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Industry restructuring and competitiveness in Russia. From price to non-price determinants

by

Valeri Mironov and Vladimir Dorogov

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C O N T E N T S

Introduction

The paper looks at the issue of structural changes in Russia's economy in the context of analysis of its competitiveness on the micro and macro levels. The first chapter will analyse structural changes and changes in competitiveness on a macro and micro level. In Section 1.1, the authors estimate RER (CPI) and ULC dynamics for Russia using the internationally accepted OECD methodology, i.e. including the portfolio of the main trading partners. Section 1.2 analyses ULC dynamics for several dozen Russian industries in 2000–2004, employing a new empirical dataset for research. This represents a step forward versus the approach of the latest OECD (July 2004) Economic survey of Russia which calculated ULC and its components indicators on the level of the Russian industry's sectors. In Section 1.3 Valery Mironov describes a new approach to the comparative analysis of changes in appraisals of integral and price competitiveness, which will make it possible to isolate, on the level of industry's sectors, the effects of various parameters of competitiveness on the integral indicator thereof registered by surveys. To our knowledge, this kind of comparative analysis has not so far been undertaken in literature on competitiveness analysis.

In Chapter 2 Valery Mironov tests the classical technique of G.Markowitz-like financial portfolio analysis for quantitative estimation of the Russian industry's sectoral portfolio diversification in 1999–2004.

1. Price and cost competitiveness and industrial productivity of the Russian economy

The growth of the Russian economy over the last five years has been attributed to many factors one of them being the rise in oil prices. It is commonly asserted that this was the main reason for the Russia's achievements while oil sector has become the principle driver of the Russian economy [1]. This observation initiated a wide discussion concerning the signs and potential risks of a "Dutch disease" and possible ways of restructuring Russian industry and increasing its diversification [2]. Current study approaches the problem of industrial restructuring starting, first, from macro level - from the evolution of price and cost competitiveness, and going then to industry level through studying the dynamics of productivity by sectors.

The issue of competitiveness of the Russian economy in general and especially of industrial competitiveness has become the major concern for the government. The main reason for that is the exhaustion of the cost advantage in industry given by Rouble devaluation in 1998. Calculations show that by 2005 unit labor costs (ULC) in industry already reached its pre-crisis level. Compared with the same indicators for main trading partners of Russia it turns out that Russian enterprises are rapidly losing their competitiveness in terms of prices as well as in terms of costs. If their productivity fails to increase in line with rising prices and costs then future growth of the Russian economy becomes questionable.

In this section we shortly describe the structure of Russian foreign trade and then present the evolution of macro-indicators of price and cost-competitiveness for the period 998 - 2004. After that we will give the analysis of productivity by industrial sectors.

1.1. Competitiveness Indicators for Russia on macro level

The structure of foreign trade

Competitiveness of countries is manifested in different ways and one of them is the structure of foreign trade. The general rule is to consider a positive relation between country's competitiveness and the share of high value-added goods in its exports. The situation with Russia is quite pitiful in this sense. It is a well known fact that raw materials always dominated in Russian export structure (see Table 1). But since 1999 this resource specialization became even more pronounced. The share of mineral fuels and lubricants over the six year period rose dramatically. The increase was particularly significant for petroleum and petroleum products - its share rose by more than 60%.

Table 1. Structure of exports from Russia by product groups, 1999 and 2004

SITC Rev.3	Description	1999 mln. US dollars	%	2004 mln. US dollars	%	Change of share, %
0	Food and live animals	617	0.8	2045	1.1	36.8
1	Beverages and tobacco	49	0.1	262	0.1	121.1
2	Crude materials, inedible, except fuels	4439	5.9	8675	4.8	-19.3
3	Mineral fuels, lubricants and related materials	31186	41.8	90748	50.2	20.1
33	Petroleum, petroleum products and related materials	18900	25.3	74398	41.1	62.5
34	Gas, natural and manufactured	11532	15.4	12596	7.0	-54.9
4	Animal and vegetable oils, fats and waxes	23	0.0	104	0.1	87.7
5	Chemicals and related products, n.e.s.	3917	5.2	7994	4.4	-15.8
6	Manufactured goods classified chiefly by material	14836	19.9	29735	16.4	-17.3
7	Machinery and transport equipment	5100	6.8	8849	4.9	-28.4

8	Miscellaneous manufactured articles	2147	2.9	1965	1.1	-62.2
9	Commodities and transactions not classified elsewhere	12349	16.5	30538	16.9	2.1
	Total	**74663**	**100.0**	**180915**	**100.0**	**-**

Source: UN Comtrade database

More than half of total exports now are represented by mineral fuels, lubricants, chemicals and related products. This resource specialisation of exports has also influenced the geography of Russian trade (for a detailed country distribution of trade see Table A1 in Annex). Since the second half of 1990's European market started to play an important role for Russian exporters of energy products. It has become a prime source of currency inflow. At the same time CIS countries (Community of Independent States) were gradually loosing their weight in geographic structure of exports (see Figure 1). The main reason for that is the decline in trade with Ukraine. Compared to 1995 its share fell almost twice though in nominal terms it stayed constant. That is why the main benchmark countries in our subsequent analysis are from European Union.

Figure 1. Share of foreign trade turnover with non-CIS countries in 1994-2005, %
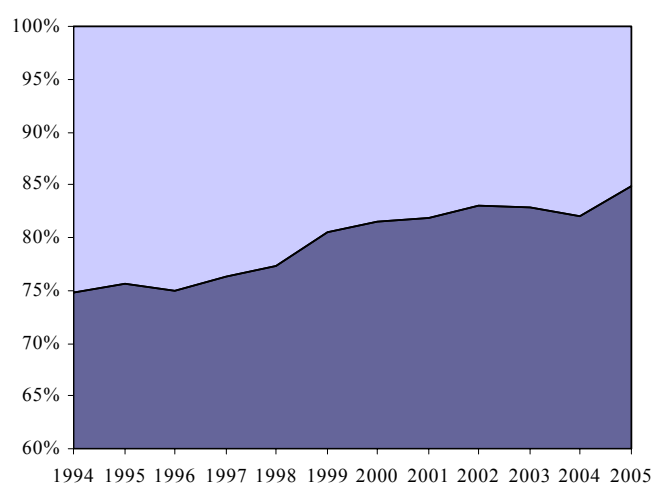
Note: Data for the first half of 2005 is taken from Central Bank RF Trade Statistics
Source: Rosstat Yearbook, 2004

This "geographic" aspect of foreign trade is of special importance for our study as we measure price and cost competitiveness of Russia in relation to its main trading partners. This approach is based on the pioneer work by OECD experts. They proposed a methodology of estimating country's competitiveness based on cross-country comparisons of price and cost data. The principal idea is not new and is based on the assumption that country's competitiveness may be defined as the relative price of foreign tradable goods in terms of domestic tradable goods. In this sense a country's competitiveness "improves" if the relative

price of its tradable goods declines. But the nominal exchange rate alone is not a satisfactory indicator of competitiveness, since movements in relative prices also matter. Instead, competitiveness is better measured by the real exchange rate, which adjusts the nominal exchange rate by domestic and foreign prices [6]. These prices are usually weighted-averages, with weights based on the domestic country's pattern of trade. Such corrected version of exchange rate is usually referred to as real effective exchange rate. Instead of data on prices one may use also data on labor costs in manufacturing. Short presentation of the calculation procedure is given in Annex and for a detailed description of this methodology one can refer to [4] and [5].

