SOCIO-ECONOMIC DEVELOPMENT STRATEGY

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About the Role of Input-Output Balance in Government Regulation of the Economy*
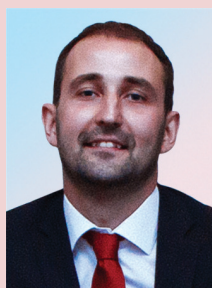
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Abstract. March 30, 2017, a notable event took place in Russia: the Federal State Statistics Service (Rosstat) published the basic input-output balance (IOB) for the national economy for 2011 and the tables that show the resources and utilization of products for 2012–2014. Economists have been waiting for this event for more than 20 years. The latest IOB was made in 1995. The present paper summarizes theoretical foundations of input-output balance and basic methodological approaches to its construction. It is shown that input-output balance is the basis for government regulation of the economy in industrialized countries. The paper evaluates the situation with the availability of necessary statistical information to build the "input – output" tables for the Russian economy. The author highlights possible areas, in which input-output balance can be used in government regulation of the economy. It is proved that input-output balance contains all the main macroeconomic indicators of the country (region) in its sectoral and national economic context. It is established that IOB is an important analytical tool for the study of inter-industrial interaction in the economy, for carrying out structural analysis of a wide range of indicators (structure of production, formation of resources, purchasers' prices, intermediate consumption, use of goods and services, value added, and others). It helps analyze

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exchange of the products in current production (intermediate) consumption and the products that enter final consumption. In addition to the study of the structure of the economy, input-output balance provides an opportunity to calculate important economic and sectoral proportions. On the basis of IOB it is also possible to calculate cost-effectiveness ratios in individual industries and the whole national economy. These ratios include labor productivity, capital productivity, and return on assets ratio. Relevant practical examples are provided for all the directions considered. It is shown that variants and forecast calculations are a significant part of interdisciplinary research. Input-output models help carry out variants calculations of the state of the economy taking into consideration changes in both personal and social needs, and in production capabilities. The author presents the results of variants calculations of economic development with the use of IOB of Russian and foreign researchers. The paper substantiates the main difference between forecast and variants calculations, which consists in using dynamic matrices of direct costs ratios. The paper classifies basic methods of forecasting direct costs ratios, summarizes the types of inter-sectoral socio-economic forecasts (demographic, social and environmental forecasts, forecasts of dynamics and structure of production, development of specific sectors, natural resources, etc.). It is concluded that the use of analytical and forecasting opportunities of input-output balances provides a strong basis for government regulation of the economy.

Key words: input-output balance, government regulation of the economy, analysis, modeling, forecasting.

One of the fundamental problems of the Russian economy is found in its weak and ineffective system for managing socio-economic processes, which results in a low level of socio-economic development and in Russia's lagging behind foreign countries in terms of competitiveness, innovative activity and people's well-being.

Modern economy is characterized by a complex industrial structure. The All-Russia Classifier of Types of Economic Activity OK 029-2014 (OKVED 2), which is in effect as of February 1, 2014, contains more than 2600 groups [18]. The sectors actively interact with each other, carrying out production and distribution of goods using fixed assets and labor force; and the redistribution of incomes takes place.

Consideration of these processes is of great importance for the development of management actions. Regulation of the economy should be based on a methodology that allows us to look inside this "black box" and explore its internal structure. In order to analyze major inter-industry connections, structural changes and proportions in the economy, to assess the effect of implementation of control actions and their effectiveness, and to identify drivers and conditions of development, it is advisable to use input-output models.

The aim of the study is to systematize various trends in the use of input-output models in government regulation of the economy. With the use of fundamental works of domestic and foreign scientists, we solved the following problems: we generalized theoretical and methodological foundations for constructing input-output models and disclosed their structure. In this case we studied the experience of designing input-output tables and the evolution of their use in different countries.

An input-output model (input-output tables) is a set of interrelated economic indicators, characterizing in detail the production and use of goods and services and the income earned in the production process broken down by detailed types of economic activity, products and services [15].

