MULTIREGIONAL MODELS IN LONG-TERM FORECASTING

ECONOMIC DEVELOPMENT

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ABSTRACT

The paper presents some new opportunities of I-O models as tools of long-term forecasting spatial development as well as the modeling of structural shifts in the national economic space. The authors have developed an operable model-program complex including 'point' and 'spatial' models of the national economy. Both models have 27-sector nomenclature including detailed fuel sector. The point model (dynamic optimization I-O model) is designated for auxiliary purposes. It is used for matching scenario forecasts of trends in input-output, capital-output and labor-output ratios for 2020 that are to be used in our multi-regional model database. Then alternative forecasts to 2020 were realized on the multi-regional I-O model of vector optimization. This model reflects new administrative division of Russia by 7 federal okrugs and distinguishes Tyumen oblast as a foremost region in the world energy strategy. This required for regionalization of Russia's I-O tables of 2003 and projecting them for 2005 base year so that their sum is equal to the I-O table from point model. Growing openness of the national economy was taken into account through dividing foreign markets by 3 geographic directions. The point model gave forecasts of macroeconomic indicators that were biased upwards in comparison with the interregional model. We estimate the prospects and consequences of uneven regional economic growth, of intensifying interregional exchange between different regions.

1. Introduction

This paper presents results of studies in forecasting economic development of Russia and some large regions realized in 2003-2007. Despite of our earlier works based on the use of I-O models the current studies are applied in character. They serve as a basis for developing long-term forecasts of Russia's economy development that are realized by authors in collaboration with the Ministry of Economic Development and Trade.

1.1 Empirical background

Under current macroeconomic conditions in Russia long-term forecasts become urgent again as the Russian economy follows a relatively stable trajectory of development since 2000. The national economy as well as its large regions (federal okrugs) has shown stable growth for 7 years. In 2001-2006 Russian GDP increased by 6,2% per annum on average, gross fixed investment – by 11,4% and real disposable incomes of population – by 11,2%.

The growth remained to be driven by rapidly growing consumer demand of population as well as of firms, which was possible owing to the significant enhancement of terms of trade and to the availability of large reserves of productive capacities. In 2001-2005 average annual growth rates of final demand expenditures came to 7,6%, imports playing increasing role in providing the demand. Average annual growth rates of import were equal to 18,4%. Export growth rates were less by half, which paradoxically did not prevent trade balance from further strengthening that went on despite of deceleration of physical increase in exports thanks to high oil and gas prices. As the result of 2005 the Federal budget surplus came to 7,4% of GDP including 6,3% falling to the share of the Stabilization Fund.[1]

But there were some negative factors that gave grounds for pessimism about prospects of growth in the future: lagging in industrial sector that grew in average by 5,3% per annum in 2001-2005; this is a low ratio of investment to the GDP (18%) as well as concentration of investments

[1] www.budgetrf.ru/Publications/ Magazines/eeg/eegrei_index.htm

in oil and gas industries. The last issue was an object of an annual report of the World Bank (2004) in which the sectoral pattern of Russian GDP was re-estimated in the favor of oil and gas industries.

At region's level rates of economic development differed substantially. Dynamics of gross regional product (GRP) is affected mainly by changes in domestic effective demand of a region because services and products produced in the region form about 60% of its GRP. Interregional differentials in production per capita an in money incomes of population remain significant. The list of leading regions changes annually. Nevertheless, some regularity of regional dynamics becomes apparent: Central, Urals and Northwest federal districts are members of leader's group with 7% and more of average annual growth in 2001-2005. Southern federal district joins this group time to time. Then Siberian district follows with the rate of 6,6%, Volga (5,5%) and Far Eastern (5,6%) federal districts because of their specialization in manufacturing. Thus, economic growth rates weaken towards to the east and the regional convergence expected is not evident. In general, interregional differentials in growth rates became less than in 90ies.

Changes in spatial pattern of production come to the further increase of leading regions shares in Russian gross regional product (these are Central, Urals and since 2004 Northwest federal districts) as well as to the decrease of lagging regions shares. GRP per capita indices do not converge too: Central district's excess over the national average index increased from 5 p.p. in 1997 to 20 p.p. in 2004, whereas the Urals share was twice as much of national average, and the Southern one was less than a half of it. Such regional diversity calls for consideration of all seven federal districts in modeling as well as distinguishing Tyumen oblast as exclusive Russia's exporter.

1.2. Organizational framework of the forecast presented

At the stage of market reforms and system crisis of Russian economy an interest in long-term forecasts was lost to a considerable degree. However it was as early as 1995 when a legal framework of state economic forecasting was formed by the federal law "About state forecasting

and programs of socio economic development of Russian federation" This law stipulates developing short-term, mid-term and long-term forecasts with time-frames of 1, 3-5 and 10 years, correspondingly, with a consequent Concept of Socio-economic Development of Russian Federation for 10 years. Nevertheless, till recently the main customer and developer of the forecast – Ministry of Economic development and Trade – concentrated its efforts on short-term and mid-term forecasts not paying too much attention to a regional component.

These documents use standard name "Forecast of socio-economic development of Russian Federation for t^{th} year and basic parameters by $(t+2)^{th}$ year" and are published and adjusted annually, since 2001. The forecast for 2003-2005 did not yet go beyond forecasting some macroeconomic and sectoral indices according 2 scenarios of more or less favorable combinations of external and internal conditions[2]. Then the next (for 2004-2006) forecast included a mid-term forecast of regional economic development by clusters of less and more developed territorial units. This forecast was developed in isolation of macroeconomic scenarios and did not consider regional interactions.

As outlook of economic growth in Russia became more evident, a need in extension of forecast time-frames became urgent. Then in the draft of Program of Socio-economic development of Russian federation for mid-term prospect (2006-2008) a section of long-term forecast (by 2015) has appeared. It was developed with the aim of estimating conditions and factors for accelerating growth ("doubling GDP in 10 years"), struggle against poverty and other targets[3]. In regional subsection of the forecast regional growth rates were presented as dependent variables on macroeconomic conditions while regions were grouped by their industrial pattern, irrespective of their geographic location and even their names.

[2]. www.economy.gov.ru
[3] Ibid.

Periodically the regional section of the forecasts was subject to criticism of experts, particularly of Institute of Transition Economics [4]. It became apparent that qualified analysis of spatial economic development requires for taking into account geographical location of regional economies and for modeling interregional economic relations that reveal in mutual exchange by products and services. In this paper, we present an approach to modeling spatial economic development for prospect of 2020 approved in the framework of our study for the Ministry.

The paper is organized as follows. Section 2 is a brief summary of model complex including optimization input-output dynamic "point" model of Russian economy and optimization multiregional input-output semidynamic model. In Section 3, we then describe the main results of the long-term forecast of spatial development of Russian economy for 2020 according to "mild-optimistic" and "optimistic" scenarios. The final section contains some concluding remarks. Sectoral and regional classifications, formal statements of models and results of calculations enter in Appendices.

