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Practical input-output calculations in the interests of government and business (research of the Institute of Economic Forecasting of the Russian Academy of Sciences)

General provisions

In 2017, Russia published the base Input-Output Tables for 2011 and the supply and use tables for 2012-2014. For the first time since 1995, the Russian and international expert community can obtain official data on the structural characteristics of the Russian economy with a high level of detail (symmetric tables contain 126 products, the supply and use tables contain 178 economic sectors and 248 products). The work done by the Russian Statistics Committee (Rosstat) will certainly promote the development of input-output research. It is important to understand what kinds of research are priorities from the point of view of improving the quality of economic policy measures generated in this country.

In the Soviet Union, input-output research was always closely associated with the planning of economic development. We can say that such planning would be extremely difficult without such research, if not impossible. Gradually input-output calculations have been used not only to analyze and forecast the structure of economy, but also for the formation of regional economic development programs.

Current and future dynamics of the Russian economy is inevitably associated with significant structural changes. Therefore, for forecasting and justification of solutions we need to use analytical instruments taking in account these feature. The business community, the Government and the expert community have certain problems in understanding the functioning of the Russian economic system. It is largely due to the lack of information required for making strategic decisions by the Government and business.

A significant amount of data contained in the input-output table place certain demands on the quality of the source statistics. Therefore, the development of I-O tables requires interaction and understanding between business and statistical services. Business need to understand their interest in quality statistics, because, ultimately, the harmonization of the positions of government and business is almost impossible without an appropriate information base and a certain amount of relevant calculations.

It should be emphasized that our experience shows that under certain conditions the business may be interested in comprehensive input-output calculations as well as the government structures. Such interest is especially evident when it comes to the development of highly capital-intensive industrial infrastructure: railways, highways, power generation and distribution, etc. That is where government's attitude can have a direct impact on the implementation of investment projects.

The main peculiarity of the input-output approach is that the input-output tables demonstrate the current economic cost structure and the directions for use of resources and products. Therefore, there is the possibility to estimate the impact of individual enterprises on the background of average industry indicators or indicators of related sectors.

In our opinion, the input-output table is the tool that can be successfully used in the dialogue between business and government intended to substantiate the significance of different sectors of the economy, the necessity of changing public investment policy or business taxation policy, etc. Apparently, in developed countries this feature of input-output calculations is not so important. However, with the growth of structural changes in the global economy, we can expect a certain Renaissance of research focused on the interests of business.

The use of the structural characteristics of economic development contained in the input-output tables contributes to the overall improvement of the quality of economic policy pursued in the country and transition to creating sustainable mechanisms to promote the implementation of long-term development strategy.

The main methodological problem of long-term forecasting is the presence of many factors, each of which has the potential to exert significant influence on the national economy in the next decades. The calculations that must be made for a comprehensive long-term forecast are so complicated that a sound "vision of the future" can only be created based on model structures. Otherwise, it would be extremely difficult to achieve consistency of individual parameters within the overall design (scenario).

The economy of any country is a virtually closed scheme, and if you think about it, it's easy to build a logical chain linking the main macroeconomic indicators. The presence of such interactions allows the building of model structures of any degree of complexity.

At the same time, one should understand that any models (even the most advanced) have a number of shortcomings.

1) First of all, any model is a simplification of reality. Apparently, it is impossible to consider all ties existing in the economy. Therefore it is required to identify key interactions in the economy and use them in the modeling and forecasting processes. Moreover, in order to become a practical tool of economic policy, the model should include a number of key social, technological and institutional hypotheses.

2) An absolute requirement is the use of actual statistics. It is undesirable to use a data calibration method used in some types of models. There may be additional calculations derived from official statistics (for example, IEF RAS would created tables for the Russian economy on a regular basis before the appearance of official input-output tables).

3) Any model represents the views of its developers on the world. It is obvious that forecasters can significantly adjust the final results of the calculations using the ideology and scenario parameters incorporated in the calculation algorithm. Therefore, the problem of the subjectivity of the forecast tools is an important issue that must be taken into account when assessing the adequacy of forecast calculations.

An understanding of the nature of the aforementioned problems of the model constructions allows us to formulate suggestions concerning the provision of instruments for applied economic forecasting.

First, the required level of validity of the forecast calculations can be achieved not by using only one model (macroeconomic or input-output) but by creating a set of models to solve applied problems: from creation of scenario conditions to a comprehensive analysis of situations in various economic activities. In fact, this approach requires a whole set of models to be used in the process of calculations on a single macroeconomic scenario.

Input-output forecasts by IEF RAS

The current set of models used in the IEF RAS includes a model for adjustment of scenario conditions, macroeconomic short- and medium - term models, input-output model associated with more detailed models of development of individual industries (mainly raw materials), and regional models. The use of such an advanced toolkit ensures the required consistency of the most output parameters in the forecast on macroeconomic and sectoral level.

Currently, the forecast calculations carried out in IEF RAS are based on the input - output methodology. Due to the high dependence of Russian economy on foreign trade and the situation on the world commodity markets, the forecast toolkit is being developed at both the national and international level.

Nationwide forecast models include RIM and CONTO. The first is an INFORUM model and is based on econometric dependencies [1]. Its role is to shape the framework conditions of the forecast, including estimates of limitations of economic growth from labor, capital and primary resources. It is expected to be integrated into a model of the world economy and trade BTM (Bilateral Trade Model), developed by INFORUM [2].

The CONTO model is focused on a detailed description of forecast scenarios in the short and medium term [3]. It is also associated with the system of forecasting parameters for the development of all regions of Russia.

