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INDUSTRIES AND INTERINDUSTRY COMPLEXES

Assessing the Impact of High-Technology Exports on the Growth Rate and Structure of the Russian Economy

I. E. Frolov and K. K. Lebedev

Abstract—The article describes an interindustry interaction model and the modeling of the impact of high-technology exports on GDP growth in the short run (2007-2015). It considers both the "net" impact and the impact adjusted for import substitution processes.

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The restorative growth of the Russian economy since 1999, based on manufacturers' price advantages and caused by the devaluation of the Russian currency and the utilization of previously idle capacities, is almost used up. If the pre-2002 economic growth was mainly of a *home-oriented* type, it has been *primary-export oriented* since 2002 [1]. The change in growth characteristics was largely due to internal factors. First, between 1997-2001, idle basic production assets (BPA) decreased from 64% to 51%, second, the share of excess labor in working population decreased from 25.5% to 4.9%, and the unoccupied population per vacancy factor decreased from 7.6% to 1.3%) [1]. The favorable price situation of the global energy market in 2002-2006 was instrumental in enhancing the nation's financial position, leading specifically to:

- growth in the Bank of Russia gold and foreign currency reserves to $303.7 bln (a 500% growth in 2006 over 2002);

- an unprecedented net surplus of the federal budget (more than 2 trillion rubles at the end of 2006);

- an increase of the Russian Stabilization Fund savings to more than 2.341 trillion rubles at the end of 2006; and

- early repayment of the foreign debt to the Paris Club, which resulted in a saving of $7.7 bln. Part of this amount went into the Investment Fund.

Positive financial outcome for the period 2002-2006 is an important but not decisive factor in sustainable development. Structural change in the national economy is unsatisfactory. The one-sided primary-export bias of the Russian economy poses a real threat to its structural stability. While the rate of economic growth in recent years has been 6-7%, the rate of GDP growth, unconnected with the behavior of energy prices, does not exceed 2-3%. [1]

[1] In 2000-2001, internal competitiveness factors accounted for 3-4 percentage points of GDP growth, in 2002-2004, for 2.5, and in 2005, for 2 percentage points [1].

To create conditions for sustained growth drastic changes must be made in production structure, the degree of diversification of exports and the economy as a whole, and development priorities. What it means in the first place is the expansion of the most promising sector, that of knowledge-intensive and high-technology manufacture. This sector's capability for knowledge and information reproduction, which is the basis for active innovation, ensures the encouragement of value added creation.

The economy's predominantly primary and processing orientation prevents it from approaching the welfare standard of developed countries. The share of energy carriers (oil, gas, oil products, and coal) ran up to 65-70% of the total volume of Russian exports in 2006, which was worth $302 bln (the share of machinery and equipment was a mere 5.4% and it has halved since 1999). In the near future, energy export will bring in Russia at best $300-350 bln a year. However, a GDP growth comparable to the United States' must measure in trillions of dollars and, hence, be of a different nature.

It should be kept in mind that a new type of economic growth has evolved in the world economy. It moving force is innovation systems, created by government and nationally oriented by business, as well as mechanisms of expanded reproduction and capitalization of innovation processes. The level and trends of leading edge (high) technologies, their mechanisms of penetration into global markets, and the legal status and protection of intellectual property became determinative characteristics of the economy's productive forces and capability. High technologies are the strategic foundation of the country's political and defense power by shaping and defining its national status worldwide. Innovation potential and its utilization to a large extent determine the long-term competitiveness of the national economy. By the same token the basis is created for its stable growth in the context of market fluctuations and globalization trends in economic relations.

Thus far, the Russian economy has been growing in the opposite phase to the growth trends of the more

Table 1. Industry pattern of the Russian real sector GVA 1998–2004, %

Industry	1998	1999	2000	2001	2002	2003	2004
FEC	38.3	34.5	38.4	38.4	38.7	40.4	41.4
MBC	17.0	16.0	16.2	17.6	17.2	16.9	15.6
Chemistry and petrochemistry	5.2	6.0	5.3	4.8	4.2	4.0	3.7
Metals and objects	13.7	19.3	17.8	15.5	15.4	16.4	18.2
Others	25.8	24.2	22.3	23.7	24.5	22.3	21.1

Table 2. Commodity pattern of Russian export 1998–2005, %

Industry	1998	1999	2000	2001	2002	2003	2004	2005
FEC	42.5	44.4	53.8	54.7	55.2	56.7	58.8	65
MBC	11.5	10.7	8.8	10.5	9.5	9.0	7.2	5.3
Chemistry and petrochemistry	8.4	8.5	7.2	7.5	6.9	6.8	6.4	5.9
Metals and objects	27.2	25.5	21.7	18.8	18.7	13.8	16.8	14.2
Others	10.4	10.9	8.5	8.5	9.7	13.7	10.8	9.6

advanced economies. One can use as omnibus measures the industry pattern of the real sector's gross value added (GVA) (Table 1) and the export pattern (Table 2), which have similar negative trends.