2. Design of the model complex

2.1. Input-Output models in modern use.

Input-output models continue in demand among regional economists. Progress in this field is a subject for annual International Conference on Input-Output Techniques. Large countries with evident interregional differentiation such as China (Okamoto, 2003), Japan (Yamaho, 2005) or Brazil (Hewings, 2006) serve as natural objects for these models. Being fully aware of limitations imposed on these models, researchers choose them because they give an opportunity to get a desired level of sectoral and regional disaggregation in view of data limitations, which is necessary for qualified analysis of mutual relations between national and regional economies as well as sectoral and regional interactions. The limitations following from technical assumptions are restrained at the stage of preparing data, which makes higher demands to preliminary

[4] http://monitoring.iet.ru

forecasts. Particularly, the permanent problem of regionalization of input-output tables in the conditions of their absence stimulated development of various adjustment techniques described by Canning (2005) and Lahr (2004).

Relaxation of the restrictive assumptions of I-O models is achieved through their integration with econometric models too (Rey, 2000). This way looks promising, but requires for more extensive data and produces specific hardship, in part with interpretation of interregional linkages, which complicates practical realization of these models.

The current economic dynamics of Russian economy allows restoring the scope of application for I-O models because their limitations in behavioral representations under economic decline are not urgent. Now I-O models confirm their advantages of relative simplicity in data preparation and instrumental realization that built up their reputation of a practical version of the Walras general equilibrium theory.

2.2. Characters of the approach

Our approach may be characterized by principle “From general to particular”. We draw general trends or a preliminary draft of forecast from an optimization input-output dynamic model of Russian economy not taking into account geographical location of resources and their degree of mobility. Then we develop a spatial forecast with the use of semidynamic optimization multiregional input-output model in the cut of 8 macroregions (7 federal districts with the separation of Tyumen oblast). Both models are presented in the cut of 27 industries and sectors. Regions and sectors are listed in Appendix A.

This approach is substantiated by the empirical fact that, in modeling regional economies, national economy factors have critical importance in comparison with specific regional factors. So, a regional forecast developed in isolation of national economic conditions would be characterized by lower quality. In developing model databases, hypotheses of future trends of input, capital and labour coefficients, of exports and imports, of market prices are of fundamental

importance. So it is advisable to work through “ex-regional” problems on the “point” model (not considering regional division) that is a simplified analog of multiregional I-O model.

The model complex may be used for solving the following problems: 1) a forecast of economic development in the cut of large regions on the basis of forecasts of changes in technologies, productive capacities, resources and external conditions; 2) estimation of changes in input coefficients needed for achieving some prescribed results as, for instance, well-known “doubling GDP in 10 years”.

2.3. Point model

This is an optimization input-output dynamic model that uses year 2005 as a base. It has three forecast periods – 2005-2010, 2011-2015 and 2016-2020. An objective function includes household and social consumption. This is a maximized part of final demand. Hereinafter we use term “final demand” in the sense of its maximized part. The formal statement of the model is presented in Appendix B.

The initial I-O table for 2005 was estimated on the base of Rosstat’s annual input-output tables as of 2002 (Rosstat, 2005) In forecasting input ratios for 2020 we took in account retrospective trends with price control as well as degrees of utilization of productive capacities. Moreover, we had possibility to use independent estimates of the Ministry of Economics and Trade developed on econometric models.

This model functions as auxiliary for building database of the multiregional model. Its optimal solution gives a projected input-output table of Russian economy for 2020.

2.4. Spatial model

Optimization multiregional input-output model functions as a principal tool in the model complex. Applied models of this type were introduced into Russian scientific practice by A. Granberg (1978) on the ideological basis created by W. Leontief, W. Isard, L. Moses. The model is combined of regional blocks (regional models of federal districts) by means of conditions of

interregional transport and conditions on regional patterns of final demand. This is a problem of linear programming of high dimensionality. The model has a forecast period from 2005 to 2020.

Each region is presented by semidynamic I-O model that calculates a state of regional economy for the last year of the forecast period. The basic restrictions of the model are balances of supply and demand over regions, industries, directions of transportation that have a sense that it is impossible to consume and export more products and services than it was produced and imported. So, any solution of a regional block shows one of possible states of regional economy meeting the needs of the nation and of region's population.

The formal statement of the model is presented in details in Appendix C. Each regional block includes balance restrictions on production and consumption of commodities and services, restrictions on labor resources, investments, and trade balances, as well as restrictions on value of outputs, imports and exports. Investments of the base year and of the last year of the forecast period are connected by function $f\left(u_g^{r0}, u_g^{r1}\right)$ that is based on a hypothesis about constant growth rates within each period (a hypothesis of exponential law). This function may be linearized with any degree of accuracy, which allows staying in the frames of linear problem.

2.5. Operational scheme

The model complex works as follows.

The initial point is the estimated I-O- table of national economy for 2005. Then we formulate basic premises concerning expected trends in exogenous parameters and solve optimization problem in 3 periods: 2006-2010, 2011-2015 and 2016-2020. As a result a projected I-O table of Russian economy for 2020 is obtained.

Independently of this, spatial extension of the national I-O table is performed. Regional I-O tables for 2005 were constructed on the basis of our estimated I-O table for Russia. The last was regionalized with the use of the static multiregional model under control of row and column totals. The formal methods of bi-proportional adjustment were applied only if empirics were absent and coefficients in hand did not have high weight ratios. The result obtained is a set of

consistent regional I-O tables of 2005 in the sense that a sum of eight I-O tables precisely coincides with estimated Russia's I-O table for 2005.

Then, having national forecast for 2020 and regional specification for 2005, we develop premises about future trends in regional coefficients with account of existing productive capacity restrictions and active investment projects as well as retrospective changes; assumptions about expected changes in regional patterns of final demand, about demographic situation, about future changes in market prices and opportunities of financing large national projects and so on.

In realization of multiregional model factors of geographic location and immobility of resources are taken into account. As a result we have obtained a system of projected regional I-O tables for 2020 that do not add up to projected Russia's I-O table for 2020. Aggregation of regional functionals (that is, maximized part of final demand) turns out to be less than the same index for Russian economy obtained from the "point" model.

3. Long-term forecast of spatial development of Russian economy for 2020

3.1. General premises

We worked out 2 sets of initial pre-conditions that constitute "mild-optimistic" and "optimistic" scenarios of Russian economic development. Both variants assume relatively bleak prospects for export growth, but expect for forward import growth, which implies the higher degree of the use of export earnings (current and accumulated earlier) for the sake of the national economy. Such assumption follows from the current state of Russia's trade balance and from favorable forecasts for market prices. Both scenarios do not suppose any radical changes in characters of the current model of Russian economy. But the "base" variant assumes more conservative hypotheses of labor saving and reduction of costs. It includes a pre-condition of maintaining a positive trade balance in large scale and moderate forecast of foreign investment inflow.