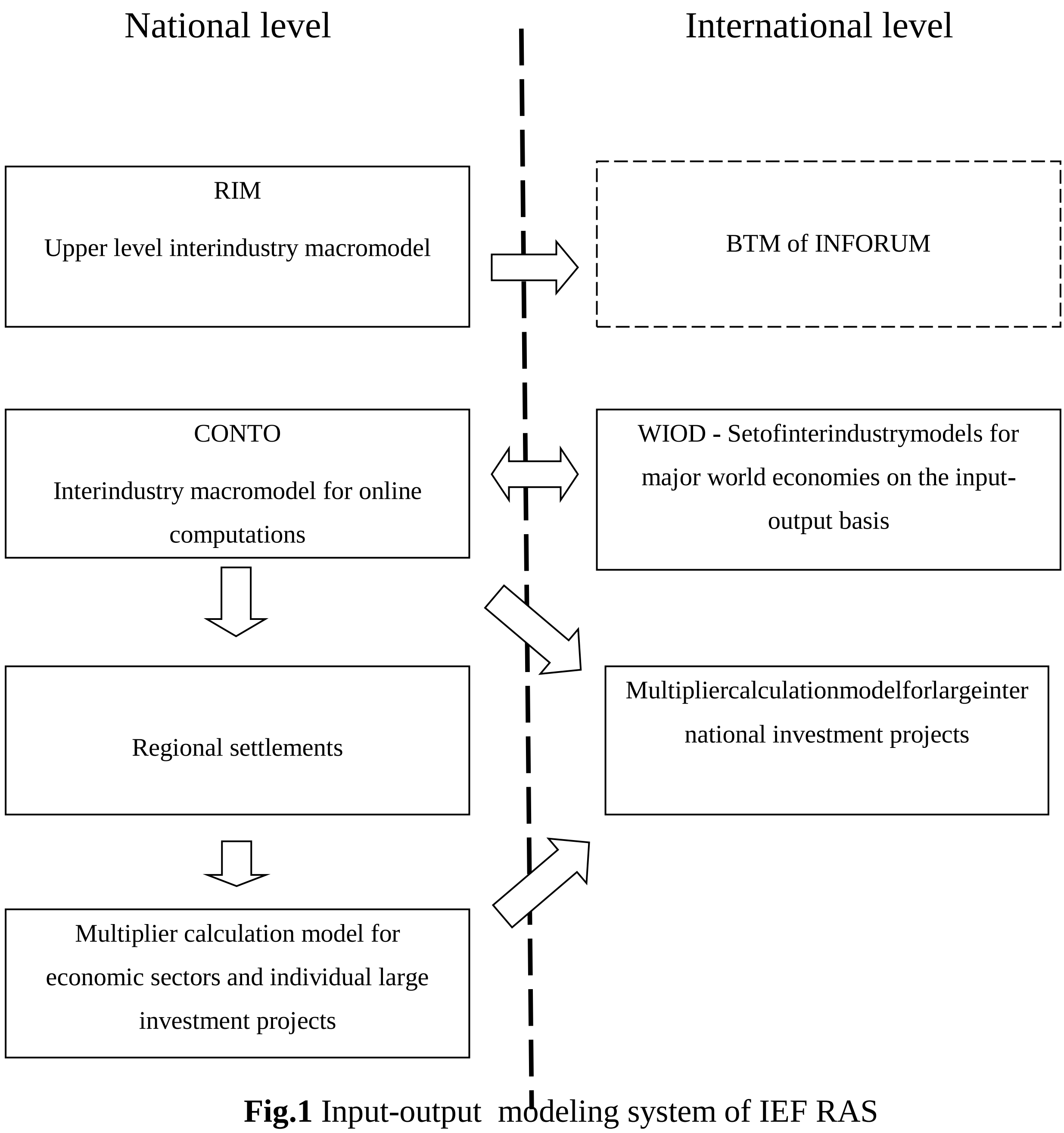

Fig.1 Input-output modeling system of IEF RAS

Models for the largest economies (USA, China, EU-28, Japan, India) have been developed within the logic of CONTO model using WIOD input-output tables[4]. They are used to support the scenario conditions of development of the world economy and the major commodity markets.

Another task in the input-output research is the development of methodology for calculating multiplicative effects, which is used for assessments at the level of sectors of economy, and practical calculations for large investment projects. Recently a methodology for assessment of effects from implementation of international projects involving the resources of several countries was developed.

Input-output macromodels

Initially, RIM[1] was considered as a tool to assess and justify practical solutions in the field of economic policy, therefore, a condition sine qua non for its development was the maximum use of actual statistical data or calculated parameters based on official statistics. In this regard, this model widely uses the data from the system of national accounts, industry statistics of Rosstat, as well as information from other Russian and international sources: Central Bank of the Russian Federation, International Energy Agency, World Bank, etc.

The most important question that inevitably arises in the analysis of any model of the forecast toolkit is its applicability for practical use. In this regard, we believe that the practical applicability of the toolkit depends on the level of analysis of a particular economy to be described, made during the development of such toolkit. Therefore, we believe it entirely insufficient to use a toolkit based primarily on the finished theoretical constructions, not tested on the real statistics of our country (no matter how attractive they may seem) [5].

We have made a list of requirements to develop the modeling toolkit, in which the macromodel focused on the solution of practical problems in the field of

[1] Russian Interindustry Model

economic policy and describing the dynamic and structural characteristics of economic development should:

1. link the dynamical and structural characteristics of economic development, that is, be of input-output nature,
2. describe the balance in the major markets, in particular, contain the balance of production and demand for the activities in question,
3. have good predictive abilities; in particular, describe a retrospective and peculiarities of modern economic situation.
4. take into account resource constraints, including constraints on the major factors of production as well as the capacity of the domestic market,
5. provide the necessary data to other model structures in the complex macroeconomic calculations and be its nucleus,
6. reflect the existing input-output interactions,
7. reflect the behavior of key economic agents on the basis of econometric equations,
8. represent, as far as possible, a closed system of calculations where exogenous variables should be mainly the economic policy parameters and indicators reflecting the development of the world economy.

The model development process improves both the model itself (adding functional blocks) and individual dependencies based on the analysis of quality and adequacy. The model is working and is regularly updated at the same time.

