinbergen principle; efficient market classification

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INTRODUCTION

Modern economic policy theory [1] has two basic tools — monetary and fiscal, reducing analysis and models to determine the overall impact of each on goals such as economic growth, employment, inflation or technological and innovation development [2, 3].

In some cases, the combined influence of tools is taken into account, but there are multiple studies that do not take such influence into account [4, 5] by considering a separate tool or a type of policy in general — monetary or fiscal, affecting technology, productivity, labour, etc. [6, 7].

The classic option is the principle of "goal-tools" by Jan Tinbergen, as well as extending its "principle of effective market classification" by Robert Mundell, arguing that not only the number of tools should be no less than the number of objectives, but each economic policy objective must be matched by the most appropriate tools [8, p. 162]. However, how to determine the degree of adaptation, and especially the conditions under which it changes when tools operate together — it still remains unanswered in economic policy theory. In addition, the effect that fewer tools manage to achieve more goals is also known in practice, which is some exception to the Tinbergen principle [9], that have a mathematical description that is used in a number of studies, but it does not seem to be widely applied in macroeconomic analysis [10–15].

That could be because each type of policy (monetary, fiscal) is equipped with some set of independent and partly interconnected tools with different application force, and over time has a cumulative effect, when the objects of influence become weakly sensitive to a given tool or type of policy, for example, monetary [16]. This increases the difficulty of implementing development policies — to stimulate specific activities. As a result, there is very slow progress on national development goals, in particular in Russia, and a reasonable change of policy is facing various restrictions [17].

Technological innovation, industrial development 4.0, structural changes and economic growth depend on credit capacity and financial policies [18–20], and this dependence is visible for various economies, including China. However, researches provide an important but one-factor description of the impact of the tool on the target, and are limited to a single tool, such as money supply (M2 aggregate) for economic growth [21]. It is important to consider how the impact of each tool and policy is distributed across the economic structure presented by sectoral and, for example, technological paradigms [17]. The task of distribution the monetary policy tools by economic development goals was first performed by the authors in the paper [22]. The **purpose** of the paper is to identify the influence structure of monetary policy tools and individual tools of fiscal policy in order to reasonably change the content of tools of influence and to stimulate specific elements of the economic system, for the development of this research and the doctrine of "distributed management" [9]. First of all, the authors explore the influence on the structure of technological paradigms (according to S. Yu. Glaziev) and on the basic sectors of the Russian economy (processing, raw materials and transactional). Such research, as far as we know from the analysis of the literature, is conducted in Russia for the first time. Structural and empirical methods, correlation and regression analysis are used in this paper. This assumption is the foundation of a number of other works [16, 22] that the tool power is not distributed evenly on the economic structure. To achieve this goal, we will define the methodology of further research, taking as the basis the doctrine of "distributed management" [9]. Then make an analysis of the impact of tools on technological paradigms and sectors of the Russian economy.

RESEARCH METHODOLOGY "DISTRIBUTED MACROMANAGEMENT": EVALUATION OF POLICY TOOLS

The methodology of this study is based on the concept of "distributed management" [9], according to which policy-making and the selection of its tools are important:

- state of the object;
- purposes of changing this state;
- methods of influence (management function);
- object state change time (according to L. Pontryagin [23]).

In addition, the sensitivity of the objectives to the tools and the power of the tools applied [9] related to the factors of the functioning of economic objects are changing.

It is not only the change of purpose, but also of the tool itself, together with the factors and conditions of the change of the object in question. Thus, emerge structural modifications on various structures allocated in the economy, in particular technological paradigms [17, 24] and sectors.

Consider the impact of monetary tools and individual fiscal policy tools on these economic structures. For this we use correlation and regression analysis and build algorithm for further research.

The task was to consider the impact of monetary and fiscal tools on the structure of technological paradigms and sectors of the Russian economy.

Provision of technological paradigms is carried out according to the Russian Classification of Types of Economic Activity (further — RCTEA), which is implemented in the paper [26, p. 15–17]. The measurement of paradigms is based on gross value added of the activities to be included in the aggregated first, second and third, then fourth and fifth paradigms. The sixth mode was allocated according to the research and development costs of the priority activities, for which the aggregated fifth paradigm was adjusted (deducted this cost, attributed to the sixth paradigm).[1] The accounting of the statistical parameters used is such that gross value added data are available since 2011, on research and development costs — since 2015. In this regard, the intervals 2011–2021 and 2015–2021 are taken and considered, respectively. Data used are adjusted to prices 2000 using GDP deflator.[2]

According to the goal of this paper and research objectives it is necessary to allocate monetary and fiscal policy tools.