The main factor that is expected to influence for economic dynamics favorably is a cut of trade balance that will be spent for domestic consumption and saving. This implies a growth of

government spending, partially at the cost of the cut of the federal budget surplus. The base variant allows for adaptation to worsening of market prices at the cost of trade balance shrinkage. This is realized through relaxation of restrictions on trade balance to admissible limit including foreign debt service and Central bank currency reserves. The second variant assumes for spending export earnings earlier and in larger scale. It is expected that the policy of budget surplus will be gradually turned to the non-deficit budget policy. So, the "optimistic" scenario requires for maintaining the favorable state of foreign markets, otherwise the cut of trade balance becomes inadmissible.

3.2. Results of the dynamic model realization

The forecast for 2020 according to the **"mild-optimistic**" scenario gave the following results (See Table 1). The ranking of growth rates looks as follows. Investments increased rapidly: annual average growth rates of investments amounted to 8,6% in 2006-2020. Then indices of final demand follow (6,6%); the GDP (5,7%); gross output (5,4%). All indices decrease in the 2nd and 3rd periods. The proportions of growth are provided by forward import growth. The gap between export and import rates shortens so that a share of exports in gross output decreases while a share of imports in consumption grows. The lowering of investment growth rates follows from the change in production pattern in the favor of less capital-intensive industries.

Summing up, the GDP used for domestic consumption and savings demonstrates higher growth rates than the GDP produced at the cost of slowing down exports and accelerating imports. After 2010 a proportion of final demand to savings changes in the favor of the latter. This scenario corresponds to the rise of competitiveness of domestic producers: first, in import substitution, next, on foreign markets.

Table 1

Basic parameters of the forecast according to "mild optimistic" scenario

	Annual average growth rate (in percentage)			
	2006-2010	2011-2015	2016-2020	2006-2020
Gross output	106,1	105,3	104,9	105,4
GDP (in producer prices)	106,2	105,6	105,3	105,7
Fixed stock investments,	109,6	108,6	107,5	108,6
Final demand,	109,5	105,7	104,7	106,6
Productivity of labour	106,0	105,9	105,5	105,8
Exports	102,9	103,5	103,6	103,4
Imports	114,0	106,1	104,2	108,0

The "**optimistic**" variant allows for the use of potential of accelerating economic growth in greater measure. So all basic macro-indicators of growth demonstrate higher values while the ranking of projected indices does not change (See Table 2). The basic hypothesis concerned to possibility of maintaining and even increasing labour productivity rates. The GDP increases by 6,5% annually, partially at the cost of industrial products that prevent a share of industries in the GDP from rapid decrease.

The "optimistic" scenario" is characterized by the growing role of domestic market in forming a value of final demand. Annual average rates of import growth are close to the "mild-optimistic" scenario as well as foreign trade balance remains to be close to zero. Investments growth rates are equal to 109,8% per annum so that the ratio of investments to the total of demand and savings rises. Growth rates of the GDP and of gross output converge because a share of relatively material-intensive industries (machinery) increases.

Table 2

Basic parameters of the forecast according to “optimistic” scenario

	Annual average growth rate (in percentage)			
	2006-2010	2011-2015	2016-2020	2006-2020
Gross output	106,5	106,2	106,2	106,3
GDP (in producer prices)	106,5	106,4	106,6	106,5
Fixed stock investments,	110,9	110,3	108,2	109,8
Final demand,	109,5	106,2	106,1	107,3
Productivity of labour	106,4	106,7	106,8	106,6
Exports	103,1	103,6	103,8	103,5
Imports	114,1	106,2	104,5	108,2

3.3. Results of the multiregional model realization

Basic results of the long-term spatial forecast according **to “mild-optimistic”** scenario are presented in Table 3. The optimization multiregional I-O model in one-period statement (2006-2020) was realized under common (with point model) assumptions about national economic trends. In general, the results of the ”point” model are repeated. So the ranking of projected indices remains to be valid: investment growth rates are the highest (8.6% annually), then maximized part of final demand (6.5%), gross regional product (5,5%) and output (5.2%) follow. Investment indices demonstrate maximal regional differentiation while regional final demand levels tend to equalize. Trends of shifting investment activities from the West to the East appear.

The effect of base is evident. So the poorest and lagged Southern federal district shows the highest rates of output and final demand while the Central district has minimal indices if growth. Production in Tyumen oblast grows at lowest rate because of high share of oil extracting while increases in this industry are projected less than 1% per annum. Regions with new hydrocarbon

deposits invest more intensively in their development and conjugated transport infrastructure. So, Northwest, Siberian and far Eastern districts lead in investments rates. At the same time the spatial pattern of industrial output changes in the favour of western regions.

Table 3

"Mild-optimistic" variant – basic macroeconomic indicators

Regions	RF	CFD	NWFD	SoFD	VFD	UFD-Tyu	Tyu	SiFD	FEFD
Gross output									
Growth rate for 2006-2020 , %%	214.8	214.8	224.1	238.6	214.5	217.2	164.7	224.2	219.3
Annual average growth rate , %%	105.2	105.2	105.5	106.0	105.2	105.3	103.4	105.5	105.4
GRP									
Growth rate for 2006-2020 , %%	224.5	219.5	236.7	253.2	230.2	234.4	163.1	245.7	236.6
Annual average growth rate, %%	105.5	105.4	105.9	106.4	105.7	105.8	103.3	106.2	105.9
Final demand									
Growth rate for 2006-2020 , %%	258.1	221.1	266.5	281.7	288.2	268.1	271.2	288.5	278.2
Annual average growth rate, %	106.5	105.4	106.8	107.1	107.3	106.8	106.9	107.3	107.1
Investments									
Growth rate for 2006-2020 , %%	343.1	254.1	291.0	312.7	359.7	385.1	414.4	551.9	336.5
Annual average growth rate, %%	108.6	106.4	107.4	107.9	108.9	109.4	109.9	112.1	108.4

Remark. Names of regions and abbreviations are listed in Appendix A

The main feature of the forecast period is reduction of variation in regional growth rates in relation to the pre-forecast period (1990-2005). This tendency is dominated by changes in regional pattern of final demand. It strengthens because of rising shares of non-transportable industries and services in regional production and consumption. Another factor of stabilization of spatial pattern of production is the strong interdependency of regional economies (growth in one region has a positive influence on another).

Changes in sectoral pattern of regional production correspond to general trends: lowering in percentage of industries and agriculture and rise of transports, communications and other services. (Appendix D represents the results by sectors) This happens due to the changes in

sectoral pattern of final demand as well as to projected changes in input ratios. At the same time the sectoral pattern of industry changes in the favour of machinery, chemicals and petrochemicals. Shares of fuel-extracting and processing industries will decline as well as shares of metallurgy and food industry. Industrial growth will lead to the rise of demand for electricity. In general, spatial patterns change to a greater extent than sectoral patterns of basic indices, but on the level of regions industrial pattern is more volatile.

