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Modeling the Investment Attractiveness of the Types of Economic Activities in the Region with the Use of the Matrix of Financial Flows*

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Abstract. The relevance of the work is due to the increased need to improve the efficiency of the state investment policy against the background of limited external sources for financing investment processes. The goal of the paper is to develop methodological tools for assessing the impact of changes in the volume of investments in fixed capital on the economic growth of the regions for the purpose of identifying the types of economic activities that have the greatest impact in terms of national economic development. The novelty of our approach consists in the fact that we integrate two tools for assessing investment effectiveness: the Cobb-Douglas production function, which is used to calculate the growth of gross output as a result of commissioning of fixed assets; and the balance model, which shows the movement of financial flows

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in the region (matrix of financial flows) and which is used to calculate direct and indirect economic effects arising from investment activities. We calculate and analyze sectoral production functions for four regions with different specialization and level of socio-economic development – the Sverdlovsk, Vologda, Chelyabinsk and Kurgan oblasts; we also calculate the marginal return on capital in 16 types of economic activity. We build matrices of financial flows for the regions under consideration for the year 2016, on the basis of which we calculate four groups of sectoral multipliers, reflecting the impact of the growth of gross output in individual industries on the aggregate growth of gross output (in the economy of the region as a whole), value added, household income and consolidated regional budget revenues. The paper shows that the cumulative effect manifested in growing GRP and tax revenues of the regional budget due to the growth of fixed capital, depending on the industry, may differ several times. Our study identifies statistical anomalies that indicate significant flaws in the data available; this fact prevents us from obtaining more accurate results. The approach we have developed and the results we have obtained can be used by the authorities to work out investment policy, taking into account the regional sectoral specifics of multiplicative economic effects.

Key words: investment attractiveness, region, investments, Cobb-Douglas production function, matrix of financial flows, multiplicative effect, investment policy.

Introduction

Investments are the basis of economic development of any state. That is why support and stimulation of investment activity is one of the priorities for all entities of the economy. However, nowadays, many Russian economists agree that investment sphere of the Russian Federation has many problems which interfere with achieving acceptable rates of economic development. First of all, it is lack of resources which are used for replenishment and expansion of the production base. From 2011 to 2016, a share of gross accumulation in gross output of the RF did not exceed 22% while there was a steady undulating outflow of capital. A.G. Aganbegyan notes that it is possible to provide average annual 2.5–3% economic growth rates with investment share into GDP at the level of 20–15%, just like it happens in the developed countries. For 5–6% economic growth rates, investment rates should remain at the level of 30–35%. If there is an objective to keep economic growth rates at the level of 7, 8% or above, it could be achieved with investment rates exceeding 40%. Currently, it happens in China and India just like in Japan, Southern Korea, and Taiwan in the periods of their accelerated development [1, p. 11-12].

The second important issue in the investment sphere is a structural imbalance. T.V. Uskova, after conducting analysis of investment processes in Russia, came to the conclusion that "the structure of investments in fixed capital is not optimal; the share of funds invested in agriculture, processing production, and construction is declining; the share of funds in machinery production, which determines the state of the country's production potential, is extremely low. Financing of the knowledge sector and industries aimed at the development of human capital is carried out as a residual" [2, p. 45]. It is possible to say that "the Russian economy is in the state of structural and technological disequilibrium which is characterized by inefficient distribution of production factors and financial resources which prevents formation of a steady economic dynamics" [3, p. 10]. In the same work it is

noted that the key component of economic policy is structural and investment policy, which implies "a set of measures, aimed at smoothing the imbalances of sectoral, technological and spatial nature, which complicate the interaction between the sectors of the economy, they are not eliminated by traditional market mechanisms and include a system of targeted actions to develop mechanisms for financing investment in fixed capital [3, p. 10]. Thus, one of the primary shortcomings of the current economic policy is the lack of a systematic and scientific approach to formation of investment strategy of economic development of the state and regions and improvement of the investment relations organization and management [4, p. 29]. The implementation of a systematic and science-based investment policy requires appropriate tools for predicting the results of the measures taken.

Methodological approach to assessment of investment attractiveness of economic activities' types in the regional system

Peculiarities of state's activity as a representative of social interests cause a number of important methodological features of the process of decision-making in investment sphere. Specifically, it is the need to take into account the set of emerging economic effects. The basics of this approach were stated by R. Musgrave [5], Williams [6] and other scientists. An important part of this concept is the division of benefits and costs into internal and external, depending on whether they arise within or outside the jurisdiction of project implementation. Many state programs, implemented on one territory, can have a certain impact on neighboring regions. The same situation is typical for specific firms and investment projects, the implementation of which can lead to the benefit of contractors (consumers of products, suppliers of raw materials and equipment, employees, etc.) and to the competitors' losses. During the implementation of a project by a private company, it can, in many cases, neglect external effects. However, during the implementation of public policy, such effects must be included in the assessment. The most important manifestations of external economic effects are so-called multiplicative effects. They mean the set of external, in relation to the implemented project, effects manifested in the intensification of activities in related types of economic activities (TEA). Multiplicative effects include increase of gross output, added value in related industries, and increase of household income and tax revenues into budgets of all levels.

