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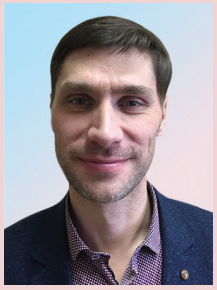
Simulation of Structural Changes in the Region's Economy Based on the Matrix of Financial Flows*



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Abstract. The article is devoted to the improvement of instruments assessing the impact of exogenous factors on the structure of the regional economy. In distinction from previous studies, the analysis is carried out not only on the basis of short-term multiplier effect, but also changes the values of multipliers, demonstrating the sensitivity / elasticity of the economic system in the region to exogenous influences in the long term. Structural changes are analyzed by the example of assessing the impact of the financial measures of the state policy of import substitution. The article presents a method of estimating the multiplicative effects, based on the balance sheet approach and the methodology of the system of national accounts. A distinctive feature of the methodology is to reflect the reproductive structures of institutional sectors in the region in relation to the import and export flows. On an example of the Sverdlovsk Oblast the authors demonstrate the possibility of using methods in predicting changes in key economic indicators in the region (wages, gross profit, tax revenues of the consolidated regional budget, final consumption expenditure, etc.). On the basis of the updated matrix of cash flows, three scenarios for structural change are calculated, in the region's economy, they determine various changes in the multipliers. The developed method makes it possible, first, to assess the direct and indirect economic effects arising in the implementation of government measures on import substitution; second, to analyze the effectiveness of import substitution programs, taking into account the features of the reproductive structure of the region, and thus to identify the sector that will provide the greatest multiplier economic effect; and third, to improve the objectivity of comparing the financial costs and benefits associated with the implementation of import substitution measures, the potential benefits of investing these funds in alternative projects. The results can be used in further studies on the effectiveness of implementation of the state policy of import substitution and modernization of the economy of the Russian Federation.

Key words: regional development, modernization, import substitution, multiplicative effects, matrix of financial flows, scenario modelling.

Economic reforms in Russia are often poorly designed and do not take into account many factors influencing the dynamics of economic processes. State management decisions are often a reaction to an unexpected economic scenario, are forced and inappropriate. The similar situation happened in terms of import substitution program which was a forced measure designed to ensure output of products, the import of which has become impossible because of the complicated foreign policy situation and the introduction of mutual trade and economic restrictions imposed by Russia and several foreign countries. The programs developed and accepted in the shortest terms were not sufficiently elaborated in terms of evaluation of economic effects. In the authors' opinion, it is necessary to conduct scenario calculations of consequences of government decisions, primarily using economic and mathematical models which are able to answer the question "what happens if..?"

The process of import substitution causes various economic effects which can be divided into direct and indirect. Direct effects are expressed in changes in the cost of goods for Russian consumers. If the price of domestic goods is lower (assuming that their quality is identical to the imported counterparts) the society saves a part of resources which can be spent on other consumption goods or investment. Conversely, if the price of domestic goods is higher, the society as a whole will suffer losses. Indirect effects of import substitution are expressed in the revitalization of related industries, creating additional workplaces, increased final consumption and increases tax revenues [11]. Along with these short-term effects, there also are longer-term effects characterizing the structural changes in the socio-economic system. They include reduced resource intensity of the economy, growth in labor productivity, reduced import dependence and increased financial stability.

One of the most promising tools for quantitative evaluation of the effects caused by government activities is currently a class of economic and mathematical models – computable balance models of general equilibrium built on the basis of social accounting matrix/ cash flow matric (CFM). This class of models helps find approaches to addressing a wide range of objectives related mainly to state regulation of the economy.

It should be noted that the first balance empirical models appeared in the 1920–30s The most well-known works in this sphere of scientific research are works by Nobel Memorial Prize winner in Economic Sciences V. Leontief [5], L.V. Kantorovich [4] R. Stone [21] and a few other outstanding scientists. On the basis of the input-output balance these scientists tried to explain the level and dynamics of goods value and production factors, the dependence of the structure of foreign trade on the level of country's economy relative supply of main production factors, the impact of technological progress on the economic structure and its development, etc. In the future, the most prevailing model in the foreign practice was the modified input-output model – Social Accounting Matrix (SAM) or, in other words, Cash Flow Matrix. Unlike the standard input-output model in CFM, together with intermediate and final consumption and GVA, it also considers transfer payments between institutional sectors (households, firms and government), as well as distribution of factor payments within each sector [10, p. 65]. The basics of using CFM as an effective tool for studying the structure of the economic system, characteristics of the reproduction process, the formation and distribution of multiplicative effects were laid in the works of R. Stone [21], G. Pyatt, J. Round [17, 18], E. Thorbecke, J. Defourny [14], etc.

