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MODELLING OF THE INFLUENCE OF EXPORT CAPACITY OF MACHINE BUILDING ON THE ECONOMIC GROWTH RATE IN RUSSIA[1]

Financial crisis of 1998 in Russia was followed by the devaluation of the national currency, sharp increase of the dollar rate and of the imported goods costs. Therefore, at the cost of huge financial losses and social expenses the conditions for reconstructive growth of the economy and increasing of the domestic demand for production and services of the home enterprises were created. In recent years, since 2001, this reconstructive growth, caused mainly by the devaluation shock, has been supported by the favorable business climate of the international oil, gas and metals markets that led to continuous increase in international prices of main energy resources, especially of oil. These external conditions guaranteed a vigorous growth in the volume of production and export of energy resources (table 1). External trade was characterized by the positive trade balance and increase in its overall volume. Flow of the substantial financial resourses to the country allowed Russia to perform financial stabilization, which led to substantial budget surplus, increase in budget expenses and increase in the volume of gold holdings of the Central Bank of Russia. Financial incomings allowed to create in 2003 the Stabilization Fund, lay the foundation of the Investment Fund, establish the National Ventures Company for the development of science and technology intensive production in the country. The economy received capital investment (table 2).

At the same time, the analysis shows that, in spite of the positive dynamics of the main economic indices, some of the forces that develop Russian economy are exhausted.

For example, positive effect of the devaluation shock, that in 1999-2002 created a price overhang for home producers and at the same time greatly influenced the dynamics of import, does not take place today any more.

[1]*The article is based on the materials of the research carried out under the auspices of RSCI (project No.05-02-02012).*

Table 1

Oil Production in the RF and Export Revenue Data. 1999-2005

Index	1999	2000	2001	2002	2003	2004	2005
Oil production, Mio t.	304.7	323.4	348.0	380.0	421.4	458.7	470.2
Oil Export, Mio t.	137.0	134.0	143.0	189.0	226.0	257.4	251.0
International oil prices*, $/bbl	17.3	26.63	22.97	23.73	27.04	34.45	48.0
Oil exporters income, $ bn.	18.82	34.89	33.43	38.72	51.13	67.63	79.22

** Grade Urals.*

Sources: [15, 16].

Domestic demand from the end consumers remains at the high level, but due to the increase of the actual financial income it tends to move to more expensive but qualitative foreign production. For instance, domestic demand for goods and services has increased in 2004-2005 relative to 2003 and reached 6.2 per. p. At the same time widening of the goods supply at the domestic market reduced from 2.9per. p. in 2003 to 2 per. p. in 2005. In 2001-2005 annual average growth of domestic demand amounted to 10.26%, annual average import increase – to 20.76% (Fig. 1) [17, 18].

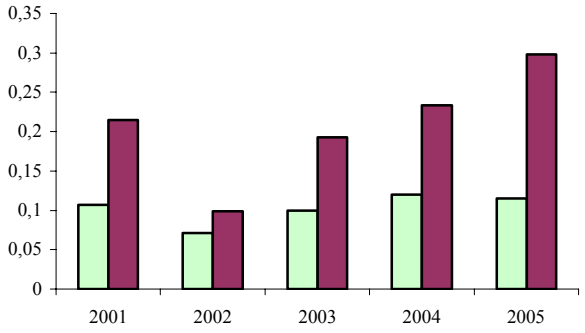


Fig. 1. Dynamics of final domestic demand ( ) and volume of import ( ) in 2001-2005

During these years competition has increased, high international prices on oil and substantial export revenues has caused improvement of the exchange-value of rouble (table 2), which led to deterioration of the competitive ability of Russian producers, that in spite of the positive dynamics of capital investment, did not manage to modernize their outdated basic

production assets (BPA) (according to the results of 2005 the wear-out percent of the BPA in machine building complex (MBC) amounted to 51.2%, that is only 2.7% lower than in 2000 [7]. A tendency of decreasing labor efficiency (increase of labor efficiency in 2003 – 6.8%, in 2004 – 6%, in 2005 – 5.1% [6]) together with the spending spree for the payment of salary (annual average growth of the real earnings in 2003-2005 amounted to 10.4% [18]) create additional burden for the financial stability of the enterprises.

Table 2

Macroeconomic Indices of the RF in 1999-2005

Index	1999	2000	2001	2002	2003	2004	2005
Growth rate of GDP, %	106.4	110.0	105.1	104.7	107.3	107.2	106.4
Budget surplus, RUB bn.	-52.9	112.6	272.0	150.0	228.0	730.0	1613.0
Stabilization fund, RUB bn. *						522.3	1237.0
Gold holdings of CBR, $ bn. **	12.456	27.951	36.622	47.793	76.938	124.541	168.396
Dynamics of actual disposable income of the citizens, % of the previous year	88.2	113.4	110.0	110.8	114.5	109.9	108.8
Inflation, %			18.6	15.1	12.0	11.7	10.9
Capital stock investment, % of the previous year	105.3	117.4	110.0	102.8	112.5	110.9	110.5
Trade balance, $ bn	219.20	167.07	79.97	96.30	129.18	145.58	137.90
Dynamics of industrial production, %	111.0	111.9	104.9	103.7	107.0	107.3	104.0
Growth rate of export cost, %	1.5	39.0	-3.1	5.3	26.7	31.0	33.6
Growth rate of import cost, %	-46.7	13.4	19.8	13.4	24.7	26.6	30.0
Dynamics of actual exchange-value of rouble, %		12.0	3.2***	5.8	4.1	13.5	3.9
Share of production of machine-building complex	10.9	8.8	10.5	9.5	9.0	7.4	5.4

(MBC) in the export production structure , %							
Share of production of energy branch in the export production structure, %	44.9	53.8	54.7	55.2	57.3	57.6	63.8

** Data on 01.01.2005 and 01.01.2006 respectively.*
*** Data on 01.01 of the following year*
**** January-October 2001*

Sources: [5, 7, 8, 10-19, 22].