In practice, to assess the impact of different factors on state economy, a variety of economic and mathematical models of general equilibrium model (GEM) are used. These models offer a formal apparatus for the analysis of the source of economy's fluctuations and also for studying macroeconomic policy. Significant progress in CGE (computable general equilibrium) models development stimulated higher demand from central banks of developed and developing countries, as well as from the largest international economic and financial institutes. As an example we can name the model of Bank of Canada (Terms-of-Trade Economic Model – ToTEM), The Federal Reserve System (SIGMA), The European Central Bank (New area – Wide Model (NAWM), and models of International Monetary Fund global economy (GEM and Global integrated monetary and fiscal GIMF). In Russia, such models are developed and used by the authorities (the Ministry of Finances and The Central Bank of the Russian Federation) and scientific organizations. In this sphere, we can point out the work of the research team under the leadership of academician

V.L. Makarov [7], as well as the work of A.V. Polbin [8] and others. The development of such models for certain districts poses a difficult practical task because of the absence of reliable statistics on several key indicators of economic cycle. First of all, correct data on interregional moving of goods and services is absent. Secondly, available statistical data does not display complex corporative networks which lead to statistical concentration of gross added value in places of head offices registration of the biggest Russian corporations. Thus, the construction of detailed models of certain regions of the Russian Federation is currently impossible. However, this does not undo the need of federal and regional authorities for adequate economic and mathematical tools that allow modeling the impact of individual measures of state policy in the field of investment on the dynamics of socio-economic development of certain entities of the Russian Federation.

For the study of economic processes at the regional level, models based on the balance method are widely used. The first such models appeared in the 1920s–1930s. Scientific works of V. Leont'ev, L.V. Kontorovich, R. Stone and other great scholars became widely known in this sphere. In the future, the modified model of inter-sectoral balance became the most widespread in foreign practice – Social Accounting Matrix (SAM), or, in other words, the matrix of financial flows. Despite the standard model of inter-sectoral balance in the matrix of financial flows (MFF), along with intermediate and final consumption and gross added value, transfer payments between institutional sectors (households, firms, and the state) are reviewed additionally, as well as distribution of factor payments within each sector. Basics of MFF usage as an effective instrument for studying the structure of economic system, peculiarities of the reproduction process, and the formation and distribution of multiplicative effects were described in the works by G. Pyatt, J. Round [9], J. Defourny, E. Thorbecke [10] and others. The example of modern methodology of SAM development and analysis is the work by P.L. Scandizzo, C. Ferrarese [11]. The balance approach toward economy of certain regions study is widely used by Russian scholars too. Models of separate regions were built [12; 13; 14; 15]: the Sverdlovsk, Kurgan, Chelyabinsk oblasts, the Republic of Buryatia, and the Khabarovsk Krai and others. On the basis of these models scholars develop methodological recommendations for assessing social efficiency of certain investment projects implementation. In this sphere we can mention the works by T.S. Novikova [16], N.N. Miheeva and V.I. Suslova [17], A.B. Kogan [18]. Moreover, in our previous paper we suggested the methodology for assessing the implementation efficiency of investment projects on the basis of the matrix of financial flows [19]. MFF of the Sverdlovsk Oblast was formed and it was used as a basis for calculations of gross output multipliers, GRP, revenue, household's income, tax revenues in the regional budget. Account of MFF "industry" was divided into 16 types of economic activity in accordance with OKVED classification, which gives the opportunity to analyze the results of investment project implementation in the sectoral context. It was mentioned that this approach is applicable only for assessment of a certain investment project with known investment amount and future production output. However, the state investment policy primarily consists of measures, which affect total amount of investments on the territory. Changes in the tax regime, as one of the key instruments of the state investment policy, are analyzed

in the works by E. Zwick, J. Mahon [20], C.L. House, M.D. Shapiro [21], R.E. Hall, D.W. Jorgenson [22]. Examples of such measures are changes of tax and monetary policy. The analysis of their impact on investment activity of enterprises is given in many works. The most widely used and accurate method of forecasting gross output is Cobb-Douglas production function. Theoretical, methodological and practical aspects of its construction and usage are thoroughly described in numerous scientific publications of Russian and foreign authors [23; 24; 25; 26; 27]. The construction of this function for a particular industry makes it possible to estimate how much the gross output of this area will change with an increase in the use of capital by one unit. In the future, the obtained information can be used to calculate the multiplicative effects using the matrix of financial flows and to set the total economic effect from investments in a particular TEA. Thus, the algorithm of assessing fixed capital increase impact on regions' economic growth rates consists of two stages:

