Modeling Interregional Inter-Branch Relations as an Element of Interaction Between the Branches of the Agroindustrial Complex

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Abstract: The specifics of the Russian economy is that the impact of spatial factors on the socio-economic development of the country is reflected in the following: a great extent, an exceptional variety of natural and geographical conditions of individual regions; the history of the state united the people, who were at different stages of economic, social and cultural development; the method of the territorial organization of the state, its division into components (regions) and the principles of their relationship with each other. These features of the socio-economic development are reflected in the methodology and theory of inter-regional and inter-branch modeling. Inter-regional and inter-industry linkages are an integral part of the economic development of the region. In this case, they can be regarded as the economic relations between the Russian regions for the effective development of the agricultural sector of the country. Inter-branch relations are characterized as a process of the effects of different industries on each other. This interaction reflects the coordination of agro-industrial complex, which is based on the market mechanism and government regulation. The main role is played by inter-sectoral and inter-regional exchanges, setting relations that are effective for the regions and industries. The paper summarizes the results of many years of research based on the use of inter-regional inter-industry models. The main types of models and their possible applications in agriculture have been analyzed. The results of studies on the development of inter-regional inter-industry models as applied to the multilevel systems "agro-industrial complex - the regions" are presented.

Key words: Optimization interregional inter-industry model % Inter-branch balance % Agroindustrial complex % Financial flows

INTRODUCTION

In modern conditions, the development of agricultural production is largely constrained by lack of development of market infrastructure, disintegration of the interests of enterprises of different agribusiness, lack of the necessary market information and inadequate skills of agricultural organizations in a competitive environment. The solution to the majority of these problems can be found through the restoration of the damaged interregional economic and production relations at all levels of the food chain, which development now is complicated due to high cost of all necessary activities.

For the development of the models of inter-regional relations in the Russian Federation, intended for the research of economic perspectives for agriculture and the recommendations in the field of agricultural policy, it is relevant to approach the agro-industrial complex as a spatial system, i.e. a system of interacting fields [1].

Most economic models were developed in the XIX century; these are modifications and synthesis of interdisciplinary models. In the middle of the last century the inter-regional inter-sectoral models of American researchers V. Leontiev, W. Izard, L. Moses, X. Chenery, B. Stevens became popular [2, 3, 4, 5, 6]. The first original publications for inter-regional inter-industry models appeared in the USSR in 1963. For a short time over ten model variants, mainly optimization ones, appeared; and the first experimental calculations were carried out under S. Nikolayev's supervision [7]. In a market economy the inter-branch balance was prepared in 1995 for the whole country. It used the elements of the world-class methodology and common standards and approaches. For a long period the works on the development of inter-regional inter-industry relations were not performed. The long-term forecasting using interregional inter-industry models was discussed in 2002 and only in 2011 at the World Forum under the auspices of the

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International Association "Input-Output+ (II OA), it was decided to develop the inter-sectoral balance of Russia for the year 2011.

MATERIALS AND METHODS

The main objective is to study the economic content of the inter-regional inter-industry relations and to identify the key organizational and economic factors of their formation and development in the agroindustrial complex in a market economy. The choice of this goal led to the need to address the following objectives:

C   Based on the study of theoretical material to identify the current state of construction of inter-industry balances;
C   To consider the scientific and methodological basis of inter-regional inter-industry models;
C   To justify the choice of the current state of the optimization of inter-regional inter-industry model.

In this paper we use a set of general scientific and economic research methods: analytical, monographic, abstract, logical, economic and statistical and economics and mathematical.

The materials of research were the basis of the reports in scientific and practical conferences of national and international level. The authors clarify and detail the inter-industry models to develop the inter-regional relations in the agroindustrial complex.

Key Part: In 1966 a huge cycle of works was performed and the whole set of balances was developed for the entire country, the republics of the USSR and for all economic regions of the RSFSR. Based on the received information, under the direction of A. Granberg, the first models that operate in the present were developed. They describe both the large regions of Russia and the relations between them [8].

In recent years, in a number of countries, there is a considerable enlivening in research of the inter-regional models that have practical significance.