In the period of the postcrisis reconstructive growth the increase of the production volume did not require substantial capital expenses: the greatest part of BPA was not used. At the moment this supply is exhausted and in order to develop the industrial potential of MBC the amount of capital investment should be increased. But according to the statistic data, actual dynamics of basic capital investment has been decreasing since 2003. Moreover, the labor power fund that was not occupied in 1992-1998 has decreased as well. (tables 2 and 3).

Table 3

Usage of BPA and amount of personnel in 1997-2001

Index	1997	1998	1999	2000	2001
Not used production facilities, % of the volume of the facilities	64.0	65.0	59.0	54.0	51.0
Amount of excess labor force, % of the number occupied in the industry	25.5	25.1	16.0	6.1	4.9

Source: [6].

Therefore, in spite of the positive dynamics of the main macroeconomic indices of the country development, inwardly oriented domestic enterprises of the processing industry are under pressure of strengthening exchange-value of rouble, increasing import and, consequently, increasing competitiveness, which lessens their role in the domestic market. Import grows more rapidly than export, commodity composition of export, where production of the natural resources sector predominates and holds 60%, is

degrading (table 2). Russia's Ministry of Economic Development and Trade forecasts that in 2006 import of MBC production will amount to 62 $ bn. This sum is equivalent to 70% of the interior Russian output and exceeds the volume of export of MBC production more than 4 times.

According to the calculations produced by Belousov A.R. [6] as matters stand in the country (in 2000-2001 internal factors of competitive strength guaranteed 3-4 per. p. growth of GDP, in 2002-2004 – 2.5, in 2005 – 2 points) the rate of economic growth is likely to reduce to 4-5% per year, and by the end of the current decade – to 3% per year. Such rates of growth will not allow to solve most of the economic and social tasks in Russia.

The results of the industrial development show that raw materials oriented type of economic growth, which replaced inwardly oriented type in 2001, can not lead to stable qualitative economic growth in long perspective. The analysis of the structure of GDP production shows that 1999-2001 annual average rate of growth amounted to 7.1%, where annual average share of the inwardly oriented competitive ability amounted to 4,56 per. p. During the period of export oriented type of development (2002-2004) the analogous indices amounted to 6.4% and 2.3 per. p. High international prices on exported goods contribute less to GDP growth. If in 1999-2001 this contribution amounted to 1.43 per. p., in 2002-2004 it was only 0.84 per. p. (Fig. 2) [6].

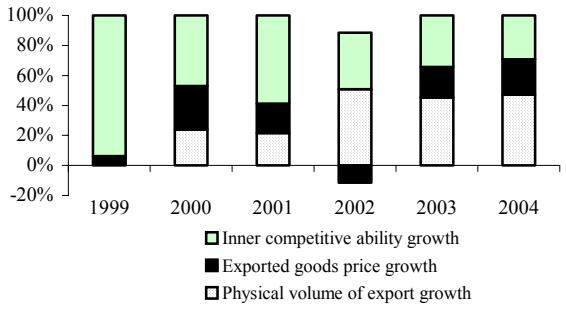


Fig. 2. Component structure of GDP growth

Fig. 2 shows that the positive effect of the favorable price climate in the international market of energy resources together with inner competitive ability growth is constantly reducing. Only the share of physical volume of export growth is rising, but its structure is badly diversified and in-

cludes mainly energy and raw materials production, while production of MBC is constantly reducing (table 2).

Raw materials oriented type of development caused a peculiar balance of value added, where raw materials sector produces more value added (16.3% GDP), than inwardly oriented sector (11.7% GDP). Export oriented branches receive value added that amount to 11.7% GDP, while inwardly oriented sector receives only 1.1%. The balance of export oriented sector, according to, for example, the data for 2003, is more than 2 times lower than the analogous index of inwardly oriented sector (-4.5% in comparison with -10.6%) [6]. This fact correlates with the indices of retirement and renewal of BPA in various branches, that directly influences their competitive ability (table 4).

Table 4

Dynamics of retirement and renewal coefficients of BPA in 2000-2004

Index	2000	2001	2002	2003	2004
Petroleum production	2.9/1	4.2/1	3.7/1,5	4.1/1,4	3.7/1
Petroleum processing	2.2/1.3	3.3/1.1	4.4/2.1	4.7/1.1	4.4/0.8
Ferrous metallurgy	0.8/0.6	1.4/0.9	1.6/1.2	1.1/1.1	2/1.4
Non-ferrous metallurgy	2.4/1	2.8/1.2	2.7/1.3	3./1.2	2.7/1.3
MBC	0.7/1	0.9/1.1	0.8/1.2	0.9/1.4	1/1.4
Renewal coefficient / Retirement coefficient					

Sources: [7, 8].

Such a low index of value added in inwardly oriented sector partially influences the dynamics of value added proper in the structure of gross value added (GVA) of the industry, where the share of fuel industry GVA substantially surpasses the analogous index for other branches, including MBC (Fig. 3) [7].