1. Calculation of the amount of gross output growth caused by the increase of fixed capital volume. For this purpose, sectoral production functions, like Cobb-Douglas production function, are built, and also the marginal return of capital is calculated. The obtained value of the capital marginal return in the industry shows how much gross output will increase in this TEA with an increase of fixed capital by one ruble. Comparison of capital marginal returns across industries reveals sectors with relative capital excesses and deficits.

2. Calculation of direct and indirect economic effects of production output growth. The increase of gross output leads, first, to increase of added value and tax revenues in the analyzed industry. Secondly, it stimulates demand for products in related industries, which generates indirect economic effects (growth of added value and budget revenues with the growth of intermediate consumption).

The novelty of the author's approach is the integration of two tools of investment efficiency evaluation: Cobb-Douglas production function, which is used for calculation of the gross output growth as a result of fixed funds commissioning in certain types of economic activity and these investments' marginal returns, along with the balance model of the financial flows in the region (matrix of financial flows), used for the calculation of multiplicative effects emerging as the result of investment activities: direct – from the investments implementation, and indirect, which reflect increase of demand in related industries.

The suggested approach will allow assessing the efficiency of investments in a particular type of economic activity and determining the directions, attraction of investments in which will ensure higher rates of the whole regional system's economic growth.

Results of calculations

The selection of regions was based on conducted studies concerning the RF regional classification according to financial and economic sources of the development [28]. In accordance with previously obtained results, regions of the Russian Federation were divided into four groups: 1) financially sufficient regions; 2) financially stable regions, developing at the expense of their own internal financial and economic sources; 3) regions developing with attraction of significant external (budgetary and non-budgetary) investment sources; 4) regions developing primarily at the expense of external financial and economic sources. For more detailed analysis, one region from each group was chosen. Thus, objects of the research

were the Sverdlovsk, Vologda, Chelyabinsk, and Kurgan oblasts, which have a number of structural and socio-economic development level differences. In particular, selected regions have differences in sectoral GRP structure and the structure of investment into fixed capital. Moreover, they have a different level of sectoral fiscal return per one output ruble and added value, the level of budgetary security and self-sufficiency, the level of diversification of the economy, as well as the degree of involvement in the processes of interregional and international trade. All named peculiarities directly affect the size of multiplicative economic effects, and suggested for their assessment balance model in the form of MFF allows conducting the analysis taking into account these features.

Stage no. 1: construction of production functions and calculation of marginal return of capital.

2005–2016 data was used for calculations. Cobb-Douglas production functions were built on the basis of these calculations, which meet the requirements of constant return of scale, positive and decreasing production factors' marginal returns:

$$Q = A \times K^{\alpha} \times L^{\beta} \quad (1)$$

Q – amount of production output;

K – amount of capital investments (fixed funds, or fixed capital);

L – amount of labor resources, or labor costs;

A – coefficient reflecting the technological level of production;

α – elasticity coefficient for labor;

β – elasticity coefficient for capital.

It was experimentally revealed that, to achieve high reliability while constructing production functions, source data must be converted to a linear type using the procedure of a linearization (extraction of the natural logarithm over all variables in the model). As a result, the formula (1) was reduced to the classic two-factor linear regression equation. As an argument for the function, data on the average annual number of employees from individual economic activities, as well as data on the value of fixed assets, were taken. The peculiarity of the applied method of production functions calculation was the usage of data on the amount of the annual gross output of goods and services. It should be noted that in most works [24; 25; 26], the authors used the amount of the gross regional product as the dependent variable. After obtaining sectoral production functions, the values of marginal return of capital, showing the interconnection between the change of gross output in rubles and the change of the amount of fixed capital by 1 ruble, were calculated. Based on the purpose of the study, the calculation of the marginal return of labor was not carried out. The results are given in *Table 1.* The analysis of the obtained coefficients showed that regions have a significant inter-sectoral differentiation of values. So, in the Sverdlovsk Oblast the highest value of marginal productivity of capital (MPC) was found in the "Construction" sector (0.867), the lowest – in the "Transport and communication" sector (0.051); the Chelyabinsk Oblast – "Wholesale and retail trade" (0.966), "Processing productions" (0.085), respectively; the Kurgan Oblast – "Construction" (5.312), "Transport and communication" (0.053); the Vologda Oblast – "Construction" (3.733), "Production and distribution of electricity, gas, and water" (0.038). Besides, there are significant interregional differences in separate industries. Thus, the highest value of marginal return on capital in the agricultural sector is observed in the Kurgan Oblast (1.098). In the Sverdlovsk Oblast this value is 0.35, in the Chelyabinsk and Vologda oblasts – 0.19 and 0.185 respectively. Different MPC values in the same industries of different regions show the lack or excess of capital regarding other production factors.