In the XXI century the Institute of Economics and Industrial Engineering of Siberian Branch of the Russian Academy of Sciences is conducting the experimental research of the inter-regional inter-industry models of three types:

C   Inter-regional inter-industry balance (this model introducing the structural parameters eliminates the multiplicity of choices of the inter-regional and inter-industry relations; the model is reduced to a system of equations with a unique solution);
C   Optimization models with national economic scalar or vector criterion of optimally;
C   The model of economic interaction of the regions with local optimality criteria (the model includes the economic mechanism for coordination of the governmental and regional interests) [9].

In addition, the two-level systems "the agro-industrial complex - the regions" are developed to emphasize the coordination of agro-industrial and regional interests, optimal distribution of common agricultural resources, the distribution of functions between the governmental and regional authorities involved in planning and management, etc. [10].

In the agricultural sector, which is among the largest and the most complex national economic forms, the inter-industry relations are intertwined with the interregional ones through the optimal combination of financial flows. The mentioned relations act as a basis for building the inter-regional inter-industry models [11].

In the total set of financial flows, there are three main types in the areas and functional value (Figure 1):

Type I: Intra-complex flows and inter-industry relations;

Type II: The inflows from other regions and certain sectors;

Type III: Outflows from the agricultural sector to other regions, industries and for the ultimate non-production consumption.

It is possible to classify the inter-industry relations and financial flows into separate groups:

The first group - the supply of main means of production (tools) from fund-producing to fund-consuming branches;

The second group - the supply of the objects (results) of labor (raw materials, semi-finished products);

The third group - the supply of finished products from the manufacturing sectors in the industry, selling products to the end consumer; and

The fourth group - provision of services by the branches of production infrastructure to the sectors of primary production [12].

All four groups of inter-industry financial flows and relations function within the regional agroindustrial complex and have the largest intensity.
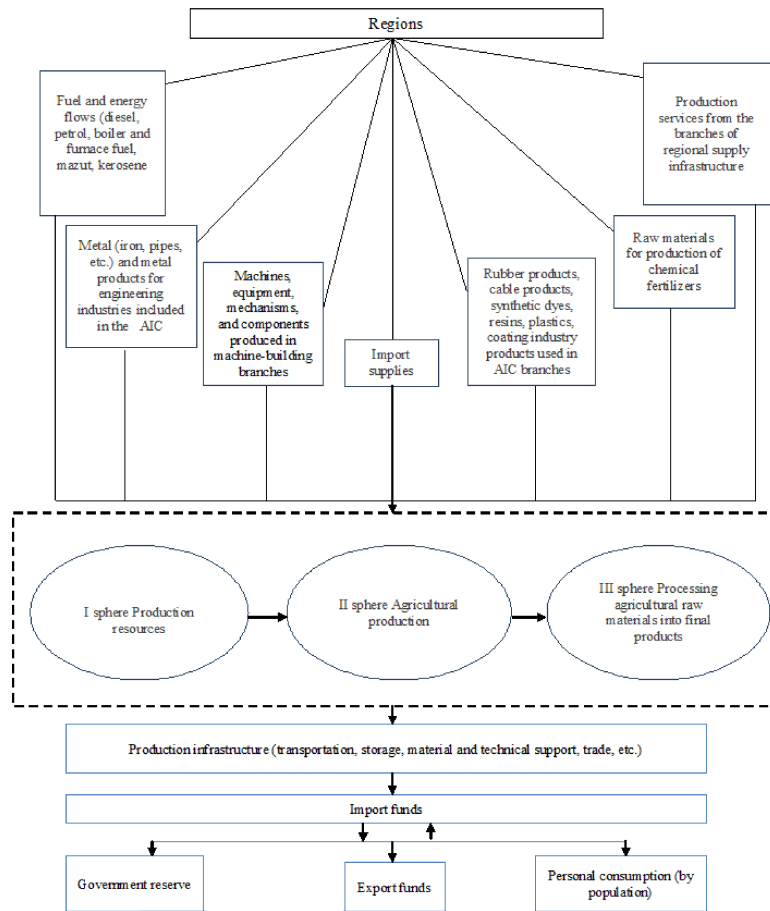
Fig. 1: Areas of inter-industry financial flows in the sectors of agroindustrial complex

The main statistical base for building the interregional inter-industry models are the regional intersectoral balances. Works in the field of regional inter-industry balances, conducted by research institutes, first were devolved as relatively independent and did not directly relate to the analogous works for the national economy as a whole. Because of this and the development of forecasting and planning inter-industry models, in all economic regions of Russia the new opportunities for the construction of spatial national economic models are created by means of uniting the regional models [13]. There are three main schemes of integration.