Though in the OECD study published in 1998 [4] Russia has been included into the list of emerging countries for which the mentioned indicators were calculated, there are no other (more recent) works that deal directly with price or cost competitiveness of the Russian economy in this sense. That is why present study is very important as far as it covers post-crisis (after 1998) period and deals with those factors that formed the current economic landscape of Russia.

It is argued in [6] that international price and cost competitiveness is an important determinant of trade flows. In addition, in a world of high capital mobility, cost-competitiveness may be an important determinant of foreign direct investment flows. Latest trends show that industries tend to locate where unit cost of non-tradable inputs, especially of labor, is low. So, the most important non-tradable input turns out to be labor. Thus, unit labor cost (measured as labor cost per unit of output) could be a particularly useful indicator of cost competitiveness [6].

Though, one should bear in mind that unit labor cost should not be interpreted as a comprehensive measure of competitiveness, but only as a reflection of cost competitiveness. For example, in the case of durable consumer and investment goods, competitiveness between advanced economies is also determined by other factors, such as product quality, customization or improved after-sales service. Furthermore, unit labor cost indicators deal exclusively with the cost of labor. Even though labor cost is an important determinant of competitiveness between advanced and developing economies, the cost of capital is also a crucial factor in comparisons of cost competitiveness between economies.

Price competitiveness and labor costs: macro level perspective

As we have put it above there are two principal measures of country's competitiveness on an aggregate level: price and cost adjusted exchange rates. Figure 2 presents time paths for two real effective exchange rate indices based on CPI and unit labor costs (ULC) for Russia.

Figure 2. Real effective exchange rates[1] based on prices (REER_CPI) and unit labor cost (REER_ULC) for Russia, 2000=100%
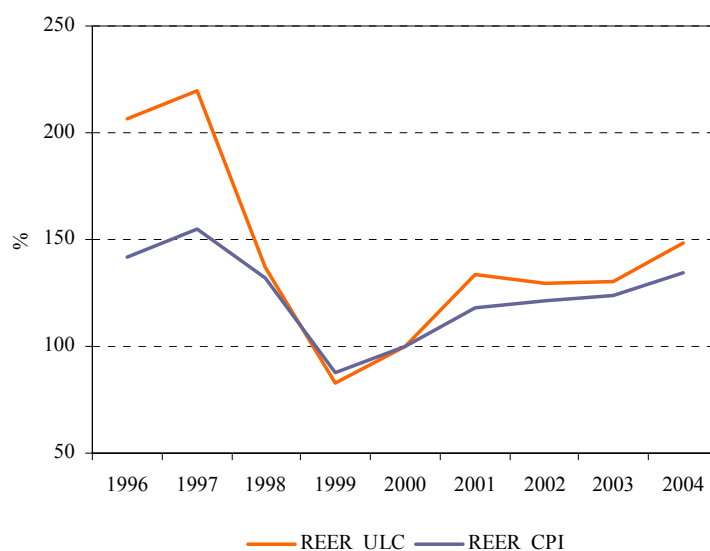
Note: OECD approach to calculation of real effective exchange rate based on unit labor costs considers only ULC in manufacturing. For Russia only data for the whole industry is available which should be taken into account while analysing the dynamics of REER_ULC.
Source: Development Center calculations

It is obvious from this figure that the main impulse for the Russian economy was given by a sharp drop of costs in 1998. That is the cost-competitiveness index (REER_ULC) fell more than two and a half times - more than the price-competitiveness index (REER_CPI). This opportunity was transferred by enterprises into increased output as it was possible to do that without additional capital expenditures - thanks to abundant spare capacity. Without serious cuts in employment some enterprises managed to use the suddenly appeared positive gap in income to start restructuring. But despite of all the positive signs this period could be characterized more likely as a recovery [1]. Only by 2002 enterprises began to realize that following this way was no longer relevant.

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[1] Real effective exchange rate is calculated relative to portfolio of currencies of main-trading partners denominated in US dollars.

Of course, increase in output was not the only consequence. Because of a sudden fall in domestic prices and increased prices for imported goods (that followed the devaluation) a new process of import substitution started. This change in price-cost structure gave rise to "new" sectors that were not developed in former USSR or only began to form in the beginning of 1990's. During this period new consumer goods producers started to appear - those that form the economic landscape nowadays. At the same time foreign corporations recognized the attractiveness of Russian market and specifically the gains of being closer to consumers. As a result some multinationals began opening local production facilities either through buying local producers gone bankrupt or through greenfield investments into new production facilities.

Figure 3. Real effective exchange rate* (REER_CPI) by countries in 2004 compared with 2000, %
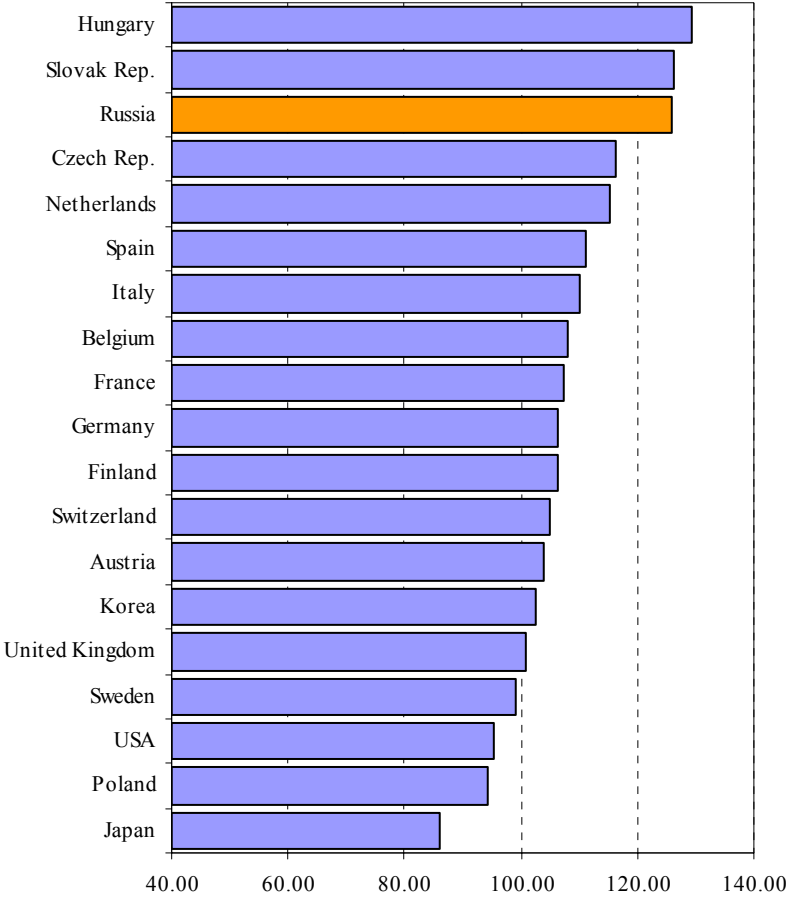