Table 1. Cobb-Douglas production function for different types of economic activities in the RF entities

TEA*	Sverdlovsk Oblast		Vologda Oblast		Chelyabinsk Oblast		Kurgan Oblast	
	Production function	MPC**	Production function	MPC	Production function	MPC	Production function	MPC
I	$Y = K^{0.35} \times L^{0.65}$	0.352	$Y = K^{0.12} \times L^{0.86}$	0.185	$Y = K^{0.2} \times L^{0.81}$	0.190	$Y = K^{0.55} \times L^{0.47}$	1.098
II	$Y = K^{0.34} \times L^{0.46}$	0.098	$Y = K^{0.10} \times L^{0.91}$	0.572	$Y = K^{0.2} \times L^{0.81}$	0.975	$Y = K^{0.09} \times L^{0.8}$	0.309
III	$Y = K^{0.13} \times L^{0.94}$	0.158	$Y = K^{0.4} \times L^{0.52}$	0.235	$Y = K^{0.53} \times L^{0.49}$	0.308	$Y = K^{0.42} \times L^{0.63}$	0.172
IV	$Y = K^{0.34} \times L^{0.74}$	0.748	$Y = K^{0.11} \times L^{0.99}$	0.257	$Y = K^{0.039} \times L^{1.05}$	0.085	$Y = K^{0.42} \times L^{0.64}$	0.926
V	$Y = K^{0.23} \times L^{0.85}$	0.147	$Y = K^{0.1} \times L^{0.97}$	0.038	$Y = K^{0.26} \times L^{0.8}$	0.119	$Y = K^{0.25} \times L^{0.78}$	0.051
VI	$Y = K^{0.3} \times L^{0.77}$	0.867	$Y = K^{0.42} \times L^{0.70}$	3.733	$Y = K^{0.43} \times L^{0.98}$	0.283	$Y = K^{0.72} \times L^{0.45}$	5.312
VII	$Y = K^{0.14} \times L^{0.91}$	0.725	$Y = K^{0.30} \times L^{0.71}$	0.867	$Y = K^{0.27} \times L^{0.75}$	0.966	$Y = K^{0.05} \times L^{0.91}$	0.133
VIII	$Y = K^{0.33} \times L^{0.71}$	0.516	$Y = K^{0.19} \times L^{0.76}$	0.244	$Y = K^{0.24} \times L^{0.76}$	0.330	$Y = K^{1.03} \times L^{0.067}$	2.319
IX	$Y = K^{0.33} \times L^{0.67}$	0.051	$Y = K^{0.21} \times L^{0.81}$	0.036	$Y = K^{0.51} \times L^{0.48}$	0.213	$Y = K^{0.28} \times L^{0.71}$	0.056
X	$Y = K^{0.65} \times L^{0.23}$	0.152	$Y = K^{0.71} \times L^{0.2}$	0.299	$Y = K^{0.22} \times L^{0.64}$	0.046	$Y = K^{0.62} \times L^{0.21}$	0.132
XI	$Y = K^{0.54} \times L^{0.45}$	0.244	$Y = K^{0.27} \times L^{0.7}$	0.060	$Y = K^{0.36} \times L^{0.61}$	0.096	$Y = K^{0.68} \times L^{0.22}$	0.182
XII	$Y = K^{0.54} \times L^{0.45}$	0.327	$Y = K^{0.29} \times L^{0.69}$	0.185	$Y = K^{0.13} \times L^{0.87}$	0.088	$Y = K^{0.53} \times L^{0.47}$	0.747
XIII	$Y = K^{0.29} \times L^{0.66}$	0.212	$Y = K^{0.04} \times L^{0.84}$	0.023	$Y = K^{0.2} \times L^{0.72}$	0.106	$Y = K^{0.59} \times L^{0.36}$	0.486
XIV	$Y = K^{0.32} \times L^{0.69}$	0.471	$Y = K^{0.15} \times L^{0.82}$	0.205	$Y = K^{0.16} \times L^{0.82}$	0.185	$Y = K^{0.48} \times L^{0.50}$	0.565
XV	$Y = K^{0.68} \times L^{0.29}$	0.467	$Y = K^{0.2} \times L^{0.67}$	0.082	$Y = K^{0.67} \times L^{0.28}$	0.473	$Y = K^{0.58} \times L^{0.33}$	0.307