The statistical base of the model is a series of Russia's input-output tables in current and constant prices for 1980-2013 agreed with the system of national accounts (SNA). These tables contain 44 economic activities. The sources of primary data were the Russian input-output tables in current prices consistent with SNA data and other industry statistics published by Rosstat.

The model uses the time series of the following indicators: capital investments by sectors, fixed capital (INF evaluation based on the Rosstat data), the balance of fuel and energy resources in 2002-2013 (in the IEA methodology), the employment structure.

The model also contains time series of national accounts, including institutional accounts, balance of money income and expenditure, indicators of the consolidated budget and the Federal budget including data for social security funds, a detailed demographic balance with a detailed sex-age structure of population, balance of payments, balance sheets of the Central Bank and credit institutions, data on sectoral employment and fixed capital, other macroeconomic and financial data.

Final demand in the model includes household consumption, government consumption, gross investments in fixed capital, and changes in inventories, exports and imports.

Gross value added is represented by wages, net profit adjusted for depreciation, gross mixed income, taxes on production less subsidies, taxes on goods and services less subsidies.

The entire model includes more than 160 series of vectors and matrices, and 860 series of macroeconomic variables. That is, the model developers have a significant amount of data for the creation of an expanded system of calculations.

Currently, the main exogenous variables of the model are: input-output coefficients (except those for which dependencies have been determined), depreciation norms, tax rates, budget cost structure, population, oil prices, dynamics of the global economy and the EU economy, the key rate.

RIM can be classified as a dynamic recursive model where investment in any sector depends on the growth of production in this sector in the current year and two previous years. Ideologically it is based on the principles and the use of the software developed by the Inforum group (G7 and Interdyme packages) [6].

Model calculations are carried out in two stages. At the first stage beta coefficients for sectoral and macroeconomic variables are estimated. At the second stage input-output calculations are carried out based on preliminary estimates of econometric parameters of equations.

The model's concept reflects the logic of a real business cycle. The model presents output dynamics in real terms and income generation in nominal terms (Fig. 2). Production and distribution of products, final demand and supply are calculated in constant and current prices, while the income and primary income distribution are calculated only in current prices.

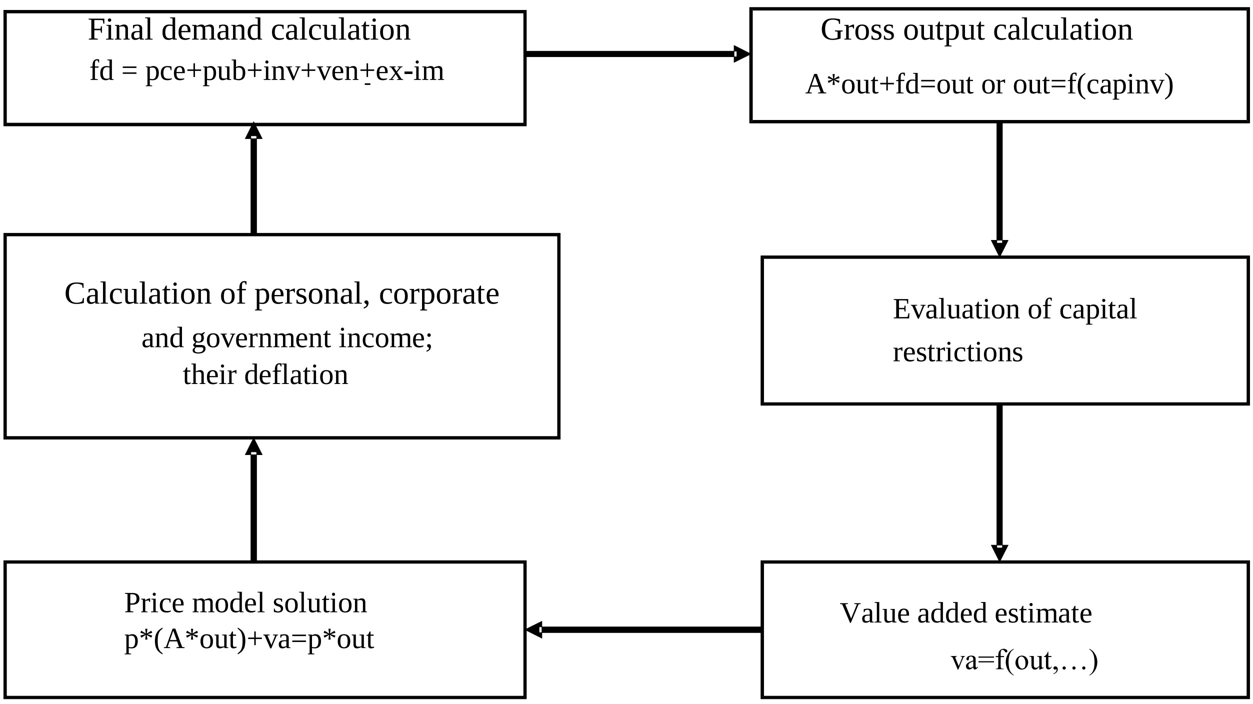

Fig. 2 Conceptual sequence of calculations in RIM

For each year, elements of final demand in constant prices by industry are calculated using econometric equations based on the values of the factors obtained at the previous iteration of factors. Then the value of final demand is used to calculate outputs by economic activity by means of direct cost matrix.

Final demand is calculated as the sum of elements of GDP use.

$$fd\,[t] = pce\,[t] + gov\,[t] + inv\,[t] + ven\,[t] + ex\,[t] - im\,[t]$$

Gross output in comparable prices is calculated in accordance with the classical Leontief model:

$out = A * out + fd$
A - direct cost matrix

fd - vector of final demand by sector

out - vector of gross output by sector

The number of persons employed by industry is calculated on the basis of outputs by economic activity and volumes of fixed capital. Then we turn from real indicators to indicators in nominal terms, i.e. the calculation of incomes and current prices.