Nowadays, of particular importance are research aimed at improving the accuracy and reliability of estimates of CFM structural elements. For these purposes, various methods of statistical analysis, methods of mathematical modeling and simulation economic agents' behavior are used. In this sphere, most relevant are works by D. Go on the estimation of CFM parameters using Bayes's cross entropy [15], and the work by P.L Scandizzo [20]. In addition, the sphere of integration of general economic equilibrium models with models of other types. In particular, the team of authors under the supervision of academician Makarov amplified the methodology of input-output models using theoretical and gaming, as well as neural network models of economic agents' behavior and interaction [6]. This is described in the work by M-K. Kim and T. Harris [16] where CFM-based analysis is amplified by a classic model of linear optimization.

In recent years, Russia has had a number of publications devoted to the study of Russian regions with the help of CFM. Models of the Kaliningrad [9], Novosibirsk [7], Chelyabinsk and Kurgan oblasts, Khabarovsk [2] and Krasnodar krais and other regions have been developed. The regions' CFMs were used to address practical issues including assessment of territory's financial sustainability [8], the impact of federal fiscal policy on the regional economy [10] and the socio-economic situation of households with different level of disposable monthly income [1]. Work by E.A. Zakharchuk and F.A. Pasynkova [3] should be considered as is studies theoretical and methodological possibilities and presents the author's approach to designing balance models of municipal units. In in foreign practice, CFM is also used to solve a wide range of practical issues. The recent works worth noting are: article by Y. Saafi [19] which assesses the change in income level of different social groups depending on the changes in world oil prices, article by A. Akkmelik [12] which estimates the impacts of domestic electricity price growth, and the already mentioned article by M-K. Kim [16] which estimates the economic impacts of forest fires with the help of CFM.

Despite the fact that theoretical and methodological aspects of CFM development and use are described in detail in the scientific literature, special attention should be given to adaptation of this model to the existing system of regional statistics in Russia. Works [10, 11] present the technique of CFM formation at the regional level; CFM of the Sverdlovsk Oblast is designed.

The article presents the methodology of evaluating multiplicative effects of financial measures of the state program on import substitution. Unlike previous works, the authors suggest that evaluation of government measures implementation is carried out

considering not only short-term multiplicative effects, but also changes in the values of multipliers with longer-term consequences. The procedure consists of four stages.

The first stage – analysis of the current economic situation in the region and design of an input-output economic and mathematical model describing the structure, parameters and interaction of institutional sectors. The use of CFM is used for this purpose. CFM integrates statistical data from various public sources (Rosstat, regional statistics institutions, Federal Tax Service, Federal Treasury, etc.). The review of changes in CFM indicators in dynamics helps reveal the reaction of key economic actors to changes in external (exogenous) conditions.

The second stage consists of scenario calculations of the changes in the CFM elements of on the basis of changes in its structure which may occur as a result of implementation of specific government measures on import substitution. The economic system of a region consists of a number of interrelated sectors; each of them is characterized by common production output and a combination of costs necessary for manufacturing these products, including labor costs. Enterprises and organizations belonging to different sectors of the economy use machines, tools and human labor in the process of economic activity for manufacturing final goods from material resources (intermediate consumption). Modernization of buildings and equipment in the framework of import substitution measures affects the production process changing both the composition of costs for manufactured products and the range of products. This process implies that part of the existing buildings, structures and equipment is occasionally replaced in order to increase future production volume. Thus, amid expanding economy, new technology is usually embodied in newly produced capital equipment specially installed for increasing the existing capacities, and, of course, in professional workforce which works with physical capital and other inputs. As a result, modernization of production equipment and introduction of new technologies lead to changes in the technological matrix and the share of intermediate consumption in gross output. The increase in the share of value added in output makes it possible to release a certain amount of production resources (labor and capital) and direct it to manufacturing of final goods or import substitution.