Note: * exchange rate based on consumer price inflation
Source: OECD Main Economic Indicators (October 2005), Development Center calculations

At first such activity was observed in fast moving consumer goods (FMCG) sector - tobacco products (BAT), food (Kraft Foods, Danone), drinks (Coca-Cola), confectionery (Cadbury-Schweppes) and household goods (Unilever). But a few years later the second phase began that was marked by the "arrival" of a more capital intensive production (like the opening of the Ford plant in Vsevolozhsk in 2002).

The subsequent evolution of both indicators of competitiveness looks very similar. But a detailed analysis shows that underlying reasons were quite different. Up to 2002 the primary cause of appreciation of CPI based real effective exchange rate (which means a fall in price-competitiveness) was domestic inflation. Even minor devaluations of nominal exchange rate undertaken by the Central Bank in this period were incapable to stop this process which was further enforced by the weakening of real exchange rates of trading partners. This rather unfavorable trend decelerated only with the introduction of euro in the beginning of 2002 and lower domestic inflation. During the next two years (2003 and 2004) the appreciation of nominal exchange rate became the main reason for worsening of price-competitiveness of domestic producers.

If we compare price-competitiveness dynamics (CPI-based real effective exchange rate) in Russia with other countries for the period 2000-2004, we'll notice that Russia had very similar performance with Central European countries like Hungary, Slovak Republic and the Czech Republic (excluding Poland). Western European countries experienced relatively smaller decreases in price-competitiveness (see Figure 3) while United States and Japan significantly improved their competitive positions. This is partly due to the adjustment of internal prices to world levels that was going in NMS and in Russia.

Figure 4. Evolution of USD unit labor cost in industry in Russia, 1995-2004, 2000=100%
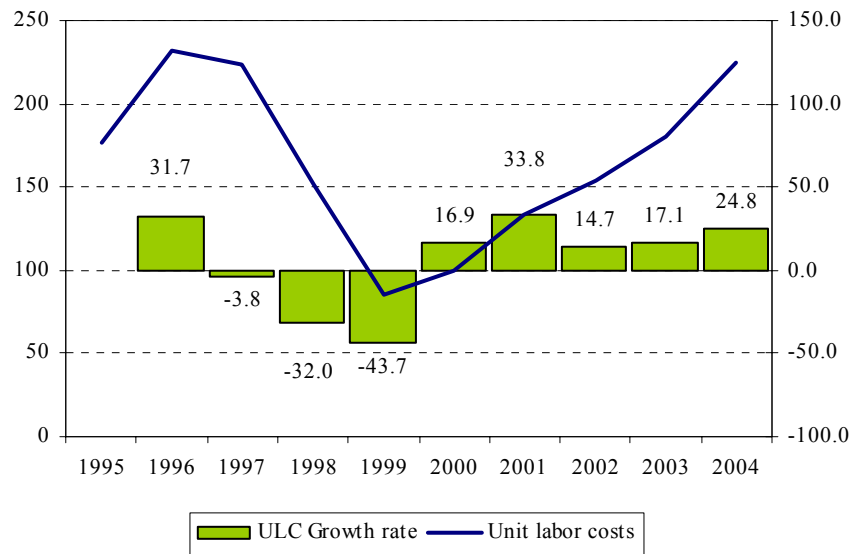
Note: Unit labor cost is calculated on the basis of data on industrial employment, production volumes at 2000 prices and average dollar denominated wages
Source: Development Center calculations

As we can see, decrease in price competitiveness was accompanied by deterioration of cost-competitiveness of the Russian economy. It was a parallel process that among all could be attributed to rising labor costs. As follows from Figure 4 unit labor cost in Russia rose substantially during the period from 2000 to 2004. In 2004 they were 2.2 times higher than in 2000. The most significant increase in unit labor costs in Russia was registered in 2004 when they rose more than 24% on year to year basis while in two previous years they grew with an average rate of 16% that was slightly higher than consumer inflation (which was 15.1% in 2002 and 12% in 2003). By the end of 2004 dollar ULC in industry reached its own pre-crisis level of 1997 (see Figure 4). So the reserve of increasing labor costs found in [3] now is totally exhausted.[2]

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[2] We speak about absolute dynamics of unit labor cost in Russian industry, so the conclusion that reserves are exhausted concerns the current ULC compared to their pre-crisis levels and not their relative levels compared to other countries. In this respect Russian enterprises still have cost advantage with regard to European and some other countries. Labor costs in Russia are generally lower than those in developed countries. For example, according to survey carried out by "Global-production.com" labor costs (measured as hourly wage cost) in Russia amount for 43.7% in comparison with South Korea, considered as a benchmark 100%. Close figures have also Poland (45.9) and the Czech Republic (41.8).

Figure 5. USD Unit labour costs in industry in 2004 compared with 2000, %
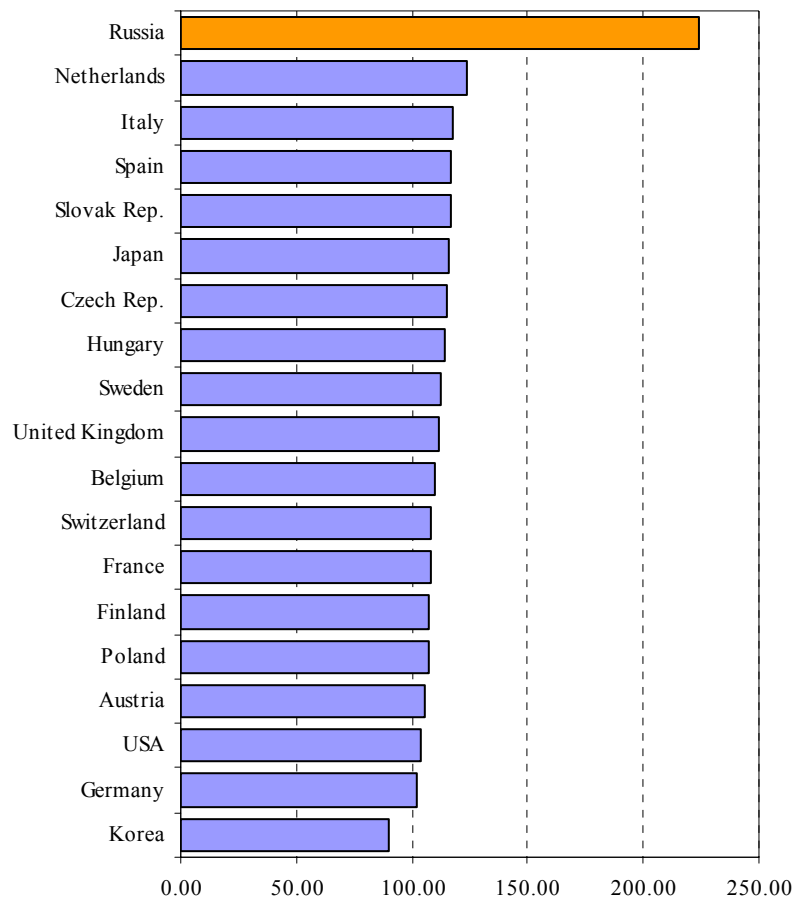
Source: OECD, Development Center calculations