Another principal result of the "base" scenario realization is that spatial disaggregating, that is, replacing each national condition by eight regional conditions and adding conditions of interregional trade-transportation links, brings to the cut of the main resulting parameter (maximized part of final demand) and other macroeconomic indices.

"Optimistic" scenario was realized under the national economic premises accepted in the "point" model from the viewpoint of maintaining favourable terms of trade. Many of exogenous parameters remained unaltered such as restrictions of employment, spatial and sectoral patterns of final demand, input-output and capital-output ratios. The basic distinction of this scenario is a hypothesis about possibility of achieving higher rates of labour productivity. Another feature is an assumption about higher growth rates of ruble money supply and, correspondingly, of domestic effective demand. The last premise may be realized in case of stable increase in positive balance of foreign currency inflow and outflow (at decreasing trade balance it is possible only if foreign investments will rise rapidly) as well as in case of the current system of backing of the national currency is changed. (Now this system sets up the growth of ruble money supply to direct relation with scales of gold and foreign currency reserves of the Central Bank.) Table 4 represents the basic results.

This scenario produced higher projected indices though relationship between them did not change: investment growth rates are the highest (10,4% annually), then maximized part of final demand (6.9%), gross regional product (GRP) (6,3%) and output (6,1%) follow. At the same time indices aggregated over regions are lower than in the "point" model.

Table 4

"Optimistic" variant – basic macroeconomic indicators

Regions	RF	CFD	NWFD	SoFD	VFD	UFD-Tyu	Tyu	SiFD	FEFD
Gross output									
Growth rate for 2006-2020 , %%	244,6	242,1	257,5	266,6	247,9	250,3	176,4	263,0	252,9
Annual average growth rate , %%	106,1	106,1	106,5	106,8	106,2	106,3	103,9	106,7	106,4
GRP									
Growth rate for 2006-2020 , %%	251,5	239,1	269,0	280,0	262,7	272,9	174,0	286,0	269,5
Annual average growth rate, %%	106,3	106,0	106,8	107,1	106,6	106,9	103,8	107,2	106,8
Final demand									
Growth rate for 2006-2020 , %%	272,9	233,8	281,7	297,8	304,7	283,5	286,8	305,1	294,1
Annual average growth rate, %	106,9	105,8	107,2	107,5	107,7	107,2	107,3	107,7	107,5
Investments									
Growth rate for 2006-2020 , %%	438,6	333,2	370,2	389,1	479,6	534,1	457,5	727,3	431,1
Annual average growth rate, %%	110,4	108,4	109,1	109,5	111,0	111,8	110,7	114,1	110,2

Regional differentiation of growth rates of output, of gross regional product and of investments has grown. This is a consequence of leading growth of manufacturing under constant spatial pattern of final demand (its maximized part). As a result a share of fuel industries in total output fell to lower mark in comparison with the previous scenario. Appendix E represents the results by sectors.

Summing up, our calculations revealed that in the conditions of forward growth of imports relative to exports domestic market gains in importance. It results in the forward growth of interregional exchange in comparison with production growth. One should expect a rise of interdependency of regional economies.

5. Conclusion

So far, we explained an applicability of the model complex consisting of "point" and "spatial" optimization input-output models for studies of regional economic growth and interregional economic relations. This approach proves to result in consistent aggregates of regional and sectoral forecasts in the conditions of limited information and time constraints. We presented a forecast of spatial development of Russia's economy for 2020 with account of limited opportunities of spending export earnings for stimulating regional growth.

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Appendix A

Industrial classification

1. Power industry.

2. Oil producing.

3. Oil processing.

4. Gas producing.

5. Coal mining.

6. Extraction of ores and nonmetallic for ferrous metallurgy.

7. Ferrous metallurgy (excluding ores).

8. Extraction of nonferrous metal ores.

9. Nonferrous metallurgy (excluding ores).

10. Chemical industry.

11. Petrochemical industry.

12. Machine-building.

13. Logging and wood industry

14. Pulp and paper industry

15. Building materials industry.

16. Light industry

17. Food industry

18. Other industries.

19. Construction

20. Agriculture and forestry

21. Transport and communication

22. Trade, public catering, logistics and procurement.

23. Other sectors.

24. Housing, communal and consumer services/

25. Public health, social maintenance, education, culture and arts.

26. Other services (real estate activities, commercial activities, and geology, meteorology, science and science services).

27. Government, finances, nongovernmental associations.

Remark. The last four sectors are considered as non-transportable products

List of regions and abbreviations

1. Central federal district (CFD)

2. Northwest federal district (NWFD)

3. Volga federal district (VFD)

4. Southern federal district (SoFD

5. Urals federal district excluding Tyumen oblast (UFD-Tyu)

6. Tyumen oblast (Tyu)

7. Siberian federal district (SiFD)

8. Far Eastern federal district (FEFD)

Formal statement of optimization input-output dynamic model of the Russia's economy

Balances of production and distribution of products

for 2010:

$$x_i^0 + x_i^1 - \sum_{j=1}^{n} a_{ij}^{01} x_j^0 - \sum_{j=1}^{n} a_{ij}^{11} x_j^1 - \alpha_i^1 z^1 - v_i^1 + w_i^1 \geq b_i^1; i = 1,...,n; \quad (1)$$

for 2015:

$$x_i^0 + x_i^1 + x_i^2 - \sum_{j=1}^{n} a_{ij}^{02} x_j^0 - \sum_{j=1}^{n} a_{ij}^{12} x_j^1 - \sum_{j=1}^{n} a_{ij}^{22} x_j^2 - \alpha_i^2 z^2 - v_i^2 + w_i^2 \geq b_i^2; i = 1,...,n; \quad (2)$$

for 2020:

$$x_i^0 + x_i^1 + x_i^2 + x_i^3 - \sum_{j=1}^{n} a_{ij}^{03} x_j^0 - \sum_{j=1}^{n} a_{ij}^{13} x_j^1 - \sum_{j=1}^{n} a_{ij}^{23} x_j^2 - \sum_{j=1}^{n} a_{ij}^{33} x_j^3 - \alpha_i^3 z^3 - v_i^3 + w_i^3 \geq b_i^3; i = 1,...,n; \quad (3)$$

corresponding restrictions for capital-forming sectors:

$$x_g^0 + x_g^1 - \sum_{j=1}^{n} a_{gj}^{01} x_j^0 - \sum_{j=1}^{n} a_{gj}^{11} x_j^1 - u_g^1 - \alpha_g^1 z^1 - v_g^1 + w_g^1 \geq b_g^1; g \in G; \quad (4)$$