* Types of economic activity: I – agriculture, hunting and forestry; II – fishing, fish farming; III – minerals' extraction; IV – processing productions; V – production and distribution of electricity, gas and water; VI – construction; VII – wholesale and retail trade, repair; VIII – hotels and restaurants; IX – transport and communication; X – financial activity; XI – operations with real estate, rent, and provision of services; XII – public administration and military security, social insurance; XIII – education; XIV – health and social services provision; XV – provision of other public, social and personal services.
** Marginal productivity of capital.
Sources: initial data of territorial agencies of the Federal statistics service of Sverdlovsk, Vologda, Chelyabinsk, and Kurgan oblasts; own model calculations.

Stage no. 2: construction of matrices of financial flows of the region and calculation of matrices of multipliers. In our previous works, the theoretical, methodological and methodical issues of a matrix of regional financial flows constructions are analyzed in sufficient details.

In addition, the possibilities of disaggregating the accounts of "Sectors" and "Households" are presented. Earlier, we have already calculated aggregated MFF of the Chelyabinsk and Kurgan oblasts for 2012, and disaggregated MFF of the Sverdlovsk Oblast for 2015. In this paper, disaggregated matrices of financial flows of four regions (the Sverdlovsk, Chelyabinsk, Kurgan oblasts) for 2016 are formed, and first developed MFF of the Vologda Oblast for 2016 is presented (*Tab. 2*).

Table 2. Aggregated matrix of financial flows of the Vologda Oblast, 2016

		1	2	3	4	5	6	7	8	9	10	11
		Goods and services	Sectors	Capital	Labor	House-holds	Regional budget	Federal budget	Off-budget funds	Invest-ments	Export	Total
1	Goods and services		613,456			214,350	38,671	25,107	13,425	114,115	301,004	1,320,128
2	Sectors	1,099,667										1,099,667
3	Sectors		290,841				3,351					294,192
4	Labor		183,602									183,602
5	Households			38,830	141,851		15,127	559	64,861			261,228
6	Regional budget		3,013	22,691		29,711		11,806				67,221
7	Federal budget		8,755	3,245							65,808	77,808
8	Off-budget funds				41,751			36,535				78,286
9	Investments			77,401		17,167	5,386	3,801			10,360	114,115
10	Import	220,461		152,025			4,686					377,172
11	TOTAL	1,320,128	1,099,667	294,192	183,602	261,228	67,221	77,808	78,286	114,115	377,172	

Source: own compilation on the data from the Territorial agency of the Vologda Oblast Federal Statistics Service, the Federal Tax Service, and the Federal Treasury.

Table 3. Ratio of regional key sectors multipliers*

		Multipliers of			
		gross output	added value	households' income	regional budget revenues
Sverdlovsk Oblast	Max. value	2.837 (5)	1.664 (13)	1.299 (13)	0.234 (10)
	Min. value	2.312 (13)	1.364 (4)	1.067 (4)	0.133 (12.14)
	Ratio	22.7%	22.1%	21.7%	75.9%
Chelyabinsk Oblast	Max. value	3.341 (5)	1.782 (13)	1.384 (13)	0.244 (10)
	Min. value	2.551 (14)	1.676 (5)	1.303 (5)	0.147 (12)
	Ratio	31.0%	6.6%	6.2%	66.0%
Vologda Oblast	Max. value	1.933 (5)	1.328 (13)	0.967 (13)	0.146 (10)
	Min. value	1.356 (9)	1.076 (4)	0.684 (4)	0.087 (12)
	Ratio	42.6%	22.7%	41.4%	71.3%
Kurgan Oblast	Max. value	2.413 (5)	1.557 (13)	1.22 (13.7)	0.172 (10)
	Min. value	1.779 (13)	1.367 (5)	1.097 (5)	0.107 (12)
	Ratio	36.2%	14.0%	11.2%	60.7%

* The number of the relevant economic activity is given in parentheses.
Source: own calculations.

The structure of the matrices of financial flows, its variables, and the analysis of revealed interconnections are described in details in [12, pp. 22-39]. Further, the "Industry" account was disaggregated according to the types of economic activities, and the matrix of MFF multipliers was calculated. The methodology of matrix of MFF multipliers calculations and interpretation of obtained values are presented in our work [29]. The multipliers of gross output, added value, household's income, and the consolidated regional budget are all given in *Table 3*.