An input-output model contains three quadrants *(Fig. 1)*. The first quadrant that includes intermediate consumption shows the value of all goods and market services consumed in a production order. The second quadrant presents the final use of goods and services, gross accumulation and exports of goods and services. The third quadrant contains the cost structure of gross value added (GVA). Important cost components of GVA (in rows) are the remuneration of employees, gross profit, gross mixed income, production-related taxes and subsidies, consumption of fixed capital, taxes and subsidies on products.

Figure 1. An input-output model

Sectors and GVA			Intermediate demand								Final demand		
			Consumer sectors								Final consumption	Accumulation	Net export
			1	2	3	4	5	6	7	8			
Producer sectors	Agriculture	1	I quadrant								II quadrant		
	Mining	2											
	Industry	3											
	Construction	4											
	Trade	5											
	Transport and communications	6											
	Services	7											
	Other	8											
GVA	Wages and salaries		III quadrant										
	Entrepreneurship profit												
	Taxes												

Source: compiled by the author with the use of [14].

Theoretical basis of input-output models was developed by W.W. Leontief. In the 1930s, he successfully implemented this method in designing the first input-output tables for the U.S. for 1919 and 1929 for 44 economic sectors [21]. By the mid-1950s, W. Leontief's ideas have gained worldwide recognition, and input-output tables were developed for the United States, France, the Netherlands, Norway, and Australia.

In domestic practice the method was first implemented in a full-scale input-output model of production and distribution of products in the national economy of the USSR for 1959. Basic input-output models (i.e. those formed on the basis of direct surveys of production and consumption) were developed further on a regular basis every five years: in 1966, 1972, 1977, 1982, and 1987.

Currently, the role of the input-output methodology that represents a powerful tool for quantitative analysis of linkages in the real economy has long been recognized in most countries of the world [42]. Development of input-output tables became part of the regular work at statistical agencies in the countries that wish to pursue meaningful industrial and regional policy [13]. Assessments of input-output tables performed at formal and informal levels with different frequency and different quality are available for 94 out of the 193 countries in the UN [44]. Moreover, state statistics agencies of the top 20 countries (which account for about 80% of world GDP) produce these tables on a regular basis. In developed countries, input-output tables were built into the system of national accounts long ago (since 1968 in accordance with the recommendations of the UN manual of national accounting SNA-68; *Tab. 1*). For example, in the U.S. yearly input-output tables for 71 types of commodities for 1947—2015 are on the open Internet on the website of the Bureau of Economic Analysis (2007 available as a base table for 389 products). The development of such tables is a necessary element of the statistical base for EU member states. These tables are developed in Japan, China, Canada, and several other countries (including Ukraine, Belarus and Kazakhstan). In order to implement major research tasks (assessment of the prevalence of technology, carbon dioxide emissions, global chains of creation of value added) database of input-output tables are created by international organizations (WIOD, OECD, GTAP) as well.

In Russia, the latest input-output tables published by Rosstat date back to 2003. Their data are aggregated into 24 types of goods (the industry is represented by 13 types). However, despite such a high degree of aggregation, the tables give information about major proportions of production and consumption in the Russian economy that are consistent with the system of national accounts. However, after 2006 even these aggregated input-output tables ceased to be constructed.