Monetary policy tools:

- volume of the National Wealth Fund, bln rubles ($xi1$)[3];
- money supply M2, bln rubles[4] ($xi2$);
- volume of the public internal debt of Russia, bln rubles ($xi5$)[5];
- the volume of the public external debt of Russia, bln rubles ($xi6$)[6];
- required reserves (balances of funds in accounts required reserves deposited by credit organizations in the Bank of Russia, on borrowed funds, bln rubles ($xi7$)[7];
- key rate, % ($xi8$)[8];
- liquidity absorption (deposits of credit organizations with the Bank of Russia plus bonds of the Bank of Russia with credit institutions, bln rubles ($xi9$).[9]

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[1] Official website of Rosstat. URL: https://rosstat.gov.ru/storage/mediabank/nauka-5.xlsx (accessed on 05.05.2023).

[2] Official website of Rosstat. URL: https://rosstat.gov.ru/storage/mediabank/VDS_god_ OKVED 2_s2011.xls (accessed on 05.05.2023).

[3] Ministry of Finance of the Russian Federation. URL: https://minfin.gov.ru/common/upload/library/2022/09/main/Dannye_na_01.09.2022.xlsx (accessed on 05.05.2023).

[4] Bank of Russia. URL: https://cbr.ru/vfs/statistics/ms/ms_m22.xlsx (accessed on 05.05.2023).

[5] Ministry of Finance of the Russian Federation. URL: https://minfin.gov.ru/common/ upload/library/2022/09/main/Obem_gosdolga_s_garantiyami_god_polnostu_na_01_09_2022.xls (accessed on 05.05.2023).

[6] Ministry of Finance of the Russian Federation. URL: https://minfin.gov.ru/common/upload/library/ 2022/09/main/Obem_gos.vnesh.dolga.xlsx (accessed on 05.05.2023).

[7] Bank of Russia. URL: https://cbr.ru/vfs/statistics/ms/mb_bd.xlsx (accessed on 05.05.2023).

[8] Bank of Russia. URL: https://cbr.ru/hd_base/KeyRate/ (accessed on 05.05.2023).

[9] Bank of Russia. URL: https://cbr.ru/vfs/statistics/ms/mb_bd.xlsx (accessed on 05.05.2023).

Fiscal (budget and tax) policy tools[10]:

- state budget revenues, bln rubles ($xi10$);
- state budget expenditures, bln rubles ($xi3$);
- deficit/surplus of the state budget, bln rubles ($xi4$).

Therefore, seven tools refer to monetary policy, and three interrelated tools refer to fiscal policy.[11]

Based on variable data, the general regression equation takes the form:

$$U_i = a_{0i} + a_{1i}xi1 + a_{2i}xi1 + a_{3i}xi3 + a_{4i}xi4 + a_{5i}xi5 + \\ + a_{6i}xi6 + a_{7i}xi7 + a_{8i}xi8 + a_{9i}xi9 + a_{10i}xi10 + \tau,$$

where U — gross value added of i-element the structure, paradigm or sector; τ — random error.

The target of the paradigms structure is the gross value added and growth rate, for sectors — gross value added in a given regression with the assessment of the impact of the same tools on the elements of economic structure.

Summarizing, we denote the general algorithm of research.

Step 1. Separation of technological paradigms and sectors by RCTEA.

Step 2. Identification of the list of monetary and fiscal policy tools, as well as the objectives characterizing the development of the elements of the allocated economic structure (for example, gross value added, its growth rate[12]).

Step 3. Preliminary correlation analysis with the designation of the link objectives and tools in pairs.

Step 4. Regression and selection of a relevant model for linking tools and objectives.

Step 5. Analysis of the tools impact on the structure of economic elements — assessment of the distributed impact of policy tools. Preparation of possible proposals for policy adjustments.

In further actions we use an algorithm that can be extended and detailed with subordination to the task of improvement of the "distributed management" doctrine.