It is possible to say that in a certain region values of various MFF multipliers in different sectors are not that different. For example, in the Sverdlovsk Oblast, the multiplier of gross output in the processing industry is the most important (2.837), and the least important – in the education sector (2.312). Consequently, the first coefficient is 22% higher, which, with all assumptions, does not seem critical. The situation is similar for the multipliers of gross added value and households' income. Maximum difference is 22 and 21% respectively. The analysis of sectoral multipliers of revenues of the consolidated regional budget showed more significant differences. Here, the difference between the values in the health sector (0.133) and the financial services sector (0.234) is 76%. The results of the comparison of other studied regions are given in *Table 3*. Since the multiplier is a numerical coefficient showing the dependence of one parameter on another, this study will focus on the impact of product output growth on a number of macroeconomic indicators of the region, such as: gross added value, households' income, regional budget revenues, and total output. Obviously, provision of per unit output growth in different industries requires different amounts of capital investment, because the increase of fixed capital per unit in different industries causes a different gross output increase. In order to take this factor into account, it is necessary to adjust the obtained industry multipliers of the current values of the capital marginal returns in relevant industries. The results of the calculations are presented in *Table 4*.

The analysis revealed the types of economic activities which have the greatest impact on increase of fixed capital. In the Sverdlovsk Oblast they are construction, wholesale and retail sector (values of adjusted added value multipliers are 1.27 and 1.13, respectively). In the Chelyabinsk Oblast the biggest return is in the sphere of wholesale and retail. Moreover, the mining sector, the hotel and restaurant sector have significant returns. It should be noted that the sector of fishing and fish farming has the largest multiplier of GAV in the Chelyabinsk region (2.7). Despite the fact that this sector can hardly be the basis of the economic development for the region, it is possible to note its prospects as one of the directions of small and medium-sized businesses development. In the Vologda Oblast, the wholesale and retail trade sector has the highest multiplier (1.34). In the Kurgan Oblast, the agricultural sector (1.635) and the processing industry sector (1.29) have the highest returns. Also, the construction sector in the Vologda and the Kurgan oblasts, as well as the sector "hotels and restaurants" in the Kurgan Oblast, should be pointed out. These sectors' values of GAV multipliers turned out to be significantly higher than average values. It can be assumed that the reason of such strong deviation is the peculiarities of the statistical accounting of fixed assets and labor costs in these TEAs. However, this aspect requires further research.

The analysis of sectoral multipliers, adjusted for the amount of marginal returns of capital, shows a significant change of capital return in

