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Russian Export Structure and Productivity[1]

Introduction

Export development is traditionally regarded as one of the ways to achieve sustainable economic growth. Recent studies confirm that the long-term development of individual countries is dependent not only upon their export volume and its growth rate, but its qualitative structure as well[2]. Labor productivity of the representative national exporters, as well as differences in the composition of factors used for production of goods exported by a particular country can be regarded as characteristics of the export qualitative structure. The first of these characteristics reflects the productivity of the export sector, while the second one indicates the average effort level to be taken by a country to extend the range of new promising export products, taking into account the existing structure of national export.

The objective of this article is to review the structure of the Russian exports and its dynamics over the last decade (the period of 1999-2006 is under review here) in the light of recent theoretical and empirical research findings on the importance of export structures to ensure sustainability of economic growth. A brief overview of the basic results of the modern approach to the study of the relationship between the structure of exports and economic growth is provided. Taking into account these results, the papers reviews both the Russian exports structure and its dynamics and also points the most promising (in terms of a long-term growth potential) products for future expansion of Russia's exports.

Modern approach to study of relationship between the structure of exports and economic growth

The traditional explanation for a country specialization in production of specific goods comes to the fact that the current structure of national exports is based, first of all, on the specifics of available physical and human capital, labor and material resources required for competitive production of goods and services, as well as quality of national institutions[3]. These factors define the levels of relative production costs and thus define the range of goods, which production could be competitive in a particular country. Consequently, it is

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[1] This article was published in Russian in "Ekonomicheskaya Politika" (Economic Policy) journal No.5, 2009.

[2] *Guerson A., Parks J., Torrado M.* Export Structure and Growth: A Detailed Analysis for Argentina. World Bank Policy Research Working Paper Series. No. 4237. 2007.

[3] *Samuelson P. A.* Prices of Factors and Goods in General Equilibrium // Review of Economic Studies. 1953. Vol. 21

possible to make significant changes to the structure of production and exports only in case of some improvements to those fundamental variables.

In the works of R. Hausmann and D. Rodrik et al. an alternative explanation of export specialization is proposed[4]. According to those authors, the structure of production and exports depends not only and not so much upon the above "fundamental" factors. One of the main ideas of their approach lies in the fact that the production of different products has different effects on the longer-term potential for economic development.

The authors' model looks as follows. The businessman, who is going to produce new goods that have never produced in this country before, faces the uncertainty in assessing the level of its potential production costs. Even if the goods are going to be manufactured under a technology implemented before (but for other purposes or in other countries), the local specifics in terms of local resource availability, as well as the specifics of the functioning of relevant institutions makes it impossible to estimate accurately local costs needed at the initial stage of production.

A relatively accurate cost assessment is possible only after the project is implemented by the entrepreneur. If the project is successful, other entrepreneurs rightly conclude that this kind of activity is promising, and therefore some of them may enter the market and compete with the first businessman. If the project fails, the other businessmen most likely will not attempt to produce the new commodity locally.

Therefore, the range of goods produced and exported by a national economy depends not only on "fundamental" factors, such as its resource availability, but also, for example, on the number of entrepreneurs capable to implement projects aimed at production of the products which are new for this economy. In addition, it is assumed that there exist new products with a higher productivity than the average for the economy (i.e., with a greater estimated return on investment). The local production of these products implies a higher probability of their successful export to the global market in the future.

When building a formal model, the authors normalized the volume of products in such a way that the price for all of them was equal to p (exogenous value, as a small open economy is considered). Each product corresponds to the level of productivity θ (in fact, it

[4] *Hausmann R., Hwang J., Rodrik D.* What you export matters. NBER Working Papers Series. 2005. No.11905; *Hausmann R.* Economic Development as Self-Discovery. KSG Working Paper. 2003. No. RWP02-023.

is the return on investment unit), which can vary within [0, h], where h is dependent on the "fundamental" characteristics of a particular economy - the quality of human capital, institutions, etc. Thus, countries with the highest h value can produce more "profitable" products. The investor is not aware of the exact θ value for a specific project before it is implemented. At the time of the decision-making on launching the production of a new product the investor assumes only that θ parameter is evenly distributed in the interval [0, h].

Once the project is implemented, the level of necessary costs for the production of new goods becomes generally known. Therefore, there is no need for new investors interested in entering the relevant market to incur incremental costs faced by the pioneer, but they receive a lower return on their investment.

The model assumes that every investor already has its own project with a profitability θ_i. Then, if θ_i is greater than θ^{max} - the maximum of the potential profitability of projects that would initiate production of new goods,- the businessman will continue his previous business. If $\theta_i < \theta^{max}$, then the businessman will switch to the production of one or more new products.

If we designate the number of investors who want to invest in the production of new goods as m, then:

$$E(\theta^{\max}) = \frac{hm}{m+1} \quad (1)$$

It is worth noting that the value of expected θ^{max} is zero if $m = 0$ and it tends to h if the expected number of entrepreneurs m, intending to invest in the new sector of the economy, tends to infinity.

Further, the authors obtain the following expressions for the expected profit and expected productivity in the production of new goods in the economy:

$$E(\pi) = ph[(1-\frac{\alpha m}{m+1})\frac{1}{2}(1+\frac{\alpha m}{m+1}) + (\frac{\alpha m}{m+1})^2] = \frac{1}{2}ph[1+(\frac{\alpha m}{m+1})^2], \quad (2)$$

$$E(\theta) = \bar{\theta} = \frac{1}{2}h[1+(\frac{\alpha m}{m+1})^2]. \quad (3)$$

It could be seen that the expected profit from the production of new goods is equal to the product of price and the expected productivity of their production. The expected productivity, in turn, depends on *h*, i.e., on the state of the "fundamental" economic factors, as well as on *m* - the number of entrepreneurs investing in the production of new goods, and this dependence is positive.

Furthermore, the authors introduce a proxy for the maximum possible productivity in the production of new goods. As such a proxy, they consider a measure of current average productivity in the export sector of the economy, which they call *ExpY*. They justify this choice by noting that the country is exporting just those domestic goods, in which they have the highest productivity and which could be competitive at the global market.

The authors propose the following approach to quantitative estimation of ExpY. At the first stage productivity index *($ProdY_k$)* is estimated for each commodity *k* exported to the world market. It represents a weighted mean of GDP per capita for all countries exporting this particular product *k*. The ratios of the share of exports of the product *k* in the total export of the country to the sum of respective relevant shares in other countries are used as weights:

$$\mathrm{ProdY_k} = \sum_{\mathrm{j}} \frac{x_{jk} / X_j}{\sum_j x_{jk} / X_j} Y_j \, , \qquad (4)$$

where

j is country index, k is product index, x_{jk} is export of product *k* by country *j*, X_j – total export of country *j*, Y_j – GDP per capita in country j.

In fact, the weights at the GDP variable in formula (4) are nothing more than a relative comparative advantage (*RCA*) of each country in regard to product *k*. Usage of such weights by the authors is based on the desire to avoid the influence of the economy of scale effect on the estimated index.

Therefore, the goods exported in significant volumes by the rich countries have a higher productivity *ProdY*. In other words, *ProdY* index for a particular product reflects the average productivity in the production of this commodity subject to the structure of its global exports.

The productivity of exports in general for each country *j* is estimated as:

$$\mathrm{ExpY_j} = \sum_{\mathrm{k}} \frac{x_{jk}}{X_j} \mathrm{ProdY}_k \qquad (5)$$

The latter index is the sum of the weighted values of productivity indices of each country's exported goods, where the weights are the shares of individual commodities in total exports of the country. Accordingly, *ExpY* index for an individual country is a measure of average productivity of its export sector, given the structure of global markets for the goods which it exports.

Hausmann, Hwang and Rodrik[5] built the values of export productivity index $ProdY_k$ for the sample of 113 countries for 1999-2001 using the United Nations Commodity Trade Statistics Database (COMTRADE). These estimates have a number of interesting features.