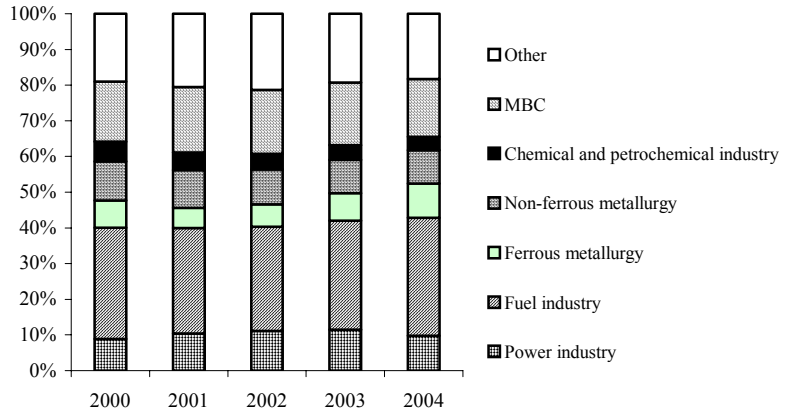


Fig. 3. GVA of the industry: branch aspect

This tendency is connected with the state of a branch BPA. In petroleum production and petroleum processing renewal coefficient is higher than retirement coefficient, while in MBC the situation is quite the opposite. (table 4). Renewal coefficient of BPA has positive dynamics, retirement of the outdated items of production assets is unavoidable, but, in case the latter exceeds the former, facilities shortage is likely to take place. In the conditions of home market and import volume growth it leads to the reduction of the market share of this or that branch, MBC in particular. In spite of the fact that the balance result of MBC enterprises in 2004 rose in comparison with 2003 at approximately 14%, in comparison with 2000 the results of 2004 are 2.5% lower, in comparison with 2001 the results of 2004 are 28.7% lower [7, 8]. Reduction of revenues leads to reduction of basic capital investment that in the long run influences the revenues. Stimulation measures for basic capital investment should be taken, which will mediate growth of the production competitive ability, expanding of the markets, growth of revenues.

The efficiency of MBC functioning in the structure of the country economy is connected with the positive effect that will take place in case of development of MBC as a branch, manufacturing final production with high value added. Among positive effects the following ones are the most significant:

- Developing home and international markets.
- Improving technological level of the industry.

- Improving qualitative component in the structure of GDP growth in Russia.
- Possibility to achieve complex functioning of the industry and exclude accumulation of material resources in the narrow circle of export oriented branches, which limits both basic capital investment and innovations.

As raw materials oriented type of economic growth has exhausted its abilities, there should be a transfer to a type of development that is based on growth of branches that constitute inwardly oriented sector. In our opinion, the leading branch in this sector is machine building that manufacture science and technology intensive production. The situation in this branch proves that there is a necessity to modernise its BPA as soon as possible and to stimulate demand (international and domestic) on its production. Consecution "from international to domestic demand" is caused by the fact that production competitive in external market will automatically become competitive in home market as well, and that is the main thesis of this research.

Development of the sector producing final production with high indices of value added and redistribution will allow, first, to improve technological level of the economy, which since the Soviet times has been on the satisfactory level only because of defence industry, second, to improve qualitative component in the structure of economic growth. Its domineering position in GDP structure of the USA in 1960-1990 did not allow Soviet economy to surpass economy of the USA, though the total rate of GDP growth in the USSR was higher than the analogous index in the USA. According to the calculations produced by Uziakov M.N. during this 30-year period total GDP growth in the USSR amounted to 5.06% per year, and in the USA – to 3.22%. The qualitative component of growth in the USSR amounted to 1%, in the USA – to 2.31%. 1% growth of qualitative component led to 1.12% growth of GDP, this fact explains the advantage of economic growth of the USA in comparison with Soviet economy [2].

Development of the processing industry allows to balance flows of resources of various quality, which increases the effectiveness of the total development of national economy and allows to avoid the conservation of exterior branches, as it happened in the USSR. Taking into account the fact that MBC, producing qualitative final production makes other adjacent branches adapt to its demands, flows of qualitative machine building recourses will circulate in the economic sphere modernizing and developing practically the whole national economy. According to the theory of multilevel economy, created by Academician Eremenko Y.V., MBC is a pick of the economic pyramid, which accumulates the resources from its

lower sectors and at the same time qualitative resources produced within MBC go down the vertical line of this pyramid [1]. The timely exchange of the necessary assortment of the resources within inter-branch cooperation and in the reproduction structure allows to carry out complex functioning of all branches of the economy, constantly improve and modernize its technological level not at the expense of a limited and narrow circle of branches but at the expense of the development of the whole Russian industry.

Thereupon it seems to be necessary and possible to build such a model of inter-branch cooperation, where stimulation of the export potential of MBC, i.e. development of its international market, will allow in the perspective, according to the above mentioned thesis, develop home market as well. The concrete task is the following: to study by means of economic and mathematic modeling of inter-branch connections in the structure of the national economy the topical question of creating such a strategy of Russian machine building development, which guarantees greater GDP growth in comparison with the strategy of stimulating export of energy and raw materials industry production.

1. Theoretical base. A great number of research works are dedicated to the problem of inter-branch cooperation and its influence on dynamics and quality of economic growth in Russia. First of all we should mention researches carried out by Academician Eremenko Y.V., his theory of multilevel economy, which shows the detailed understanding of the processes that take place at both the branch level and at the level of the country economy on the whole. The detailed study of the economy structure, its quantitative and qualitative characteristics, the subject of the inter-branch balance and its peculiarities is described in works [2-4] and other works.