The first step concerning nominal indicators is to calculate components of gross value added: wages, net profits and depreciation, gross mixed income, net taxes on production and net taxes on products. All indicators are calculated by industry.

$va = tax + taxop + wagesal + mixed + profit.$
va - gross value added

wagesal - payroll

profit - net cash flow (net profit and depreciation charges)

mixed -gross mixed income

tax - net taxes on products

taxop- net taxes on production

The value of current prices is calculated on the basis of elements of value added and gross output in constant prices in accordance with the Leontief price model:

$$p*A * OUT + va = p * OUT$$

OUT - diagonal matrix of gross output

p - vector of current prices

va - vector of value added

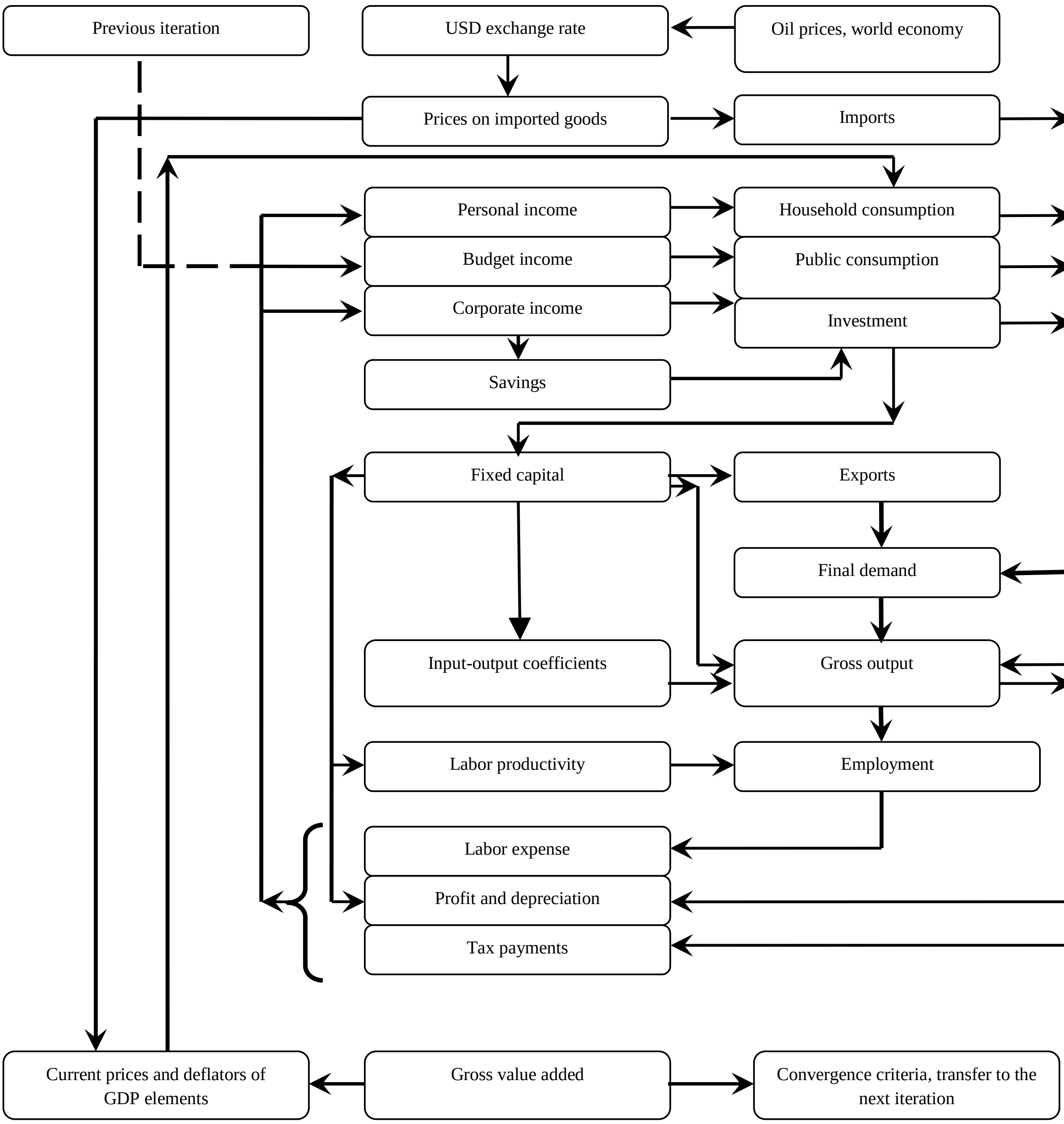

Fig. 3 Fundamental interactions between RIM units

The price index in the quantitative value of input-output identity combines value added per unit of output with unit costs of intermediate goods and services:

$pA + v = p,$

$v=va/out$

Elements of value added are indicators of incomes of economic agents-households, government and business. Transition from nominal income to the final demand in constant prices is carried out using sectoral price indices and is realized within the framework of income distribution, thus closing the calculation procedure. The calculation process is repeated until the convergence conditions are fulfilled. Convergence criteria consists in the equality of GDP volumes calculated during the current and previous iterations with a given accuracy (Fig. 3). After convergence is reached, the model moves on to the next year within the projection period.

As already mentioned, the other input-output model CONTO shows detailed calculations for the medium term. The model uses a 44-branch classification of economic activities. This classification provides for the best use of the Rosstat official data about SNA, production and cost, and easily meets the challenges facing the model developers in the evaluation of economic consequences of various solutions in the field of economic policy. In the structure of integrated interdisciplinary calculations the purpose of the CONTO input-output model is to create coherent dynamics of macroeconomic and sectoral indicators of economic development for a given projection period. The model is based on the dynamic calculation of the basic parameters of the input-output table in constant and current prices.

The input variables of the model are the parameters of economic policy and characteristics of the world economy development.