The first scheme reduces the regional models in "a point" model of agroindustrial complex, which is a copy of the primary version of the model of regional inter-Industry balance.

All regional balances and limits are summed up, cost factors are averaged and interregional connections are excluded. This scheme is a synthesis of the regional models in a sense that the overall state production volume of the final product and the resources should be determined as the sums of the respective regional units; and the overall state expenditure rates have to be determined as the weighted average of the regional values. For example, the natural organization of the development of accounting inter-industry balances is when the overall state balance is obtained by offsetting the regional ones.

In the second scheme there is also the united regional balance of products and resources, but in the overall system some elements of the regional models remain (production volumes, expenditure coefficients) and the other part is lost (the end product of the regions, export and import, regional resources). The number of variable regional production volumes becomes excessive compared to the number of product balances.

The above approach with inter-industry financial flows and relations is common for economic and regional AIC [14]. However, in the transition to regional AIC the material flows are transformed.
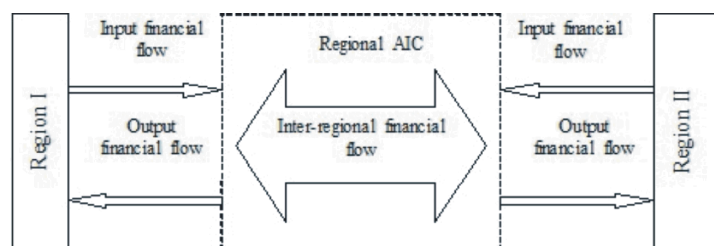
Fig. 2: The transformation of the financial flows of the regional AIC

Each of them is divided into three flows: one intra- and two inter-regional (input and output) (Figure 2).

Thus, the essence of the transformation of inter-complex, as well as input and output inter-industry financial flows of AIC is their stratification, caused by the presence of inter-regional exchange. Therefore inter-industry relations of AIC are transformed into intra- and interregional ones. Compared with the national economic AIC, in the regional complexes the correlation of external and internal inter-industrial flows changes in favor of external (as part of the flows between the agricultural industries of AIC transforms into an interregional flow) [15].

The third scheme leads to the construction of spatial (inter-regional) models of the economy. Their distinguishing feature is that they retain all the conditions of regional models and, in addition, include the compatibility conditions of the interregional economic relations [16].

For the system of statistical inter-industry production balances the third scheme of combination is as follows.

$$X^r = A^r x^r + d^r, \ r = 1,...m, \tag{1}$$

$$\sum_{r=1}^{m} d^r = d$$

where

A^r - Matrix of the coefficients of material costs in the region r;

x^r, y^r - Vectors of gross and final product volumes in the region r;

d^r - Vector of regional products export and import balance r;

d - Vector of export and import balance in the country.

The system (1) has a block structure: the blocks of regional and inter-industry balances are linked with the conditions of the balances of interregional exchange. This scheme is not yet a complete model of analysis of territorial proportions; it describes only the general structure of the relationship between the blocks of the interregional model. In (1), there are many degrees of freedom, in particular in the choice of inter-regional relations.

Scheme combining regional models are a common basis for the construction of the above three types of interregional models. Each of these types of models is some specification of the second and third schemes of regional models combination. It can be said that any particular inter-regional model is "arranged" from the typical blocks [17].

Balance interregional inter-industry models are the results of such changes of the schemes combining regional models, which eliminate the multiple choice of inter-industry and inter-regional relations.