Table 4. Matrix of regional sectoral multipliers of 2016

	Sectors	Marginal capital return	MFF multiplies				MFF multiplies with the marginal capital return			
			gross output	GAV	households' income	regional budget revenues	gross output	GAV	households' income	regional budget revenues
Sverdlovsk Oblast	I	0.352	2.677	1.484	1.160	0.149	0.942	0.522	0.408	0.052
	II	0.098	2.516	1.562	1.231	0.200	0.247	0.153	0.121	0.020
	III	0.158	2.693	1.439	1.133	0.175	0.426	0.227	0.179	0.028
	IV	0.748	2.837	1.364	1.067	0.139	2.122	1.02	0.798	0.104
	V	0.147	2.796	1.383	1.083	0.144	0.411	0.204	0.159	0.021
	VI	0.867	2.682	1.472	1.151	0.146	2.325	1.276	0.998	0.127
	VII	0.725	2.534	1.568	1.228	0.161	1.837	1.137	0.890	0.117
	VIII	0.516	2.700	1.462	1.144	0.153	1.393	0.754	0.590	0.079
	IX	0.051	2.609	1.516	1.188	0.160	0.133	0.077	0.061	0.008
	X	0.152	2.683	1.424	1.134	0.234	0.408	0.217	0.172	0.036
	XI	0.244	2.509	1.589	1.246	0.175	0.612	0.388	0.304	0.043
	XII	0.327	2.478	1.556	1.214	0.133	0.810	0.508	0.397	0.043
	XIII	0.212	2.312	1.664	1.299	0.142	0.490	0.352	0.275	0.030
	XIV	0.471	2.453	1.579	1.232	0.133	1.155	0.744	0.580	0.063
	XV	0.467	2.530	1.543	1.207	0.147	1.181	0.72	0.564	0.069
Chelyabinsk Oblast	I	0.190	2.946	1.746	1.354	0.172	0.560	0.331	0.257	0.033
	II	0.975	2.770	1.763	1.368	0.175	2.701	1.719	1.334	0.170
	III	0.308	2.926	1.722	1.346	0.205	0.901	0.53	0.414	0.063
	IV	0.085	3.237	1.696	1.317	0.170	0.275	0.145	0.112	0.014
	V	0.119	3.341	1.676	1.303	0.171	0.398	0.2	0.155	0.020
	VI	0.283	3.029	1.728	1.341	0.170	0.857	0.489	0.379	0.048
	VII	0.966	2.828	1.753	1.362	0.178	2.732	1.693	1.315	0.172
	VIII	0.330	3.032	1.726	1.342	0.180	1.001	0.57	0.443	0.059
	IX	0.213	2.726	1.768	1.374	0.181	0.581	0.376	0.293	0.039
	X	0.046	3.005	1.699	1.337	0.244	0.138	0.079	0.062	0.011
	XI	0.096	2.770	1.764	1.372	0.187	0.266	0.17	0.132	0.018
	XII	0.088	2.698	1.744	1.353	0.147	0.237	0.154	0.119	0.013
	XIII	0.106	2.387	1.782	1.384	0.156	0.253	0.189	0.147	0.017
	XIV	0.185	2.551	1.766	1.369	0.149	0.472	0.327	0.253	0.028
	XV	0.473	2.749	1.745	1.357	0.171	1.300	0.825	0.642	0.081
Vologda Oblast	I	0.185	1.774	1.13	0.733	0.094	0.328	0.209	0.136	0.017
	II	0.572	1.391	1.218	0.754	0.096	0.796	0.697	0.431	0.055
	III	0.235	1.750	1.146	0.766	0.112	0.411	0.27	0.180	0.026
	IV	0.257	1.916	1.076	0.684	0.093	0.492	0.276	0.176	0.024
	V	0.038	1.933	1.082	0.704	0.099	0.073	0.041	0.027	0.004
	VI	3.733	1.884	1.105	0.726	0.092	7.032	4.124	2.709	0.345
	VII	0.867	1.553	1.186	0.781	0.138	1.346	1.028	0.677	0.120
	VIII	0.244	1.814	1.13	0.751	0.102	0.443	0.275	0.183	0.025
	IX	0.036	1.356	1.222	0.751	0.101	0.049	0.044	0.027	0.004
	X	0.299	1.773	1.116	0.738	0.146	0.530	0.334	0.221	0.044
	XI	0.060	1.574	1.191	0.791	0.127	0.094	0.072	0.047	0.008
	XII	0.185	1.725	1.205	0.850	0.087	0.319	0.223	0.157	0.016
	XIII	0.023	1.394	1.328	0.967	0.105	0.032	0.03	0.022	0.002
	XIV	0.205	1.614	1.239	0.876	0.095	0.331	0.254	0.180	0.019
	XV	0.082	1.608	1.217	0.839	0.106	0.132	0.1	0.069	0.009
Kurgan Oblast	I	1.098	2.199	1.489	1.206	0.124	1.414	1.635	1.324	0.136
	II	0.309	2.207	1.463	1.186	0.142	0.682	0.453	0.366	0.044
	III	0.172	2.195	1.45	1.179	0.169	0.378	0.249	0.203	0.029
	IV	0.926	2.363	1.398	1.123	0.115	2.188	1.294	1.040	0.106
	V	0.051	2.413	1.367	1.097	0.119	0.123	0.07	0.056	0.006
	VI	5.312	2.285	1.426	1.145	0.119	2.136	7.575	6.082	0.634
	VII	0.133	2.057	1.513	1.220	0.139	0.274	0.201	0.162	0.018
	VIII	2.319	2.231	1.448	1.164	0.123	5.173	3.358	2.700	0.286
	IX	0.056	2.189	1.488	1.206	0.133	0.123	0.083	0.068	0.007
	X	0.132	2.255	1.418	1.154	0.172	0.298	0.187	0.152	0.023
	XI	0.182	2.137	1.483	1.194	0.134	0.389	0.27	0.217	0.024
	XII	0.747	1.858	1.534	1.204	0.107	1.388	1.145	0.899	0.080
	XIII	0.486	1.779	1.557	1.220	0.110	0.865	0.756	0.593	0.054
	XIV	0.565	1.931	1.508	1.186	0.108	1.091	0.852	0.670	0.061
	XV	0.307	2.076	1.486	1.187	0.125	0.637	0.457	0.364	0.038

Source: own compilation.

different sectors. Thus, in the Sverdlovsk Oblast, the multiplier of gross output in the sector "Construction" (2.325) has the highest value. The "Processing production" sector has a close multiplier (2.122). "The transport and communication" sector has a lowest value of gross output multiplier (0.133). Consequently, the difference of the multiplier value was more than 17 times. The results of calculations for the rest of the studied regions are given in *Table 5*.