The key exogenous parameters are:

- Population of the Russian Federation, mln people
- World economy growth rate, percentage points
- USD to EUR exchange rate, Euro per dollar
- USD to the Russian ruble exchange rate, rubles per dollar
- World prices on crude oil and main petroleum products (gasoline, diesel fuel, fuel oil, kerosene), USD per ton
- World gas prices, USD per thousand cubic meters

- Price indices for products of natural monopolies (gas industry, energy production, transport services)
- Volume of housing commissioning, mln sqm
- Fixed assets disposal standards by types of economic activity, percent
- Capital intensity growth indices by types of economic activities
- Indices of changes in material intensity and energy intensity by economic activity
- Income tax rate, percent
- Mineral extraction tax rate, rubles per ton
- Duty on exports of crude oil and oil products (gasoline, diesel fuel, fuel oil, kerosene), percent
- Output dynamics in the basic materials sectors
  - Crude oil
  - Natural gas production
  - Production of petroleum products
- Level of tax collection for mineral extraction tax on oil and gas, determined on the basis of projected structure of oil production and the system of incentives for MET

The algorithm of calculations within the model is a sequential transition from calculation in constant prices to the formation of estimated input-output tables in current basic prices and prices of the end customer.

In modeling, dynamics of the key cost factors is associated with technologies development parameters through cost factors (underlying characteristics of consumption of primary resources are generated on the basis of cross-country comparisons)[7]. The acceleration of investment activity has a direct impact on changes in manufacturing productivity.

Stiffness of the model structure is achieved by linking each of the end use elements to the relevant balance construction. Consequently, the growth of demand is always coordinated with corresponding resource capacities of the economy (Fig. 4).

Some cost factors are calculated in the model if they have a clear interpretation and are significant. In particular, this is how a large part of the energy-related cost components are formed.

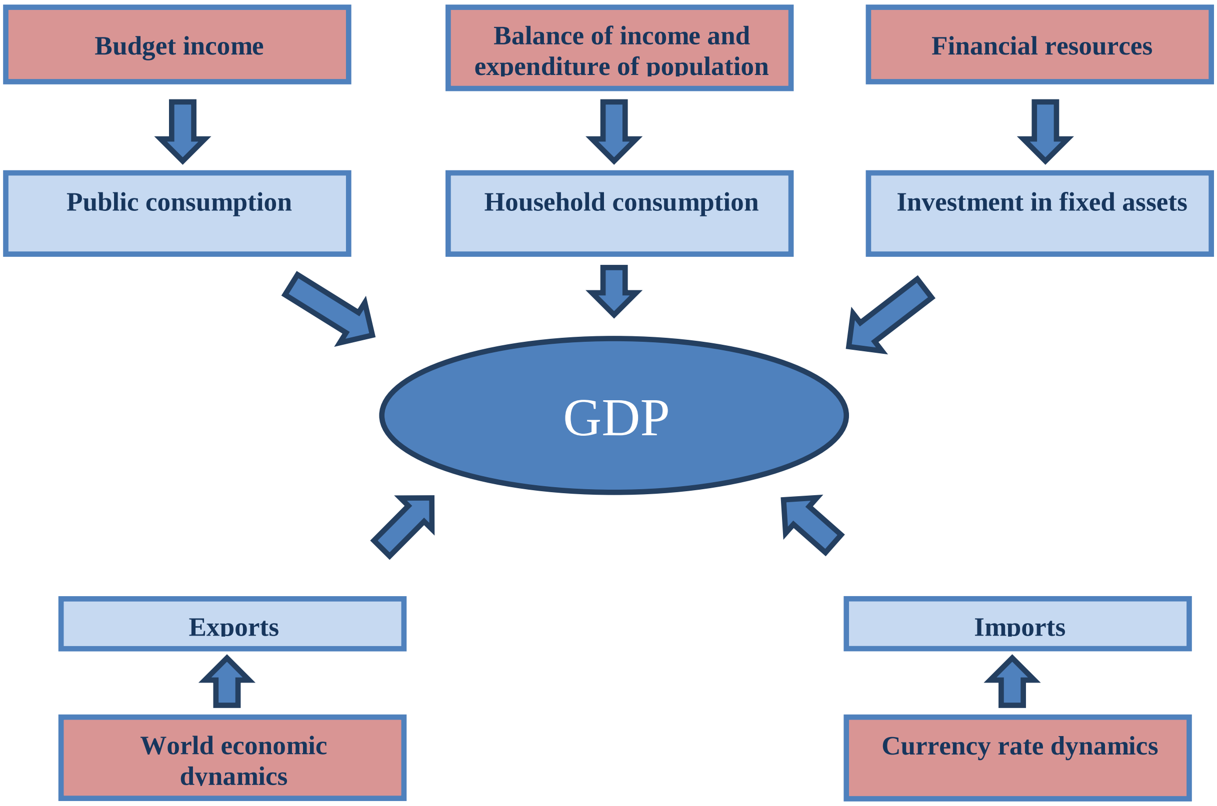

Fig. 4–Adjustment of demand parameters in the model

In connection with the peculiarities of the input-output table in which investments are presented in the corresponding column according to the directions of use (technological structure), the model ensures an appropriate division of the total investment flows into construction and installation works, procurement of machinery and equipment and other investments. Thus, changes in the sectoral dynamics of sectoral investments lead to corresponding changes in the overall technological structure of capital investments in the economy.

Formation of the table in current prices is carried out through the solution of a modified price model of input-output table, where regulated prices of natural monopolies are set as exogenuos variables.

The most natural way of pricing by activity in the input-output model is to use the classical Leontief price model. The basic equation of this model is as follows (3.23):

$$p*X - p*A*X = va,$$

where

p –price vector;

X – vector of gross output;

A – matrix of input-output coefficients;

va – vector of value added.