The increase in unit labor costs in industry in Russia was much more rapid than in other countries (see Figure 5). Besides that additional factors such as energy prices also play a crucial role. Though they still stay well below their pre-crisis level, real energy prices increase during the last couple of years has generated additional cost pressure not only on industry but on the economy as a whole.

1.2. ULC dynamics at the level of sectors and subsectors of Russian industry in 2000–2004

Productivity and labor cost at industry level

While the analysis of competitiveness on aggregate level gives us a general picture, it is less informative relative to structural aspects as it hinders lots of peculiarities of industry

development. In this aspect a step towards a more disaggregated industrial structure seems to be a natural improvement in the analysis.

A few remarks should be made at this point. If on the macro level price-competitiveness could be easily measured (see above) this is not the case at industry level. It happens due to the fact that data (both prices and volumes) on detailed sectoral classification are not comparable by countries. That is why we have to rely on a different set of indicators. One of them is the productivity level measured as output per worker.

But productivity being a good indicator is not sufficient - an assessment of industrial competitiveness must also take into account those indicators that determine dynamics of costs, for example wages. That is why it is useful to analyze both labor productivity and wages simultaneously. One approach is to consider unit labor costs on the level of industrial sectors (see Figure 6).

Figure 6. Unit labor costs in Russian industry, 2004 compared to 2000 level, %

Industry	Value
Industry, total	124
Medical industry	156
Typographical industry	147
Electric-power industry	121
Machinebuilding and metall-processing	118
Construction materials industry	116
Flour and grain industry	112
Ferrous metallurgy	103
Chemical and petrochemical industry	97
Food industry	88
Light industry	88
Wood, pulp and paper industry	72
Glass/ceramics	64
Fuel industry	62
Non-ferrous metallurgy	38
Microbiologic industry	-10

Source: Development Center calculations.

We can see that unit labor costs in industrial sectors more than doubled since 2000. The maximum increase in ULC is registered in medical and typographical industries (increase by 156% and 147% correspondingly), and the minimum - in non-ferrous metallurgy (only 38% growth). In microbiologic industry unit labor costs even fell by approximately 10%. This could be regarded as a positive sign of increase in competitiveness if it was not the opposite. Situation in this sector is characterized by a dramatic reduction of employees: total number of workers fell more than twofold. Of course, there was a corresponding drop in total wage fund.

The second approach makes it possible to avoid such ambiguities in ULC dynamics. Let's look at the evolution of labor productivity and labor costs separately but on one diagram (see Figure 7).

Figure 7. Growth rates of labor productivity and wage fund in 2000-2004
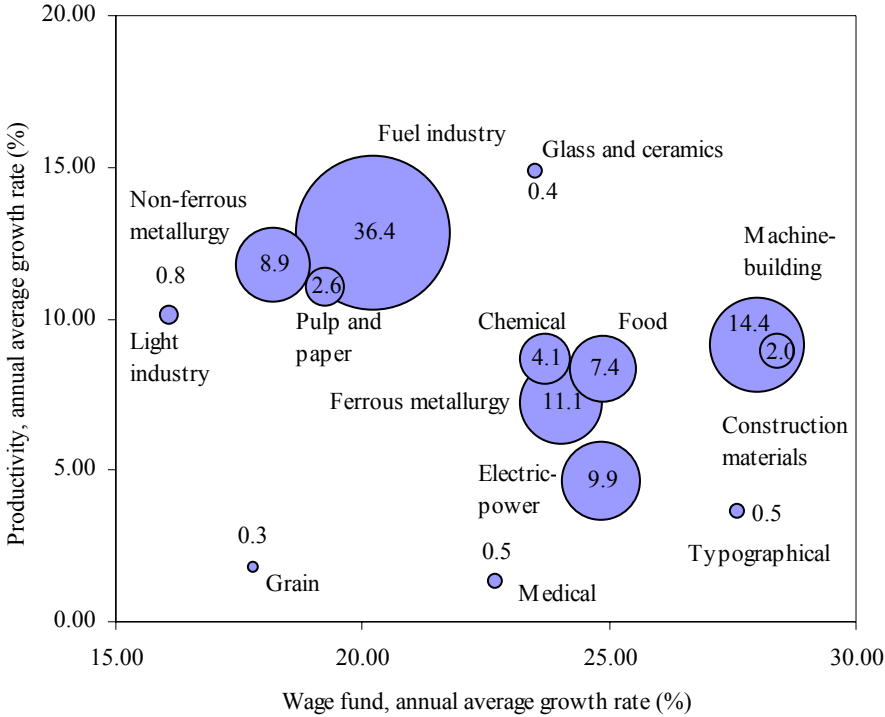
Note: Sectoral data covers large and medium size industrial enterprises with more than 15 persons employed;
Data is preliminary and is subject to future revisions;
Circle size corresponds to sector's share in gross value added in industry as a whole in 2004.
Source: Ministry of Economic Development and Trade, Development Center calculations

During the four year period labor productivity rose in sectors that managed to keep rather moderate growth of wage fund. For large sectors there is a negative relationship between wage fund growth and productivity growth.[3] To a certain degree this is attributed to optimization of workforce composition. The most optimistic observers think that this is a consequence of various large scale restructuring programs that reduce the number of the least efficient workers. In this case the competitiveness of industrial enterprises gets an additional impulse thanks to an improvement in the quality of labor inputs. In small sectors there is a different situation that probably couldn't be generalized and brought to some clear trend. These sectors are dispersed all over the diagram and if we go down to more disaggregated level (see Table A2) we will see much more heterogeneous picture. Nevertheless it is possible to discern three main groups of industries:

1. The first one comprises those sectors that have high growth rates of labor productivity and moderate growth of wage fund. This group covers export oriented sectors such as fuel industry, non-ferrous metallurgy and pulp and paper. Of course, high figures of growth mean not only steps in modernization of production capacities but also increase in prices on world markets (like in case with oil) and recovery from very low initial levels of productivity (like in case of pulp and paper).