The share of the machine building complex (MBC) and the chemical industry in the real sector GVA has decreased since 2001, while the share of the fuel industry has been steadily on the rise [2, 3]. In the export pattern, as in the GVA pattern, there has been the "washing out" of the MBC share with a parallel rise in the share of primary goods [2, 3].

Thus, the qualitative characteristics of Russian economic growth are still unsatisfactory. This creates additional problems and lowers the competitive power of Russian enterprises compared with their Western counterparts, which upon Russia's WTO entry will be much more active in the domestic market.

Theoretical aspects of the study of qualitative components of economic growth have been described by Yu. V. Yaremenko [4] and M. N. Uzyakov [5, 6]. N. V. Suvorov's papers deal with the procedural aspects of the assessment and analysis of economic situation using the interindustry balance (IIB) and describe predictive-analytical calculations of its coefficients at the necessary extrapolation of IIB 1995 data to the present period [7]. A description of the development of the economy with due regard for innovation processes is given in papers by N. I. Komkov [8], A.A. Varshavskii [9], and V. N. Borisov [10, 11].

The above studies created a theoretical framework for solving this problem: in what ways must export be promoted and which industries must be prioritized in order to maximize the impact of export deliveries upon GDP growth taking into account its structural change in the medium run.

Statement of the problem and an IIB-based mathematical-economic model of production and investment processes. As mentioned above, the primary export type of growth has come to the end of its tether, and we need to shift to a different type, based on the growth of industries that a part of the home-oriented group. In our view, the leading sector in this group is machine building putting out high-technology products. This shift will lead, first, to an increase in the quality component's share in the GVA structure of the economy [5]; second, to growth in the economic dynamics owing to an essentially different pattern of interindustry interactions; and third, to domestic market expansion.

This study is predicated on the assumption that the kind of export to be stimulated must be one that *simultaneously* secures growth in domestic market. As only products competitive on the worldwide market can be exported, technologically homogeneous products manufactured by the same producers for the home market should be able to compete with their look-alikes sold by the outlet chains of the world's leading manufacturers. Therefore, export-oriented enterprises modernizing their basic production assets to put out export products can simultaneously commission capacities for the manufacture of technologically homogeneous products to be sold at the home market by way of *import substitution*.

To reach these goals there are customs, fiscal, and taxation instruments designed to create an *objectively real* competitive environment in which Russian enterprises will be able to develop in line with worldwide

innovations embodied in foreign-made products and technologies. However, what domestic producers need in the first place is new products and technologies they could launch at the world market so as to successfully compete with foreign producers. Since priority should be assigned to processing sectors and their most high-tech sector, MBC, new machine-building technologies merit special attention. However, during 1992-1998, many machine-building enterprises were completely destroyed and are current noncompetitive; therefore, we should pay attention not to the MBC in general but to the exporting sectors alone. *High-technology* products refers here to the defense establishment, including civil aircraft and satellite engineering, as well as power machine building and automobile manufacture. According to the Russian Classification of Economic Activities these sectors comprise:

- arms and ammunition manufacture;
- manufacture of engines and turbine other than aircraft, automobile, and motorcycle engines;
- manufacture of centrifuges, calendars, and vending machines;
- manufacture of nuclear reactors and components;
- manufacture of helicopters, aircraft, and other flying machines;
- manufacture of spacecraft, including boosters; and
- automobile manufacture.

This separation corresponds to different kinds of production:

1) mass production (automobiles);

2) mainstream production (in the first place, civil aircraft); and

3) individual production (nuclear reactors, boosters e spacecraft [2]

World competitive products of the above industries are:

- Yamal, Express, and Uragan-K spacecraft, Soyuz-2 boosters, and the Angara modular booster under construction (rocket-and-space industry);
- the Advanced Front-line Aviation Complex as well as the 4++ generation aircraft MiG-35 and Su-35 (aircraft industry);
- the Sukhoi SuperJet-100 (SSJ-100) regional liner (civil aircraft industry);
- the Oir-1I, S-300, and other antiaircraft defense systems (radio industry);
- the AES-2006 (Water-Moderated Power Reactor 1200 IW) project, as well as a low-power offshore nuclear power plant (nuclear industry);
- the PGU-110 and PGU-325 gas turbine and combined-cycle plants designed for thermal plant refitting (power machine building); and
- Russian-made Toyotas and Magnas (automobile manufacture).

Technological re-equipment should be carried out by way of the modernization (qualitative aspect) and expansion (quantitative aspect) of the production facilities of economic agents based on increased capital investment from private and public sources.

Production and investment model. The DEMMII [3] contains two macroblocks. The first is mathematical-economic (production) based on the mathematical-economic modeling of interindustry links conditioned by growth in exports and the beginning of an import substitution trend. Our calculation of the mathematical-economic macroblock of the production and investment model yielded a forecast of the utilization of the high-technology export potential and its impact upon Russian economic development in 2007-2015.