Thus, the second stage evaluates potential changes in the structure CFM – changes in the ratio of value added and intermediate consumption in gross output, the share of imported goods and services in intermediate and final consumption. Based on this evaluation analysis matrix of average propensities is designed.

Technically, the second stage contains the following steps. When scenario calculations are made, one or more matrix parameters are changed reflecting structural changes in the economy of the region caused by public administration activities. Later, the model is substituted with the volume of gross output planned according to the program of import substitution, and the process of conversion is triggered. Iterations are made until the sums of income and expenditures of each CFM match.

In the third stage, the calculated values of CFM indices are compared with the actual values (obtained at the first stage), which helps assess the end result from the implementation of import substitution measures taking into account the multiplicative effects. Any indicator (or combination of indicators) may be considered as the final result of CFM. However, in the authors' view, the development of state import substitution policy it is necessary to focus on the growth of gross value added, tax revenues of regional budgets, as well as final consumption expenditures.

The fourth stage is comparative evaluation of multipliers of actual and estimated cash flow matrices. Structural changes in CFM affect the size of multipliers. Since the multiplier shows the scale of change of an endogenous factor with a single change in the exogenous factor, higher multiplier values indicate the growing sensitivity/elasticity of the regional economic system and its structural elements to exogenous influences such as change in investment, import/export, and amount of federal financing in the regions of the state import substitution program.

The authors consider the hypothetical examples of using the technique for evaluating multiplicative effects for forecasting changes in key economic indicators – gross profit of the economy, household income, income of the government sector – as a result of influence of modernization which leads to changes in the shares of intermediate consumption and gross value added in gross output, as well as measures in the context the import substitution program, which affect the share of imports in the commodity balance in the region[1].

Table 1 shows the CMF of the Sverdlovsk Oblast in 2014 when gross output of all industries in the region at market prices amounted to 3574.1 billion rubles (cell 2.1). The volume of imports amounted to 515.3 billion rubles (cell 10.1). According to the system of national accounts methodology, the total output at market prices is the sum of intermediate consumption, taxes on products (VAT, customs and excise duties) and value added, which, in turn, consists

[1] The use of a hypothetical example is explained by lack of information about sufficient details on the Sverdlovsk Oblast. The adopted state import substitution program presents totals costs without describing their structure.

Table 1. Sverdlovsk Oblast cash flow matrix in 2014*

			1	2	3	4	5	6	7	8	9	10	11
			Goods and services	Industries	Capital	Labor	House-holds	Regional budget	Federal budget	Non-budget funds	Investment	ROW	TOTAL
1	Goods and services	Mln rubles		1836351			1249037	204966	93969	4742	379364	320968	4089397
		Share, %		51.4			88.3	88.1	58.4	2.2	100	62.3	
2	Industries	Mln rubles	3574143										3574143
		Share, %	87.4										
3	Capital	Mln rubles		839170									839170
		Share, %		23.5									
4	Labor	Mln rubles		796466									796466
		Share, %		22.3									
5	Households	Mln rubles			592679	610965				210476			1414120
		Share, %			70.6	76.7				97.8			
6	Regional budget	Mln rubles		39107	58486		86842		22365			25848	232648
		Share, %		1.1	7.0		6.2		13.9			5.0	
7	Federal budget	Mln rubles		63049	5531							92352	160932
		Share, %		1.7	0.7							17.9	
8	Non-budget funds	Mln rubles				185501			29716				215217
		Share, %				23.3			18.5				
9	Savings	Mln rubles			182474		78240	27682	14881			76087	379364
		Share, %			21.7		5.5	11.9	9.2			14.8	
10	ROW	Mln rubles	515254										515254
		Share, %	12.6										
11	TOTAL	Mln rubles	4089397	3574143	839170	796466	1414119	232648	160932	215218	379364	515255	
		Share, %	100	100	100	100	100	100	100	100	100	100	

* Calculated by the authors.

of wages, profit, gross mixed income, and taxes on production (property tax, tax on mineral extraction tax, etc.). In 2014, in the Sverdlovsk Oblast intermediate consumption (calculated by all types of economic activity) amounted to 1836.4 billion rubles (cell 1.2), gross profit and mixed income – 839.2 billion rubles (cell 3.2), wages – 796.5 billion rubles (cell 4.2), taxes on production – 39.1 billion rubles (cell 6.2), taxes on products – 63.1 billion rubles (cell 7.2).