First of all, these values are strongly correlated with the level of GDP per capita[6]. It can be partially explained by the design of $ProdY_k$, but not entirely, because when *ExpY* is estimated with *ProdY's* that are constructed without taking into account the country's own exports, the correlation with GDP per capita is not much different. A more substantive explanation lies in the fact that as per the authors' model, the productivity of the export sector depends on the *h* value (formula 2), which is based on the fundamental macroeconomic indicators that also affect the level of GDP per capita in the standard growth models.

The fact that countries with high export productivity have been often demonstrating a significant economic growth over the latest decades, suggests a tentative link between the growth rates and the levels of exports productivity. For the formal analysis of this relationship, the authors estimated several regressions.

They showed that the productivity of national exports, measured by *ExpY*, actually has a significant positive effect on the rate of economic growth in each of the models reviewed.

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[5] *Hausmann R., Hwang J., Rodrik D.* What your export matters. NBER Working Papers Series. 2005. No. 11905.

[6] However, the authors note that there is a number of small countries with relatively low levels of GDP, but with a rather high productivity of export. As a rule, this country, a larger share of which exports account for specific products with great *ProdY* (an example can be French Polynesia, which became, according to the authors' estimates, one of the five countries with the highest productivity of exports. The majority of its exports is artificially cultivated pearls, *ProdY* of which in 2001 amounted to USD 22,888).

Further development of the approach to the analysis of the determinants of export diversification and economic growth is presented in the work by Hausmann and Klinger[7].

The basic idea of this study is that the factors necessary for the production of one good are incomplete substitutes for the factors of production of other goods. The level of substitution (replacement efficiency) varies among different pairs of goods. For example, to switch from the production of cotton shirts instead of cotton trousers is far less expensive than a transfer to the production of computers, since the latter requires the development of entirely new technology, staff training, purchase of new equipment, patents, etc.

Given the cost of launching the production of new goods, the speed of transition from the production of old goods to the new ones essentially depends upon the density of “product space" in the segment of that space, in which the country has the greatest comparative advantage[8].

The formal model used by the authors of the article represents a version of the model with overlapping generations for companies, who live two periods and produce a unit of some product during each of them. In the economy there exist only two products: "standard" one, which has been traditionally produced in the economy, and a new product with a higher price and productivity.

The company can either produce the old product and get a unit of profit, or start manufacturing the new product and get a higher profit. But this would require additional costs of transition to the new product for the company, due to the reasons stated above. These costs depend upon the "distance" between the old and new products (i.e., on the similarity of their factors of production). But as soon as one company switches to the new product, the specific factors necessary for its development become common knowledge and there is no further need to other firms to bear the entire costs of transition to the new product. The

[7] *Hausmann R., Klinger B.* Structural Transformation and Patterns of Comparative Advantage in the Product Space. John F. Kennedy School of Government – Harvard University. 2006. No. rwp06-041.

[8] Hausmann and Klinger have proposed the following illustration. Products are like trees in the forest, which can grow in the forest close or far away from each other depending on how similar the factors required for their production are. Firms can be compared with monkeys living in the forest, which receive different income (profit), living at different trees (i.e., monkeys as a rule prefer bananas rather than spruce cones). The wood is the same for all countries, but the monkeys belonging to one or another country occupy some particular part of it (production of existing goods in the country). They can jump to another, not occupied by them tree (the development of new products), more attractive to them (in terms of profits), but there is a likelihood that they will not jump so far, if the distance between trees is too large.

companies select the distance at which they would place the new product from the old ones maximizing their profits.

The space density of all goods can be represented by a matrix which elements are the distances between pairs of goods.

In building an empirical measure of the distance between the goods the authors of the article assume that the space of goods is not homogeneous, and the similarity of factors of production for a pair of products can be defined by the probability that the country is specialized in exports of both of those products, i.e., the *RCA* index is a high for both of them.

An empirical indicator selected in the article to define technological proximity of the two goods is the likelihood that a country exports Product 1, provided that it exports Product 2. Selection of exports rather than production in general is based on the assumption that the exported goods are the most competitive and profitable ones in any national economy. The selection of conditional probability, rather than just the probability that two products are exported at the same time, is made in order to eliminate the distorting effect of a commodity exported by many countries. It should be noted that, since P (A | B) ≠ P (B | A), the authors propose to use the minimum of these two values to avoid asymmetries in the estimates[9].

To reduce the statistical "noise" in the data, only those pairs of goods for each of which RCA> 1 are taken into regard to build up the index of similarity of goods. According to the authors, this guarantees that the export of a particular pair of goods by a country is not accidental, but is based on the similarity of the necessary factors of production and exports.

A reverse value to the "distance" between two goods is defined as:

$$\varphi_{ijt} = \min\{P(x_{it} \mid x_{jt}), P(x_{jt} \mid x_{it})\}, \qquad (6)$$

where

i,j – goods indices, *t* – time, and for each country c the following is defined:

$$x_{ict} = \begin{cases} 1, if \quad RCA_{ict} > 1 \\ 0, \quad otherwise \end{cases}, \qquad (7)$$

[9] This point is not essential since assuming the asymmetry of distances does not change much the results of estimation.

$$RCA_{ict} = \frac{xval_{ict} / \sum_{i} xval_{ict}}{\sum_{c} xval_{ict} / \sum_{i}\sum_{c} xval_{ict}}, \tag{8}$$

$xval_{ict}$ – product export i by country c in the period t.

Value φ_{ij} varies in the range from 0 to 1 and reflects probability of simultaneous specialization of countries in the export of i and j products.

If the characteristics of the product space are important for the transition from manufacturing of one type of product to another, then, as the authors note, the probability that a new product in the next period will have high value of *RCA (> 1)* depends on how many factors of production required for this product is already in use in this economy. In other words, a significant factor for successful development of the new product is the value of "distance" between this new product and all products, which to date are produced / exported in the economy.

To account for this, the authors build a generalized characteristic of the national export structure, which they call "density". For each product available at the world market, it shows how close it is "surrounded" by goods already exported by that country (at the level *RCA> 1)*:

$$density_{ict} = \frac{\sum_{k} \varphi_{ikt} x_{ckt}}{\sum_{k} \varphi_{ikt}} \tag{9}$$

Apparently the value of density will be in the range from 0 to 1.

In accordance with the model, firms are more likely to switch to manufacturing and export of a new product if the density value for it is high, that is, if the economy is specialized in the export of similar goods. This fact was demonstrated empirically in the paper by Hausmann and Klinger. Thus, the possibility of explaining the structure of the produced and exported goods at the national level through the proposed distance measure between products is confirmed.

Another interesting issue is how the product space looks in practice. One of the works, in which it was built empirically, based on actual data on the structure of global trade in goods, is the article by Hidalgo, Klinger, Barabas and Hausmann[10]. Graphical presentation of the product space provided by the authors contains a number of circles of different colors and sizes, linked by straight lines. Circles illustrate the goods, the size of each circle reflects the volume of world trade in this good, and color designates the industry, to which it belongs. The lines connecting the circles represent the "distances" between the goods, i.e. the values calculated by the formula (6).

One of the results, obtained by the authors, is that the product space is the densest in the places, where the most technologically complicated goods are concentrated, while the "simpler" goods, such as raw materials, are located at the periphery. In fact, this is a reflection of the observation that technologically advanced countries find it easier to switch to the production of new goods than less developed or resource dependent economies.

Taking into account the fact that, as a rule, countries are starting to produce and export products which are the closest to those already present in their export basket, it is not surprising that the poor economies need much more time and effort to transit from production of raw materials and low-tech products to the production of technically more sophisticated goods.

Structure and productivity of the Russian export

Before discussing the productivity estimates for Russia's exports, we will review its structure and dynamics over the recent years.

Tables 1 and 2 show the goods that made the largest share of Russian export in 2006[11]. In the first Table a breakdown by industry is presented (by sector, 2-digit product classification code), the second one provides a break-down by product (by product subgroups, 4-digit product classification code).

As one can see, the greater share of the Russian exports is made by oil and oil products (mainly crude oil) and gas. Together they represent 66.8% of the total exports at the sectoral level and 60.4% at the product level. More clearly the overall structure of exports is presented at Fig. 1 and 2, showing the cumulative share of exports at the sectoral and product levels, respectively. Besides oil and gas, large shares of exports are taken by metals,

[10] *Hidalgo C. A., Klinger B., Barajas A.-L., Hausmann R.* The Product Space Conditions the Development of Nations. Science Online. 2007. 13 November.