The second macroblock of the DEMMII model is an investment one. In its framework we made recommendations for an industry investment policy to achieve proposed goals by promotional measures.

The DEMMII is based on input-output tables for 2000-2003, which were used to build an averaged dynamics of input-output coefficients for 2007-2015. Based on interindustry coefficient models we built a macroeconomic forecast of the Russian GDP, adjusted for similar forecasts of the Institute of Economic Forecasting and the Centre for Macroeconomic Analysis and Short-term Forecasting 13, 14]. The medium-term growth data of the MBC and the high-technology sector were culled from the RAS Presidium Comprehensive Basic Research Program "Forecast of the Technological Development of the Russian Economy in the Context of New Global Integration Processes" [11, 15]. Next, using the baseline GDP growth option, we modeled two scenarios:

DEMMII-1, which only envisions the encouragement of export deliveries within specified volumes and does not take import substitution trends into account; and

DEMMII-2, which envisions export promotion on the same scale DEMMII-1, but additionally considers import substitution trends.

The aim of the modeling exercise was to validate the effectiveness of encouragement of the MBC for the period to 2015, and to monitor the trends in the consumption of foreign-made products.

As expected, the MBC model confirmed its effectiveness after the first hypothesis had been entered into it. The second hypothesis was entered after it became obvious that the dynamics of intermediate consumption of foreign-made products had an inhibitory effect on the dynamics of the real sector GVA.

The DEMMII industry structure consists of industry complexes.

Aggregated Block 1:

[2] As for spacecraft and boosters, we do not consider here their export in natural units, but the export of payload orbital injection services in value terms. This study also considered joint projects in which Russia holds a substantial parts, e.g., the Sea Launch program.

[3] The Dynamic Economical & Mathematical Model of Inter-branch Interaction was derived from SEMMII (Economical & Mathematical Model of Inter-branch Interaction), designed to identify Russia's most cost-efficient branches of industry (see [12]).

Table 3. Import substitution hypothesis in the automobile industry

Indicator	2007	2008	2009	2010	2011	2012	2013	2014	2015
Output, thou units	264	336	465	593	722	850	1000	1180	1390
Localization, %	17.2	18.4	19.7	21	22.5	24	25.7	27.5	30
Import substitution, bln rubles	13.5	19	28	38	50	62	80	101	127

- the fuel and energy complex (FEC) composed of the oil and gas and coal industries and electric energy industry;

- the metallurgical complex (metallurgy) composed of ferrous and nonferrous metallurgy;

- the chemical and petrochemical industry (NPC); and

- the machine-building complex (MBC).

Aggregated Block 2 is a consolidation of the remaining industries: woodworking, construction materials, light, and food.

Aggregated Block 3 consolidates all the sectors of the Services block. The first hypothesis included in the DEMMII concerns the expected export growth rate in 2007-2015, from $13 bln in 2007 to $27 bln in 2015. Because the likelihood of increase in oil and gas exports is substantially higher than that of, say, coal industry exports, the rise in FEC and metallurgical exports was modeled on the pro rate basis, i.e., depending on an industry's share in the total exports of the complex.

We adopted the following shares of the total Russian export:

	Share, %
FEC	100.00
Oil and gas	96.51
Coal	2.10
Electricity	1.39
Metallurgy	100.00
Iron and steel	37.40
Nonferrous metals	62.60
Chemistry and petrochemicals	100.00
MBC	100.00

The second hypothesis concerns the rate and pattern of import substitution, which allows to diminish the import dependence of Russian industry and to reduce the rate of growth of intermediate consumption of foreign-made products, thus increasing the country's GDP.

The modeling of import substitution in the MBC involved three time series according to MBC branches: 1) automobile industry; 2) civil aircraft manufacture; and 3) power machine building.

Automobile industry. At present, Russia produces such makes as BMW, Hummer, Hyundai, Kia, Ford, SSangYong Rexton, and Renault. At the end of 2006, the sales of Russian-produced foreign brands amounted to 280 000 cars, a 65% increase over 2005. Moreover, during 2006, the Ministry of Economic Development and Trade signed another ten agreements with world automakers, which would provide $2 bln worth of investment before 2012. These agreements include two major commitments: an output of at least 25 000 units a year and the gradual increase of the localization factor to 30%. The localization factor is the volume of GVA generated by host country's car assembly plant. In other words, the buildup of the localization factor to 30% means that almost a third of the finished car's GVA will be generated by Russian enterprises.

The accepted 2007 localization factor was 17%, which is the average for the manufacturers' indicators. It is assumed that the localization factor will reach 30% by 2015 as stipulated by the Ministry of Economic Development agreements (Table 3).

Civil aircraft manufacture sector. Import substitution in the civil aviation sector is based on an IEF forecast relying on the production plans of the Joint Aircraft Building Corporation, or OAK. For example, OAK plans to build over a ten-year period more than 1100 civil aircraft worth 780-840 bln rubles (Table 4).