Prices in this model are defined as:

$$p = (E-A)^{-1} * va.$$

Prices in the Russian economy are dependent on a number of factors. In particular, the high share of imports in consumption directly affects the part of the consumed products which comes from abroad. On the other hand, the most important source of price dynamics remains the prices of natural monopolies. This necessitates the transition to a modified pricing model, separately shaping dynamics for imported and domestic goods and services.

If part of the production cost is accounted for by imports (the dynamics of import prices is defined in its own logic) then the pricing model formula can be converted as follows:

$$p_j^{in} = \sum_{i=1}^{n} a_{ij}^{in} p_i^{in} + \sum_{i=1}^{n} a_{ij}^{im} p_i^{im} + va_j .$$

The same but in matrix form: $\overrightarrow{p^{in}} = \left(A^{in}\right)^T \overrightarrow{p^{in}} + \left(A^{im}\right)^T \overrightarrow{p^{im}} + \vec{va}$.

The final equation of the modified pricing model:

$$\overrightarrow{p^{in}} = \left[E - \left(A^{in}\right)^T\right]^{-1} \cdot \left(\left(A^{im}\right)^T \overrightarrow{p^{im}} + \overrightarrow{va}\right).$$

where $\overrightarrow{p^{in}}$ – vector of price indices for domestic products;

A^{in} – matrix of direct costs of domestic products;

A^{im} – matrix direct cost of imported products;

$\overrightarrow{p^{im}}$ – vector of price indices for imports;

a_{ij}– input coefficient of i-sector for the products of j-sector;

$va = p_{in} * X – p_{in} * A_{in} * X – p_{im} * A_{im} * X$.

Calculations are done by iteration and provide an opportunity to assess the impact of foreign trade prices, infrastructure tariffs and condition of fixed assets on the dynamics of the producer price.

The series of the applied forecasting calculations performed on the CONTO model and the models of the IEF RAS, suggests that this design provides an opportunity to significantly increase the overall validity and interpretability of both the final forecast results and specific calculations by industry, as well as to create a necessary amount of quantitative estimates needed for decision-making in the field of economic policy.

2.4 Harmonization of macroeconomic and regional forecasts of Russian economic development [8]

The biggest problem of regional modeling and forecasting is the problem of inconsistent regional forecasts and programs. It is not only the lack of consistency of processes and programs implemented at the Federal level, lack of coordination of various regional programs with each other, but also certain contradictions in the regional research work. These contradictions are determined by the inconsistencies of the forecasting techniques, statistics, and the differences inherent in projection scenarios.

It is impossible to completely solve the problem of coherence between the regional forecasts and programs. But a certain unification of the methodological approaches can significantly increase the level of consistency of the forecasting and analytical research. The most important area in this respect is the development of the national accounts system at the regional level.

The insufficient level of implementation of the SNA methodology at the regional level necessitates the development of design tables of production and use of GRP linked to the tables of production and use of GDP.

Therefore, the development of a regional forecast, which will be consistent with macroeconomic scenarios and forecasts requires, first of all, a sufficiently detailed projection research at the Federal level, and, secondly, appropriate tools (system of models) that provide the necessary measure of harmonization and the balance of regional and macroeconomic forecasts.

Understanding of the dependence of regional economic processes on the overall national macroeconomic situation is present in many regional studies, and there are also examples of the development of forecasting systems directly linking the dynamics of regional development indicators with the relevant indicators of the Russian Federation.

This means that the natural sequence (logic) of a regional forecast development should include at least the following steps:

1. Provide an analysis of the current economic situation at the Federal and regional levels and assessment of the possibilities and alternatives of economic development.