2. The second group covers sectors with lower growth rate of labor productivity (about 5-8% per annum) but higher growth of wage fund (25-28% growth rate compared to 17-20% growth rate for industries from the first group). These are: ferrous metallurgy, electric-power industry, chemical and food industries, machine-building and construction materials. While ferrous metallurgy and chemical industries consider foreign markets as their main source of revenues (very much like fuel industry and non-ferrous metallurgy), they also enjoy higher domestic demand which was not growing rapidly during the last few years.

3. The third group covers "extreme" cases - those sectors that produce very little value added and have different combinations of growth rates of wage funds and labor productivity (which are also very volatile). This group contains primarily sectors that ship goods for domestic consumers: light industry, food industry, glass and ceramics, grain, medical and typographical industries. These are relatively "young" sectors compared with developed fuel or ferrous industries.

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[3] "Large" means that their input in total value added in industry is about 8% and higher.

In general we see very substantial inter-sectoral differences that are evident across the period. Even within broader sectors we find large differentiation in terms of productivity growth and wage fund growth. For example, in machine-building industry almost all sectors suffer a serious decline while railroad machine-building and manufacturing of food and light-industry equipment demonstrate strong performance.

Of course, an increase in overall productivity in 2000-2004 was partly achieved by the reduction in employment levels, but some sectors increased employment. These increases took place in dynamic sectors with strongly rising output and increasing productivity. Among them we can point out tea industry, beverages and soft drinks, food concentrates, meat industry (processing of meat), manufacture of containers and boxes of paper and paperboard, and notably railroad machine-building. Among strong performers we find also construction materials industry which having one of the highest growth rates of wages (approximately 28%) demonstrated sustainable growth in labor productivity (about 9% per annum).

Overall, the conclusion seems rather straightforward - we register good performance of industries oriented towards domestic market and satisfaction of basic needs of people. They really did perform well especially when production is supported by foreign investments (the case of beverages). But the share of these sectors in total output is relatively low compared with resource-based and heavy industries. These are industries that produce export goods like oil, gas, ferrous and non-ferrous metallurgy. They didn't have extreme growth rates (normally they are close to industry average figures of growth), but they still form the industrial "core", and the stability of this "core" determines the performance of Russian economy as a whole.

Conclusions

The growth of the Russian economy that followed after the financial crisis of 1998 was driven by a number of factors one of which was a sharp decline in labor costs accompanied by an improvement in price-competitiveness of domestic producers. These factors through import-substitution process gave a strong impulse to the development of those industries that are oriented towards local markets such as food, beverages and construction materials.

These sectors managed to improve labor productivity and represent now the most dynamic ones. Unfortunately their contribution into gross value added is relatively small as the main

share of value added is generated by heavy and resource-based industries. The latter still form the "core" of the Russian economy and ensure its stability.

By the end of 2004 two negative trends became apparent: unit labor costs in manufacturing reached their pre-crisis level while price-competitiveness demonstrated significant deterioration (real effective exchange rate almost reached the level of 1998). Further development of the Russian economy depends now on the industry's ability to gain control over costs and productivity improvement which is impossible without further restructuring.

1.3. Integral competitiveness as a result of interplay between price and non-price factors

In this paragraph we are inclined to describe the optional methodological approach to comparative analysis of changes in appraisals of integral and price competitiveness.

Having constructed and analysed objective indicators of competitiveness described above, we shall move on to the analysis of subjective, i.e. survey-based appraisals of competitiveness, which, in our view, are integral in nature and reflect price and non-price aspects of competitiveness.

In discussing the isolation of the effect of non-price factors from integral competitiveness, we note that non-price competitiveness factors are understood as the aspects of production efficiency improvement that are related to labor productivity and product quality improvements. These factors include:

- Human performance, including workers' skill and motivation

- Technological factors, including R&D potential and capacity to adapt and use technologies

- Managerial and organizational factors determining the ability to organize interaction between groups involved in production both within and outside of a firm (consumers, suppliers, R&D centers, and so on).

At the same time, the effect of non-price competitiveness factors related to productivity improvement to a certain extent neutralizes the negative effect of a decline in basic price competitiveness.

We estimated the dynamics of integral competitiveness using surveys conducted by the Centre for Economic Analysis under the Government of the Russian Federation (CEA).[4] It should be noted that it is hardly appropriate to use ULC analyzed in sections 1.1–1.2 as an integral indicator of competitiveness. ULC reflect the aggregate effect of the exchange rate, labor costs and productivity on competitiveness but fail to take into account product quality.

Figure 7. Appraisals of integral competitiveness of industry's sectors on key markets *