The import substitution hypothesis in the civil aircraft manufacture sector contemplates an approximate growth in import substitution from 5 bln rubles in 2007 to 75 bln rubles in 2015 (Table 5).

Import substitution in *power machine building* is based on the Unified Energy Systems' investment program, which envisages the technical re-equipment of cogeneration plants, state district power plants, and generating capacities. According to the model the bulk of orders by 2015 will belong to Russian enterprises (Table 5).

Import substitution figures are basic data for the DEMMII-2, as are the export dynamics data, i.e., according to industries' share of the complex.

It is assumed that import substitution in the chemical and petrochemical industry increased uniformly from 2008 to 2015 and considered as a share in chemical imports for a similar period. Import substitution in metallurgy was considered in the same way. According to the hypothesis, by 2015, import substitution in the

Table 4. Delivery of new civil aircraft until 2015

Liner type	Approximate price, mln rubles (in 2006 prices)	IAC certificate year	Units produced before 2007	2007-2010 program, units	2011-2015 program, units	Delivery program cost, bln rubles (in 2006 prices)
An-38	130	2002	8	35	120	21–25
An-140	270	2000	3*	40	140	48–50
An-148	700	2006	0**	40	130	115–125
An-124	–	1989/2001	35	0	2	8–10
Tu-204/214	1200/1300	1994/1998	42	40	100	170–180
Tu-334	550	2004	1	10	40	30–35
Il-96	2500	1992	17	8	20	68–75
SuperJet-100	750	2009 (forecast)	0	20	420	300–320
MS-21	800–900	2013 (forecast)	0	0	20	18–20

Notes: * Exclusive of aircraft manufactured in Ukraine and Iran.
** Exclusive of aircraft manufactured in Ukraine.
Source: [15], authors' calculations.

Table 5. Import substitution hypothesis in civil aircraft manufacture and power machine building

Indicator	2007	2008	2009	2010	2011	2012	2013	2014	2015
Civil aircraft manufacture									
Share of civil airliner deliveries to the Russian domestic market, %	30	34	37	35	44	53	62	71	80
Import substitution, bln rubles	5	7	9	12	15	25	35	50	75
Power machine building									
Investment in the Russian power industry, bln rubles	405	643	601	468	401	377	391	446	559
Share of import substitution, %	30	33	37	40	46	52	58	64	70
Import substitution, bln rubles	122	214	220	187	184	196	227	285	391

chemical industry will be 70% and in metallurgy, 80%. Import substitution in the FEC was not considered because energy resources do not have to be replaced and the substitution of conversion products will not add up to a significant quantity.

DEMMII-1 and DEMMII-2 modeling results. Predictive modeling for 2007-2015 yielded the following data:

- patterns of the growth rates of industry complexes' GVA;

- the behavior of the GVA industry structure;

- GDP dynamics in the event of utilization of the export and import substitution potential;

- the dynamics of the necessary volume of permanent investment in the MBC;

- the dynamics of the potential volume of tax deductions across the economy. [4]; and

- the dynamics of new jobs created in Russian industry.

The best mean rates of GVA growth in the period 2007-2015 are for the industry complexes of MBC, NPC, and Metallurgy. Positive dynamics continues according to DEMMII-1 and DEMMII-2 results.

According to Table 6, in DEMMII-2, the MBC share of the GVA industry makeup is 26.85%, whereas export promotion alone leads to an MBC share of 26.4%. Under the conditions of both the DEMMII-1 and the DEMMII-2, in the event of MBC encourage-

[4] Our calculations of the potential volume of tax deductions partly drew upon the outcomes of the Quarterly Forecast project implemented under M. N. Uzyakov's guidance at the IEF [13].

ment the share of high-conversion industries is greater than in the event of encouragement of any other complex.

The industry pattern of the real sector GVA [5] appears to be the best at the promotion of not only the MBC complex but also the NPC complex. On the other hand, the promotion of the Metallurgy complex leads to (unessentially) worse indicators. However, moderate increase of export volume (DEMMII-2) at MBC promotion yields the highest increments (relative to DEMMII-1) of the shares of high-conversion industries, viz, the MBC, NPC and Metallurgy.

The volumes of tax deductions across the economy in the case of both the DEMMII-1 and the DEMMII-2 (Table 7) differ insignificantly. By the end of 2015, the volume of aggregate taxes may be approximately 0.7 trillion rubles in 2006 prices. However, if export growth increases (DEMMII-1), the difference between tax deductions relative to those that can be received under more moderate export growth rates rises under a small decline.

The import substitution factor in the DEMMII-2 allows a greater amount of tax deductions at the encouragement of similar industry complexes. With the MBC encouragement, subject to DEMMII-2 conditions, the consolidated budget for the period 2007-2015 may increase by 256 bln rubles (or more than 38%); with the encouragement of Metallurgy and the NPC, by 99 bln and 60 bln rubles respectively (or 16% and 11.5%) (in 2006 prices).