Quantification of the impact of policy tools on gross value added and growth in technological paradigms and sectors implies multiple regression analysis. The final model was selected by the rejection method, taking into account the results of the evaluation of the pair correlations. Fisher, Student, Akaike and Schwarz criterions are applied. To eliminate autocorrelation and heteroskedasticity of model residues, standard errors were evaluated using the Newey-West criterion. Multicollinearity was eliminated by removing collinear factors from the model and the effects were estimated in pairs. All the final models were statistically significant according to the Fisher criterion (F- criterion).

The study of the influence of monetary and fiscal policy tools on the sectoral structure of the Russian economy was carried out by constructing regressions using the least squares method, which is a standard procedure in regression analysis. Autocorrelation and multicollinearity were found in model selection. Standard errors were also evaluated in the Newey-West form. Final rejection of the model — the choice of the best was based on t and F-criterions, coefficient of determination. Models were tested for heteroscedasticity residues, according to the White test, for autocorrelation of residues, according to the Darbin-Watson criterion.

Initially, tools were included if correlation was found. However, this approach created multicollinearity, so the accuracy of the analysis of the impact of tools on targets was sharply reduced. Therefore, collinear variables were consistently eliminated and

[10] Ministry of Finance of the Russian Federation. URL: https://minfin.gov.ru/common/upload/ library/2022/10/main/fedbud.xlsx (accessed on 05.05.2023).

[11] It does not take into account the structure of taxes, as it is an independent and complex tool in the influence on the structure of the economy, requiring additional and sufficient research.

[12] The objectives may be multiple, such as the flow of labour, investment in the sector or paradigm, etc.

the best model was selected. The regression equation was selected for each of the selected paradigms and, accordingly, for each sector of the economy.[13]

Using this method, it is possible to analyze the distribution of the influence of monetary and fiscal policy tools on the elements of the economic structure, highlighting the most significant results by paradigms and sectors.

IMPACT OF POLICY TOOLS TO TECHNOLOGICAL PARADIGMS

Based on the methodology presented above, we will give the general result of its application, which is summarized in the *Table* of the *Appendix*.

The following results are from these assessments, which concern the study of the impact of policy tools on the goals in each technological paradigm.

First, the change in the size of the money supply of M2 worked to increase the value added of the first, third and fifth paradigms, without affecting the growth rate of all paradigms.

Second, the National Welfare Fund had a positive impact on the value added of the fourth and fifth paradigms, which can be explained by the achievement of the goal of stimulating the development of high-tech sectors. Probably for the same reason, budget expenditures have had a positive impact on the value added of the fifth paradigm, no longer affecting other paradigms and the pace of their development (*Table* of the *Appendix*). At the same time, the same positive impact was on the growth rate of value added of the fourth paradigm and inhibitory effect on the growth rate of value added of the fifth paradigm.

Third, the key rate did not affect the value added and the rate of growth. This result requires, of course, additional research, which was not the task of this paper. However, given that the change in the key rate does not show a good correlation even with capital inflows and outflows and a very weak negative association with investment, we can assume that such a result is possible.

Fourth, required reserves and liquidity absorption, as their volumes increase, operate to increase the value added of the fifth and the first to third paradigms (*Table* of the *Appendix*).

Fifth, it is noteworthy that the national wealth fund, the money supply, budget expenditures, domestic debt are operating to stimulate the fifth technological order. This immediately shows policy' orientations with the right tools to develop high-tech economic sectors.

Thus, a fairly laborious analysis revealed the following features of policy at the instrumental level:

1) the greater impact of the number of tools occurred in the fifth technological paradigm, and its weak development is due to the fact that the strength of these tools was low, it was constrained by the content of policies;

2) the first and third paradigms were also influenced by almost the same tools as the fifth paradigm, but this influence was probably much more significant, as the first and third paradigms of GDP share;

3) the added value of the fifth paradigm increased with expansion of the Welfare Fund, money supply M2, state budget expenditure, domestic debt, required reserves and liquidity absorption, but with a reduction of external debt (*Table* of the *Appendix*);

4) the added value of the first and third paradigms will increase with expansion of money supply M2, domestic debt, required reserves, but with a reduction of external debt. According to quantitative estimates, which take up to 35 pages with tables, it can be specified that the impact of the Fund, required reserves, liquidity absorption have not as significant an impact as, let's say, money supply and budget expenditure or domestic debt;

[13] In total, three allocated sectors by gross value added give the GDP of the Russian Federation as well as the paradigms of consideration.