It should be noted that in each industry production process uses a unique set of raw materials and products (intermediate consumption) and a specific list of capital (buildings, equipment) and human resources (specialists of different professions and different skill levels). Obtaining necessary information requires extensive research and observations, which, unfortunately, are currently not held in Russia. However, the designed aggregate CFM of the Sverdlovsk Oblast helps calculate the potential effects of the introduction of new technology entailing an increase in the share of value added in gross output.

The present article uses the model with aggregated accounts "Goods and services" and "Industries", which does not imply analysis of certain types of economic activity. The possibility of using CFM for sector analysis and calculation of multipliers is presented in the authors' previous work [12].

Suppose that as a result of production modernization and introduction of new technology the share of intermediate consumption (IC) in gross output (GO) in the Sverdlovsk Oblast will reduce from 51.4% to 50.4%. Since this figure is the result of correlation of two indicators, it can be changed either through faster GO growth compared to IC, or through faster reduction in GO compared to IC.

The authors consider the scenario in which intermediate consumption is reduced and gross output is unchanged. Such development of the economy is possible in case of active introduction of power-saving technologies. The reduction in the share of IC means an equal increase in value added. The results of model calculations of changes and transformed CFM are represented in *Table 2*.

A 1% decrease in IC (35.7 billion rubles) (cell 1.2) leads to the growth of value added by the same amount. Additional value added is distributed among the main factors of production, labor and capital, as well as taxes in the proportion prevailing in the economic system of the Sverdlovsk Oblast. Thus, the amount of profit, wages and tax revenues will increase by 17.9 billion rubles (cell 3.2), 10.7 billion rubles (cell 4.2), 7.1 billion rubles (total of cells 6.2 and 7.2) respectively. In the future, these figures will continue to move along chains of correlation between institutional sectors in proportions established

Table 2. Analysis CFM of the Sverdlovsk Oblast designed as a result of a 1% increase in the share of value added in gross output, million rubles*

			1	2	3	4	5	6	7	8	9	10	11
			Goods and services	Industries	Capital	Labor	House-holds	Regional budget	Federal budget	Non-budget funds	Investment	ROW	TOTAL
1	Goods and services	Result		1800610			1267450	210340	93969	4742	385129	320968	4083208
		Change		-35741			18413	5374	0	0	5765	0	-6189
2	Industries	Result	3574143										3574143
		Change	0										0
3	Capital	Result		857041									857041
		Change		17871									17871
4	Labor	Result		807189									807189
		Change		10722									10722
5	Households	Result			605300	619191				210476			1434967
		Change			12622	8225				0			20847
6	Regional budget	Result		42681	59731		88123		22365			25848	238748
		Change		3574	1246		1280		0			0	6100
7	Federal budget	Result		66623	5649							86162	158434
		Change		3574	118							-6189	-2497
8	Non-budget funds	Result				187998			27219				215217
		Change				2497			-2497				0
9	Savings	Result			186360		79394	28408	14881			76087	385129
		Change			3886		1153	726	0			0	5765
10	ROW	Result	509065										509065
		Change	-6189										-6189
11	TOTAL	Result	4083208	3574143	857040	807189	1434967	238748	158434	215218	385129	509065	
		Change	-6189	0	17871	10722	20847	6100	-2497	0	5765	-6189	

*Calculated by the authors.

in the economic system. I.e., the additional amount of labor remuneration received as a result of production modernization will be divided by the amount available to households – 8.2 billion rubles (cell 5.4[2]), extra-budgetary funds – 2.5 billion rubles (cell 8.4). A similar process will take place with additional profit, a part of which will be at the disposal of households – 12.6 billion rubles (cell 5.3), the other part – at the disposal of the public administration sector in the form of income tax – 1.3 billion rubles (total of cells 6.3 and 7.3). As a result of these changes, the total amount of disposable income of households will increase by 20.8 billion rubles (cell 5.11) and the volume of final consumption funded by households will increase by 18.4 billion rubles (cell 1.5). Regional budget revenues will increase by 6.1 billion rubles (cell 6.11), which will cause an increase in expenditures on final consumption financed regional authorities by 5.4 billion rubles (cell 1.6). At the same time, the volume of investments will increase – 5.7 billion rubles (cell 1.9).

The considered scenario assumes that gross output remains unchanged. This means that a decrease in intermediate product output caused by technological progress is replaced by output of final consumption product with the entire increase in consumption met at the expense of local production.