The analysis showed that economic effect from fixed capital increase in different sectors, expressed in GRP growth and consolidated regional budget revenues, may significantly differ (sometimes in several times). Therefore, the federal and regional investment policy should be carried out taking into account these features. In accordance with the proposed approach, the total economic effect from investments in a particular TEA, expressed in gross added value, is calculated by the following formula:

$$\mathrm{Eff}_{\mathrm{sec}} = \mathrm{I} \times M_{\mathrm{GAV}} + V \times MP_k \times M_{\mathrm{GAV}} \quad (2)$$

in which $\mathrm{Eff}_{\mathrm{sec}}$ – overall economic effect in the sector;

I – amount of investments in the sector;

V – value of fixed capital increase in the sector;

MP_k – marginal capital return in the sector;

M_{GAV} – gross added value multiplier of the matrix of financial flows in the sector.

Taking into account the methodology improvement, the algorithm for calculating the overall economic effect from investments in a specific TEA looks like this:

1. Calculation of the amount of fixed capital increase in sectors.
2. Calculation of the multiplicative effect from investment demand in the economy of the region.
3. Calculation of the direct effect in the form of gross output growth in the region connected to increase of the fixed capital amount.
4. Calculation of the multiplicative effect from increase of products' gross output in the sector.
5. Calculation of the economic effect from investments in the sector conducted by summing the calculations' results in paragraphs 2, 3, and 4.

Table 5. Ratio of key multipliers of regional sectors with marginal capital return

		Multipliers			
		Gross output (GO)	Added value (AV)	Households' income (HI)	Regional budget revenues (RBR)
Sverdlovsk Oblast	Max. value	2.325 (6)	1.276 (6)	0.998 (6)	0.127 (9)
	Min. value	0.133 (9)	0.077 (9)	0.061 (9)	0.008 (9)
	Ratio	1648.1%	1557.1%	1536.1%	1487.5%
Chelyabinsk Oblast	Max. value	2.732 (7)	1.693 (7)	1.334 (2)	0.172 (7)
	Min. value	0.237 (12)	0.079 (10)	0.062 (10)	0.011 (10)
	Ratio	1052.7%	2043.0%	2051.6%	1463.6%
Vologda Oblast	Max. value	7.032 (6)	4.124 (6)	2.709 (6)	0.345 (6)
	Min. value	0.032 (13)	0.03(13)	0.022 (13)	0.004 (5)
	Ratio	21875.0%	13646.7%	12213.6%	8525.0%
Kurgan Oblast	Max. value	5.173 (8)	7.575 (6)	6.082 (6)	0.634 (6)
	Min. value	0.123 (5.9)	0.07 (5)	0.056 (5)	0.006 (5)
	Ratio	4105.7%	10721.4%	10760.7%	10466.7%

Source: own calculations.

Discussion and conclusions

The integration of production function significantly affected the calculations of multiplicative effects and allowed, in our opinion, more precise definition of sectors which have the highest return of fixed capital increase, taking into account direct and indirect economic effects. Data from Table 5 show that regions have high inter-sectoral differentiation of capital marginal return. Thus, in the Sverdlovsk Oblast, the value of this indicator varies from 0.051 in the "Transport and communication" sector to 0.857 in the "Construction" sector. As a result, the analysis of primary sectoral multipliers showed that the greatest return, in terms of aggregate demand, might be brought by investments in processing production (multiplier 2.682) and, after their adjustment and calculation of the whole effect, investments in construction (total multiplier 5.007). The matrix of inter-sectoral regional multipliers lets federal authorities to compare the efficiency of investments into the same sphere in different regions and, by that, better redistribute budget funds for regional development better.

The author's methodological approach and tools might be used by the federal and regional authorities for rapid analysis of specific investment projects and state measures to stimulate investment. They give the opportunity to improve the efficiency of management decisions in determining industry trends and subsequent implementation of investment policy.

However, the obtained results can not be called definitive, because the calculations revealed significant anomalies caused by imperfections of the statistical accounting of several important regional indicators. The most striking example of this anomaly is the accounting of fixed assets in the sectors "Construction" and "Transport and communications" in the Kurgan and Vologda oblasts. As a result, we obtained extremely high values of marginal capital return in these industries, which, obviously, require additional research. The actions of the authorities can have a significant impact on the relative excess or shortage of production factors.

The analysis of the "Financial services and insurance" sector also needs to be clarified. This is caused by two factors. First of all, the specifics of the financial sector functioning, which do not require a high provision of physical capital which is the basis of the fixed funds growth rate, used to build the sectoral production function. Second, the high concentration of financial capital in Moscow. Additional examination of economic sectors which are related to the sphere of services, such as trade, medicine, education, etc., is required.

Improvement of the methodology of building regional MFFs, as well as gathering of additional statistical data about individual activities, will increase the accuracy and reliability of the effectiveness assessment of public investment policy measures, which ultimately will enhance the efficiency of social resources usage and significantly improve the quality of life and the level of national welfare.

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