5) the small number of tools influences the value added of the fourth paradigm and the sixth paradigm, and the growth rate of all paradigms is not affected by the number of tools, except for the Fund, whose growth positively affects the growth rate of the fourth paradigm and slows the fifth paradigm, domestic debt, which is a constraint on the fifth paradigm, and budget revenues that have a positive impact on the fourth paradigm.

The result of the analysis of the distribution of the influence of tools by the structure of technological paradigms confirms the validity of the formulation of the "distributed management" doctrine for modification in the sense of expanding the Tinbergen principle and clarifying the effective classification of the market, because the power of the tool and the direction of influence are essential.

Thus, monetary and fiscal policy tools (with the exception of taxes that were not considered, and this structure a priori adopted unchanged as another equal condition) have different effects on the gross value added of each of the paradigms, but have little influence on its growth rate. This, along with other factors, ensures the dynamics of the general structure and development of paradigms in their system.

Further, describe the results obtained for the sectors under consideration in the Russian economy.

IMPACT OF POLICY TOOLS TO ECONOMIC SECTORS

This research confirms the very interesting fact that the structural economic system, i.e. its presentation, for example, in the form of technological paradigms or economic sectors, determines the degree of influence of monetary and fiscal policy tools. It differs in structure and sector.

Consider the impact of monetary and fiscal policy tools on gross value added generated in three sectors of the Russian economy (processing, raw materials, transactional). The *Table* summarizes the results of the construction and selection of regressions, including supporting correlation analysis. Plus noted that the accumulation of the tool leads to an increase in the goal (value added or its rate). Minus in the *Table* indicates the reverse change when increasing the tool reduces the target and decreasing the tool increases.

The *Table* thus shows that the increase in money supply, domestic debt and required reserves contributed to the development of the proccesing sector, as well as the raw materials and transactional sectors. Lower key rate also stimulated processing and other sectors. External debt reduction operated to develop three sectors of the Russian economy, as well as the National Welfare Fund. Thus, withdrawals into the fund, i.e. the accumulation of the fund's resources, led to a constraint on the development of the Russian economy. In other words, this research concludes that there is an interaction. Taking into account that the growth of the money supply ensures growth of gross value added of all sectors of the economy, it is necessary to use stock resources for economic development.

The correlation analysis confirms that the most significant impact of monetary and fiscal policy tools is provided on the manufacturing sector at the time period under consideration. In particular, the variation of these tools explains the change in value added in processing between 75 and 88.4%. Value added of processing increased as the National Welfare Fund, interest rate, external debt, and when reserves, domestic debt and money supply grew. Liquidity absorption did not affect processing value added.

In the raw material sector, tool variations cause changes in value added in the range of 65.2–84%, i.e. less significant but still significant impact. Value added increases with increased absorption of liquidity, domestic debt, and money supply, with declining the National Welfare Fund and external debt. No impact of key rate and required reserves.

In the transaction sector, tool variations caused changes in value added in the range of

Table

Impact of Monetary and Fiscal Policy Instruments on Gross Value Added in Sectors of The Russian Economy in 2011–2022

Value added of the economic sectors	Tools						
	National wealth fund *xi*1	Money supply M2.*xi*2	Domestic debt *xi*5	External debt *xi*6	Required reserves *xi*7	Key rate *xi*8	Liquidity absorption *xi*9
Processing	–	+	+	–	+	–	ni
Raw materials	–	+	+	–	ni	ni	+
Transactional	–	+	+	–	ni	–	ni

Source: Compiled by the authors.

Note: ni — no impact, that is, the impact of the tool is absent. The lack of impact of the tool on the gross value added of the sector was noted in the case, if in any of the obtained specifications of the regression model the tool coefficient was not statistically significant and thus the tool was excluded from the regression models for the GVA of the economy.

57.9–79.8%. In other words, the impact of tools on the value added generated in the "service economy" is even less evident than in the raw material sector. The reduction of the National Welfare Fund, the key rate and external debt, as well as the increase in money supply and domestic debt worked to increase the added value of the sector (*Table*). However, required reserves and liquidity absorption did not affect value added.

It has also been found that the strongest influence on sectoral dynamics was the increase in the money supply, which led to an increase in the share of processing, the transaction sector, excluding raw materials, and the value added of the three sectors. Key rate as tool showed selective effects. As the share and value added of the processing and transactional sector increased, but with the growth — the share of the raw materials sector increased.