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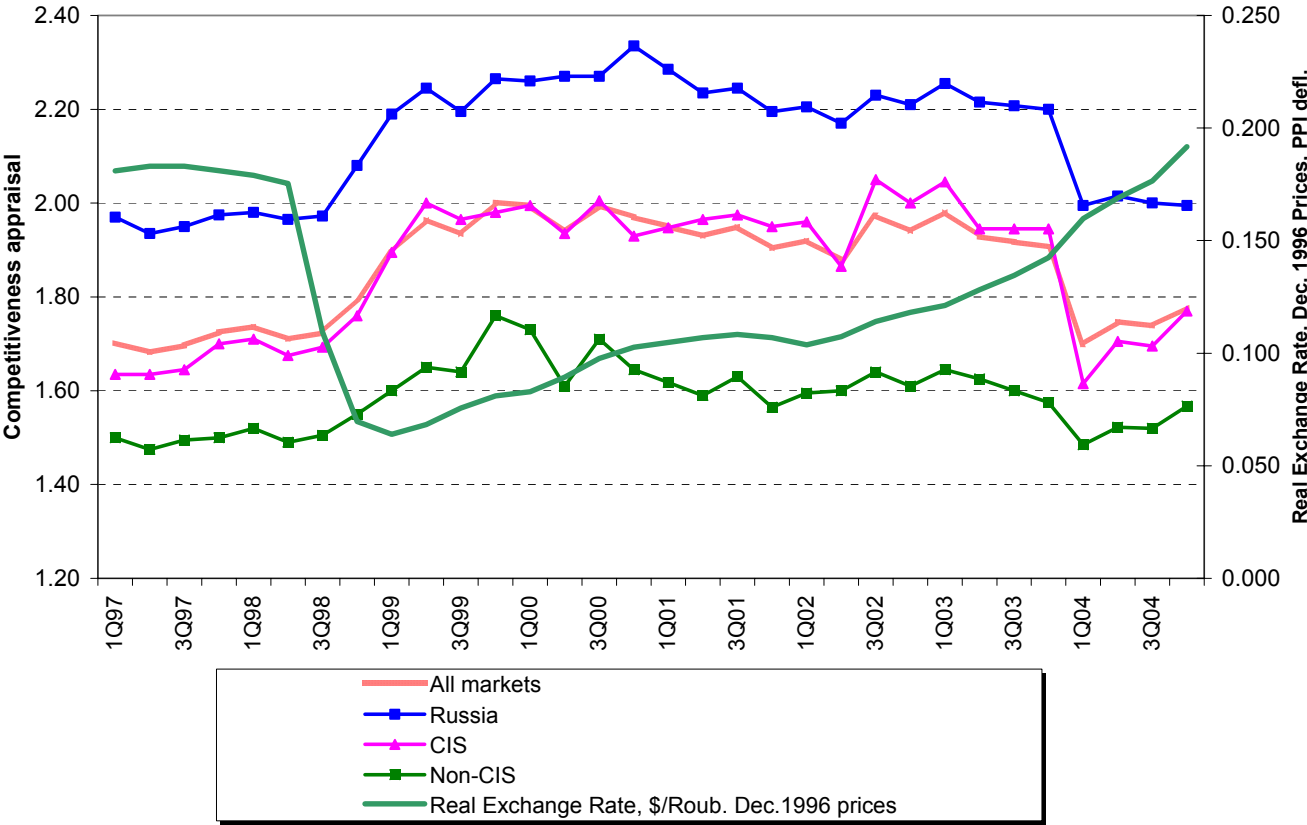
[4] Prior to 2004, CEA surveys asked business managers to express their opinion on the competitiveness of their core products on three markets: Russia, the CIS, and non-CIS countries. The CEA ranked their responses on a five-point scale: high, low, and average competitiveness, products are non-competitive, no answer provided. In processing source data in our previous research we aggregate the appraisals on a five-point scale, with 5 standing for a "high" appraisal of competitiveness, 4 – "average", 3 – "low", 2 – products are non-competitive, 1 – "no answer" (if 2.5 is used as an average rank for this answer, the dynamics of appraisals do not change crucially, while the overall level of appraisals rises). In calculating the average (for all markets) competitiveness appraisal, we use the arithmetical mean of the three markets. From 2004, the CEA started asking business managers' opinions on the competitiveness of their core products on four markets: Russia, the CIS, the euro zone, and other markets, switching to a four-point scale: high average, low competitiveness and no answer provided. Due to this, we switched to a four-point scale in processing the source data, with 4 standing for "high", 3 – for "average", 2 – for "low" competitiveness, and 1 – no answer provided. To maintain continuity from the accumulated database we made two steps: first, the 1997–2003 data was converted into a four-point scale (by merging the "low" and "non-competitive products" appraisals into one "low" appraisal; second, in a new data set, data on competitiveness in the euro zone and other markets was merged into the "non-CIS countries" appraisal.

* Level of competitiveness – average appraisal of core products on three markets (including Russia, the CIS and non-CIS countries), appraisals were aggregated based on a four-point scale using CEA source data for industry as a whole.

Source: CEA, Rosstat, Development Center.

Comparison of dynamics of integral appraisals of competitiveness viewed as a sum of factors (price and non-price) determining competitiveness and its purely price aspects will help isolate the dynamics of productivity and product quality. A comparative analysis of the dynamics of integral appraisals of competitiveness and ULC allows product quality dynamics to be isolated. This analysis will be carried out at further stages of the Project.

Table 2. Indicators of Russian industry's competitiveness

	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005
Absolute values											
Economic growth											
GDP growth, y-o-y, %	95.9	96.4	101.4	94.7	106.4	110	105.1	104.7	107.3	107.1	106.0
Industrial output growth, y-o-y, %	96.7	96.0	102.0	94.8	111.0	111.9	104.9	103.7	107.0	106.1	104.9
Integral competitiveness indicators based on survey data											
Appraisals of competitiveness level based on CEA surveys *	n/a	n/a	2.06	2.16	2.6	2.67	2.59	2.54	2.56	2.16	n/a
Price competitiveness indicators based on statistics											
Real $/RUB exchange rate (1994=100%)**	47.5	45.2	45.1	127	98.9	78.4	75.8	68.2	55.9	41.1	36.2
Ratio of nominal $/RUB exchange rate to PPP ***	3	2.3	2.3	3.5	4.4	3.8	3.5	3.3	2.9	2.3	2.0
Average monthly wages,. $	135,5	179,2	195,0	134,9	84,1	109,8	151,3	181,2	230,0	300,4	370,0
Electricity price. $./1000 kWh. End of period	39.8	42.2	44.1	11.6	10.4	14.8	17.9	21.2	25.8	31.2	34.2
Labour productivity in Russia's industry. Growth index. Y-o-y. %	102	104	108	98.8	113	109	104	108	114	112	107
Relative indicators, 1997=100%											
Economic growth											
GDP growth. Y-o-y. %	102.3	98.6	100	94.7	100.8	110.8	116.5	122.0	130.9	140.2	148.6
Industrial output growth. Y-o-y. %	102.1	98.0	100	94.8	105.2	117.8	123.5	128.1	137.1	145.4	152.5
Integral competitiveness indicators based on survey data											
Competitiveness appraisals *	n/a	n/a	100	105	126	130	126	124	125	105	n/a
Price competitiveness indicators based on statistics											
Real exchange rate **	105	100	100	281	219	174	168	151	124	91	80
Ratio of nominal $/RUB to PPP ***	134	102	100	152	194	167	155	145	128	103	87
Average monthly wages.,$	69,5	91,9	100,0	69,2	43,1	56,3	77,6	92,9	118,0	154,1	190,7
Electricity price. $ /1000 kWh. end of period	90.3	95.6	100	26.2	23.7	33.5	40.5	48	58.5	68.5	78
Labour productivity in Russia's industry. %	88.9	92.3	100	98.8	112	122	127	136	155	174	186

* Level of competitiveness – average appraisal of competitiveness of core products for three markets (including Russia, the CIS and non-CIS countries), appraisals were aggregated using a four-point scale based on CEA survey data for industry as a whole.

** $/Rub exchange rate deflated by PPI .

*** Ratio of nominal exchange rate to Purchasing Power Parity (PPP), estimated using OECD survey data.

Source: Rosstat, Development Center, CEA

2. Diversification of Russian industry's sectoral portfolio – is growth quality improving?

Acceleration of Russian economic growth from the current 6–7% to the levels of the world's fastest growing economies, in particular, China, growing at an annual rate of about 9%, will only be possible if the manufacturing sector boosts its contribution to growth, because the long-term growth prospects in the extractive industries are limited by the rate of reserve expansion, and, most importantly, by how fast demand for commodities from the national and the world's economy will rise. The extractive industries' prospective growth is estimated at 2–3% a year.

In this environment, one important factor that should secure accelerated economic growth is the reduction of economic risks in general and the diversification of the economy's structure in particular. Risk reduction means increasing the sustainability of economic growth. Diversification is usually understood as the faster development of the manufacturing industries (primarily high-tech ones) and the services sector versus other sectors, a higher degree of primary commodities processing, and the reduction of the manufacturing and services sectors' dependence on the commodity industries and the rate of commodity export growth.