Useful results were obtained in modeling industry's job creation potential in promoting one or another industry complex (Table 8). The greatest number of jobs can be created by promoting the MBC under both the DEMMII-1 and the DEMMII-2. In the DEMMII-1, the encouragement of the NPC increase the number of jobs almost all through the forecasting period, whereas the encouragement of other industries has a job cutting effect. At a greater increase in exports (DEMMII-1) and growth of the difference in incremental GVA across industry, productivity will start to grow, which bears out the decrease in the volume of employment for the generation of greater GVA.

The GDP dynamics figures in the event of MBC potential utilization are the best in the DEMMII-1 and DEMMII-2 (Fig. 1). Still, the import substitution factor in the DEMMII-2 permits greater GDP growth indicators. Encouraging economic growth through FEC is impractical in view of the following restrictions:

—the oil and gas industry lacks the resources for stepping up exports due to export infrastructure and resource base limitations. The prospecting for, development, and commissioning of new fields require massive investment, which can be exploited jointly with foreign partners [6]. The building of new export capacities, too, requires huge investment[7];

—the other FEC branches are much less important than the oil and gas industry and have nothing like its strong export infrastructure; and

- the unstable price situation of the world energy market.

The promotion of the MBC leads to growth of its share in the commodity structure of Russian exports. Naturally, with a more substantial increase in exports (DEMMII-1) the MBC share of the commodity structure of exports should be higher than under the DEMMII-2. Positive factors are not just the faster growth of the MBC share of the export structure than that possible in the absence of promotion, but also the contraction of the discrepancy between the shares according to the DEMMII-1 and the DEMMII-2. If the difference in the MBC shares in the DEMMII -1 and the DEMMII-2 at the end of 2007 was 0.93 percentage points, at the end of 2015 it was only 0.79 percentage points, which was an 18% fall. In other words, more moderate—and more realistic—increase of export volume results in faster buildup of the MBC share of the nation's export structure. The average annual growth of the MBC share in 2007-2015 was 104.8% according to the DEMMII-1 and 105.67% according to the.DEMMII-2.

Table 6. Industry pattern of Russian industry's GVA according to DEMMII-1 and DEMMII-2, %

Share of the complex	Promotion			
	FEC	Metal-lurgy	CPC	MBC
DEMMII-1				
FEC	40.24	38.54	38.67	38.49
Metallurgy	17.80	19.44	17.85	17.95
CPC	3.42	3.42	4.49	3.43
MBC	24.75	24.76	24.77	26.43
Others	13.79	13.84	14.23	13.71
DEMMII-2				
FEC	40.24	38.55	38.68	38.51
Metallurgy	17.75	19.63	17.81	17.94
CPC	3.41	3.41	4.62	3.43
MBC	24.58	24.59	24.60	26.85
Others	14.01	13.81	14.30	13.27

[5] Averaged indicators of complexes' shares for the period 2007-2015.

[6] The most dramatic example is the Shtokman offshore gas condensate field in the Russian part of the Barents Sea. The cost of its development is about $20 bln.

[7] The cost of construction of the first phase of the East Siberia - Pacific trunk line is $11 bln as of early 2007.

Table 7. Total tax deductions according to DEMMII-1 and DEMMII-2, trillion rubles

Taxes under complex promotion	2007	2008	2009	2010	2011	2012	2013	2014	2015
DEMMII-1									
FEC	6.55	6.78	7.06	7.40	7.80	8.27	8.82	9.48	10.24
Metallurgy	6.55	6.78	7.06	7.40	7.79	8.26	8.82	9.48	10.24
CPC	6.54	6.76	7.05	7.39	7.78	8.25	8.81	9.48	10.23
MBC	6.55	6.78	7.06	7.40	7.80	8.27	8.83	9.48	10.25
DEMMII-2									
FEC	6.55	6.78	7.06	7.40	7.80	8.27	8.82	9.48	10.24
Metallurgy	6.55	6.78	7.07	7.41	7.81	8.28	8.84	9.49	10.26
CPC	6.54	6.77	7.05	7.39	7.79	8.26	8.82	9.48	10.24
MBC	6.56	6.79	7.08	7.42	7.83	8.30	8.87	9.53	10.30

Table 8. Dynamics of additional jobs in industry under the promotion of different complexes according to DEMMII-1 and DEMMII-2, thou pers

Complex promotion	2007	2008	2009	2010	2011	2012	2013	2014	2015
DEMMII-1									
FEC	10.98	10.18	9.73	9.32	8.50	8.09	7.62	7.26	6.84
Metallurgy	21.77	20.29	19.44	18.63	16.95	16.07	15.03	14.18	13.20
CPC	54.70	55.93	58.92	62.18	62.40	65.30	67.48	70.40	72.46
MBC	340.15	329.24	326.73	323.43	303.49	296.23	284.94	276.31	264.10
DEMMII-2									
FEC	10.98	10.18	9.73	9.32	8.50	8.09	7.62	7.26	6.84
Metallurgy	21.77	21.18	21.04	20.75	19.47	18.86	18.00	17.26	16.30
CPC	54.70	58.43	63.83	69.39	71.81	76.81	80.98	85.77	89.59
MBC	387.98	394.36	412.10	426.19	419.10	424.41	428.69	441.05	462.73

Modernizing the production plant (qualitative component) and expanding it (quantitative component) requires massive investment infusions. Investment in the MBC capital stock must grow at annual rate of 6–7%. [8]

On average, according to the DEMMII-1, investment volume must be about 235 bln rubles a year, and according to the DEMMII-2, 245 bln rubles (Fig. 2).