Table 1. Developers of input-output tables

Country	Institute/organization	Accessible archive	URL
Germany	Federal Statistical Office	1999–2015	https://www.destatis.de/EN/Publications/Specialized/Nationalaccounts/NationalAccounts.html
France	France's National Institute for Statistics and Economic Studies	2005, 2010	http://www.bdm.insee.fr/bdm2/choixTheme?code=1#arbo:montrerbranches=theme1/theme2/theme145/theme343
UK	Office for National Statistics	1997–2014	http://www.ons.gov.uk/ons/taxonomy/index.html?nscl=Supply+and+Use+Tables#tab-data-tables
Canada	Statistics Canada	1980–2015	http://www5.statcan.gc.ca/subject-sujet/result-resultat?pid=3764&id=2745&lang=eng&type=ARRAY&sortType=1&pageNum=1&more=0
U.S.	Bureau of Economic Analysis	1947–2015	http://bea.gov/industry/io_annual.htm
Japan	Statistics Bureau	1990, 1995, 2000, 2005, 2011	http://www.soumu.go.jp/english/dgpp_ss/data/io/io05.htm
European Union	Eurostat	1990–2015	http://ec.europa.eu/eurostat/data/database
Russia	Federal State Statistics Service	1998–2003, 2011–2014	http://www.gks.ru/wps/wcm/connect/rosstat_main/rosstat/ru/statistics/publications/catalog/doc_1135086739625
	Institute of Economic Forecasting, RAS	1980–2013	http://macroforecast.ru/statistics.html
International organizations	World Input-Output Database (WIOD)	2000–2014	http://www.wiod.org/new_site/database/niots.htm
	Organization for Economic Co-operation and Development (OECD)	1995–2011	http://www.oecd.org/trade/input-outputtables.htm
	Global Trade Analysis Project (GTAP)	1993–2015	https://www.gtap.agecon.purdue.edu/databases/default.asp

This fact forced research organizations (RAS Institute of Economic Forecasting, the Institute of Economics and Industrial Engineering of the Siberian Branch of RAS, the Institute for Macroeconomic Research, etc.) to carry out experimental estimation of input-output tables. The results of such assessments can be quite different; however, they can be neither confirmed nor refuted [15]. The real picture of the internal structure of an economy, including the clarification of parameters of non-observed economic activities by its types, can be done only with the help of designing basic input-output tables according to a comprehensive pattern on the basis of a large-scale survey of the Russian economy.

14 February, 2009, the Resolution of the RF Government No. 201-r, which ordered the Federal State Statistics Service (Rosstat) "for the purpose of forming official statistical information about the inter-sectoral linkages and structural proportions of economy of the Russian Federation, as well as improving the quality of statistical and predictive calculations of macroeconomic indicators" to

develop basic input-output tables for 2011 and to submit them in 2015 to the Government of the Russian Federation, as well as to develop basic input-output tables on a regular basis once every five years [17]. In pursuance of this resolution Rosstat organized a survey of costs in the Russian economy and developed basic input-output tables for 2011. At the end of March 2017, the materials were published in the public domain. The development of the next basic input-output tables for 2016 was launched last year. It can be argued that the work on regular creation of Russian input-output tables has been streamlined after the difficulties of the 1990s. The scientific community and public authorities have obtained a reliable source of information for a wide range of interdisciplinary studies.

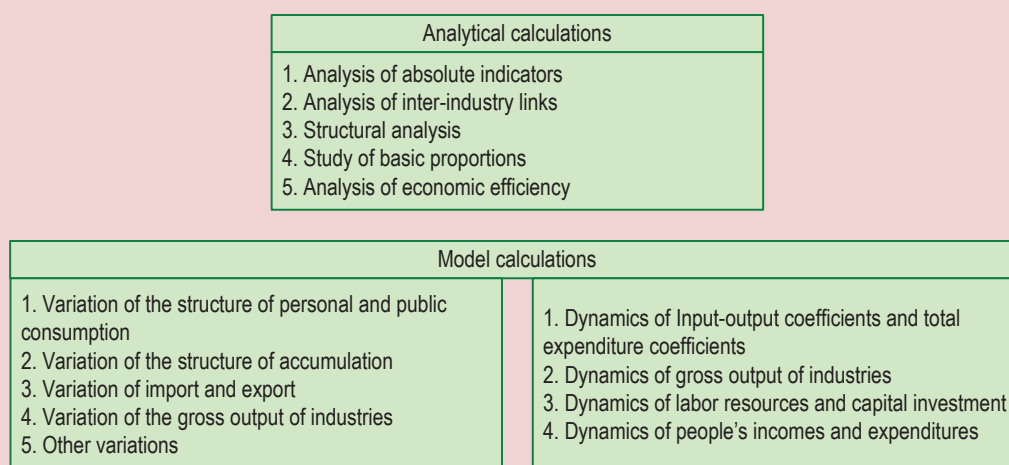Practical application of input-output tables is considered in the works of many domestic and foreign scientists such as W.W. Leontief, E.F. Baranov, A.G. Granberg, M.N. Uzyakov, Yu.V. Yaremenko, V.S. Nem-chinov, A.G. Aganbegyan, V.S. Dadayan, V.V. Kossov, M.Ya. Lemeshev, L.I. Danchenko, V.L. Ven, E.B. Ershov, V.Ya. Lumel'skii, I.N. Rabinovich, L.A. Khiatser, B.A. Shchen-nikov, A.I. Erlikh and others, as well as foreign economists, such as A. Ghosh, N. Rasmussen, R. Stone, V.D. Fischer, M. Holzmann, K. Masaaki, Y. Morimoto, H. Neudecker, V. Strnad, H. Tail, M. Hatanaka, I. Yamada, etc.