The USSR's first interregional inter-industry balances were built on the model of X. Chenery - L. Moses for the three republics of Transcaucasian economic region and for two economic zones (the Russian Federation and the rest of the country). The specificity of the used model is the hypothesis of stability of the structure of each region supply with products of all sectors. Similar hypothesis (but in a relaxed form) is widely used in the practice of building the planning regional balances in Russia. The problem at issue is the models including import ratios in relation to the volume of products consumption in the region and balances of adding and non-adding import. The model of inter-regional balance accepts the stronger assumption: stability of not the coefficients of the total imports, but its geographical structure. Based on this, the model can be seen as the tool for verification of compatibility of the regional forecasts on the structure of products import and analysis of the implications of certain predictions [18].

Using the model of interregional balance it is possible to perform a variety of analytical calculations, for example:

C   Determination of production volume in different regions and regional needs in the labor force, capital stock and other types of costs depending on the territorial proportions of the final use of products;

C   Determination of the final product and needs in the labor force, capital stock and other types of costs for different regions depending on the territorial proportions of production.

It is crucial that these complex calculations include the impact of the changes in the conditions of production and consumption in some regions on the economic indicators in other regions; and in general, the agroindustrial complex is presented as a single spatial system [19].

Interregional optimization models can be interpreted as such specifications of the schemes uniting the regional models, which preserve the freedom of choices among the options of regional and industrial development and interregional exchange [20].

The first stages of experimental implementation of the interregional optimization models were carried out regardless of the research of the inter-industry models of individual regions. The task now is to organize the development and application of this model in the framework of a two-level system" the agro-industrial complex - the regions".

The third type of inter-regional models is the models of economic interaction of the regions with local optimality criteria. In these models, the choice of the planning solutions is performed with the economic mechanism. The experimentally tested model was the one with following structure: the standard inter-industry models of the regions include additional trade balance equations and the conditions common to all regions are the balances of goods export and import. For each region the level of population consumption is maximized and the coordination of regional solutions is performed by selecting the prices of the exchanged products and adjusting the balance of inter-regional exchange.

The main purpose of the optimization interregional inter-industry model is centralized planning calculations of the territorial proportions of agroindustrial complex. At the conditions, when the proper models are developed for economic regions and the information of these models is supplied to the interregional inter-industry optimization models, there is an increase in the value of the latter one for the coordination of regional projects and adjustment of the aggregates of agricultural development taking into account spatial factors [21].

The general structure of the interregional inter-industry optimization model for the case of two regions is shown in Figure 3.

In the interregional inter-industry optimization model the regional blocks of submodel are connected by:

C   Conditions that characterize the necessary correlations of the regional standards of living;

C   The terms of the interregional exchange balancing and development of the transportation system;

C   Restrictions in agricultural resources [22].

Obviously, the "work" with these conditions should have a major impact on the coordination of regional solutions.

Each regional block is a model of the area with open inputs and outputs, i.e. the system of the balances of production and distribution of products, the use of labor, investments, natural resources and transport activities (Figure 4).

Modifications of interregional inter-industry models differ primarily in the methods of "control of" the relations of regional life levels: through the establishment of the regional shares in the national supply fund, through the regulation of employment and income and the distribution of supply fund, by changing the prices of interregional exchange and identifying the balance of the inter-regional exchange.

Thus, in the model of regional economic cooperation for each region the level of consumption is maximized and the harmonization of regional solutions is implemented by choosing the prices of the exchanged products and adjustment of the balance of interexchange [23]

The circle of the economic planning tasks for which it is possible to use the optimization interregional inter-industry model depends essentially on the stage of planning.

In the early stages of the state budget development the interregional inter-industry optimization model can be used primarily to study the influence of the regional factors on the trends of the economy development in general, elaboration of the general concept of productive forces distribution and evaluation of the opportunities and consequences of rapprochement of the regional levels of development and welfare. For these purposes it is sufficient to use the large-aggregated model.