[11] Hereinafter the data on exports and imports is presented from the United Nations Commodity Trade Statistics Database (COMTRADE).

coal, and chemical industry products. The top six items in the export list make 70% of the total exports, the first 19 items make 80%.

Table 1

Russian Export Breakdown by Industry, 2006.

Code	Commodity group	Export volume (USD mln)	Share (%)	Cumulative share (%)
33	Oil and oil products	141114	51.2	51.2
34	Natural and produced gas	43228	15.7	66.8
68	Non-ferrous metals	19229	7.0	73.8
67	Iron and steel	16984	6.2	80.0
24	Wood and Timber	5668	2.1	82.0
51	Chemical elements and compounds	5306	1.9	84.0
71	Machinery except electrical equipment	5195	1.9	85.8
73	Vehicles	5009	1.8	87.7
32	Coal, coke	4590	1.7	89.3
56	Fertilizers	4077	1.5	90.8
28	Metal-bearing ores and metal scrap	3089	1.1	91.9
66	Non-metallic mineral products	2604	0.9	92.9
72	Electrical machinery	2562	0.9	93.8
4	Grain	1806	0.7	94.4
64	Paper and cardboard	1537	0.6	95.0

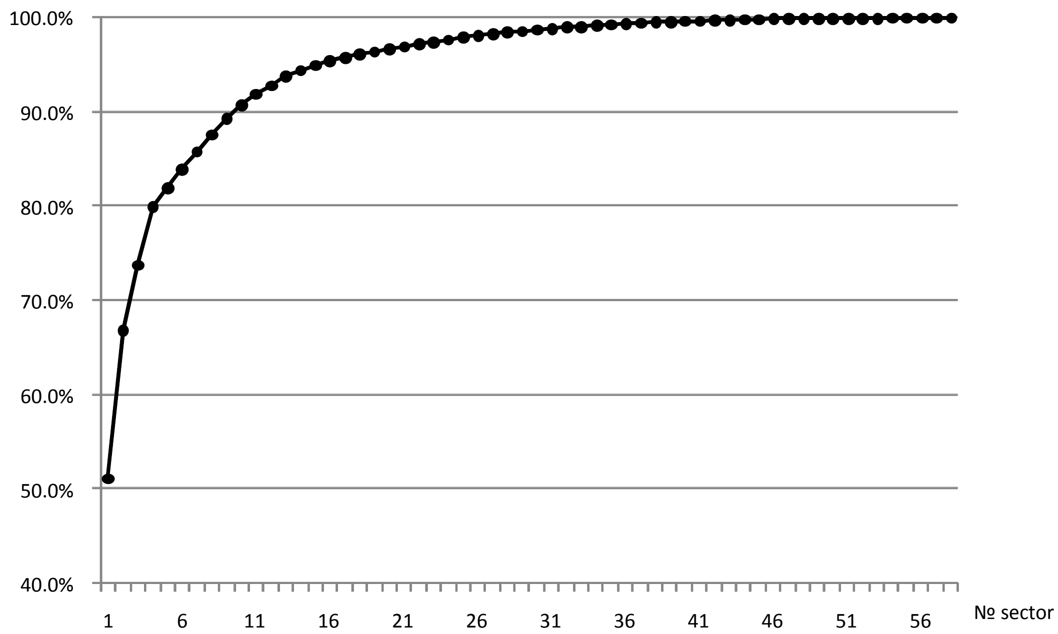


Fig. 1. **Cumulative share of export breakdown by industry (%), 2006**

Table 2

Russian Export Breakdown by Product, 2006

Code	Commodity group	Export volume (USD mln)	Share (%)	Cumulative share (%)
3310	Crude and partially refined oil	96675	41.8	41.8
3411	Natural gas	43228	18.7	60.4
6841	Aluminum and its alloys, unprocessed	6412	2.8	63.2
6831	Nickel and its alloys, unprocessed	5906	2.6	65.7
6725	Iron balls, billets, slabs etc.	5421	2.3	68.1
3214	Coal (antracite, bitumen)	4341	1.9	70.0
6822	Nickel and its alloys, processed	2801	1.2	71.2
2422	Bolt timber, scale wood	2520	1.1	72.3
2432	Sawn logs, unhewn timber	2265	1.0	73.2
6727	Rolled steel and iron for the rerolling	2245	1.0	74.2
2820	Iron and steel scrap	2031	0.9	75.1
6672	Raw diamonds, not technical	1718	0.7	75.8
6821	Copper and its alloys, unworked	1671	0.7	76.5
5611	Nitrogen-containing fertilizers	1510	0.7	77.2
6712	Pig Iron	1456	0.6	77.8
410	Wheat, whole	1368	0.6	78.4
5619	Fertilizers	1364	0.6	79.0
6742	Steel and iron sheets (thickness 3–475 mm)	1316	0.6	79.6
6743	Steel and iron sheets (thickness less 3 mm)	1306	0.6	80.1

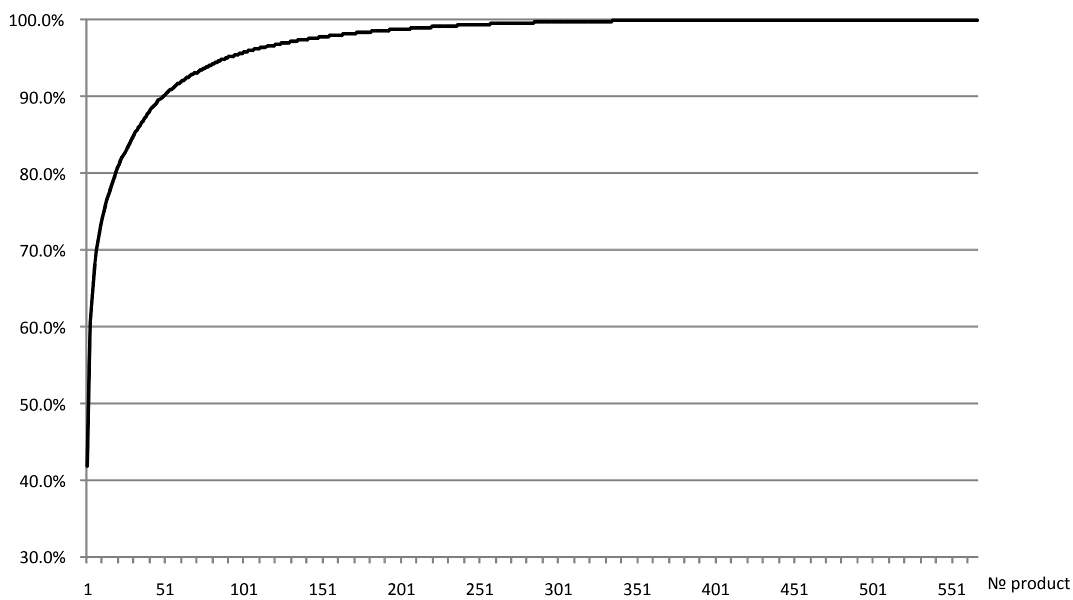


Fig. 2. **Cumulative share of export breakdown by product (%), 2006**

It is worth paying attention to the fact that Russia exports mainly unprocessed raw materials.

Fig. 3 shows the dynamics of export concentration in the period of 1999-2006: changes in the share of the first ten and twenty products in total exports. As one can see, the percentage of the first twenty products during this period increased from 70 to 80%, and while the share of top ten products rose from just over 60% to about 75%, the share of the next ten ones declined slightly.