$$x_g^0 + x_g^1 + x_g^2 - \sum_{j=1}^{n} a_{gj}^{02} x_j^0 - \sum_{j=1}^{n} a_{gj}^{12} x_j^1 - \sum_{j=1}^{n} a_{gj}^{22} x_j^2 - u_g^2 - \alpha_g^2 z^2 - v_g^2 + w_g^2 \geq b_g^2; g \in G; \quad (5)$$

$$x_g^0 + x_g^1 + x_g^2 + x_g^3 - \sum_{j=1}^{n} a_{gj}^{03} x_j^0 - \sum_{j=1}^{n} a_{gj}^{13} x_j^1 - \sum_{j=1}^{n} a_{gj}^{23} x_j^2 - \sum_{j=1}^{n} a_{gj}^{33} x_j^3 - u_g^3 - \alpha_g^3 z^3 - v_g^3 + w_g^3 \geq b_g^3; g \in G; \quad (6)$$

corresponding restrictions for the sector of transport ($i = \tau$):

$$x_\tau^0 + x_\tau^1 - \sum_{j=1}^{n} a_{\tau j}^{01} x_j^0 - \sum_{j=1}^{n} a_{\tau j}^{11} x_j^1 - \alpha_\tau^1 z^1 - \sum_{j=1}^{n} c_{\tau j}^{v1} v_j^1 - \sum_{j=1}^{n} c_{\tau j}^{w1} w_j^1 \geq b_\tau^1; \quad (7)$$

$$x_\tau^0 + x_\tau^1 + x_\tau^2 - \sum_{j=1}^{n} a_{\tau j}^{02} x_j^0 - \sum_{j=1}^{n} a_{\tau j}^{12} x_j^1 - \sum_{j=1}^{n} a_{\tau j}^{22} x_j^2 - \alpha_\tau^2 z^2 - \sum_{j=1}^{n} c_{\tau j}^{v2} v_j^2 - \sum_{j=1}^{n} c_{\tau j}^{w2} w_j^2 \geq b_\tau^2; \quad (8)$$

$$x_\tau^0 + x_\tau^1 + x_\tau^2 + x_\tau^3 - \sum_{j=1}^{n} a_{\tau j}^{03} x_j^0 - \sum_{j=1}^{n} a_{\tau j}^{13} x_j^1 - \sum_{j=1}^{n} a_{\tau j}^{23} x_j^2 - \sum_{j=1}^{n} a_{\tau j}^{33} x_j^3 - \alpha_\tau^3 z^3 - \sum_{j=1}^{n} c_{\tau j}^{v3} v_j^3 - \sum_{j=1}^{n} c_{\tau j}^{w3} w_j^3 \geq b_\tau^3; \quad (9)$$

Balances of labor resources:

for 2010:

$$\sum_{j=1}^{n} t_j^{01} x_j^0 + \sum_{j=1}^{n} t_j^{11} x_j^1 \le T_1; \tag{10}$$

for 2015:

$$\sum_{j=1}^{n} t_j^{02} x_j^0 + \sum_{j=1}^{n} t_j^{12} x_j^1 + \sum_{j=1}^{n} t_j^{22} x_j^2 \le T_2; \tag{11}$$

for 2020:

$$\sum_{j=1}^{n} t_j^{03} x_j^0 + \sum_{j=1}^{n} t_j^{13} x_j^1 + \sum_{j=1}^{n} t_j^{23} x_j^2 + \sum_{j=1}^{n} t_j^{33} x_j^3 \le T_3; \tag{12}$$

Balances of investments:

at period 1 (2006-2010):

$$\sum_{j=1}^{n} k_{gj}^{01} x_j^0 + \sum_{j=1}^{n} k_{gj}^{11} x_j^1 - f_1(u_g^0, u_g^1) \le 0; \; g \in G; \tag{13}$$

at period 2 (2011-2020):

$$\sum_{j=1}^{n} k_{gj}^{02} x_j^0 + \sum_{j=1}^{n} k_{gj}^{12} x_j^1 + \sum_{j=1}^{n} k_{gj}^{22} x_j^2 - f_2(u_g^1, u_g^2) \le 0; \; g \in G; \tag{14}$$

at period 3 (2016-2020):

$$\sum_{j=1}^{n} k_{gj}^{03} x_j^0 + \sum_{j=1}^{n} k_{gj}^{13} x_j^1 + \sum_{j=1}^{n} k_{gj}^{23} x_j^3 + \sum_{j=1}^{n} k_{gj}^{33} x_j^3 - f_3(u_g^2, u_g^3) \le 0; \; g \in G; \tag{15}$$

Foreign trade balances:

for 2010:

$$\sum_{j=1}^{n} \beta_j^1 v_j^1 - \sum_{j=1}^{n} \gamma_j^1 w_j^1 \ge Q_1; \tag{16}$$

for 2015:

$$\sum_{j=1}^{n} \beta_j^2 v_j^2 - \sum_{j=1}^{n} \gamma_j^2 w_j^2 \ge Q_2; \tag{17}$$

for 2020:

$$\sum_{j=1}^{n} \beta_j^3 v_j^3 - \sum_{j=1}^{n} \gamma_j^3 w^3 \geq Q^3; \quad (18)$$

Restrictions on outputs and increases in outputs:

$$x_j^0 \leq d_j^0; x_j^1 \leq d_j^1; x_j^2 \leq d_j^2; x_j^3 \leq d_j^3; \; j = 1,...,n; \quad (19)$$

Restrictions on maximum and minimum exports and imports:

$$q_j^1 \leq v_j^1 \leq \overline{q}_j^1; q_j^2 \leq v_j^2 \leq \overline{q}_j^2; q_j^3 \leq v_j^3 \leq \overline{q}_j^3; \; p_j^1 \leq w_j^1 \leq \overline{p}_j^1; \; p_j^2 \leq w_j^2 \leq \overline{p}_j^2; p_j^3 \leq w_j^3 \leq \overline{p}_j^3; \; j = 1,...,n; \quad (20)$$

Objective function:

$$z^1 + \delta^1 z^2 + \delta^2 z^3 \rightarrow max;$$

List of symbols:

Variables:

x_i^0 - base output in sector *i* (as of 2005);

x_i^1 - increase in output of sector *i* over a period 1 (2006 – 2010);

x_i^2 - increase in output of sector *i* over a period 2 (2011 – 2015);

x_i^3 - increase in output of sector *i* over a period 3 (2016 – 2020);

z^1 - value of maximized part of final demand in 2010;

z^2 - value of maximized part of final demand in 2015;

z^3 - value of maximized part of final demand in 2020;

v_i^1 - export of products of sector *i* in 2010;

v_i^2 - export of products of sector *i* in 2015;

v_i^3 - export of products of sector *i* in 2020;

w_i^1 - import of products of sector *i* in в 2010;

w_i^2 - import of products of sector *i* in 2015;

w_i^3 - import of products of sector *i* in 2020;

u_g^1 - gross fixed investments in 2010 (in the part of capital-forming sector g);

u_g^2 - fixed investments in 2015 (in the part of capital-forming sector g);

u_g^3 - fixed investments in 2020 (in the part of capital-forming sector g);