2. Develop macroeconomic scenarios at the Federal level.

3. Develop a toolkit for working out macroeconomic scenarios at the Federal level.

4. Conduct macroeconomic forecasting calculations at the Federal level.

5. Develop regional models (for Federal districts and subjects of the Federation).

6. Develop a system of interconnection and adjustment of models of the Federal and regional levels.

7. Develop regional scenarios linked to national economic scenarios.

8. Make regional economic projections linked methodologically and scenario wise with the Federal economic projections.

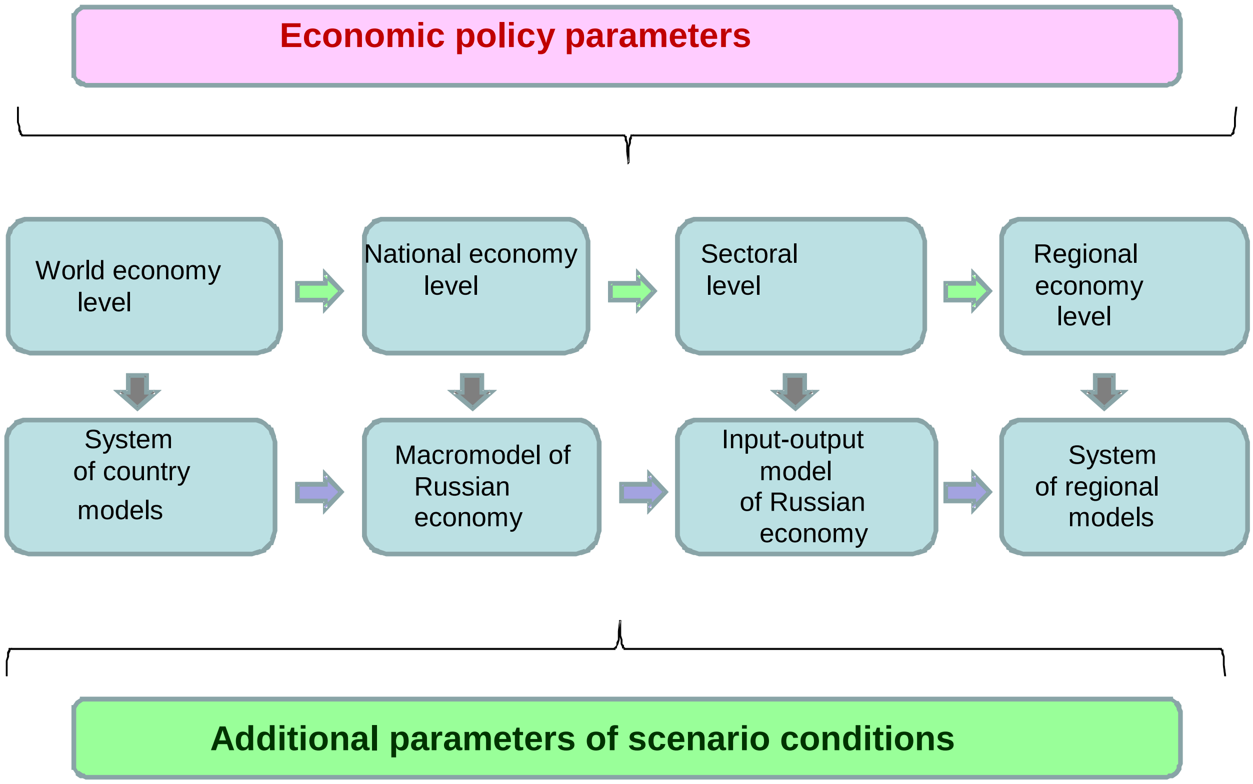

Fig. 5 Scheme of the coordination of macroeconomic and regional forecasts

While working out regional scenarios and projections it is a natural desire to rely on forecasts concerning the prospects for economic and sectoral development.

This problem can be solved using a system of macroeconomic and input-output models developed in IEF RAS.

The available forecast of the Russian economic development based on the Input-Output tables and the consensus forecasts of regional economic development (including the production structure) provides for solution of a number of applied forecast problems.

In particular, one of such problems is the projection of interregional and input-output flows of rail freight.

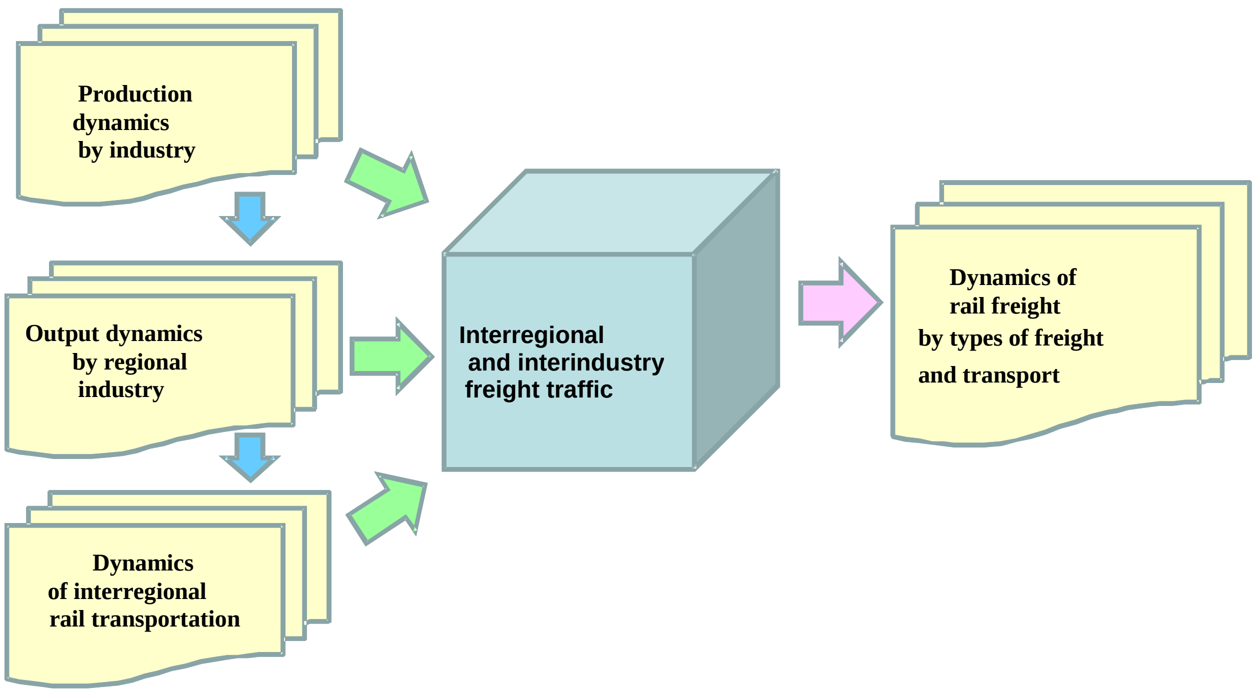

Fig. 6 Scheme of rail transportation forecasting

Quantitative assessment of multiplicative effects for decision-making in economic policy [9]

Assessments of multiplicative effects are widely used in conducting applied economic analysis. Some of them are used as a basis of the "input-output" methodology.IEF RAS also uses assessment of the system of input-output links.

For a start let us introduce a few key definitions:

“Multiplier (macroeconomics) – numerical factor indicating how many times the final development indicator will change in conditions of investment or production growth in the analyzed activity. Production and investment multipliers may differ in the macroeconomic analysis.

Multiplier effect – the product of multiplier by initial change of output, investment or other key indicators of industry development. It reflects the effect of an increase in indicators in the analyzed activity in the light of its contribution to economic dynamics.”

We think it important to add one more definition to the above definitions.

Integral multiplier effect – annual increment in a macroeconomic indicator of national (gross output, GDP, budget revenues) or regional (gross output, gross regional product, regional budget income) economic development; it is generated by a combined increase in production and investment in the framework of implementation of investment projects.

These are the key concepts for understanding the proposed methodology of calculation of multipliers and multiplier effects. The structure of the Russian economy is quite diverse. The importance of the sectors is not always determined by their current share in value added or output. It is important to understand their development potential. On the other hand, a sector with a high multiplier value may not have an equally powerful impact on macroeconomic parameters just because its contribution to these indicators is fairly modest. It is equally important to understand that when investing in any project multiplier effects of investment in any project will depend not only on how effectively investment resources were spent but also on what goods or services will be produced and who and where will consume them.