The authors consider another scenario as an example, in which the implementation of the import substitution policy related to technological changes is associated with the increased share of intermediate consumption in gross output.

For comparison: as in the previous scenario, suppose a 1% increase in the share of intermediate consumption in gross output – from 51.4% to 52.4%. The results of calculating changes and the transformed matrix are presented[3] in *Table 3*. The gross profit will be reduced by 14.3 billion rubles (cell 3.2), the total amount of wages – by 14.3 billion rubles (cell 4.2). These changes lead to the reduction in the total amount of disposable resources of household by 21.1 billion rubles (cell 5.12), of regional budget revenues – by 5.5 billion rubles (cell 6.12) and the volume of investment by 4.9 billion rubles (cell 1.9). The presented changes will lead to the reduction in the total final consumption by 23.5 billion rubles (total of cells 1.5 and 1.6).

This scenario, like the previous one, assumes that the value of total gross output remains unchanged. To maintain the total GVA at the same level with a 1% increase in the share of intermediate consumption in gross output gross output should be increased by 63.7 billion rubles. *Therefore, if the*

[2] Changes are calculated as difference between respective cells in Tables 1 and 2.

[3] Changes are calculated as difference between respective cells in Tables 1 and 3.

Table 3. CFM of the Sverdlovsk Oblast designed as a result of a 1% decrease in the share of value added in gross output, million rubles*

			1	2	3	4	5	6	7	8	9	10	11
			Goods and services	Industries	Capital	Labor	Households	Regional budget	Federal budget	Non-budget funds	Investment	ROW	TOTAL
1	Goods and services	Result		1872093			1230432	200115	93969	4742	374435	320968	
		Change		35741			-18605	-4851	0	0	-4929	0	7356
2	Industries	Result	3574143										
		Change	0										0
3	Capital	Result		824873									
		Change		-14297									-14297
4	Labor	Result		782170									
		Change		-14297									-14297
5	Households	Result			582582	599999				210476			
		Change			-10097	-10967				0			-21064
6	Regional budget	Result		35890	57490		85549		22365			25848	
		Change		-3217	-996		-1294		0			0	-5507
7	Federal budget	Result		59117	5436							99707	
		Change		-3932	-94							7356	3330
8	Non-budget funds	Result				182171			33046				
		Change				-3330			3330				0
9	Savings	Result			179365		77075	27027	14881			76087	
		Change			-3109		-1165	-655	0			0	-4929
10	ROW	Result	522609										
		Change	7356										7356
11	TOTAL	Result	4096752	3574143	824873	782170	1393056	227141	164261	215217	374435	522610	
		Change	7356	0	-14297	-14297	-21064	-5507	3330	0	-4929	7356	

*Calculated by the authors.

Table 4. CFM of the Sverdlovsk Oblast designed as a result of a 1% decrease in the share of inports in gross output, million rubles*

			1	2	3	4	5	6	7	8	9	10	11
			Goods and services	Industries	Capital	Labor	House-holds	Regional budget	Federal budget	Non-budget funds	Investment	ROW	TOTAL
1	Goods and services	Result		1857356			1261198	206695	93969	4742	382447	282991	4089397
		Change		21005			12161	1728	0	0	3083	-37977	0
2	Industries	Result	3615026										3615026
		Change	40883										40883
3	Capital	Result		848769									848769
		Change		9599									9599
4	Labor	Result		805579									805577
		Change		9110									9110
5	Households	Result			599458	617954				210476			1427888
		Change			6779	6988				0			13767
6	Regional budget	Result		39555	59155		87688		22365			25848	234610
		Change		447	669		846		0			0	1962
7	Federal budget	Result		63770	5594							89444	158809
		Change		721	63							-2907	-2122
8	Non-budget funds	Result				187623			27594				215217
		Change				2122			-2122				0
9	Savings	Result			184561		79002	27915	14881			76087	382447
		Change			2087		762	233	0			0	3083
10	ROW	Result	474370										473370
		Change	-40883										-40883
11	TOTAL	Result	4086490	3615026	848769	805577	1427888	234610	158809	215217	382447	474370	
		Change	0	40883	9599	9110	13767	1962	-2122	0	3083	-43800	

* Calculated by the authors.

implementation of the import substitution policy leads to an increase in the share of intermediate consumption thus ensuring the growth of gross output in the amount sufficient to preserve the value of gross value added in absolute terms at the same level, it can be considered cost-effective.