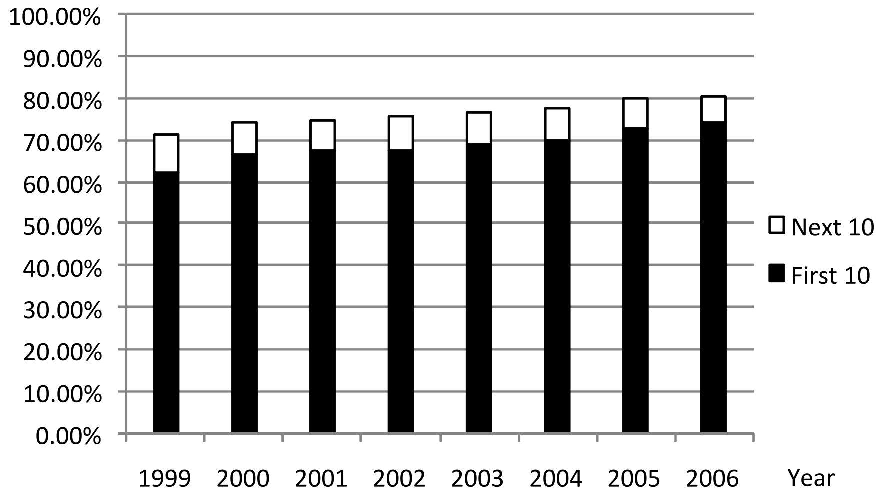


Fig. 3. **Share of 10 and 20 Top Exported Products (%), 1999–2006**

The degree of export concentration can be measured more accurately with the help of Hirschman index, which is the square root of the sum of squared shares of each product - the higher the value, the higher the degree of concentration. The values of the index for the Russian exports are presented in *Table. 3* and *Fig. 4*.

Table 3

Russian Export Concentration, 1999–2006

Year	1999	2000	2001	2002	2003	2004	2005	2006
Hirschman index	0.324	0.366	0.381	0.387	0.405	0.419	0.460	0.461
Share of 5 top exported products (%)	55.1	59.4	61.0	60.0	61.8	61.7	66.0	68.1
Share of 10 top exported products (%)	62.2	66.6	67.4	67.7	69.2	69.7	72.6	74.2
Share of 20 top exported products (%)	71.3	74.4	74.8	75.5	76.5	77.7	79.8	80.7

Number of goods, the export volume of which exceeds USD 5 mln	281	307	294	297	323	331	340	345
Number of goods, the export volume of which exceeds USD 10 mln	221	243	240	239	265	287	291	299

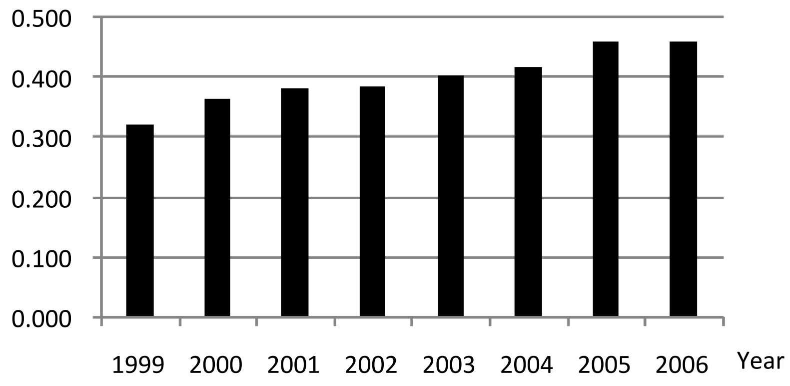


Fig. 4. **Hirschman index**

Relative changes in the index are of interest. Judging from *Fig. 4*, the degree of concentration of the Russian exports has increased by factor of 1.5 in seven years, but in the last year of this period, the growth of export concentration virtually stopped.

Apparently, growth in the concentration of Russian exports reflects primarily the increased fuel prices in the reporting period. The effect, however, was so significant because the supply of oil and gas (gas prices are dependent on oil prices) make the greatest share in the Russian export. This is confirmed by the fact that overall growth of export concentration is observed for the top ten export goods.

Let us now review the productivity estimates for Russian exports and their dynamics. To this end, we will use the method of Hausmann, Hwang and Rodrik and proposed by them formulas for assessing the productivity of individual product and the average productivity of a country's exports in general (formulas (4) and (5), respectively).

The data on exports were taken at the level of product subgroups, GDP per capita – in terms of purchasing power parity, in USD. Export productivity dynamics of some countries is presented in *Fig. 5*.

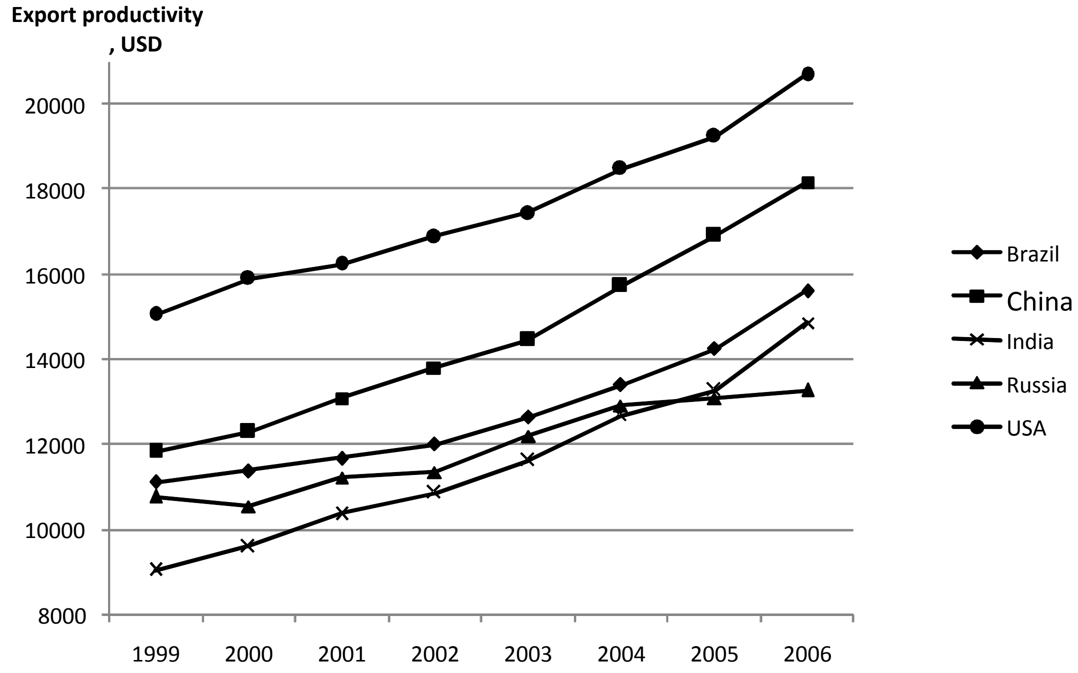


Fig. 5. **Dynamics in average export productivity (USD), 1999–2006**

One can see that in 1999 the productivity of Russian exports was less than the corresponding indicator for China by approximately 15%, and in 2006 - already by 35%. This demonstrates a much higher rate of introduction of the new products and diversification of exports by Chinese economy. *Fig. 5* also reflects that in 2006 Russia was lagging behind both India and Brazil in terms of productivity of the export structure.

A more detailed analysis of the data for Russia shows that, firstly, the major reason for the modestly growing trend in the country's estimates of export productivity reflects growth of natural gas exports, and secondly, excluding oil and gas from the average productivity estimates for Russia shows that there was no any noticeable growth in productivity.

Fig. 6 and *7* present the relationship between GDP per capita and export productivity level in 2006. One can observe a strong and apparently exponential interrelation (this observation is similar to the results obtained by Hausmann, Hwang and Rodrik[12]).

The graph highlights the countries that showed significant growth recently – China, India, Brazil. For them the value of export productivity is greater than the average for coun-

[12] *Hausmann R., Hwang J., Rodrik D.* What you export matters.

tries with approximately the same level of GDP per capita (relevant dots lie below the curve at the figure), which is also consistent with the results by Hausmann, Hwang, and Rodrik.