The entire range of application of input-output models in economic research can be grouped into two blocs: analytical and model (contingency and forecast) calculations *(Fig. 2)*.

Analytical calculations

An input-output table presents all key *macroeconomic indicators* (including those broken down by economic activities and institutional sectors):

Figure 2. Areas of application of input-output models

Analytical calculations

1. Analysis of absolute indicators
2. Analysis of inter-industry links
3. Structural analysis
4. Study of basic proportions
5. Analysis of economic efficiency

Model calculations

1. Variation of the structure of personal and public consumption
2. Variation of the structure of accumulation
3. Variation of import and export
4. Variation of the gross output of industries
5. Other variations

1. Dynamics of Input-output coefficients and total expenditure coefficients
2. Dynamics of gross output of industries
3. Dynamics of labor resources and capital investment
4. Dynamics of people's incomes and expenditures

– gross output;

– intermediate consumption;

– gross value added;

– final consumption (households and government);

– gross accumulation;

– change of inventories;

– import and export;

– payroll;

– gross profit and gross mixed income;

– taxes (VAT, excise duties, customs duties and others), etc.

Analysis of these indicators is of great practical importance and is widely used in economic research [4, 9, 11, 12, 19, 34, 36, 47, 48, 50, 51, 53]. On the basis of these indicators it is possible to conduct dynamic and interregional comparisons and different calculations of relative indicators.

Input-output models are an important analytical tool for *the study of inter-industrial interaction in the economy*. It helps analyze the exchange of goods in current production (intermediate) consumption (quadrant 1) and goods coming in final consumption (quadrant 2).

The analysis is carried out on the basis of input-output coefficients[1] and total expenditure coefficients[2], which characterize the structure of material costs by individual

sectors. The more intense relationships in the economy, the higher is the value of total costs, i.e., additional output induced with the help of inter-sectoral linkages. For example, the direct costs of production of 1,000 rubles of ferrous metals are 671 rubles, the total costs, taking into account the inter-industry interactions, are equal to 1,447 rubles.

The analysis of inter-industry relations is reflected in the works of many researchers. For example, J. Richter assesses the impact of the growth of tourist expenditures on the economy of Austria [54]; L. Beiriz considers the dependence of scientific research expenditures from the volume of foreign trade in automobiles and pharmaceutical products with major trading partners – the U.S. and China [24].

Input-output models also help carry out *structural analysis* on a wide range of economic indicators, such as:

– production structure in economic sectors;

– structure of formation of resources of goods and services;

– structure of purchasers' prices by type of goods and services;

– goods structure of intermediate consumption;

– industry structure of the intermediate demand (including that broken down by domestic and imported goods and services);

– structure of the use of goods and services (including that broken down by domestic and imported goods and services);

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[1] Input-output coefficients are industry indicators that express the immediate cost of production of one industry to produce goods in another industry.

[2] Total expenditure coefficients are economic indicators that characterize both direct and indirect costs of one economic sector to produce products of another economic sector, i.e. that take into account economic turnover of raw materials throughout the entire chain of technological links.