In terms of content, the mechanism of the multiplier effect consists in initiating changes in the output or investment that leads to growth of production in related sectors and across the economy as a whole, generation of additional incomes (profits, taxes, wages) on this basis and their subsequent redistribution into additional volumes of final demand.

If the issue is the formation of mechanisms linking the parameters of the third quadrant of the input-output table (value added) and the second quadrant (final demand). The solution to this problem is possible when using the data of consolidated accounts of SNA by forming dependencies: the volume of taxes and government consumption, wages and consumption of households, gross profit and investment.

To determine the characteristics of income turning into consumption in the reporting statistics of national accounts, we estimated the following elasticities:

- change of household consumption per unit change of wages – 0.87;
- change of investment in fixed capital per unit change of gross profits – 0.6;
- change of public consumption per unit change of taxes– 0.85.

In assessing the elasticity of return on investment, calculations included only the portion of investment from own funds and did not account for other sources of funding for fixed capital investment. Therefore, multiplicative effects associated with the transformation of depreciation charges, are taken into account in the evaluation of the investment multiplier and should be excluded from estimates of the multiplicative effects of the distribution and redistribution of added value.

To calculate the multiplier effect from implementation of a large investment project it is necessary to have certain information including:

1) estimated production volume;

2) duration of the investment stage of the project;

3) amount of funds at the investment stage;

4) share of imports in purchases of machinery and equipment;

5) rate of fixed capital depreciation.

The major investment projects generally take much time for implementation (energy, development of industrial infrastructure). Accordingly, the time factor should certainly be taken into account.

The production efficiency in almost all sectors of the Russian economy will inevitably be increasing in the long run. Respectively, the cost structure will be changing. Therefore, the assessment of the multiplier effects from implementation of long-term projects and the contribution of various economic sectors to these effects will also be changing. These changes will be associated with the influence of two major factors:

1) The share of imports in the cost structure will be changing along with the growth and development of economy;

2) Increase in the production efficiency will be accompanied by substitution of primary resources by the products of activities with a high added value, an increase in spending on research and development, use of advanced technologies, etc.

Therefore, an integrated assessment of the contribution of major projects in economic development in the long term calls for assessment of the dynamics of specific multipliers by economic activity, taking into account any possible dynamical and structural characteristics of economic development in the long term.

This necessitates the use of macro-structural long-term forecasting tools and evaluation of prospects of structural changes.

Use of the information about the parameters of annual investments and characteristics of the technological structure of investments will allow us to assess the multiplier effects at the investment stage of the project.

The next stage gives rise to a multiplier effect associated with an increase in output on the newly created capacities. It is formed in accordance with the logic of calculation of the production multiplier.

The resulting integral multiplier effect can be presented in the following equation(3.1.):

$$TotalMul = \sum_{i=1}^{TB} \frac{Inv(i) * InvMul}{(1+d)^{i-1}} + \sum_{i=TB+1}^{TB+TF} \frac{Out(i) * OutMul}{(1+d)^{i-1}}$$

where

TotalMul– integral multiplier effect;

InvMul – investment multiplier;

OutMul – production multiplier:

d – discount rate;

$Inv(i)$– amount of capital investments in year i;

$Out(i)$–amount of production in year i;

TB– project implementation period;

TF – period of the project operation.

Given the hypothesis of maintaining the level of labor productivity in economic sectors, the value of multiplicative effects on employment is calculated as the sum of the products of increment in gross output by average unit costs by economic activity:

$$ML = \sum_i \left(\frac{(X_i + \Delta X_i)}{X_i} * L_i\right),$$

where L_i is the number of workers employed in the i-th economic activity; X_i is thegross output of the i-th economic activity; ΔX_i is the increment of gross output in the i-th economic activity due to multiplier effects.

Multiplier effects from the implementation of international investment projects

Effects from realization of international projects in the country-supplier of the equipment are as follows:

- growth of external demand for products of investment destination (taking into account the share of national production in the respective capital costs) and the related effect of production growth in the fund-creating industries (investment effect with the subsequent closure of increment in value added);

- growth of external demand for the products of industries that serve the production facility during the operational phase (the effect of increase in output with subsequent closure of increment in value added).

In principle, the methodology of determining the multiplicative effects in the framework of the international project is not different from the above-described general methodology. One of the few differences is that the involvement of the recipient country and third countries in the project can affect the volume of exports from the country providing the products associated with the project only indirectly (for example, to increase the export of metal to a third country for manufacture of equipment). As such supplies cannot exert a significant influence on the assessment of multiplicative effects, they are not taken into account in our calculations. Another feature is the estimation of an increment in output and profit generated by the project:

as the project is external to the supplier country, the growth of output and value added from operation of the facility is not considered when calculating the effect on output and GDP of the supplier country.

The main task of the calculations for the supplier country is to get a correct account of the degree of its participation in the project (share in the supply of resources of investment and current industrial consumption).

Multiplicative effects for the recipient country

Effects in the implementation of international projects for the recipient country are as follows:

- growth in demand for products of the fund-creating industries, primarily the construction industry (including the share of the national production in the capital expenses) and the related effect of production growth in the fund-creating industries (investment effect with the subsequent closure of increment in value added);

- growth of production in the industries that serve the facility at the stage of electricity generation (effect of increase in production with subsequent closure of the growth in value added).

For the recipient country, the methodology of determining the multiplicative effects in the framework of the international project is fully consistent with the general methodology, taking into account the import of resources of investment and current industrial consumption. The only difference is in the method of accounting for the profit generated by the project. Since such projects are as a rule largely funded through foreign loans and/or the supplier's equity, the profit from the facility operation must go primarily to the return on investment and depreciation. Therefore, these additional revenues should not be considered when determining the multiplier effect (in the "closure" of value added).

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