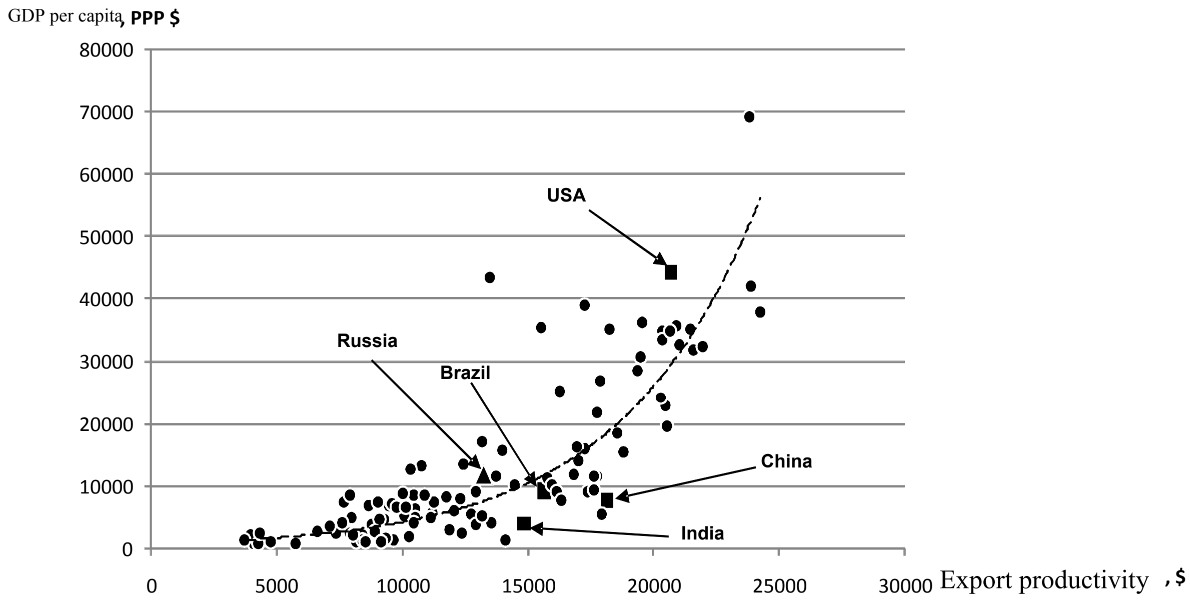


Fig. 6. GDP per capita (USD PPP) and the productivity of exports (USD), 2006

At the same time, one can see that the situation for Russia is different: the level of productivity of its exports is lower than the average level of productivity for countries with similar GDP (the dot is above the curve). Within the framework proposed by Hausmann, Hwang and Rodrik it means that in comparison with India, Brazil and China the Russia's medium-term growth prospects are less promising.

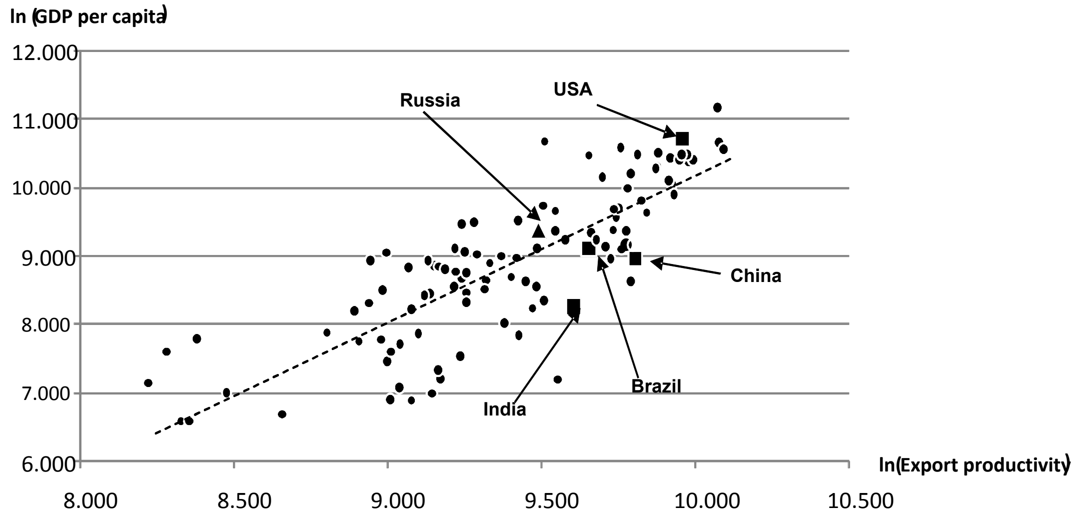


Fig. 7. GDP per capita (USD PPP) and export productivity (in the logarithmic scale), 2006.

Let us review the dynamics of GDP per capita and export productivity for Russia in more detail (see *Fig. 8*).

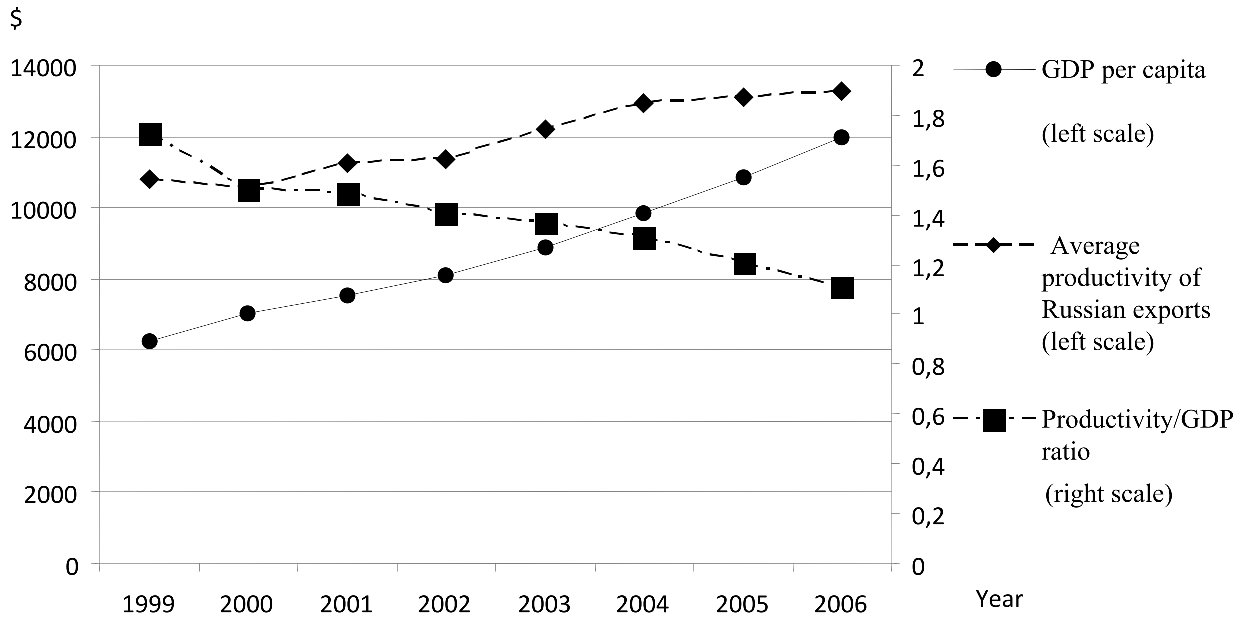


Fig. 8. GDP per capita (USD PPP, left scale), the average productivity of the Russian exports (USD, left scale) and their ratio (right scale), 1999–2006

One can see from the graph that both GDP per capita and export productivity grew at pretty stable rates during all period under review. However, growth of export productivity was notably lower than the GDP growth rate, which was reflected in the dynamics of their ratio, i.e., the improvements in export structure in the recent years did not «catch up» with the growth rates of economy. If in 1999 the ratio of export productivity to GDP per capita made about 1.7, in 2006 this value has declined to 1.1. It can be explained by the fact that considerable part of general growth in exports was caused by the increased exports of raw materials, which have relatively small values of export productivity.

Dynamics of the ratio of export productivity to GDP per capita for some other countries is presented at *Fig. 9*.