— functional structure of the final demand (including that broken down by domestic and imported goods and services);

— product structure of functional elements of the final demand (including that broken down by domestic and imported goods and services);

— element-by-element structure of value added by economic sectors;

— sectoral structure of the elements of added value;

— cost structure of domestic and imported goods and services.

Examples of structural analysis with the use of input-output models can be found in the works of many researchers. For example, the works of R. Paniccia devoted to the structural analysis of the Italian economy at the regional level [23], the works of D. Nyhus on analyzing structural changes in the system of reproduction, energy intensity and environmental damage for the Chinese economy [27], and the works of A. Shirov on the problems of structural changes in the national economy of Russia [37].

In addition to the study of the structure of the economy, input-output models give an opportunity to calculate important *economic and sectoral proportions (Tab. 2)*.

On the basis of input-output models it is possible to calculate *economic effectiveness* ratios such as labor productivity, capital productivity, and profitability for individual industries and for the whole national economic complex *(Tab. 3)*.

Examples of assessing economic efficiency on the basis of input-output models can be found in the works of L. Safiullina (assessment of competitiveness of Russian regions [22]), M. Grassini (evaluation of the effectiveness of the Italian economy and its individual sectors [45]).

Table 2. Indicators of national economic and sectoral proportions

Characteristic of the indicator	Calculation formula
Ratio of production consumed to production produced	R/X
Ratio of resources to production output	N/X
Ratio of resources to consumption	R/N
Proportion of import in aggregate internal consumption	I/R
Proportion of local production in ensuring the consumption of products	(R – I)/R
Proportion of export in total production	W/X
Proportion of export in the total amount of resources	W/N
Proportion of value added in gross output	M/X
Proportion of material costs in the prime cost of goods	C/(C + V + A)
Proportion of amortization in the prime cost of goods	A/(C + V + A)
Proportion of labor remuneration in the prime cost of goods	V/(C + V + A)
Explanation: X – gross output; Y – volume of final product produced; W – export volume; I – import volume; R – consumption volume (R = X – W + I); N – amount of resources (N = X + I); C – material expenses; A – capital consumption (amortization); V – payroll; M – gross value added; S –accumulation fund.	

Table 3. Indicators characterizing the efficiency of the national economy and individual sectors

Characteristic of the indicator	Calculation formula
Material costs per ruble of gross output, rub.	C/X
Labor productivity, rub./person:	
– by gross output	X/L
– by product produced	(Y – A)/L
Yield of capital investments, rub./rub.:	
– by gross output	X/F
– by product produced	(Y – A)/F
Profitability, %:	
– by self cost	M/(C + V)·100%
– by the average annual value of fixed assets	M/F·100%
– by the sum of the values of the consumed capital and labor	M/(A + V)·100%
Explanation: L – number of people employed in economic sectors; F – average annual value of fixed assets; M – profit.	

Figure 3. Dynamics of the value added multiplier in the economy of the Russian Federation and the U.S.
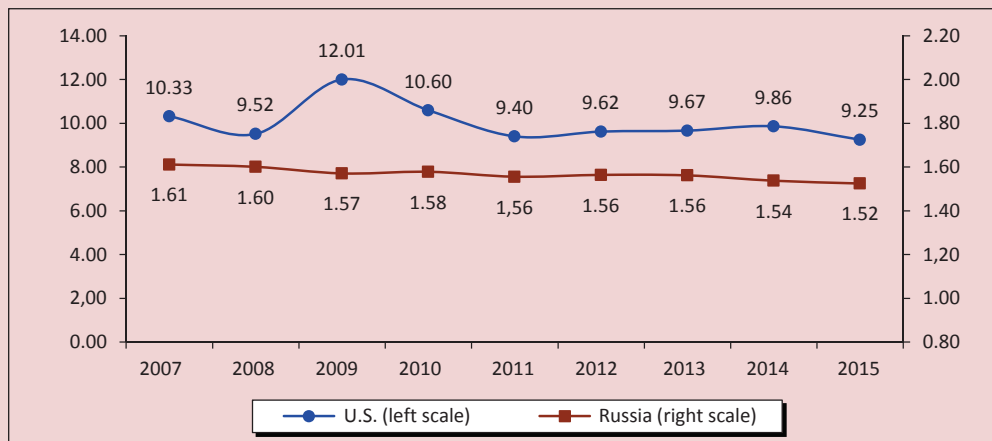
Source: calculated by the author with the use of [16, 46].