It should be mentioned that informational database of the official sources is quite poor. For instance, the last disaggregated interindustry balance was compiled in 1995, it included about 256 branches and sectors of national economy. More modern, accessible to the public tables "Costs-Output" [20] include only 15 branches of real sector and do not allow to carry out a detailed research.

2. Modeling instruments. 15 branches of real sector[2] represented in the tables "Costs-Output" and a great number of service branches are devided into 3 blocks – N_1 ("Industry 1"), representing the most important, basic branches of real sector, each of them will be examined separately. Block N_2 ("Industry 2") also includes branches of real sector, but those that do not have great influence on MBC in comparison with the branches of

[2] *Branch "Shale oils and peat" is excluded from the study due to the little volume of total output and due to its little influence on.MBC.*

block N_1. Block N_3 (Services) all sectors providing different services represented in the tables "Costs-Output".

Block 1 – Industry (N_1) (seven branches):

Power industry – *1;*
Ferrous metallurgy – *2;*
Non-ferrous metallurgy – *3;*
Machine building – *4;*
Chemical industry – *5;*
Oil and gas industry – *6;*
Coal industry – 7.

Block 2 – Industry (N_2) (five branches):

Woodworking industry – *8;*
Building materials industry – *9;*
Light industry – *10;*
Food industry – *11;*
Other industrial products – *12*.

Block 3 – Services (N_3) (nine branches):

Building production – *13;*
Agricultural products, agricultural services and forestry products – *14;*
Transport and connection services – *15;*
Intermediary services – *16;*
Products of other activities – *17;*
Housing and communal services, non-productive communal services – *18;*
Healthcare, physical culture, social maintenance, education, culture and art services– *19;*
Science and scientific maintenance, geology and exploring, geodesic and hydrometeorology services– *20;*
Financial intermediary services, management and social associations insurance – *21*.

Operation with inter-branch flows of the represented branches results in volumes of intermediate product (IP), IP structure and its growth for both domestic and foreign production. The main result at this stage of the research is the specification of GVA volume or, factually, GDP. The branch pattern of block N_1 allows to estimate GVA volume of the main branches of the domestic industry and total output volumes of each block and the industry as a whole.

The comparative analysis of different branches of the economy is of particular interest as there are analogous models for MBC and oil and gas sector as well. Equal growth rates of MBC and oil and gas sector export were taken. It was taken into account that because of the differences in

factual export volumes of the represented branches the results calculated in other conditions will substantially distort the real pattern. Another hypothetic scenario could be as follows: export volume growth rises by the same quantity, but due to the existing difference of factual export volume the results could be incorrect as well. So, it was decided to estimate export growth for the represented branches at the same volume in value terms. All calculations were corrected taking into account intermediate trade margins (ITM), transport margins (TM) and net product taxes (NPT). 2002 was taken as the basic year, as there is the whole system of the tables "Costs-Output" for this year.

3. Hypotheses and conditions of modeling. Actual export volume of MBC according to the results of 2002 amounted to 279 734 947 thousand roubles. Hypothesis No.1 is that according to the results of 2002 export volume of MBC was not the factual one, but a value that 1.5 times exceeded the factual one. So, according to the hypothesis, export volume of MBC will amount to 139 867 473.5 thousand roubles.

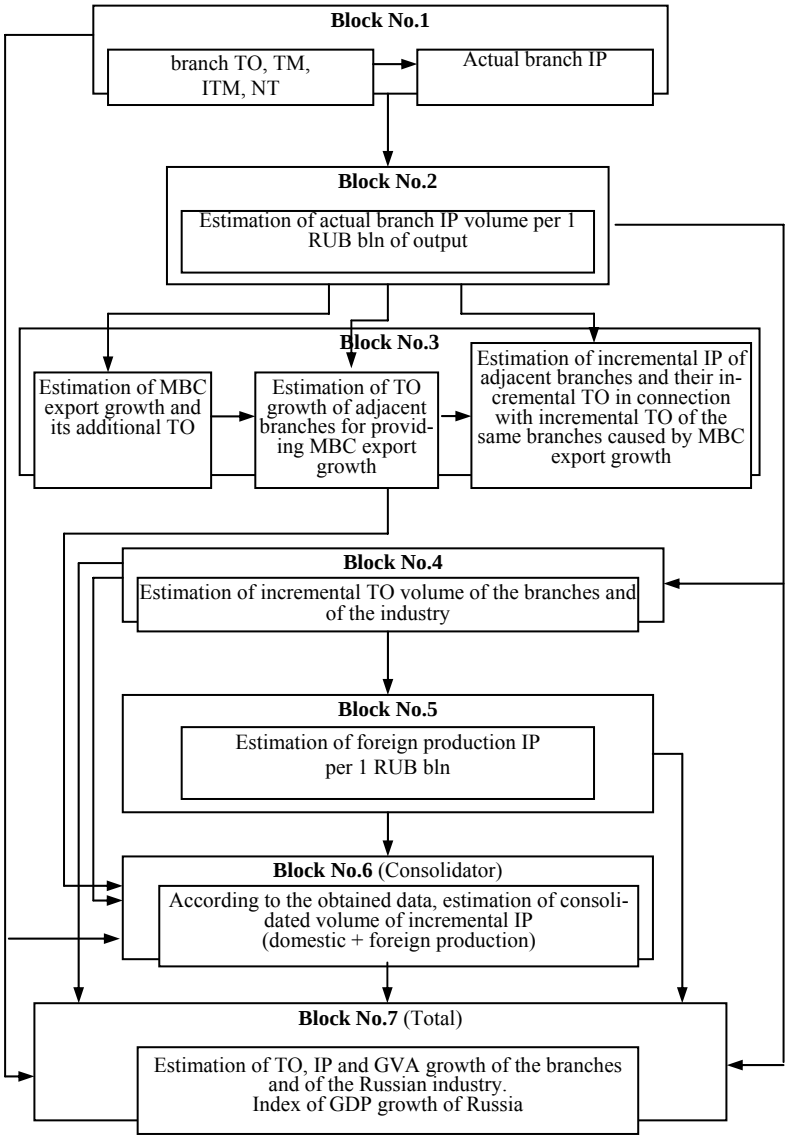
Moreover, it is supposed that this production volume is produced by the working capacities of domestic enterprises and supplied to external market in full scale. In other words*, import substitution does not take place yet.*