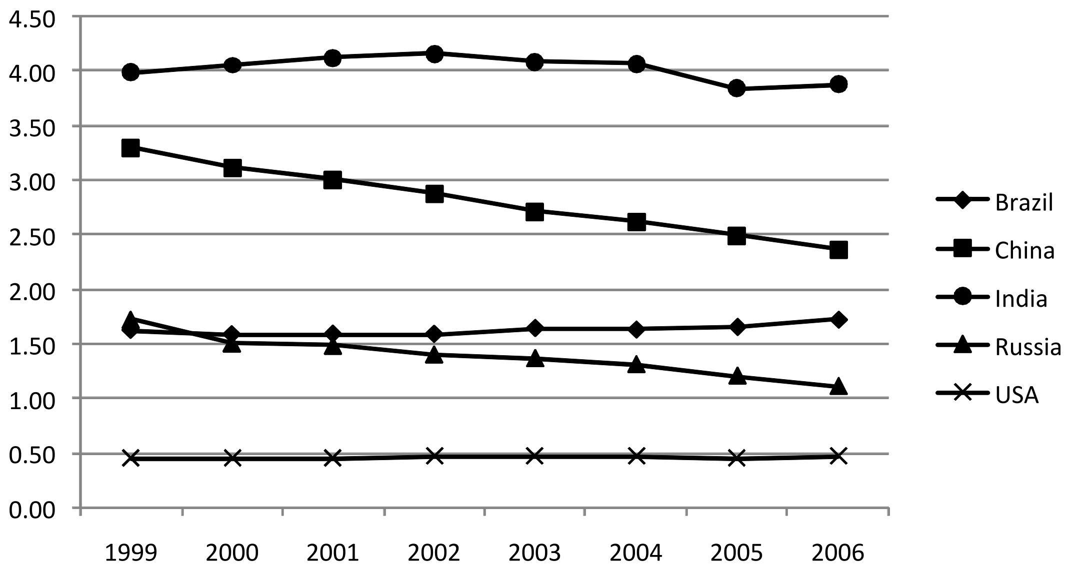


Fig. 9. Ratio of export productivity to GDP (in PPP) per capita for a number of countries, 1999–2006

As can be seen from the figure 9, among the countries under review the largest and relatively stable value of the ratio of export productivity to GDP per capita is demonstrated by India, which by the logic of articles by Hausmann et. al. can suggest that this country has a considerable potential of medium-term economic growth. India is followed by China, but for this country, as well as for Russia, the value of the ratio under review declined throughout the period - a tentative indicator that the country's growth rate would slow down in the medium term[13].

It follows from the works of R. Hausmann and others, that in principle, a country can improve the growth prospects of its economy by implementing one out of two alternative strategies: either by producing and exporting more of its currently manufactured products with high productivity, or by transition to the production / export of new products with high

[13] Estimates for the US are apparently underestimated, as this country exports a lot of services, not included in our estimates.

export productivity. In this regard, we will review the volume of exports and productivity of the top ten products in terms of export volume for Russia, as well as the dynamics of these parameters over time.

Fig. 10 presents the export volumes of the top ten goods, *Fig. 11* - their corresponding percentage share in total exports, Fig. 12 - indicators of export productivity of these goods.

The first two graphs confirm what has already been mentioned: in the period under review the share of oil and gas exports increased significantly as compared with other exported goods. Fig. 12 is of additional interest: one can claim that the average productivity of the top ten exports was gradually, but not much, growing from 1999 to 2006. It should be noted that none of these products exceeded the average value of productivity for the Russian exports in general (i.e., *ExpY* value), equal to USD 10.770 in 1999 and USD 13.260 in 2006.

To assess this result, it is necessary to compare it with the dynamic productivity of other Russian export goods, not included in the top ten. Table 4 shows the 25 products of the Russian exports in 2006 with the largest values of export productivity (selected from the first 125 items in total exports by volume), and Fig. 13 illustrates the dynamics of the combined share of these relatively more productive goods in total the exports. As one can see, this share had experienced significant variations during the period under review, and from 2003 to 2005 it decreased almost by half. But most importantly, in general the share of high-productivity goods is very low and all the changes occurred in the range of 1 to 2% of total exports.

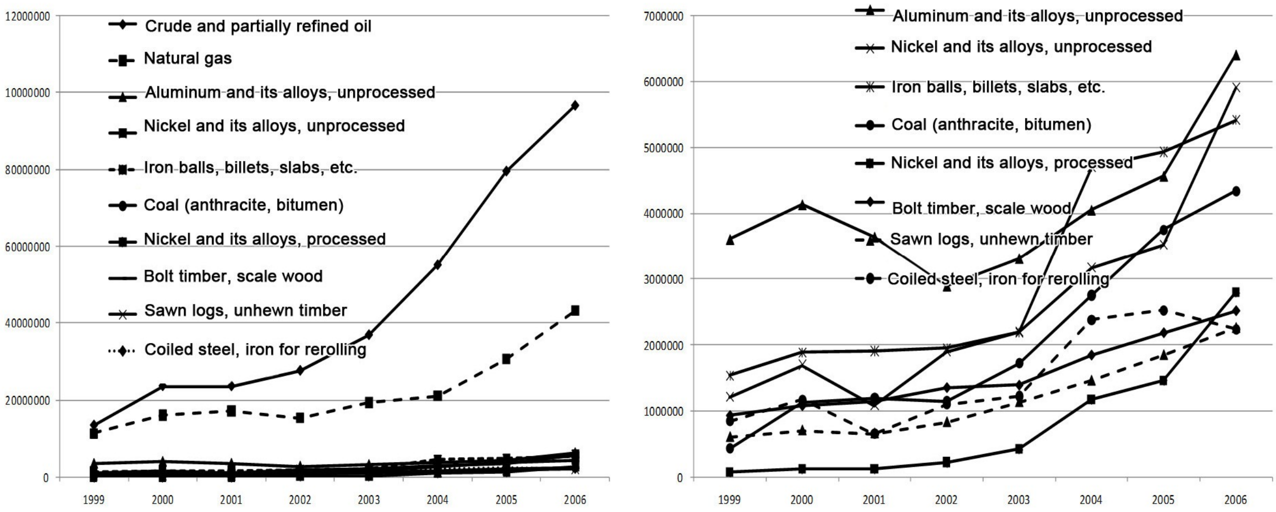


Fig. 10. Annual export volumes of the ten top Russian export goods (USD thou.)

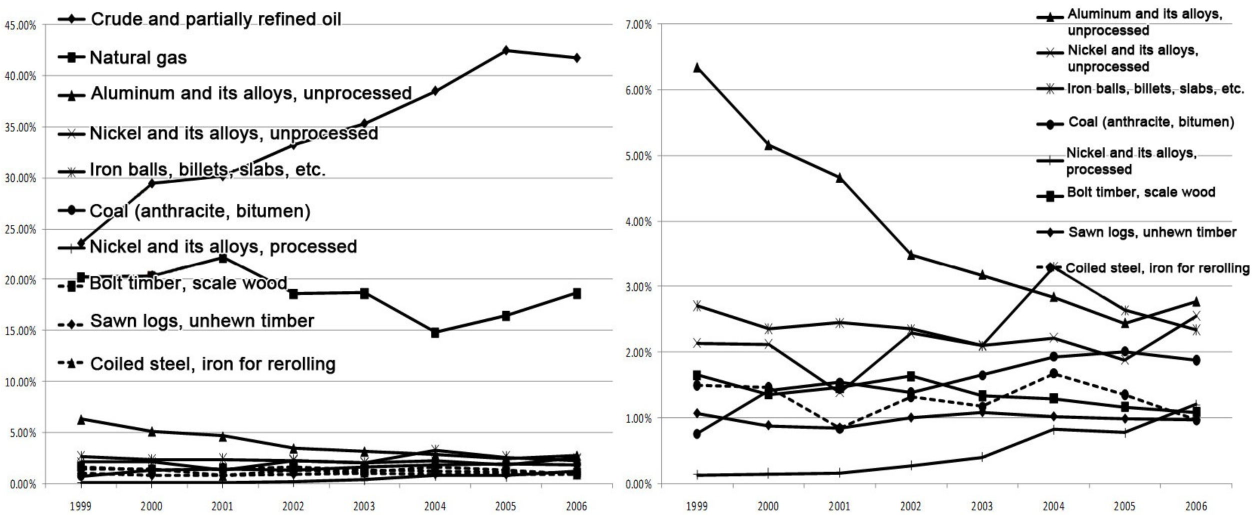


Fig. 11. Export volumes for 10 major export commodities of Russia as a share of total exports (%)

