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INDICATIVE FORECAST-PLANNING OF THE CONSTRUCTION AND TRANSPORT COMPLEXES JOINT DEVELOPMENT

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Abstract

The modern economy of the Russian Federation is constantly facing crisis phenomena at various levels. At the macro level, it is the absence or low GDP growth rate, the critical dependence of the economy on oil and gas exports, the volatility and undervaluation of the exchange rate, the small share of the manufacturing industry and the prolonged destruction of its fixed assets, the dependence on external sanctions, corruption. In all cases, this is the inefficiency of governance mechanisms. The problems of the development of the transport complex as an important component of the Russian economy, ensuring the balance of output of the construction and other types of economic activity were considered. Indicators of productivity potential, equilibrium index, output limits, indicative increments of output of branches are used to assess the influence of the transport complex component on the basis of the «input-output» model. Methods for analyzing the mechanisms of managing the developing economy systems are considered. On the basis of the model of the economic system in the mode of autonomy, methods of assessing productivity indicators have been developed. The procedure for calculating indicative dynamics of volume proportions of output for autonomous mode is considered. An example of the calculation results for the structure of the inter-industry balance of the Russian Federation is given.

Keywords: Balance, indicative increments, outputs, transport complex

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1. Introduction

The Russian economy, with its raw material orientation, is heavily dependent on external circumstances (energy market conditions, political situation). A pressing problem in the recovery of the economy is the effective reduction of this dependence.

The international division of labor allows individual national economic systems to have a structure in which a certain group of industries (in this case raw materials) is overburdened. Market mechanisms exacerbate this imbalance, as during periods of stable external conditions this hypertrophy minimizes production costs. The imbalance in the branches of the economy has increased the dependence of the national economy on the outside world and the instability of its development. A number of conditions need to be in place to avoid economic instability as a result of market self-regulation, such as a substantial and lasting change in the proportions of output of the economic activities concerned with sufficient resources and growth potential in other sectors, which cannot realistically be guaranteed.

The transport complex is an essential component of the national economic organism, and its development is associated with the presence of sufficient industries of the construction complex. In recent years, despite the dynamism of the transport sector, it has increasingly become a "bottleneck" of economic growth. The main constraints on the increase in the volume of goods transport are:

- underdevelopment of the transport and logistics system;
- considerable lag between the development of the road network and the motorization of society (the introduction of paved public roads is more than twice as high as in the early 2000s);
- insufficient development of export transport infrastructure (seaports, border crossings) Capacity constraints on railway lines;
- high cost of aviation fuel;
- underdeveloped airport network of the country.

At the same time, the measures being taken to develop the transport complex by 2030, will significantly improve the quality of the transport complex, which will be characterized by indicators.

2. Problem Statement

Development of the world, national and region economy has a cycle nature (Asea & Zak, 1999; Lin, 2018).

In the current context of economic downturn, there is a need to ensure not only a positive development trend, but also sufficient conditions for the realization of stable development, which may require a range of measures, including non-market measures. Stable development refers to a combination of positive changes in the long-term state of the economy, including adverse external influences.

The recovery package should include:

- Elimination of bottlenecks in economic development, which includes the transport complex of the Russian Federation.
- Diversification of the sectoral structure of the Russian economy.

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- Ensuring the self-sufficiency of the economy by reducing dependence on external factors (increasing its autonomous capacity).
- Establishing adequate mechanisms to manage the development of alternative (innovative) industries.
- Providing adequate resources for economic diversification.

Indicative planning is a promising tool for managing sustainable economy development (Abdikeyev, et al., 2017).

3. Research Questions

Innovations aimed at the stable, self-sufficient development of the economy are considered. For this purpose, a closed cost-release model of the Leontiev type (Leontief, 1977) is used.