So, MBC producing high value added and increasing output will naturally increase its IP volume. This IP volume will become additional TO volume for other branches with the following IP volume growth of these branches, etc. As a result we get additional IP and TO volumes of the industry that will allow to calculate its GVA volume. Estimating GVA of the industry we can get TO, IP and GVA of branches N_1 (disaggregated), N_2 and N_3, which will produce additional results for the following analysis.

Hypothesis No.2 deals with fuel and energy complex and its influence on GVA growth of the industry as a whole and of its branches. In this case there are supposed to be changes in MBC analogous to the ones described in the first hypothesis. The reason of export volume 1.5 times growth in the oil and gas sector is the fact that in 2002 and currently export volume of FEC is much higher than export volume of MBC. As a result, *due to the wider base effect*, it will the same 1.5 times increase export and, consequently, output of FEC. The obtained data will be difficult to interpret due to its noncomparability. Moreover, comparison of the effects from MBC and oil and gas sector export growth at the identical parameters is also of interest.

4. Methodology and algorithm of modeling. The consolidated model of inter-branch cooperation conditionally contains *7 estimation blocks* of

basic incremental and actual indices of the industry. The diagram (Fig. 4) shows the logical order of estimating these indices. As a result of the step-by-step passage from the first block of the factual data according to the "Costs-Output" tables of 2002 to the last, seventh block of the final indices TO, IP and GVA Russian GDP growth in case of export volume growth by a certain quantity can be estimated.



Block No.1 is a block of factual basic data formation.

Block No.2 estimates IP of each branch and block per 1 RUB bn. of actual output, which allows to estimate further incremental IP.

If to denote AIP of Russian and foreign production as ${}_P AIP_i^j$ or ${}_3 AIP_i^j$ respectively, where $i = 1...21$ and $j = 1...21$, AIP of Russian and foreign production per *1 RUB bn.* will be equal to $({}_P AIP_i^j / ATO_i)$ or $({}_3 AIP_i^j / ATO_i)$ respectively, where $i = 1...21$, $j = 1...21$.

Then in branch aspect estimation of IP volume of, for instance, power industry per 1 RUB bn. of output is calculated according to the following formulae:

$$ {}_P AIP_1 = \sum_{j=1}^{21} ({}_P AIP_1^j / ATO_1), \quad (1) $$

$$ {}_3 AIP_1 = \sum_{j=1}^{21} ({}_3 AIP_1^j / ATO_1). \quad (2) $$

Further according to the number of the branches it is necessary to determine actual total IP volume per *1RUB bn.* of output of all branches of the Russian industry, i.e. AIP of real sector of the RF.

It is possible to estimate AIP per *1RUB bn.* of output of other branches by formulae analogous to (1) and (2) and, summarizing this data, obtain AIP of the RF industry:

$$ {}_P AIP_I = \sum_{i=1}^{12} \sum_{j=1}^{12} ({}_P AIP_j^i / ATO_j), \text{ where } i, j = 1...12 \text{ [3]}. \quad (3) $$

It is necessary to estimate incremental TO of MBC in *Block No.3* in order to provide, on the one hand, invariable volume of home market consumption (this is one of the conditions for the modeling), on the other hand, export volume growth. We will take as supposition that *coefficient* of MBC export volume growth and, consequently, its TO (taking into account invariable volume of home market consumption) equals 1.5. *Alongside with that it is necessary to subtract actual export volume (AE) for estimation of multiplicative effect on T and GVA of the industry only due to probable increase.* Therefore, as it is defined, additional volume of output amounts to 139 867 473.5 thousand rouble, which is equal to the for-

[3] *Hereinafter the range is shortened due to presentation of the AIP estimation methodology only for the industry; consequently, block of services (N_3) is not included.*

mula $\Delta E_4 = \Delta TO_4 = (AE_4 k) - AE_4$, where ΔE_4 – *MBC incremental export volume, k – AE growth coefficient estimated by us.*

As MBC has increased TO volume, consequently, it has increased IP volume of adjacent branches of the industry production as well. Having obtained IP volume per *1 RUB bn.* of output of every branch, we will yet take only AIP volume per *1 RUB bn.* of the MBC output, as it has increased TO volume and, consequently, IP. This TO volume increase is TO of order I. Then incremental IP of MBC production, for instance, of the power industry will be defined as follows:

$$\Delta_P IP_4^1 = \Delta TO_1^1 = ({}_P AIP_4^1 / ATO_4)\Delta E_4 . \qquad (4)$$

Having defined at this stage all incremental IP volumes of MBC production for all the represented branches by the analogous formula (4), incremental TO volumes of all represented branches, which are to provide MBC incremental export volume to a defined level *k,* were obtained. The fact is that the volume of production, for instance 1, that will be used by the MBC, is a part of TO of power industry itself.