At further stages of planning the emphasis is shifted to the field of the detailed justification of development and location of production in the industries and regions, development of transport, inter-regional relations, etc.
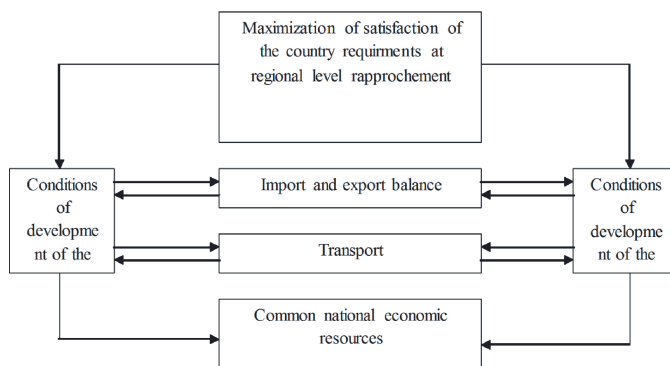
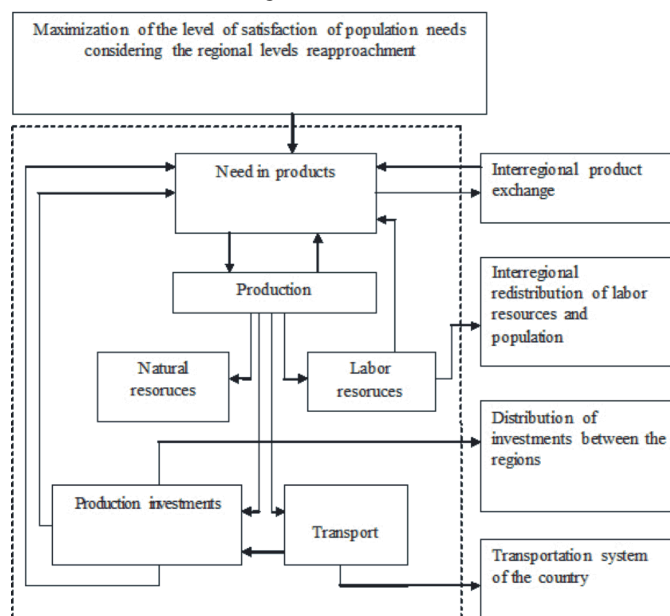Fig. 3: The general structure of the rational interregional model

Fig. 4: Structure of the regional block of optimization model

It is necessary to use the much more detailed interregional models. Finally, at the final stages of elaboration of the plan for economic development the inter-regional model can serve as a tool for validation and verification of the balance of the consolidated socio-economic, sectoral and regional projections.

The detailed optimization model of interregional inter-industry relations can include a large number of general economic, industry and regional conditions. But it should not be regarded as the dominant model, replacing the consolidated inter-regional and inter-industry model. On the contrary, its effect is best used as part of multilevel models of financial planning of agroindustrial complex development [24].

In the system of territorial-production planning models of agroindustrial complex development it performs the function of one of the top models and has the largest

number of bilateral information links with the consolidated inter-sectoral and inter-regional models. The features of agroindustrial complex development in the regions determined in the inter-regional inter-industry optimization model are specified and detailed while agreeing the solutions in the model system.

CONCLUSION

In 90ies the interest in the long-term forecasts was significantly lost. Study of the problems of long-term forecasting using interregional inter-industry models was renewed and intensified in 2002. Medium and long-term forecasting of agroindustrial complex development and individual industries became more and more popular. Acute need for a clear and predictable governmental socio-economic policy and identification of potential

problems and targets for long-term perspective facilitated the preparation of the forecasts of socio-economic development of Russia, the last of which was the forecast up to 2020, as contained in the Concept of long-term development of the Russian Federation until 2020.

Currently, the development of interregional inter-industry optimization model provides three periods: 2011 - 2015, 2016 - 2020 and 2021 - 2030. Implementation of the model provides the forecast tables of goods and services distribution in the economy, both for last year of the projection period and for all its intermediate time points.

In recent years several modifications of the interregional inter-industry optimization model were experimentally tested, in a semi-dynamic statement the fully dynamic - two-period one with network and chess representation of interregional relations.

At the present stage of modeling the calculations of the inter-regional inter-industry optimization models allow identifying the key indicators of all the major regions of the country. However, using the model for a more detailed study of the problems of inter-regional relations in agroindustrial complex is possible as well. The studies of interregional inter-industry relations, started over 50 years ago, continue and remain relevant at pesent.

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