We propose using a new technique for measuring risk levels and diversification of industry's sectoral portfolio, which, to our knowledge, has not so far been used in economic research. Under this approach, a set of industries can be represented as an asset portfolio (similarly to a financial asset portfolio in a classical G. Markowitz analysis) with a structure that depends on individual sectors' shares in total output, and a "return" that depends on individual sectors' growth rates. In this case, the standard indicators of the portfolio's variance decomposable into non-systemic and systemic risks serve as a quantitative measure of sectoral portfolio diversification. Under this technique, non-systemic risk means risk related to the variance of individual sectors' growth rates. Systemic risk means is the part of the aggregate variance of industry's sectoral portfolio which is related to co-variance of growth rates of individual sectors. In a sense, an increase in the contribution of non-systemic risk to the sectoral portfolio's total risk and, accordingly, a decrease in the contribution of systemic risk, suggests a rise in sectoral portfolio diversification. In addition, an absolute change in the portfolio's

variance is a measure of economic growth sustainability, which is in itself an important measure of competitiveness.

Based on this approach, we started a series of complex calculations making it possible to estimate the dynamics of Russian industry's sectoral portfolio diversification in 1999–2004 (Partial Results of them one can see in Annex, Table A2.Russian Industry Growth Rates Correlation Matrix, 1999-2004).

Figure 8. Dynamics of Russian industry's sectoral portfolio in 1999–2004 – analysis of seasonally adjusted average monthly growth*
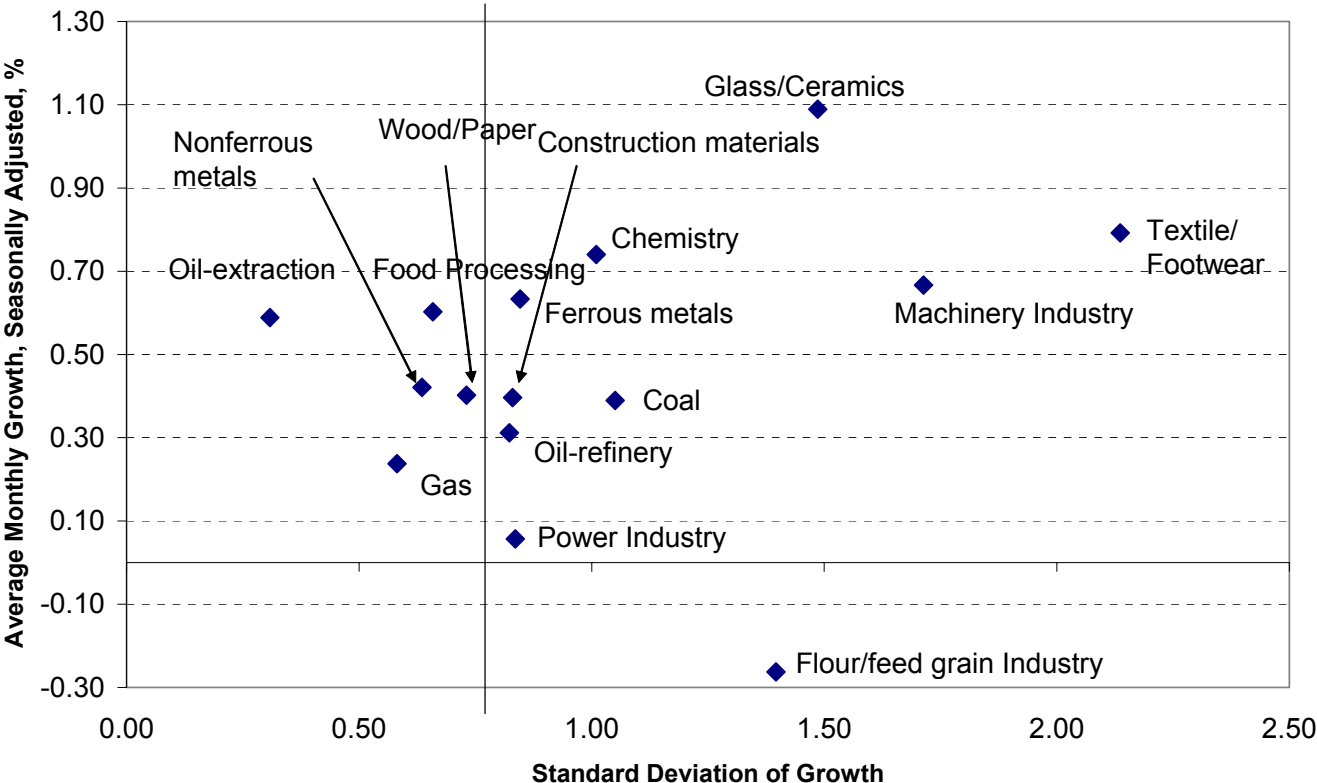
 * Calculations are based on the time series of industrial sectors' production growth indices (month-on-month, in seasonally adjusted terms) using Center for Economic Analysis (CEA)– Higher School of Economics data. The sample covers 235 industrial products.
Source: Development Center, Center for Economic Analysis–Higher School of Economics.

The analysis of growth statistics for individual industries showed the following:

While in 1999–2004 total industry showed an average monthly growth of 0.5% in seasonally adjusted terms, the fastest growth (1.1% in seasonally adjusted terms) was seen in the glass/ceramics industry, the slowest – in the flour/feed grain industry (-0.3%). The oil-extracting industry showed the most stable growth – standard deviation at the level of 0.3 is 2–6 times lower than that for other commodity industries. The least stable growth was seen in the textile/footwear industry, in which standard deviation was triple the average monthly figure in 1999–2004.

The analysis of growth characteristics of the sectoral portfolio showed the following:

Risk dynamics of Russian industry's sectoral portfolio are wave-like – a reduction in 2000 to the lowest level for the entire six-year period, a sharp rise in 2002, a drop in 2003-2004. The level and contribution of systemic risk was lower in 2003–2004 than that in 1999 and afterwards, suggesting a decreased relationship between individual industries's growth and a rise in the economy's diversification.