Total volume of incremental IP of production of all represented MBC branches or total volume of incremental TO of all represented branches of *order 1* are estimated by the following formula:

$$\Delta_P IP_4^j = \Delta TO_I^1 = \sum_{i=1}^{12} ({}_P AIP_4^i / ATO_4)\Delta E_4 . \qquad (5)$$

It should be explained what is incremental TO volume of branches of *order 1*. The fact is that together with MBC export growth there is IP volume growth in adjacent branches, and that is incremental TO of these branches. This increment is increment of *the first order*, because to provide increment of their own TO the branches increase IP volume of production of their adjacent sectors. In its turn, production used in this or that branch is final production of this branch and, consequently, a component of its TO, that will be increment of *the second order.* In other words, *the production chain of the first order* is "the MBC export increment – IP increment of production of adjacent branches or TO increment of adjacent branches of the first order", *the production chain of the second order* is "MBC export increment - IP increment of production of adjacent branches or TO increment of adjacent branches – IP increment of adjacent branches for providing TO increment of the first order – TO increment of adjacent branches of the second order".

The IP value of the branches caused by the necessity of their TO increment of the first order is the following:

$$\Delta_P IP_j^i = ({}_P AIP_j^i / ATO_j \Delta TO_j^1 . \quad (6)$$

Consequently, total IP volume of all the branches or of the RF industry as a whole in the process of TO of *the second order* formation will be equal to:

$$\Delta_P IP_I = \sum_{i=1}^{12} \sum_{j=1}^{12} \Delta_P IP_j^i . \quad (7)$$

It is natural, that TO of *the first order* will cause IP increment, which will be the base for TO increment of *the second order*, because what is used in one branch as intermediate production is final production of another branch and, consequently, a component of its TO:

$$\Delta TO_i^2 = \sum_{i=1}^{12} \Delta_P IP_1^i , \quad (8)$$

i.e. TO of order II is formed as a line, while IP is formed as a column.

Total volume ΔTO_I^2 of *the second order* of Russian industry can be obtained by analogous to (8) calculations:

$$\Delta TO_I^2 = \sum_{j=1}^{12} \sum_{i=1}^{12} \Delta_P IP_j^i . \quad (9)$$

In *Block No.4* combined volume of total output (CTO) of all represented branches and of the RF industry as a whole is estimated:

$$CTO_j = ATO_j + \Delta TO_j^1 + \Delta TO_j^2 , \quad (10)$$

$$CTO_I = \sum_{j=1}^{12} CTO_j . \quad (11)$$

For further research it is necessary to define incremental IP volume of foreign production per *1 RUB bn.* of inhouse TO, which is necessary for obtaining incremental IP volume of foreign production. It is of special importance, because consumption of foreign production has no positive influence on the national industry, as there is no corresponding inter-branch cooperation. Therefore, value added of final production of the national industry becomes a certain Δ lower, while in case of consumption of analogous inhouse production, GVA of the industry and its corresponding part would be higher due to TO increment.

The process of estimating IP of foreign production reflected in *Block No.5* is analogous to estimating IP of Russian production, but with one reservation: estimating IP of foreign production there is no division of incremental TO into order I and II. Calculation is based on combined incremental TO volume:

$$\Delta_3 IP_1^i = \sum_{i=1}^{12} ({}_3 AIP_1^i / ATO_1)\Delta TO_1. \quad (12)$$

For the industry there is the following formula:

$$\Delta_3 IP_I = \sum_{j=1}^{12}\sum_{i=1}^{12} ({}_3 AIP_j^i / ATO_j)\Delta TO_j. \quad (13)$$

Having defined TO of the branches and TO of the industry it is necessary to estimate GVA of the branches and of the industry as a whole, that will constitute GDP increment index. In addition to this, all necessary margins must be subtracted. In order to do this the difference between TO and IP volumes of Russian and foreign production must be calculated. This difference will constitute combined or branch GVA, and GDP increment index of Russia.

In order to do this, in *Block No.6* CIP of production produced in Russia and abroad for the RF industry is estimated:

$$CIP_I = \sum_{j=1}^{12}\sum_{i=1}^{12} ({}_P AIP_j^i / \Delta_P IP_j^i) + \sum_{j=1}^{12}\sum_{i=1}^{12} ({}_3 AIP_j^i / \Delta_3 IP_j^i) =$$
$$= \sum_{j=1}^{21}\sum_{i=1}^{21} ({}_P AIP_j^i + {}_3 AIP_j^i) + (\Delta_P IP_j^i + \Delta_3 IP_j^i). \quad (14)$$

By these means, we get quite a simple formula of estimating GVA volume of each branch and of the RF industry as a whole. Further, besides IP, all fixed margins ITM, TM and NPT, which naturally have grown due to TO increment in all the branches, should be taken into account as well. ITM and NPT can be estimated analogously to (15)-(17).