Parameters:

a_{ij}^{01} - input-output coefficients providing a value of output of sector j in 2010 not exceeding a base value;

a_{ij}^{02} - input-output coefficients providing a value of output of sector j in 2015 not exceeding a base value;

a_{ij}^{03} - input-output coefficients providing a value of output of sector j in 2020 not exceeding a base value;

a_{ij}^{11} - input-output coefficients for 2010 that provide an increase in output in 2006-2010 ;

a_{ij}^{12} - input-output coefficients for 2015 that provide an increase in the output attained over a period 1;

a_{ij}^{13} - input-output coefficients for 2020 that provide an increase in the output attained over a period 1;

a_{ij}^{22} - input-output coefficients for 2015 that provide an increase in output of sector j in 2011-2015;

a_{ij}^{23} - input-output coefficients for 2020 that provide an increase in the output attained over a period 2;

a_{ij}^{33} - input-output coefficients for 2020 that provide an increase in output of sector j in 2016-2020;

$\alpha_i^1, \alpha_i^2, \alpha_i^3$ - a share of products of sector i in the maximized part of final demand (correspondingly, in 2010, 2015 and 2020);

$c_{\tau j}^{v1}$ - transport costs of exporting a product unit of sector j in 2010;

$c_{\tau j}^{w1}$ - transport costs of importing a product unit of sector j in 2010;

$c_{\tau j}^{v2}$ - transport costs of exporting a product unit of sector *j* in 2015;

$c_{\tau j}^{w2}$ - transport costs of importing a product unit of sector *j* in 2015;

$c_{\tau j}^{v3}$ - transport costs of exporting a product unit of sector *j* in 2020;

$c_{\tau j}^{w3}$ - transport costs of importing a product unit of sector *j* in 2020;

t_j^{01} - labour coefficients providing a value of output of sector *j* in 2010 not exceeding a base value;

t_j^{02} - labour coefficients providing a value of output of sector *j* in 2015 not exceeding a base value;

t_j^{03} - labour coefficients providing a value of output of sector *j* in 2020 not exceeding a base value;

t_j^{11} - labour coefficients for 2010 that provide an increase in output in 2006-2010 ;

t_j^{12} - labour coefficients for 2015 that provide an increase in the output attained over a period 1;

t_j^{13} - labour coefficients for 2020 that provide an increase in the output attained over a period 1;

t_i^{22} - labour coefficients for 2015 that provide an increase in output of sector *j* in 2011-2015;

t_j^{23} - labour coefficients for 2020 that provide an increase in the output attained over a period 2;

t_i^{33} - labour coefficients for 2020 that provide an increase in output of sector *j* in 2016-2020;

k_{gj}^{01} - capital coefficients that maintain an output of sector *j* on the base level in 2006-2010 (in the part of costs of capital-forming sector *g*);

k_{gj}^{02} - capital coefficients that maintain an output of sector *j* on the base level in 2006-2015 (in the part of costs of capital-forming sector *g*);

k_{gj}^{03} - capital coefficients that maintain an output of sector *j* on the base level in 2006-2020 (in the part of costs of capital-forming sector *g*);

k_{gj}^{11} - capital coefficients that provide an increase in output of sector *j* in 2006-2010 (in the part of costs of capital-forming sector *g*);

k_{gj}^{12} - capital coefficients that provide an increase in output of sector *j* in 2006-2010 and maintain the increase in 2006-2015 (in the part of costs of capital-forming sector *g*);

k_{gj}^{13} - capital coefficients that provide an increase in output of sector *j* in 2006-2010 and maintain the increase in 2006-2020 (in the part of costs of capital-forming sector *g*);

k_{gj}^{22} - capital coefficients that provide an increase in output of sector *j* in 2011-2015 (in the part of costs of capital-forming sector *g*);

k_{gj}^{23} - capital coefficients that provide an increase in output of sector *j* in 2011-2015 and maintain the increase in 2006-2020 (in the part of costs of capital-forming sector *g*);

k_{gj}^{33} - capital coefficients that provide an increase in output of sector *j* in 2016-2020 (in the part of costs of capital-forming sector *g*);

u_g^0 - a base value (2005) of investments (in the part of costs of capital-forming sector *g*);

$f_1(u_g^0, u_g^1)$ - a dependence function of total investments for period 1 on their base values and on their values attained in the last year of period 1 (for a given law of growth);

$f_2(u_g^1, u_g^2)$ - a dependence function of total investments for period 2 on their values attained in the last year of period 1 and on their values attained in the last year of period 2 (for a given law of growth);

$f_3(u_g^2, u_g^3)$ - a dependence function of total investments for period 3 on their values attained in the last year of period 2 and on their values attained in the last year of period 3 (for a given law of growth);

β_j^1 - coefficients converting domestic basic prices (in rubles) into foreign market prices (in dollars) for exported products of sector *j* in 2010;

γ_j^1 - coefficients converting domestic basic prices (in rubles) into foreign market prices (in dollars) for imported products of sector *j* in 2010;

β_j^2 - coefficients converting domestic basic prices (in rubles) into foreign market prices (in dollars) for exported products of sector *j* in 2015;

γ_j^2 - coefficients converting domestic basic prices (in rubles) into foreign market prices (in dollars) for imported products of sector *j* in 2015;

β_j^3 - coefficients converting domestic basic prices (in rubles) into foreign market prices (in dollars) for exported products of sector *j* in 2020;

γ_j^3 - coefficients converting domestic basic prices (in rubles) into foreign market prices (in dollars) for imported products of sector *j* in 2020;

$d_j^0, d_j^1, d_j^2, d_j^3$ - restrictions on variables of output of sector *j* (increases in outputs);

Q^1, Q^2, Q^3 - restrictions on values of trade balances (correspondingly, in 2010, 2015 , 2020);

T^1, T^2, T^3 - expected employment (correspondingly. in 2010, 2015 and 2020);

$q_j^1, q_j^2, q_j^3, \overline{q}_j^1, \overline{q}_j^2, \overline{q}_j^3$ - maximum and minimum exports of products of sector *j* (in 2010, 2015 and 2020);

$p_j^1, p_j^2, p_j^3, \overline{p}_j^1, \overline{p}_j^2, \overline{p}_j^3$ - maximum and minimum imports of products of sector *j* (in 2010, 2015 and 2020);

δ^1, δ^2 - discounting coefficients for final demand, $0 < \delta^i \le 1, i = 1,2$

Formal statement of optimization multiregional input-output model of Russia's economy