We used the input-output methodology to calculate the value added multiplier[3], an indicator of the adaptability of the economy and the degree of processing of natural resources *(Fig. 3)* [11, 12]. In addition, this methodology is the basis for designing vertical integration of enterprises — a key tool to increasethe value added multiplier in the economy.

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[3]   This indicator is calculated by the ratio of total value of commodity weight to the cost of primary raw material resources involved in economic turnover and is calculated according to official data on the detailed development of production account of the SNA.

The analytical possibilities offered by input-output models led to their extensive use in the practice of economic analysis. A fundamental monograph on input-output models by R.E. Miller and P.D. Blair [49] notes that at present, input-output analysis is one of the methods most widely used in economics. It helps analyze absolute indicators of inter-industry linkages, structure and basic proportions of the economy and its economic efficiency.

Model calculations

Input-output tables can be easily turned into an economic-mathematical model. The model is based on the following basic input-output equation:

$$x = Ax + y, \qquad (1)$$

where x stands for the "vector of gross output"; A — for the "matrix of coefficients of direct costs; y — for the "vector of the final product".

The simulation uses the following equation:

$$(E - A)^{-1} \cdot y = x, \qquad (2)$$

where E is the identity matrix; $(E - A)^{-1}$ is the matrix of coefficients of the total cost.

The use of input-output models even in their simplest forms allows us to perform variations calculations of the state of the economy and take into account its changes in both personal and social needs, and production capabilities. That is, with the help of this model it is possible to use two hypotheses of economic development

options. The first one consists on the fact that the final product (final demand) is a driver of development of economic sectors (what happens to the economy, if final demand is changed). The second (opposite) hypothesis implies that the dynamics of production within an industry determines the growth of the final product (what will happen to the economy if the volume of production of goods and services is changed). The model calculations are focused on the achievement of certain final results in the production (increase or decrease in the volume of production) and social (improved standard of living) spheres. Of course, more complex models are used in practice, but their meaning remains the same — they help interconnect a variety of economic indicators.

If the tables contain an additional row that characterizes the cost of labor per unit of output by individual goods, then it is possible to calculate the total need for labor, which occurs when the final demand for certain types of products increases, considering not only direct costs but also indirect costs induced in related industries [15]. No less importance is attached to an opposite task to determine the extent of reduction in the aggregate demand for labor resources if demand for a particular product reduces given the decline in demand for products of related industries and, consequently, reduction in the manpower requirements. This kind of analysis is in demand when assessing the extent of unemployment that may occur, for example,

in a crisis or when major changes take place in the structure of production that requires reallocation of labor from some industries to others [15].

The works on the development of methodology and practical application of inter-industry simulation have a long history. The principles of input-output models, as we have already noted, were developed in the first half of the 20th century by W.W. Leontief; however, the practical use of input-output models began later. This is largely due to the extensive amount of calculations that are necessary to perform in order to build a forecast and high requirements to the completeness and quality of statistical data.

A great contribution to the development of input-output models was made by Soviet scientists. In the 1960s–1980s in the Soviet Union there was an upsurge in the development of input-output models. A lot of works on static and dynamic input-output models were published by A.G. Granberg [3] and E.B. Ershov [6]. During this period, F.N. Klotsvog, N.F. Shatilov, V.V. Kossov, Ya.M. Urinson, E.F. Baranov, Yu.V. Yaremenko, and others created their models. Currently, input-output models are developed at the Institute of Macroeconomic Research (L.A. Strizhkova), at RAS Institute of Economic Forecasting (M.N. Uzyakov, N.V. Suvorov, A.R. Belousov, etc.), at the Institute of Economics and Industrial Engineering, Siberian Branch of RAS (V.I. Suslov, B.V. Melent'ev, Yu.S. Yershov, and others), at the

Council for the Study of Productive Forces, at the Institute for System Studies of RAS, at RAS Energy Research Institute (D.V. Shapot), and a number of regional institutes *(Tab. 4)*.