The productivity of the economic system is determined by analogy with the efficiency factor in thermodynamics as $\pi = Y/Z$, where Z is intermediate input, Y is the added value (GDP), V is gross output. We denote material content $a = Z/V$, gross output $V = Y + Z$. Then:

$$\pi = (V\text{-}Z)/Z = 1/a - 1. \quad (1)$$

Because different models of the economy have different productivity, you can consider the task of choosing the model with the highest productivity value. Productivity potential of the economic system for the model of economy is defined as:

$$\pi^x = \max_{V,Z} \pi . \quad (2)$$

The reproduction model (Gusev, 2018) of a multi-product system defines the output multiplier (a measure of the productivity of the economic system) as a function of the structural proportions of outputs and the prices of outputs and services of industries. The maximization of this output-input indicator determines a balanced output-price structure corresponding to the reproduction regime, where the incremental shares are the same for all products and services.

4. Purpose of the Study

The purpose of considering the mechanisms for managing the developing economy systems is to develop the methods for calculation and analyzing indicators of productivity potential, equilibrium index, output limits and indicative increments of output of branches. They may be used to assess the influence of the transport complex component on the basis of the «input-output» model. Methods of assessing productivity indicators must be developed based on the model of the economic system in the mode of autonomy. For receiving the recommendations on the ways of obtaining the stability of economy system growth, the procedure for calculating indicative dynamics of volume proportions of output for autonomous mode must be developed. An example of the calculation results for the structure of the inter-industry balance of the Russian Federation is given.

5. Research Methods

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The conception of endogenous growth of an economic system (Bambi et al., 2014) is under consideration. Scheduling in systems with continuous-time dynamics usually apply optimal or sub-optimal methods (Sardarmehni & Heydari, 2018)

For the multi-product macro technology (Gusev, 2018) it is assumed that the direct input of industry *j* to output of products or services of type *i* is Z_{ij}, V_j - output of products and services of type *j,* a_{ij} - unit cost coefficients:

$$a_{ij} = Z_{ij} / V_j .$$

The cost-release model can be presented by the following ratio:

$$V_i(t) = \gamma \sum_{j=1}^{n} a_{ij} V_j(t), \tag{3}$$

where γ is the release multiplier. Optimization task statement for the output structure of V_i with the maximum output multiplier criterion γ is as follows:

$$\max_{Vi} \gamma. \tag{4}$$

The technological restriction on the output:

$$V_i(t) \geq \gamma \sum_{j=1}^{n} a_{ij} V_j(t). \tag{5}$$

The unit costs of a_{ij} product *j* for the production of *i* and the growth of output:

$$V_i(t) \geq V_i(t-1), i = 1,...,n. \tag{6}$$

For solving the problem of beeline programming (4), (5), (6) may be allied nonlinear optimal procedures (Murillo et al., 2015).

Then the productivity potential of the economic system for the model of the economy is:

$$\pi^x = \gamma - 1 \tag{7}$$

and represents the share of value added in the value of intermediate consumption under the equilibrium regime of the economic system. Since $\pi \leq \pi^x$, then always $\gamma \geq 1/a$; in equilibrium mode we have:

$$a = 1/\gamma. \tag{8}$$

Equilibrium of the economic system u = π/ π0 determines the degree of equilibrium of the system. Obviously,

$$0 \leq u \leq 1, \max u = 1. \tag{9}$$

6. Findings

6.1. Calculation of equilibrium output ratios

The values V_i are interpreted as proportional to the volume of transport services performed and the restrictions on them are:

$$V_i(t) \geq 1, i = 1,...,n. \tag{10}$$

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Using the data on the inter-industry balance, we will get equilibrium proportions of output for all activities (Bambi et al., 2014), including the transport complex. The productivity of the economic system according to this data is 94.4%.