Overall during 2007-2015, the Russia MBC will require about 2 trillion rubles, or $80-90 bln. For instance, the gas industry's investment need until 2010 is $200 bln and the oil industry's, $240 bln. By the most optimistic projection, the FEC's investment need by 2010 is $300 bln. Therefore, even with a longer time horizon the MBC requires at least half as much funds to improve its competitive power.

[8] Subject to the estimation of investment volumes in constant 2006 prices.

DEMMII production and investment model investment macroblock. In its framework we formulated and proposed recommendations for an industrial investment policy. While the mathematical macroblock of the production and investment model defined necessary investment resources for the modernization and expansion of the MBC production plant, the current section will determine the following factors:

- sources of investment for both the real and private sectors;

- a disbursement algorithm and the phase of harmonious inclusion of public funds in the total investment process for accelerated growth of enterprises' equity funds; and

- proposals to improve the yield and payback of government investments not interfering with investment in production plant modernization and expansion.

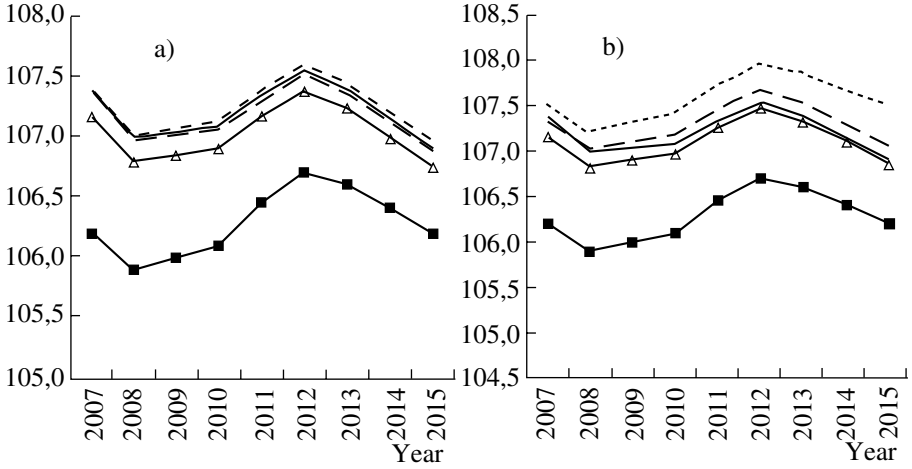

Fig. 1. Dynamics of the growth rates of Russia's GDP in the period 2007-2015 under the utilization of the export potential of industry complexes' in
DEMMII-1 (a) and DEMMII-2 (b):—FEC; - - - metallurgy; –△– NPC;—MBC; –■– no promotion.

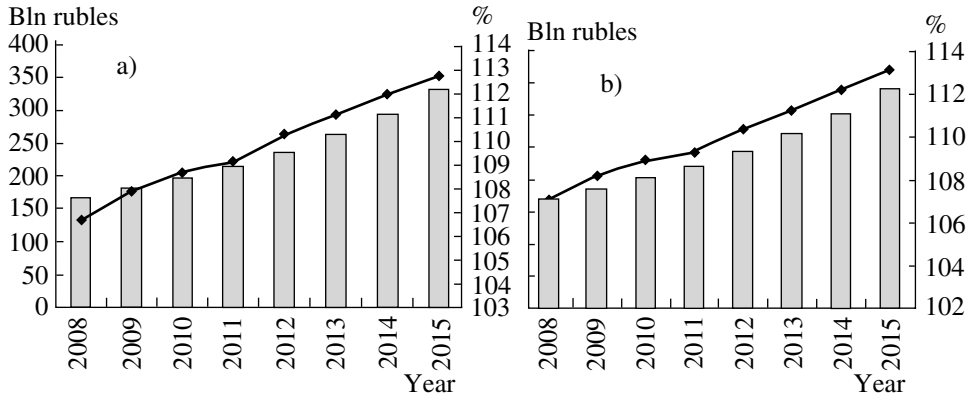

Fig. 2. Dynamics of necessary investment in MBC basic production assets in 2007-2015 according to DEMMII-1, bln rubles (a) and DEMMII-2, bln rubles (b), in 2006 prices : ■ investment; –◆– growth rate.