Regional blocks of the model

Balances of production and distribution of products

$$x_i^{r0} + x_i^{r1} - \sum_{j=1}^{n} a_{ij}^{r0} x_j^0 - \sum_{j=1}^{n} a_{ij}^{r1} x_j^1 - \alpha_i^r z^r - \sum_{s \neq r} x_i^{rs} + \sum_{s \neq r} x_i^{sr} - \sum_{h=1}^{3} v_i^{rh} + \sum_{h=1}^{3} w_i^{rh} \geq b_i^r; i = 1,...,n; \quad (1)$$

corresponding restrictions for capital-forming sectors:

$$x_g^{r0} + x_g^{r1} - \sum_{j=1}^{n} a_{gj}^{r0} x_j^0 - \sum_{j=1}^{n} a_{gj}^{r1} x_j^1 - u_g^{r1} - \alpha_g^r z^r - \sum_{s \neq r} x_g^{rs} + \sum_{s \neq r} x_g^{sr} - \sum_{h=1}^{3} v_g^{rh} + \sum_{h=1}^{3} w_g^{rh} \geq b_g^r; g \in G; \quad (2)$$

corresponding restrictions for the sector of transport ($i = \tau$):

$$x_\tau^{r0} + x_\tau^{r1} - \sum_{j=1}^{n} a_{\tau j}^{r0} x_j^0 - \sum_{j=1}^{n} a_{\tau j}^{r1} x_j^1 - \alpha_\tau^r z^r - \sum_{k,s:k \neq s} \sum_{j=1}^{n} a_{\tau rj}^{ks} x_j^{ks} - \sum_{h=1}^{3} \sum_{j=1}^{n} c_{\tau j}^{rvh} v_j^{rh} - \sum_{h=1}^{3} \sum_{j=1}^{n} c_{\tau j}^{rwh} w_j^{rh} \geq b_\tau^r; \quad (3)$$

Balances of labor resources:

$$\sum_{j=1}^{n} t_j^{r0} x_j^0 + \sum_{j=1}^{n} t_j^{r1} x_j^1 \leq T^r; \quad (4)$$

Balances of investments:

$$\sum_{j=1}^{n} k_{gj}^{r0} x_j^0 + \sum_{j=1}^{n} k_{ji}^{r1} x_i^1 - f_1(u_g^{r0}, u_g^{r1}) \leq 0; g \in G; \quad (5)$$

Regional foreign trade balances:

$$\sum_{j=1}^{n} \beta_j^r v_j^r - \sum_{j=1}^{n} \gamma_j^r w_j^r \geq Q^r; \quad (6)$$

Restrictions on outputs and increases in outputs:

$$x_j^{r0} \leq d_j^{r0}; x_j^{r1} \leq d_j^{r1}; j = 1,...,n; \quad (7)$$

Restrictions on maximum and minimum exports and imports (quotas on imports and exports):

$$q_j \leq \sum_r v_j^r \leq \bar{q}_j; p_j \leq \sum_r w_j^r \leq \bar{p}_j; j = 1,...,n; \quad (8)$$

System-wide restrictions

Restrictions on territorial pattern of final demand

$$z^r - \alpha^r z \geq 0;\ r = 1,...,R \qquad (9)$$

Restrictions on maximum and minimum exports and imports:

$$\sum_{r=1}^{R}\sum_{j=1}^{n}\beta_j^r v_j^r - \sum_{r=1}^{R}\sum_{j=1}^{n}\gamma_j^r w_j^r \geq Q;; \qquad (10)$$

Objective function:

$$z \to max \qquad (11)$$

List of symbols:

Variables:

x_i^{r0} - output of sector *i* of region *r* produced in the last year of forecasting period on production facilities that worked at the beginning of the period;

x_i^{r1} - increase in output of sector *i* in region *r* for the period;

x_i^{rs} - transportation of products of sector *i* from region *r* to region *s* in the last year of forecasting period;

x_i^{sr} - transportation of products of sector *i* from region *s* to region *r* in the last year of forecasting period;

z^r - value of final demand of region *r* in the last year of forecasting period;

v_i^{rh} - export of products of sector *i* of region *r* in the last year of forecasting period in direction *h*;

w_i^{rh} - import of products of sector *i* of region *r* in the last year of forecasting period in direction *h*;

u_g^{r1} - gross investment of region *r* in the last year of the period (in the part of capital-forming sector *g*) that are calculated as a sum of investments in the base year u_g^{r0} and increases in investments $\sum_{k=1}^{T}\Delta u_g^{r0}(k)$ (T - length of the period);

z - a value of maximized part of final demand in the last year of the period;

α^r - a share of region *r* in maximized part of final demand in the last year of the period.

Parameters:

a_{ij}^{r0} - input-output coefficients providing a value of output of sector *j* of region *r* in the last year of the period not exceeding a base value;

a_{ij}^{r1} - input-output coefficients providing an increase in output of sector *j* of region *r* over the period;

α_i^r - a share of products (services) of sector *i* of region *r* in maximized part of final demand in the last year of the period;

$a_{\tau rj}^{ks}$ - transport costs of region *r* for transportation of a product unit of sector *j* from region *k* to region *s* in the last year of the period;

b_i^r - fixed part of final demand of sector *i* of region *r* in the last year of the period;

$c_{\tau j}^{rvh}$ - transport costs of exporting a product unit of sector *j* of region *r* in the last year of the period by direction *h*;

$c_{\tau j}^{rwh}$ - transport costs of importing a product unit of sector *j* of region *r* in the last year of the period by direction *h*;

t_i^{r0} - labour coefficients providing a value of output of sector *i* of region *r* in the last year of the period not exceeding a base value;

t_i^{r1} - labour coefficients in the last year of the period providing an increase in output of sector *i* of region *r* over the period;

k_{gi}^{r0} - capital coefficients maintaining output of sector *i* of region *r* over the period on the level attained in the base year (in the part of costs of capital-forming sector *g*);

k_{gi}^{r1} - capital coefficients providing an increase in output of sector *i* of regiona *r* for the period (in the part of costs of capital-forming sector *g*);

u_g^{r0} - base value of investment in the part of costs of capital-forming sector *g* of region *r*;

$f(u_g^{r0}, u_g^{r1})$ - dependence function of total investment of region *r* for the period on its base value and its value attained in the last year of the period (for a given law of growth);

β_i^r - coefficients converting domestic basic prices (in rubles) into foreign market prices (in dollars) for products of sector *i* exported from region *r* in the last year of the period;

γ_i^r - coefficients converting domestic basic prices (in rubles) into foreign market prices (in dollars) for products of sector *i* imported by region *r* in the last year of the period;

T^r - restrictions on number of labour resources of region *r* in the last year of the period;

Q^r - restrictions on trade balance of region *r* in the last year of the period;

$d_i^{r0}, d_i^{r1},$ - restrictions on values of output variables and on increases in outputs of region r in the last year of the period;

$q_i, \overline{q}_i$ - maximum and minimum exports of products of sector i in the last year of the period;

$p_i, \overline{p}_i$ - maximum and minimum imports of products of sector i in the last year of the period;

Q - restriction on value of national trade balance in the last year of the period.