Domestic debt growth is positively associated with growth in all three sectors, while the reduction of external debt has increased value added in all sectors and processing.

Reduced liquidity absorption, i.e. saturation of the economy with the most liquid assets, led to an increase in the share of the transaction sector and a reduction in the share of the raw materials sector.

Thus, this analysis supports the assumption that the economic structure of tools is uneven. This is the root cause of the model of economic growth, in the way in which tools operate within the established economic structure. Impact depends on whether the structure is considered — by paradigms or sectors. However, the general assessment remains that the money supply, liquidity absorption and key rate significantly affected the structure of the Russian economy (by sectors[14]).

CONCLUSION

Summarizing the analysis conducted and the presented implementation of the "distributed management" doctrine on the example

[14] There is no study of the effect on paradigms shares. This conclusion is therefore derived from sectoral analysis of the dynamics and impact of tools on sectoral structure.

of monetary and fiscal policy tools for the selected types of economic structures, we will formulate the most important conclusions.

First, it is shown that standard approaches in the theory of economic policy need to be expanded due to the "distributed management" doctrine, the application of which allows to assess the distribution of influence of policy tools by the structure of the economy.

Second, the presented algorithm of assessment of the impact of tools of monetary and fiscal policy allows to see the force and direction of influence on the considered interval of time selected tools of macroeconomic policy. It is also established that the development of processing and high-level technological paradigms depended more on monetary than budgetary tools, and the transfer of resources to the national welfare fund hampered their development. The main influence was the M2 money supply, key rate, value of external debt and domestic debt, size of the National Welfare Fund, but multidirectional on individual tools. Fiscal policy measures — income, expenditure, deficit/surplus did not have an equal impact on the development of the sectors considered.

Third, the research could not, due to objective circumstances, answer questions about the reasons for the impact of tools. Moreover, modern statistics measure relevant parameters in such a way that they reflect a particular impact, including accumulated over time. The idea of cumulative effect is only introduced into the theory of economic policy, but the fact that over time the influence of the tool may weaken, and the sensitivity of the object of the economic structure decreases, makes it necessary to expand the subject area of research and in this direction.

The scientific novelty of the conducted study is not limited to the development of a practical algorithm and methods for assessing the impact of tools on the goals of economic development, depending on the state of the structure of the economy and its receptivity to the impact of these tools, but also to confirmation of theoretical significance of the "distributed management" doctrine.

A further step of the approved algorithm, which is applied for the first time in technological systems and sectors, is to coordination the results for different structures, i.e. to specify the content of the tools aimed at stimulating the development of certain sectors and/or selected high-technology industries. The perspective of the research is also the need to develop a software module that allows such calculations and assessments to be carried out not manually but automatically, defining the zones of influence of tools and their correction depending on the situation in the economy. This approach allows instrumentalizing monetary and fiscal policy, and for Russia shows the importance of activating it is budget policy, which, in fact, has been deduced from the necessary determinations of the new model of economic growth.

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Appendix

Table

Influence of Monetary and Fiscal Policy Instruments on Gross Value Added and Its Growth Rate of Technological Modes, 2011–2021

GVA and growth rate of technological modes	Instruments									
	National wealth fund (*xi*1)	Money supply M2, (*xi*2)	Budget expenditures (*xi*3)	Budget deficit/surplus (*xi*4)	Domestic debt (*xi*5)	External debt (*xi*6)	Required reserves (*xi*7)	Key rate (*xi*8)	Liquidity absorption (*xi*9)	Budget revenues (*xi*10)
GVA 1–3	NI	+	NI	NI	+	–	+	NI	NI	NI
GVA 4	+	NI	NI	NI	NI	NI	NI	NI	NI	+
GVA 5	+	+	+	NI	+	–	+	NI	+	NI
GVA 6	NI	NI	NI	NI	–	NI	NI	NI	NI	–
Growth rate of GVA 1–3	NI	NI	NI	NI	NI	NI	NI	NI	NI	NI
Growth rate of GVA4	+	NI	NI	NI	NI	NI	NI	NI	NI	+
Growth rate of GVA 5	–	NI	NI	NI	–	NI	NI	NI	NI	NI
Growth rate of GVA 6	NI	NI	NI	NI	NI	NI	NI	NI	NI	NI

Source: Compiled by the authors.

Note: NI — no impact; + directly impact; — reverse impact (target reduction).