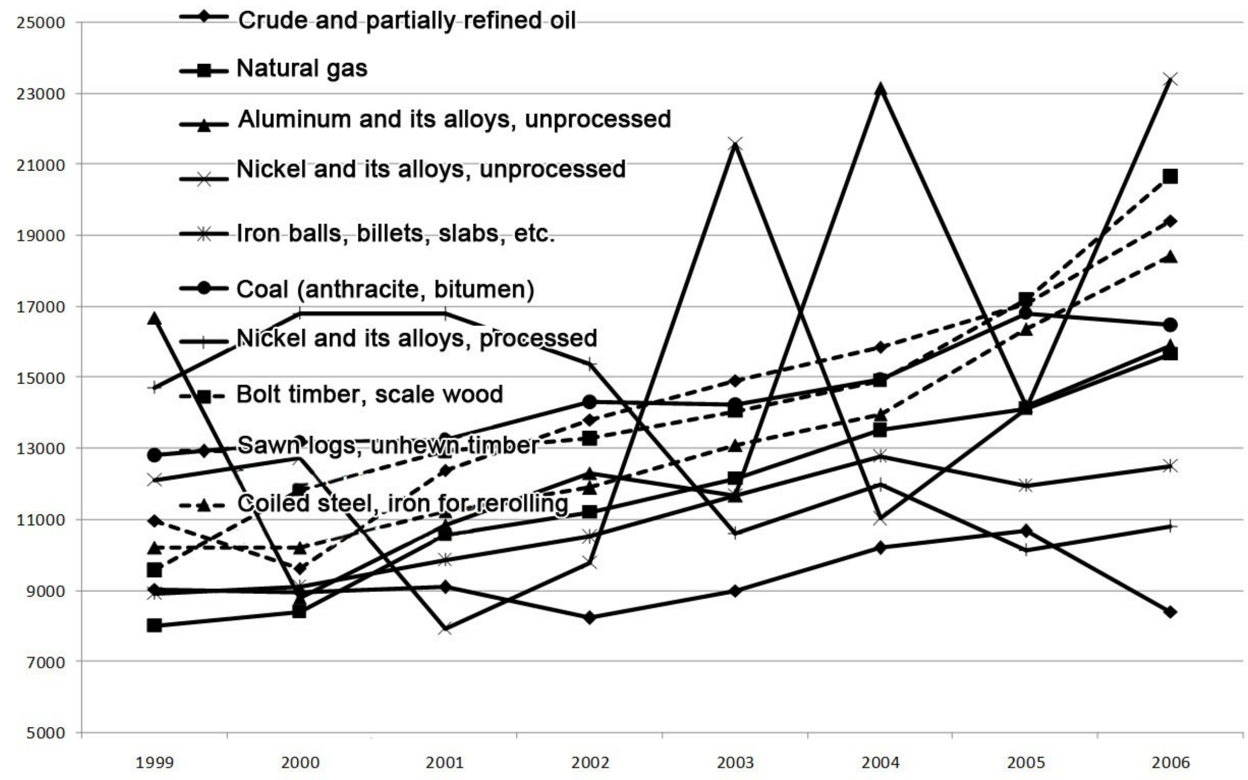


Fig. 12. Export productivity for 10 major export goods of Russia (USD/per capita)

Table 4

Products with the highest export productivity among the top 125 products in terms of export volume of Russia, 2006

Commodity	Productivity (USD per capita)	Commodity	Productivity (USD per capita)
Structural steel and iron	43607.5	Watches, watchcase	32021.1
Materials for cars	39054.5	Glycosides	31964.8
Steel and iron parts and structures	38593.9	Published music	31832.7
Rails	38026	Disc, tape and other audio recordings	31464.6
Particle accelerators	37464	Polished or frosted glass in rectangular pieces	30459.8
Hormones	35137	Furs	30412.9
Uranium, thorium and their alloys	34719.7	Bacon, ham, salted, smoked pork	30271
Orthopedic products, hearing aids, etc.	34644.2	Chemical reagents for photos	30270.4
Organic-inorganic, heterocyclic mixture	33854.3	Aircrafts, aircraft motors	30194.3
Safety glass, tempered or laminate	33313.5	Grinding and polishing wheels	29737.3
Railway and tram engine-driven carriages	33083	Electronic medical equipment	29553.1
Nitrate mixtures	32637.5	Textile	29492.3

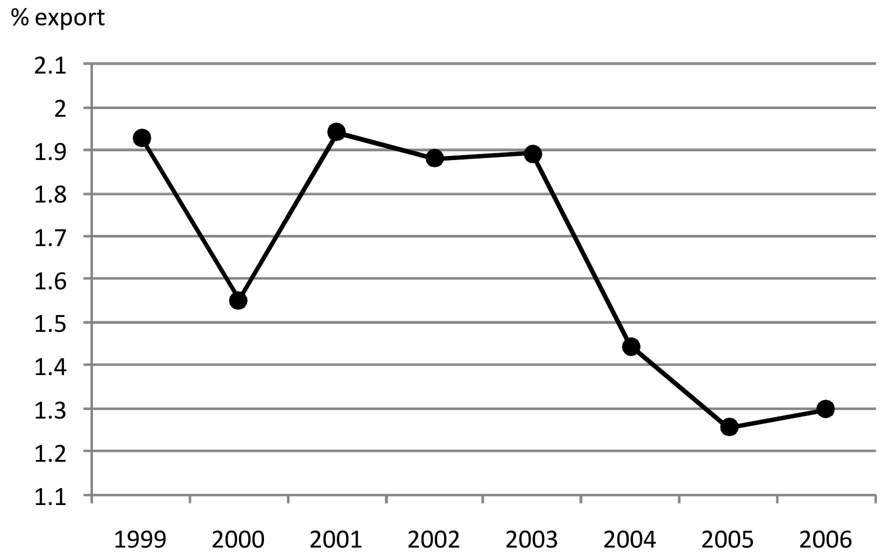


Fig. 13. The total share of 25 products with a maximum value of export productivity in Russia (%), 1999–2006

Based on the above results, one can note that the share in total exports of nearly all top 125 commodities is very small, it almost did not change over time, and even was decreasing for some of them. At the same time, the export productivity of many high-productive goods has significantly increased during the period, and that its productivity value in 2006 was on average 1.5-2 times higher than in 1999.At the same time, for the majority of these products the value of productivity is much higher (2.5-3.5 times) than the average productivity value for the Russia's exports in general.

The obtained results show that among Russian exports there are quite a number of goods with high (and growing) productivity. This indicates that the expansion of production and export of such goods could likely improve the overall prospects for economic growth.

To assess the priority areas of diversification for Russian exports, one should take into account that in accordance with the works by Hausmann and Klinger[14], the costs of diversification significantly vary across different products. Accordingly, different export baskets (sets of new export products) are characterized by different potential for further diversification, associated with the level of costs needed to launch the production of goods that are close to those included in the basket.

[14] *Hausmann R., Klinger B.* Structural Transformation and Patterns of Comparative Advantage in the Product Space.