The sources of government investment are funds, which were made possible by an exceptionally good price situation at the world energy market. At present, the FEC cannot give a growth impetus to the Russian economy, and thus funds should be expended on the technological modernization of the MBC as the most cost-efficient branch of the real sector of the national economy.

The first source of government investment is the Stabilization Fund, and the second, the Investment Fund, which began financing infrastructural projects in 2006. Yet, many experts agree that the Investment Fund investment should not be limited to the creation and modernization of the infrastructure. The third source is the National Venture Fund, which is assumed to be a coinvestor of the sector's IT. At the same time, given its focus, the venture fund may help modernize radioelectronics. The fourth possible source of government investment is the so-called National Development Bank, which was approved at the end of 2006.

From these sources, two merit particular attention. The first is the Stabilization Fund, which is the most likely coinvestor because the Venture and Investment funds are narrowly specialized. The second is the Development Bank, which was established in Russia in 2007. It has more than 80 counterparts around the world, and in nearly every country, its main functions are technology development and export promotion.

A possible benchmark for Stabilization Fund investment is provided by expert analyses according to which the retooling and development of the knowledge-intensive sector of the MBC will demand up to 150 bln rubles annually, or some 5% of the fund as of the end of 2006. By investing in modernization the government offers an incentive to private investors. Private investments, too, are composed of several sources, which can be utilized by every economic agent.

The first—inraindustry—source is formed by the consolidation of the equity funds of enterprises dominating the total investment process.

The second—interindustry—source is formed by diversification and integration processes. Integration here refers to cooperation with countries actively supporting this sector, such as China (weapons and munitions, nuclear industry), India (weapons and munitions, nuclear industry), Iran (power machine building, weapons and munitions, and nuclear industry), Bulgaria (nuclear industry), Vietnam (power machine building), Venezuela (weapons and munitions), and Japan (automobile industry, etc.).

The third—public area—source is a stock exchange borrowing instrument (IPO, bonds, and credit notes). If a company goes public by way of an IPO its goodwill and capitalization grow, and its chances of receiving credit ratings increase.

All that improves the accessibility of the fourth source of private investment—the credit instrument—formed by the banking sector.

The dynamics of recent years bears evidence of the rising popularity of IPO as a source of financial borrowing. In 2002-2003, three companies raised $27.7 mln, in 2004, five companies raised $638 mln (the share of the Irkut science-production company being 20%), in 2005, 11 companies raised $4.9 bln, and in 2006, 16 companies raised $17.5 bln. According to forecasts, the amount of borrowing in 2007 may exceed $30 bln.

The possibility of disbursement of the above sources of private investment has been confirmed by Russia's first private public defense company, Irkut, which in March 2004 placed 26% of its authorized capital and raised

$127 mln. This amount of borrowing was the largest in 2004 within Russian sites. The company resources were spent on buying the Yakovlev experimental design office, which enabled the company to carry out the next phase of consolidation and diversification. Thus, for defense companies, the called-up capital can become a benchmark. Enterprises in the civilian sector in view of smaller restrictions and the absence of special defense requirements can count on greater income from placement. The total potential of the IPO market of all Russian companies for the period to 2015 is estimated at approximately $40 bln. If defense ministry enterprises attract 20% of funds in this period (as Irkut did in 2004), the volume of IPO-raised investment in these enterprises may amount to $7-8 bln until 2015.

Algorithm of inclusion of government investment in the economic agent's total investment process. An optimal goal of the state machinery may be an algorithm for harmonious inclusion of government investment in the total investment process of economic agents.

The inclusion of government investment takes place at the point of the intraindustry sources loop as part of the private investment sources. Own funds are generated from two sources: depreciation deductions and sales revenue. However, the wearout percent of basic production assets exceeds 50-60% and the majority of equipment is either completely worn out or likely to be so in the near future, i.e., the amount of depreciation deductions is decreasing, whereas the share of equity funds in the investment sources is 70-80%. Government investment committed to the expansion of production plant and modernization tend to increase depreciation funds thanks to the commissioning of new equipment and the modernization of existing equipment, which helps to raise competitiveness (production process output) and the quality and range of products, and hence, the revenues and equity funds. This results in:

- the harmonious inclusion of government investment in the economic agent's investment process, which does not affect established intraindustry ties;

- the realization of a national interest encouraging private investment; and

- the buildup of a major source of investment, namely, enterprises' equity funds, almost from the very start of implementation of the proposed algorithm of development of the economic agent's investment environment.

Government investment yield and payback. The yield and payback process is not based on the repayment of invested money at minimum or no interest. This algorithm has a greater efficiency on account of the continuity of the modernization process and the possibility of freeing public funds (Fig. 3).

Another important factor in the proposed algorithm is the growth of economic agents' vested interest, because an enterprise will be motivated not to give away its money to the state but to invest it in the development of related enterprises, which directly affects the competitiveness of this enterprise. The proposed algorithm allows to realize the mutual interest of the two parties: the government (investor) and the economic agent (investee).