Variants calculations play an important part in the use of input-output models. Researchers consider various options for economic development in the implementation of certain scenarios – from assessing the effects of changes in the rates of social contributions to the country's withdrawal from the Eurozone *(Tab. 5)*.

We developed an inter-industry model of the economy that allows us, in addition to the analysis of key indicators and basic proportions in the economy, to carry out variants calculations of changes in the output of goods and services, the number of employees (by occupations), and the volume of payroll by industry and the whole economy under the reduction or increase in final demand for the products [11, 12]. The model allows us to see what will happen to the economy if demand increases in one of the sectors (e.g. in agriculture due to food import restrictions as a result of reciprocal sanctions). The model also shows the extent to which the output in individual industries and in the economy on the whole increases, the extent to which it will be necessary to increase the number of employees (broken down by professions, i.e. how many managers, workers, lawyers etc. will be required for this) and the payroll fund.

Table 4. Input-output models of development of the Russian economy

Developer	Model	Essence
Center for Macroeconomic Analysis And Short-term Forecasting	Model for long-term development of Russia's economy	Short-, medium-, and long-term analysis of the economic situation and scenario forecasting of economic dynamics of Russia
E.B. Ershov and Yu.V. Yaremenko	Model for inter-industry interactions [40]	Forecasting the structure of production – material inter-industry proportions
Institute for Macroeconomic Studies	Tools of input-output models [32]	The core of the tools used in the implementation of scenario and forecast calculations is a system of input-output models (static and dynamic input-output models of price; price model based on input-output tables; natural cost input-output model) and cross-sectoral model of financial flows that helps more fully consider the openness of a market economy and forecast VRD assessments
RAS Institute of Economic Forecasting	Macroeconomic input-output model of the Russian economy RIM [30]	Analysis and forecast of development of the Russian economy from the point of view of its structure. The model consists of three blocks: the block of production and distribution of products, the block of prices and revenues, and the block of estimated parameters. Production is simulated for 25 economic sectors (including 15 industrial branches). Import is also allocated in the composition of resources. Components of final use are as follows: household consumption, government agencies and nonprofit organizations, gross investment in fixed capital, change in inventories, and export
Institute of Economics and Industrial Engineering, Siberian Branch of the Russian Academy of Sciences	Optimization interregional inter-industry models SIRENA and SIRENA-2 [35]	Study of the influence of territorial factors on the trend of development of the national economy, study of the concept of development and location of productive forces, assessment of the possibilities and consequences of the convergence of regional levels of economic development and welfare

The main point in which forecast calculations differ from variants calculations is the use of dynamic matrices of coefficients of direct costs by the former. The problem of their analyzing and forecasting at present is successfully solved with the help of a sufficiently large number of techniques [1, 10, 31, 33, 39, 43, 52]:

– simple and poorly formalized methods (extrapolation, expert reviews, method of applying matrices, analysis of variance, etc.);

– technology and economic methods (methods of technological and merchandizing shifts, regulatory method, correlation, regression and factor analysis);

– formalized economic and mathematical methods: analysis of time series (smoothing methods, autoregression, finite difference equations), methods for studying dependencies, linear programming method, RAS method, and others.

The system of inter-industry socio-economic forecasts includes demographic, social and environmental forecasts, forecasts of dynamics and structure of production, development of sectors, development of natural resources, etc. *(Tab. 6).*

A promising direction in the use of input-output models is to analyze the effects of economic decisions: evaluation of investment

Table 5. Examples of calculations of economic development with the use of input-output models