$$CTM_1 = ATT_1 + \Delta TM_1, \quad (15)$$

$$\Delta TM_1 = (ATT_1 / ATO_1)\Delta TO_1, \quad (16)$$

$$CTM_I = \sum_{j=1}^{12} CTM_j. \quad (17)$$

Having obtained all the necessary data, in *Block No. 7* we calculate incremental GVA of the industry and combined GVA volume of the industry for estimating the RF GDP and its increment in comparison with the

factual index in 2002:

$$\Delta GVA_I = \sum_{j=1}^{12} \Delta TO_j - \sum_{j=1}^{12}\sum_{i=1}^{12} \Delta_P IP_j^i - \sum_{j=1}^{12}\sum_{i=1}^{12} \Delta_3 IP_j^i - \sum_{j=1}^{12} \Delta TM_{n_j} -$$

$$- \sum_{j=1}^{12} \Delta ITM_j - \sum_{j=1}^{12} \Delta NPT_j = \sum_{j=1}^{12} (\Delta TO_j - \sum_{j=1}^{12} (\Delta_P IP_j^i) - \quad (18)$$

$$- \Delta TM_j - \Delta_j - \Delta NPT_j$$

$$CGVA_I = \sum_{j=1}^{12} AGVA_j + \sum_{j=1}^{12} \Delta GVA_j \,. \quad (19)$$

Interpretation of the obtained results and conclusions. The results obtained by means of the modeling should be attributed to the following macroeconomic categories:

– total output of the branches and of the industry as a whole;

– intermediate consumption of the branches and of the industry as a whole;

– gross value added, created in the branches and in the industry as a whole.

TO increments of the branches and blocks caused by supposition about export increment are reflected in table 5.

Table 5

SEMMII Results. Total Output: Branch Aspect

Branch	ATO, RUB bn.	Oil and Gas Branch		Machine building	
		ΔTO		ΔTO	
		RUB bn.	%	RUB bn.	%
Power Industry	725.90	733.53	101.05	734.32	101.16
Ferrous Metallurgy	491.56	492.99	100.29	507.15	103.17
Non-ferrous Metallurgy	669.08	669.41	100.05	679.40	101.54
Machine building	1280.19	1283.27	100.24	1424.25	111.25
Chemical	446.50	448.81	100.52	451.39	101.10
Oil and Gas	1514.68	1662.18	109.74	1519.98	100.35
Coal	98.55	98.85	100.31	99.60	101.08
Block N2	2192.16	2193.66	100.07	2196.29	100.19
Industry, total	7418.62	7582.69	102.21	7612.41	102.61

From the data in table 5 we see that MBC becomes the leader in the increment of growth. The reason for this is export volume increment that is in fact the added volume of MBC TO, besides implements of the first and second orders. There is also high increment in ferrous metallurgy, as this sector is the main supplier of MBC.

Comparing the data in table 5 we also see that with MBC export increment, and, consequently, its output, TO volumes of adjacent branches grow at higher rates, which proves the thesis of higher effectiveness of the complex functioning of the RF industry in case of MBC priority.

Due to low competitive ability of domestic enterprises, a great part in MBC IP structure is taken by foreign production. As the research has shown, with MBC production volume increment, there are higher rates of foreign production consumption in the sector than in case of oil and gas industry increment. It will definitely have a lowering effect on GVA increment of the RF industry, because in case of consuming final products of foreign production incremental GVA of this production remains in the structure of industry of the producer-country. On the contrary, in case of volume growth in consumption of domestic production GVA volume of the industry will be at a higher level.

Estimations of IP have shown that branch indices in case of MBC TO increment are higher than in case of analogous increment in oil and gas industry (table 6).

Table 6

SEMMII Results. IP of Russian and foreign production, %

Sector	MBC		Oil and Gas sector	
	IP of Russian production	IP of foreign production	IP of Russian production	IP of foreign production
Power Industry	100.72	101.03	100.72	100.94
Ferrous Metallurgy	102.32	103.11	100.17	100.29
Non-ferrous Metallurgy	100.96	101.52	100.01	100.05
Machine building	112.62	111.05	100.15	100.24
Chemical	100.79	101.09	100.35	100.51
Oil and Gas	100.18	100.33	111.25	109.13
Coal	100.40	101.02	100.08	100.29
Block N2	100.11	100.17	100.03	100.06
Industry, total	102.73	103.40	102.10	100.76

As IP increment of Russian production leads to TO growth and further to GVA growth this fact proves the effectiveness of MBC development priority, but, however, it is correct only in case of adequate IP increment of domestic production. In our case none of these take place.

With stimulation of external markets for MBC production in connection with the dynamics of IP of foreign production GVA index for Russian industry appeared lower.

Growth rates reflected in table 7 are a kind of addition to growth rates of the economy in 2002 depending on the variant of calculations.

Table 7

SEMMII Results. Growth of the Branch GVA, %

Branches	Growth of the GVA with export increase in MBC	Growth of the GVA with export increase in oil and gas branch
Power Industry	101.56	101.35
Ferrous Metallurgy	104.47	100.48
Non-ferrous Metallurgy	102.46	100.10
Machine building	109.44	100.37
Chemical	101.64	100.82
Oil and Gas	100.49	108.54
Coal	101.95	100.60
Block N2	100.30	100.13
Industry, total	100.80	100.83

Adjustment for index-deflator of the corresponding year gives the RF GDP increment in case of stimulation of development of MBC or oil and gas sector external markets (table 8).

Table 8

The RF GDP growth in 2002 factual and in case of stimulation MBC and FEC, %

Growth Rate	Growth, %
Factual	104.70
Stimulating FEC export	105.33
Stimulating MBC export	105.3

The calculations show that growth rates of GDP in case of FEC stimulation would lead to surpassing of the rates at 0.03%. But it is not a big

discrepancy, taking into account that in output volume value terms FEC ranks over MBC and takes the dominating position in the industry. Positive results in case of MBC stimulation are quite evident.

The most important result of the carried out research is the idea about qualitative structure of real sector GVA. According to table 9, MBC production export growth was followed by increasing of MBC GVA share in GDP.