Table 1. Indicative values of output growth in industries

Types of economic activity	Volume ratios ≥0.01
Agriculture, hunting and services in these areas	0.63
Production 2, 3, 10-16	2.30
Production 4, 6, 7, 8	9.10
Production of crude oil and natural gas; provision of services in these areas	7.88
Food production, including beverages	0.30
Coke production; petroleum products production	7.20
Chemical production (without powder and explosives)	3.78
Manufacture of rubber and plastic products	6.52
Production of other non-metallic mineral products	6.36
Steel production	7.49
Manufacture of finished metal products	7.06
Manufacture of machinery and equipment (without production of arms)	5.36
Manufacture of equipment 24-27	5.11
Manufacture of motor vehicles, trailers and semi-trailers	3,75
Manufacture of ships, aircraft, spacecraft and other means of transport; manufacture of other engineering and petrochemical products	5.13
Production of furniture and other products not elsewhere classified	1.10
Treatment of secondary raw materials	15.67
Production, transmission and distribution of electricity, gas, steam and hot water	18.11
Water collection, treatment and distribution	8.26
Construction	2.11
Sale, maintenance and repair of motor vehicles and motorcycles (without retail motor fuels)	9.20
Wholesale trade, including trading through agents other than motor vehicles and motorcycles	22.02
Retail trade other than motor vehicles and motorcycles; repair of household and personal	0.32

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Types of economic activity	Volume ratios ≥0.01
items; retail sale of motor fuels	
Hotels and restaurants	1.83
Land transport activities	21.36
Water transport activities	10.35
Air and space transport activities	4.21
Transport support and ancillary activities	19.76
Link	4.67
Financial intermediation	11.09
Real estate transactions	6.65
Support activities 31-34	18.57
Computing and information technology activities	11.25
Provision of other services	13.55
Public administration and military security; social insurance	0.55
Education	0.50
Health and social services	0.21
Service delivery 55-59	0.63

The table shows that a transport complex comprising land transport, water transport, air and space transport activities, ancillary and additional transport activities require a substantial increase in the volume of work performed, among other activities. Land transport activities need to be maximized (this is also one of the largest increases among all industries).

6.2. Indicative plans for the development of the transport complex

At the short time implementing a change in the output structure, making them equilibrium according to the table 1, is impossible. In order to determine the most rational plan for the development of the industry, the following mission statement can be used: maximum output multiplier criterion γ (4), technological restriction on output (5) and a condition for a growth rate of 1.5 per cycle:

$$V_i(t) \le 1{,}5\,V_i(t-1), i = 1,..., n. \quad (11)$$

In order to record the results of the previous clock, the direct cost coefficients shall be recalculated:

$$\overline{a_{ij}} = a_{ij} \cdot V_i / V_j . \quad (12)$$

The latter transform does not change the spectrum of the direct input matrix A (its eigen numbers and eigenvectors).

By repeating these procedures from tact to tact, we get an indicative multi-stroke plan-forecast of the joint development of the construction industry and the transport complex.