Author	Variants calculations
V. Potapenko	Studying the options for development of the pension system in Russia [38]. Assessment of the impact of changes in the rates of social contributions [20]
A. Yantovskii	Studying economic effects for Russia, Belarus, Kazakhstan and Ukraine in the creation of the Single economic space [8]
N. Suslov	Assessment of the macroeconomic effects of the implementation of major investment projects in the energy sector and the impact of changes in the technologies of energy consumption or changes in external economic conditions in the energy markets through the use of the interregional input-output model of the Russian economy [34]
V. Gil'mundinov	Assessment of the impact of inflation targeting in the modern Russian conditions [2, 41]
K.Veib	Modeling technological change in the sector of renewable energy production (solar energy, wind energy, energy produced by burning biomass, hydro and geothermal energy) [24]
D. Mullins	Analyzing the functioning of the gasoline production sector in South Africa and determining the optimal level of gasoline consumption for sustainable economic growth in the absence of its own energy resources and strong dependence of domestic prices on world markets [22]
M. Plikh	Modelling economic dynamics in the implementation of the project for extraction of shale gas in Poland [26]
D. Mead	Study of the macroeconomic consequences of expanding gas production in the U.S. [27]
R. Horst	Studying the dynamics of economic activity and employment in the whole economy and for individual states in terms of reducing military expenditure of the U.S. budget [27]
R. Bardacci	Assessing the impact of Italy's exit from the Eurozone [25]
U. Lekhr	Measuring and modelling the energy efficiency in the economy and assessing the impact of its decline on economic dynamics [24]
A. Ozina–Emsina and V. Ozolin	Evaluation of changes in the structure of foreign trade and relevant industry developments in Latvia and other Baltic States in the period of economic growth 2004–2007 associated with the accession to the European Union, and in the period of recession (2008–2010) [22]

Table 6. Examples of forecast calculations of economic development with the use of input-output models

Author	Forecast calculations
Team of researchers at RAS Institute of Economic Forecasting	Long-term forecast of Russia's economic development for 2007–2030 according to two scenarios [5]. Forecast of socio-economic development of the Vologda Oblast up to 2020 [7]. Forecast of socio-economic development of the Ivanovo Oblast [29]
K. Savchishina	Long-term forecast of indicators of the budgetary sphere and the influence of budgetary performance on the macroeconomic dynamics of the Russian Federation [22]. Analysis and calculation of economic dynamics of the Republic of Belarus in the medium term (2012–2016) [22]
A. Baranov	Forecast of development of the Russian economy in 2012–2015 for moderately optimistic (inertial) and pessimistic development scenarios of the global economy [41]
V. Gil'mundinov	Analysis and long-term forecast of the impact of financial and trade shocks on economic development of the Russian Federation [2]
N. Bagautdinova	Forecast of development of the regional economy based on the implementation of potential of industrial enterprises [28]
D. Mead	Forecast of multifactor productivity in the inter-industry modeling of the U.S. economy [27]
G.F. Verduzco	Analysis and a long-term forecast of development of the economy in Mexico [27]
L.Chezzi	Evaluation and forecast of macroeconomic impact of the implementation of the European agreement on budgetary balance [23]

projects taking into account government support, the effectiveness of federal target programs; substantiation of establishing special economic zones.

Thus, the paper may be useful to those people who make management decisions. Input-output models are also an important tool for analyzing and developing scientifically substantiated variants of scenarios of development of economy and simulation of the effects of their implementation on the socio-economic system. It is possible to use gross output, labor productivity, intermediate consumption, the rate of accumulation of fixed capital, labor remuneration, volume of external and interregional trade, employment, unemployment, and others can be used as control variables. The use of analytical and predictive capability of input-output models provides a solid foundation for state regulation of the economy. Their application helps carry out an in-depth analysis of major inter-industry connections, structural changes and proportions, link the needs and resources in the framework of the whole social production, coordinate the development of related industries and manufacturing, ensure the proportionality and coherence of all elements of the national economy, and calculate different development scenarios.

The novelty of the present research that provides its contribution to the development of science consists in the fact that it systematizes traditional and identifies new approaches to the practical use of the input-output methodology in state regulation of the economy.

It is advisable to use input-output models to calculate the multiplier of value added (the indicator of adaptability of the economy and the extent of processing of natural resources) and to design vertical integration of enterprises (a key tool to increase the multiplier of value added in the economy).

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