"Mild-optimistic" variant – growth rates for 2006-2020, %% *Appendix D*

	RF	CFD	NWFD	SoFD	VFD	UFD-Tyu	Tyu	SiFD	FEFD
1. Power industry.	149.7	139.3	157.1	167.0	151.2	148.0	133.8	154.4	151.7
2. Oil producing.	112.0		145.0	128.0	100.0		110.0	153.6	170.8
3. Oil processing.	125.4	130.2	136.0	128.5	119.8		136.3	122.5	132.4
4. Gas producing.	120.9		412.4	137.4	100.0	105.0	114.3	475.3	316.0
5. Coal mining.	147.9	103.6	139.6	115.6		115.6		153.0	128.0
6. Ores and nonmetallic for ferrous metallurgy.	146.3	177.6	160.0	130.0	140.0	105.0		105.0	
7. Ferrous metallurgy (excluding ores).	186.8	223.6	199.2	193.6	176.8	175.0	300.0	159.2	128.0
8. Extraction of nonferrous metal ores.	147.4		170.0	160.0	150.0	110.0		140.0	150.4
9. Nonferrous metallurgy (excluding ores).	163.7	149.2	182.6	179.2	190.0	180.4		155.3	145.6
10. Chemical industry.	179.5	201.3	195.3	201.3	167.5	167.5	201.3	167.5	150.6
11. Petrochemical industry.	187.7	205.7	214.5	176.3	176.3	176.3	214.5	176.3	157.2
12. Machine-building.	289.3	314.4	296.3	369.0	271.6	253.6	298.3	284.1	220.4
13. Logging and wood industry	153.4	168.0	144.6	167.0	160.7	144.6	144.6	144.6	139.1
14. Pulp and paper industry	158.7	174.4	156.5	174.4	174.4	149.6	174.4	149.6	143.4
15. Building materials industry.	193.2	178.1	229.6	173.1	166.4	196.0	400.0	228.8	262.3
16. Light industry	142.1	134.8	138.4	189.7	140.2	140.8	105.0	142.6	136.0
17. Food industry	180.9	167.6	189.6	206.0	201.4	167.6	201.4	167.6	150.7
18. Other industries.	202.9	218.3	186.3	232.0	186.3	186.3	186.3	186.3	164.7
19. Construction	294.4	219.0	276.3	279.6	298.6	320.3	389.2	469.0	307.5
20. Agriculture and forestry	143.7	147.0	137.0	159.8	137.0	137.0	137.0	137.0	127.8
21. Transport and communication	185.4	177.1	200.9	209.4	185.8	180.2	147.5	196.0	195.7
22. Trade, public catering, logistics, etc.	267.5	245.5	275.4	310.2	295.0	321.9	209.4	294.2	283.0
23. Other sectors.	170.1	169.8	160.0	198.0	160.0	160.0	190.0	160.0	145.0
24. Housing, communal, consumer services.	185.4	154.2	189.9	214.1	202.9	187.1	180.5	205.3	196.9
25. Public health, social maintenance, etc.	242.0	194.6	249.0	275.1	269.3	252.9	252.5	272.0	264.8
26. Other services.	232.5	221.5	260.3	292.2	247.4	245.3	163.7	248.7	248.2
27. Government, finances, etc.	242.9	208.2	260.8	293.4	284.3	269.9	221.1	283.0	271.4
TOTAL OUTPUT	214.8	214.8	224.2	238.6	214.5	217.2	164.7	224.2	219.3

"Optimistic" variant – growth rates for 2006-2020, %% *Appendix E*

	RF	CFD	NWFD	SoFD	VFD	UFD-Tyu	Tyu	SiFD	FEFD
1. Power industry.	171.8	157.3	180.3	186.5	176.1	177.4	142.6	183.0	174.2
2. Oil producing.	118.2		161.0	150.0	100.0		114.0	210.0	190.3
3. Oil processing.	138.5	140.0	148.0	156.5	130.0		160.0	132.0	164.3
4. Gas producing.	135.5		450.0	142.0	100.0	200.0	129.0	553.9	316.0
5. Coal mining.	170.7	103.5	140.0	116.0		115.6		176.0	168.9
6. Ores and nonmetallic for ferrous metallurgy.	172.2	145.9	157.4	130.0	140.0	251.9		153.4	
7. Ferrous metallurgy (excluding ores).	224.5	246.0	252.0	232.0	200.0	202.8	300.0	245.0	128.0
8. Extraction of nonferrous metal ores.	173.8		170.0	160.0	150.0	110.0		140.0	199.4
9. Nonferrous metallurgy (excluding ores).	187.7	155.0	190.0	183.0	195.0	190.0		196.9	130.4
10. Chemical industry.	209.8	221.0	240.0	224.0	193.6	210.0	225.0	207.9	150.7
11. Petrochemical industry.	245.3	251.0	305.0	255.0	228.3	210.0	270.0	310.0	280.0
12. Machine-building.	425.7	470.0	450.0	490.0	404.8	315.8	370.0	440.0	380.6
13. Logging and wood industry	175.9	180.0	195.0	180.0	185.0	144.6	194.0	145.9	173.7
14. Pulp and paper industry	176.3	169.8	192.0	174.4	149.6	149.6	185.0	149.6	143.4
15. Building materials industry.	237.5	217.3	250.0	206.0	230.0	250.0	360.0	290.0	330.0
16. Light industry	159.8	157.6	170.4	197.9	140.2	140.8	150.0	178.1	166.0
17. Food industry	190.1	178.9	201.4	235.0	167.6	167.6	230.0	201.4	181.9
18. Other industries.	225.7	233.0	229.5	238.0	211.7	186.3	240.0	229.5	207.9
19. Construction	358.2	265.5	333.5	331.0	373.5	434.7	428.7	599.1	374.2
20. Agriculture and forestry	152.3	161.0	137.0	184.1	137.0	137.0	154.1	137.0	127.8
21. Transport and communication	201.2	191.7	203.9	224.9	204.9	227.4	151.1	215.3	214.6
22. Trade, public catering, logistics, etc.	289.1	265.0	299.2	332.0	318.3	345.5	223.4	321.3	308.3
23. Other sectors.	193.4	205.0	205.0	220.0	160.0	160.0	200.0	180.8	180.0
24. Housing, communal and consumer services.	201.0	167.4	206.5	228.1	221.8	204.9	191.8	223.0	213.0
25. Public health, social maintenance, etc.	256.1	206.0	263.5	291.0	285.0	267.8	267.0	287.9	280.2
26. Other services.	261.1	245.0	294.6	318.0	292.4	274.4	176.0	284.8	278.1
27. Government, finances, etc	258.7	221.9	278.5	310.8	301.9	286.5	233.5	302.6	290.6
TOTAL OUTPUT	244.6	242.1	257.5	266.6	247.9	250.4	176.4	263.0	252.9