The implementation of the import substitution policy does not only lead to structural changes, but also affects the share of imports in the overall balance of goods and services of a territory. In 2014, in the Sverdlovsk Oblast the share of imports in the total volume of goods and services amounted to 12.6% (cell 10.1, table 1). To reduce this index by 1 percentage point – to 11.6% – it is necessary to replace 40.9 billion rubles of imported products by products of resident enterprises of the region. Let us consider this scenario. The results of structural changes and transformed CFM are represented in *Table 4.* An increase in gross output by 40.9 billion rubles will lead to creation of 19.8 billion rubles of value added (total of cells 3.2, 4.2, 6.2 and 7.2[4]) , including 9.6 billion rubles of income and 9.1 billion rubles of wages, 1.1 billion rubles of taxes . The change in the total value added leads to an increase in disposable income of institutional sectors. In particular, the disposable income of households will increase by 13.8 billion rubles (cell 5.11), the revenues of regional governments will increase by 2 billion rubles (cell 6.11), and investments – by 3.1 billion rubles (cell 9.11). The total increase in final demand in the economy of the territory will reach 13.9 billion rubles (total of cells 1.5 and 1.6).

It is obvious that import substitution requires that a certain amount of investment is ejected. It is necessary to invest in creation of new and expansion of the existing businesses, to train new staff. Transition of Russian enterprises to using domestic products will also require investment. In order to judge the benefits of import substitution, it is necessary to correctly assess the resources required for its implementation and the amount of potential benefits.

Changes in the CFM structure lead to changes in the value of CFM multipliers *(Table 5)*.

The decrease in the share of intermediate consumption in gross output (column 2) leads to the declining multipliers of gross output and production of resident enterprises of the region (lines 1 and 2), however, it results in the increase in the value of multipliers of gross value added in the form of profits and wages (lines 3 and 4). The opposite situation is observed if the share of intermediate consumption in gross output is increased (column 3). These changes result in the growing value of multipliers of aggregate demand and output of resident enterprises of

[4] Changes are calculated as difference between respective cells in Tables 1 and 4.

Table 5. Changes in multipliers of CFM gross output of the Sverdlovsk Oblast*

		Multiplier value			
		Actual 2014	At a 1% decrease in the share of IC in GO	At a 1% increase in the share of IC in GO	At a 1% decrease in the share of imports in product balance
		1	2	3	4
1	Goods and services	3.937	3.892	3.984	4.073
2	Industries	3.441	3.401	3.482	3.601
3	Capital	0.808	0.816	0.804	0.845
4	Labor	0.767	0.768	0.762	0.802
5	Households	1.159	1.165	1.152	1.213
6	Regional budget	0.165	0.169	0.162	0.173

*Calculated by the authors on the basis of Tables 1, 2, 3, 4.

the region (lines 1 and 2), but have a negative impact on the multipliers of value added – profits and wages (lines 3 and 4). The change in the ratio of value added and intermediate consumption also leads to changes in the multipliers of household income and the sector of public administration, although these changes are not significant (lines 5 and 6). The best result for the region's economy occurs amid reducing share of imports in product balance in the region. Table 5 demonstrates that the values of all multipliers in column 4 are higher compared to the initial ones in column 1. However, in this situation it is highly important to have a mechanism of reducing the share of imports – or a market competitive mechanism either by increasing the ratio of price and quality of local products, or by introducing administrative restrictive measures for the import of products, which in the long term may lead to reduction in competition, formation of product imbalance and rising prices.

For more detailed and accurate analysis of exogenous impacts of state modernization and import substitution programs on the socio-economic situation in the territory it is required to carry out additional research focused on CFM specification. Thus, depending on the research purpose, the emphasis should be put on different accounts. To analyze the impacts of technological progress on the region's economy it is reasonable to emphasize disaggregation of the first and second accounts – "Goods and services", "Industries". For this purpose, it is necessary to conduct extensive studies aimed at making current regional input-output tables for certain territories of the Russian Federation, which will help identify the cost structure, study the structure of income and expenses of population groups

with different financial status, as well as flows of interregional trade, migration and capital circulation. The authors note that these studies should be of a systematic character, which will help track the dynamics of processes and identify causal relations.

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