Oil and gas sector export growth does not cause GVA growth in other sectors of the economy. Ferrous metallurgy GVA reduced to a lesser extent after MBC production export growth because there is a high level of inter-branch cooperation.

Table 9

SEMMII Results.
Branch structure of real sector GVA, %

Branch	MBC		Oil and gas sector	
	IGVA share	AGVA share	IGVA share	AGVA share
Power Industry	10.91	11.8	10.88	11.8
Ferrous Metallurgy	5.42	5.7	5.20	5.7
Non-ferrous Metallurgy	8.31	8.8	8.11	8.8
Machine building	17.12	17.1	15.68	17.1
Chemical	4.40	4.7	4.36	4.7
Oil and Gas	25.6	26.15	27.68	26.15
Coal	1.43	1.44	1.41	1.44
Block N2	26.73	24	26.66	24

Therefore, having abstracted from quantitative component (i.e. growth rates) we see the qualitative effect of MBC stimulation:

- Branch GVA have higher growth rates (table 7), that speaks about the first component of growth quality;
- branch structure of real sector GVA contains more GVA of the branches producing production of higher (in comparison with FEC) redistribution (table 9). This is the second component of growth quality.

The obtained results lead to the following conclusions:

1. Recognition of Russian MBC production at external market will allow to increase total output volume, that together with competitive ability growth will lead to home market development.
2. MBC production growth gives lower increment of the economy GVA in comparison with FEC increment, but there are higher GVA growth rates of the branches. That is the first component of economic growth quality.
3. Further expansion of MBC value added share in the structure of real sector GVA increase shares of ferrous metallurgy and chemical industry, which produce production of high redistribution. Together it increases the second qualitative component of economic growth.
4. According to the research [2], substantial qualitative component in GDP growth structure produces higher economic effect even at lower rates in comparison with growth of GDP where quantitative component takes the domineering position.

Therefore, SEMMII results should be acknowledged as successful for proving greater economic effect in case of MBC stimulation, in spite of the fact that in this variant GDP growth rates are 0.03% lower than with FEC stimulation.

It is evident, that high GDP growth rates are difficult to achieve in the conditions when output growth is followed by great IP increment of foreign production. In this respect, in order to broaden the research, a dynamic model, which will take into account both export volume growth and import substitution factor, should be developed. The value of this model is the possibility to obtain the following results:

- perspective estimation of basic macroeconomic indices (TO, IP, TM, ITM, NPT and GVA) for 2006-2015;
- Plotting of the dynamic range of GDP index-deflator for 2006-2015 for further obtaining of GDP increment;
- estimation of annual branch GVA increments as the first component of qualitative growth;
- estimation of branch structure of GVA as the second component of qualitative growth;
- estimation of volumes and growth rates of GVA flexibility in case of import substitution.

Growth of competitive ability of the production, development of home and external markets, positive dynamics of investment in BPA, timely expansion of production base and its qualitative modernization will lead Russia to the new, qualitative level of its economic development.

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***Main Indications of the Variables in* SEMMII Model**

ATO_j – actual total output of branch $j = (1...21)$

ΔTO_j – incremental total output of branch $j = (1...21)$ in absolute terms

CTO_j – combined total output of branch $j = (1...21)$

ATO_I – actual total output of the industry

ΔTO_I – incremental total output of the industry in absolute terms

CTO_I – combined total output of the industry

ΔTO_j^1 – incremental total output of branch in absolute terms of order I, where $j = (1...21)$

ΔTO_j^2 – incremental total output of branch in absolute terms of order II, where $j = (1...21)$

${}_P AIP_j^i$ – actual volume IP by branch j of Russian production of branch i where $i, j = (1...21)$

$\Delta_P IP_j^i$ – incremental volume IP by branch j of Russian production of branch i in absolute terms, where $i, j = (1...21)$

${}_P CIP_j^i$ – combined volume IP by branch j of Russian production of branch i , where $i, j = (1...21)$

${}_P AIP_I^i$ – actual volume IP of Russian production of branch i of the industry overall, where $i = (1...21)$

$\Delta_P IP_I^i$ - incremental volume IP of Russian production of branch i of the industry overall in absolute terms, where $i = (1...21)$

${}_P CIP_I^i$ – combined volume IP of Russian production of branch i of the industry overall, where $i = (1...21)$

$\Delta_3 IP_j^i$ – incremental volume IP by a branch of foreign production of branch i in absolute terms, where $i, j = (1...21)$

${}_3CIP_j^i$ – combined volume IP by branch j of foreign production of branch i, where $i, j = (1...21)$

${}_3AIP_I^i$ – incremental volume IP of foreign production of branch i of the industry overall, where $i = (1...21)$

$\Delta_3 IP_I^i$ – incremental volume IP of foreign production of branch i of the industry overall in absolute terms, where $i = (1...21)$

${}_3CIP_I^i$ – combined volume IP of foreign production of branch i of the industry overall, where $i = (1...21)$

ATM_j – actual volume of transport margin on production of branch j, where $j = (1...21)$

ΔTM_j – incremental volume of transport margin on production of branch j in absolute terms, where $j = (1...21)$

CTM_j – combined volume of transport margin on production of branch j, where $j = (1...21)$

$AGVA_j$ – actual volume of gross value added of branch j, where $j = (1...21)$

ΔGVA_j – incremental volume of gross value added of branch j in absolute terms, where $j = (1...21)$

$CGVA_j$ – combined volume of gross value added of branch j, where $j = (1...21)$