In order to be able to distinguish a group of products that are rather promising in terms of economic growth and at the same time creating good opportunities for further export diversification of, we can use another indicator, proposed by Hausmann and Klinger - namely, estimates of the "distance" between each of the product and the overall basket of products in the world trade:

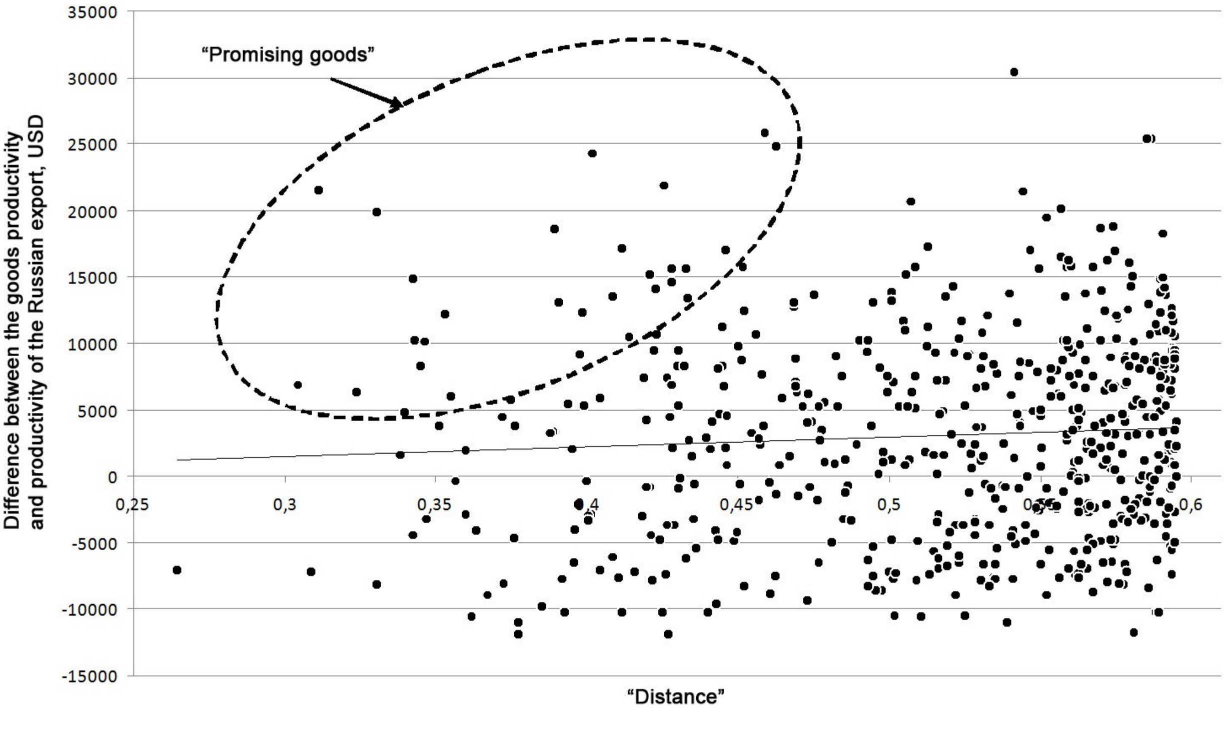
$$Dist_{ict} = \log\left[\frac{1}{density_{ict}}\right] = \log\left[\frac{\sum_k \varphi_{ikt} x_{ckt}}{\sum_k \varphi_{ikt}}\right], \quad (10)$$

where $density_{ict}$, φ_{ikt}, x_{ckt} are calculated by formulae (9), (6) and (7) accordingly.

Commodity's "distance" to the world export basket reflects the degree of similarity of the factors required for its production with the factors of production of the goods from the world export basket. The lower is this value, the more attractive it is to develop the production and export of such a product, as there are more opportunities to use the resources necessary for its production also for the production of other similar goods.

Fig. 14 presents a graph, which horizontal axis is the distance between the individual products in the Russian export and the world export basket, and the vertical axis is the difference between the product's export productivity and its average value for the overall Russian exports. 567 products of the Russian exports in 2006 are reviewed.

Fig. 14. **Russian export goods productivity and their "distance" from the world export basket, 2006**



The higher is the difference between the product's export productivity and the average productivity of the country exports in general (vertical axis), the more attractive is the expansion of its exports for the economy. At the same time, the less is the distance between a product and the global commodity basket (horizontal axis), the more promising is the product in terms of future opportunities for export diversification and the easier it will be to develop exports of new products due to the similarity of factors required for their production with those that are already used in the economy. Thus, among Russian exported products the most preferred products in terms of growth prospects and in terms of diversification are the goods placed in the upper left corner of the graph (in *Fig. 14* - inside the dotted line area).

The list of those goods is presented in Table 7. In 2006 their share in the total Russian exports made about 0.6 %.

Table 7

The most attractive commodities for export expansion

Commodity code	Commodity	Export productivity (USD)	Deviation from average level, ProdY – ExpInc (USD)	Distance
6880	Uranium, thorium and their alloys	34719.70	21459.29	0.311326
7314	Railway and tram engine-driven carriages	33083.02	19822.61	0.330753
2516	Wood paste	20081.12	6820.711	0.304596
7315	Railway and tram carriages	19579.80	6319.391	0.323841
5153	Thorium compounds and mixtures	21511.22	8250.816	0.345279
6831	Nickel and its alloys, unprocessed	23398.27	10137.86	0.346308
451	Rye, whole	23502.62	10242.21	0.343264
2518	Sulfite Wood paste	25466.42	12206.01	0.35351
7117	Nuclear reactors	28084.80	14824.39	0.342434
7297	Particle accelerators	37464.01	24203.6	0.401827
8923	published music	31832.66	18572.25	0.389246
5415	Hormones	35137.04	21876.64	0.425699
6762	Materials for railway carriages	39054.49	25794.08	0.458969
6761	Rails, steel and iron	38026.04	24765.63	0.462881
2120	Furs	30412.94	17152.53	0.411895
5134	Mixtures of halogens and sulfur from metals or metalloids	26289.93	13029.52	0.390739
7351	Military vessels	25581.40	12320.99	0.398517
6634	Mica, processed	26818.04	13557.63	0.408681
13	Swine	28439.49	15179.08	0.420642
452	Oats, whole-grain	28809.82	15549.42	0.427843

6832	Nickel and its alloys, processed	28892.75	15632.34	0.432902
5126	Inorganic esters and their salts	27284.38	14023.98	0.422905
913	Bacon	27865.71	14605.31	0.427978

There can be identified several major groups of such effective products: metals (uranium, nickel) and their alloys, agricultural products (rye, oats, swine, pork fat), chemical industry products (hormones, complex inorganic esters), basic industry products (rails, carriages) and defense industry (military vehicles), as well as some products that require a serious level of scientific and technological base (nuclear reactors, particle accelerators).

As one can see from Table 7, not all products from the list of most preferred for export expansion are high-tech goods. This result is one of the key findings of the analysis proposed by R. Hausmann at al.: to ensure sustainable economic growth it is not necessary to switch exclusively to production/export of high-tech products; often the production of simpler goods can generate a greater effect.

Conclusions. This work is devoted to the analysis of the Russian export structure, identification of products which export expansion is the most preferable from the perspective of economic growth in Russia.

The major finding from the review of the Russian export structure in recent years (1999-2006) is that during this period the share of raw materials in exports has significantly increased. The share of the top ten exported products increased by 10 p.p. and in 2006 made 74.2%; the share of the top twenty exported products - by 9 p.p. (80.7%, respectively). These changes are largely due to the increased prices for oil and gas.

We used the methodology of Hausmann, Hwang and Rodrik to build productivity indices of exported products , which have shown that the share of the most productive goods in Russian exports is low. The combined share of top 25 commodities throughout the period did not exceed 2%, and in recent years it has fallen nearly to 1 %. This fact is reflected in the behavior of another index, which characterizes the productivity of the Russia's export sector in general. Productivity of the Russian exports was growing throughout the period but slower than, for example, in countries such as Brazil, India and China. The ratio of export productivity to GDP per capita, which according to Hausmann et al. defines the medium-term prospects for economic growth, in Russia is the lowest among the BRIC countries. This ratio was decreasing from 1999 to 2006. This may be an indication that if the prevailing trend is maintained, the growth rate of Russian economy in the long run will not keep pace with growth in other BRIC countries. In general, the productivity level of Russian exports was lower than the average productivity of the countries with similar GDP per capita. This fact indicates that the medium-term growth prospects in Russia are less favorable than in many countries with a comparable development level.

In accordance with the logics of R. Hausmann at al., to increase the rate of future economic growth it is necessary to launch or expand the production of export goods that meet two criteria: a relatively high value of export productivity and relatively small "distance" to the worldwide export basket. Based on these criteria, we identified a group of currently exported goods in Russia, which future growth in production and exports is the most preferable to improve the potential for economic growth and export diversification. As expected from the theory, as well as from empirical evidence obtained in similar studies for other countries, not all products in this group are high-tech ones.