In modernizing large enterprises the government may count in the long run on the substitution of private investments for public ones, i.e., the formation of a National Replacement Fund. Growth in production efficiency and the output of better and more varied products will allow an enterprise eventually to broaden its external and then, according to our main proposition, its internal market. After the modernization is completed, with considerable government support, at a reasonably large number of big and leading enterprises, the latter may jointly set up a National Replacement Fund by deducting a certain percentage of their earnings. The greater the membership of the National Replacement Fund the greater is its capital or the smaller the percent of deduction from the earnings of an individual agent. Fund money will be channeled into the modernization of smaller economic agents which are suppliers of larger representatives.

Thus, public money can be committed to other objectives. The interest of larger enterprises in the mod-

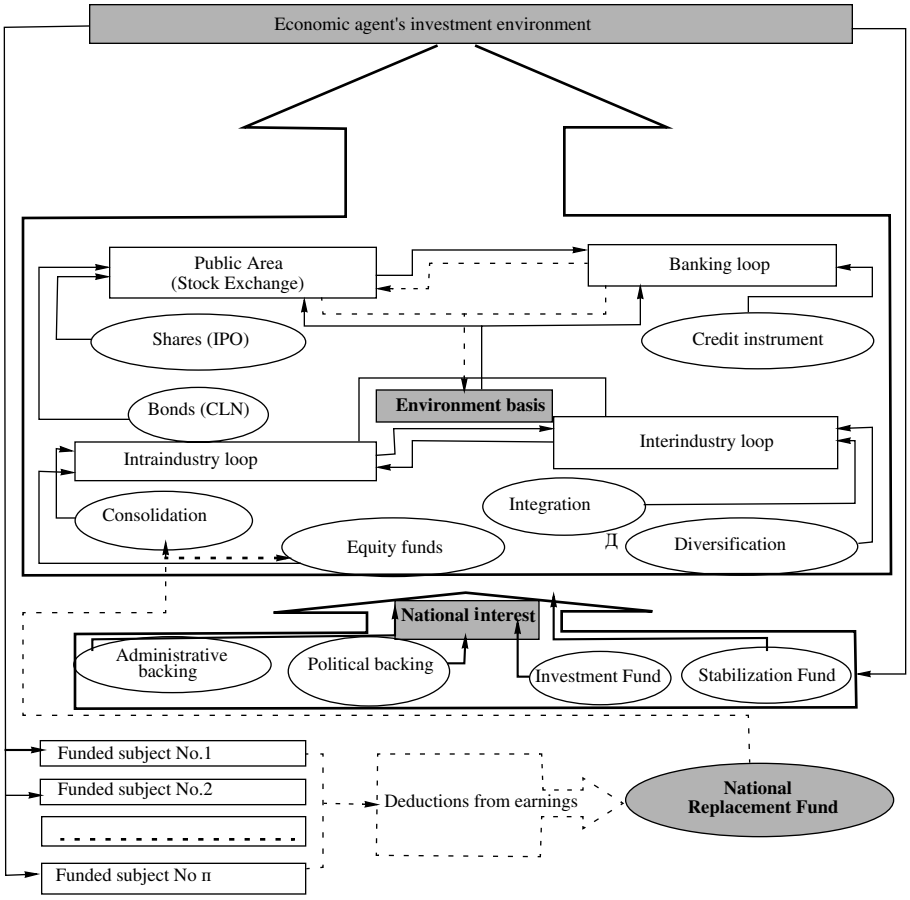

Fig. 3. Flow chart of the government investment payback and yield.

ernization of their suppliers stems from their concern about the retooling of the enterprises supplying them with parts and assemblies, which will increase the general competitiveness of the industry and its product.

* * *

Our studies and comparative analysis of results led us to the following conclusions.

1. The DEMMII interindustry production and investment model accommodates any number of hypotheses concerning import substitution volumes and technology.

2. The MBC is the most cost-efficient sector, and its promotion to a lesser (DEMMII-1 scenario) or greater (DEMMII-2 scenario) extent results in diversified and vigorous economic growth. On the other hand, the promotion of the chemical industry and metallurgy yields positive results too, whereas the promotion of the FEC, first, has no resources, and second, leads rather to an extensive type of growth.

3. More massive buildup of export and import substitution (DEMMII-2) leads to faster growth of labor productivity than under the DEMMII-1 scenario.

4. Despite the fact that when encouraged, all industry complexes create new jobs, industry employment continued to decline, which suggests faster growth in the service sector's employment.

5. To carry out modernization and expand production facilities, the annual rate of growth of permanent investment in the MBC must be in excess of 20%, which is clearly unrealistic under the present economic policies. But even if this rate of growth is achieved, the volume of investment required to improve the sector's competitive strength is at least half as much as what is required for the re-equipment and retooling of the FEC.

Export promotion and import substitution efforts will give the Russian economy an impetus for faster growth in the short and medium term. Besides, the modernization of its capital assets will be instrumental in shaping the base on which the technological development of Russia's economy will be possible once it joins the WTO.

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