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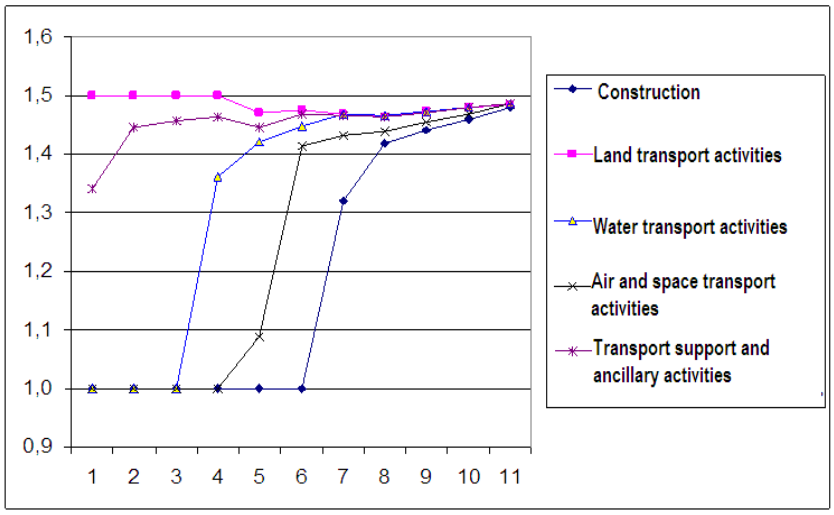
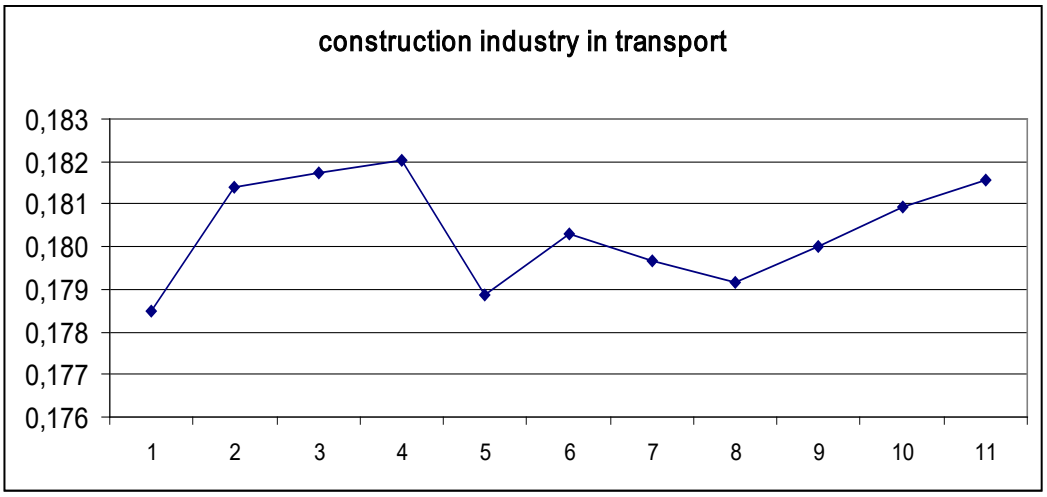
Starting with the tact 6 (figure 1), the ratio of transport service volumes is evened out (the proportions become almost identical), while the proportions of other activities differ. This shows the great importance of the transport complex for the development of the economy of the Russian Federation.



Indicative plan-forecast for the joint development of the construction industry and transport complex

Each cycle of an indicative plan may take up a certain calendar time required to achieve the relevant indicators.



The indicative forecast for the development of the share of the construction industry engaged in the development of the transport complex

The share of the construction industry engaged in the development of the transport complex (figure 2) varies relatively little, fluctuating about the value of 0.18. Indeed the main part of consumption is that the construction industry activities belong to the land transport activities, the share of which is the maximum.

7. Conclusion

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The long-term model of financing the transport sector envisages the development of various forms of public-private partnership, increasing the availability of credit resources by subsidizing part of the interest rates from the federal budget, stimulation of the development of leasing activities, assistance in protection and insurance of capital of private investors, use of transport bonds. Credit and leasing are expected to play an important role in railway, air and maritime investment programs.

A set of measures for the recovery of the economy against adverse external influences, ensuring the self-sufficiency of the economy by diversifying it, reducing dependence on external factors (Abdikeyev et al., 2017) (enhancing its autonomous capacity), should include:

- Demonopolization of some of the most critical industries requires that the growth conditions of the enterprises concerned be ensured.
- Mechanisms for monitoring the structural performance of the economy, using estimates of potential productivity values and sectoral output ratios.
- Control of investment flows for first-line industries by their contribution to GDP growth.
- Control of price growth for industries, according to estimates of intervals of their acceptable changes.
- Sufficient resources to diversify the economy, which is possible if sufficient resources, are diverted from the extractive sector to the development of innovative industries.
- Mechanisms for managing the development of alternative innovative industries with the characteristic of self-regulation.

These measures, which constitute a transitional stage in the diversification of the Russian Federation's economy, may be temporary. They represent possible mechanisms for the response of the economic system to external shocks. As these effects change in a favorable direction, the need for economic recovery measures may disappear, but the readiness and efficiency of the mechanisms must be maintained. Indicative planning is a promising tool for managing sustainable, innovative economy development. For constructing this tool the applying of computation methods of robust control is perspective (Arunkumar et al., 2018).

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