Figure 9. Indicator of Russian industry diversification dynamics – dynamics of risk indicators for Russian industry's sectoral portfolio (15 industries based on former official industry classification-OKONH) in post-devaluation period
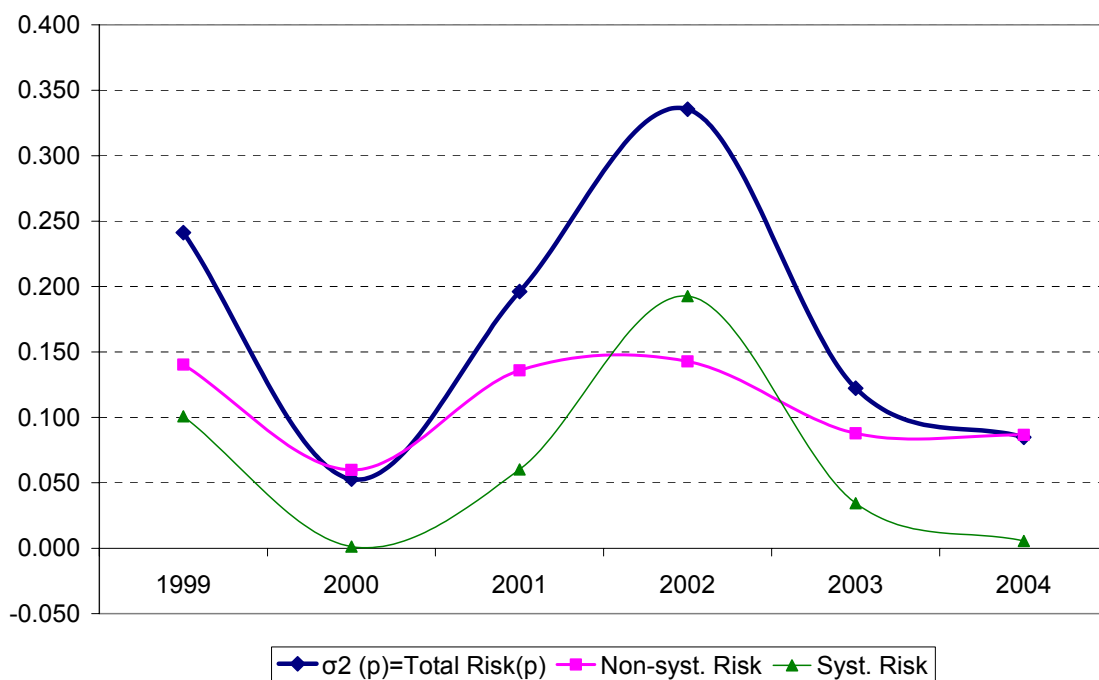
Source: Development Center Calculations, CEA–Higher School of Economics, Rosstat.

In 2004, the level of the sectoral portfolio's non-systemic risk remained almost the same as in1999, suggesting that the total risk level of the sectoral portfolio is generally more closely related to processes occurring within individual industries than to dependence of these processes on some external factors such as a rise in commodity exports and demand by commodity exports. If these assumptions are accurate, then economic policy seeking to maintain high growth rates in industry should focus on addressing the intra-industry restructuring problems, which make the largest contribution to the sectoral portfolio's total risk.

In this context, without denying the importance of "horizontal" policy measures aimed at stimulating diversification and providing incentives for developing all sectors of the economy, the government could start phasing in "vertical" measures, which would be more specific in enhancing the stability of individual sectors of the economy. Whether these should be the manufacturing or extractive sectors is the question that could be answered as part of further analysis.

Vertical measures of government economic policy aiming to promote diversification may include tax and tariff measures, establishment of special economic zones, export supporting measures, provision of incentives to achieve a higher degree of primary commodities processing (above all for exportable commodities) within commodity sectors (not only in the fuel and energy industries but also in the woodworking/paper and chemical and petrochemical industries as well as agriculture).

Conclusions

In the first chapter we show that the growth of the Russian economy that followed after the financial crisis of 1998 was driven by a number of factors one of which was a sharp decline in labor costs accompanied by an improvement in price-competitiveness of domestic producers. These factors through import-substitution process gave a strong impulse to the development of those industries that are oriented towards local markets such as food, beverages and construction materials. These sectors managed to improve labor productivity and represent now the most dynamic ones. Nevertheless their contribution into overall growth is relatively small as the main share of output is generated by heavy and resource-based industries. The latter still form the "core" of the Russian economy and ensure its stability.

By the end of 2004 two negative trends became apparent: unit labor costs in manufacturing became closer to their pre-crisis level while price-competitiveness demonstrated significant deterioration (real effective exchange rate almost reached the level of 1998). Further development of the Russian economy depends now on the industry's ability to optimize costs and improve productivity which will be impossible without large-scale restructuring.

Later in the first chapter we describe the optional methodological approach to comparative analysis of changes in appraisals of integral and price competitiveness. Comparison of dynamics of integral appraisals of competitiveness viewed as a sum of price and non-price factors determining competitiveness (gathered through the polls) and it's purely price aspects will help isolate the dynamics of productivity and product quality. A comparative analysis of the dynamics of integral appraisals of competitiveness and ULC allows product quality dynamics to be isolated. This analysis will be carried out at further stages of the Project.

In the second chapter a new technique for measuring risk levels and diversification of industry's sectoral portfolio was proposed. Under this approach, a set of industries can be represented as an asset portfolio (similarly to a financial asset portfolio in a classical G. Markowitz analysis) with a structure that depends on individual sectors' shares in total output, and a "return" that depends on individual sectors' growth rates. In this case, the standard indicators of the portfolio's variance decomposable into non-systemic and systemic risks serve as a quantitative measure of sectoral portfolio diversification. Under this technique, non-systemic risk means risk related to the variance of individual sectors' growth rates. Systemic risk means is the part of the aggregate variance of industry's sectoral portfolio which is related to co-variance of growth rates of individual sectors. In a sense, an increase in the contribution of non-systemic risk to the sectoral portfolio's total risk and, accordingly, a decrease in the contribution of systemic risk, suggests a rise in sectoral portfolio diversification. In addition, an absolute change in the portfolio's variance is a measure of economic growth sustainability, which is in itself an important measure of competitiveness. Based on this approach, we started a series of complex calculations making it possible to estimate the dynamics of Russian industry's sectoral portfolio diversification in 1999–2004.

Literature

1. Ahrend, R. (2004), "Accounting for Russia's Post-Crisis Growth", OECD Working Paper, September.

2. Ahrend, R. and Tompson, W. (2005), "Fifteen Years of Economic Reform in Russia: What has been achieved? What Remains to be done?", OECD Working Paper, May.

3. Ahrend, R. (2004), "Russian Industrial Restructuring: Trends in Productivity, Competitiveness and Comparative Advantage", OECD Working Paper, October.

4. Durand, M., Madaschi, C. And Terribile, F. (1998), "Trends in OECD Countries' International Competitiveness: The Influence of Emerging Markets Economies", OECD Working Paper #195.

5. Durand, M., Simon, J. and Webb, C. (1992), "OECD's Indicators of International Trade and Competitiveness", OECD Working Paper #120.

6. Turner, Anthony G. and Stephen S. Golub (1997), "Multilateral Unit Labor Cost Based Indicators of Competitiveness for Industrial, Developing and Transition Economies", IMF Staff Studies for the World Economic Outlook, December.

7. Zanello, Alessandro and Dominique Desruelle (1997), "A Primer on the IMF's Information Notification System," IMF Working Paper 97/71.

Annex I. Competitiveness indicators: real effective exchange rate (OECD approach)

The calculation of real effective exchange rate is done in the following way:

Let $R_{i,0}^t$ be the index of real effective exchange rate of country i with base period 0. X_i^t is the exchange rate against the US dollar in period t (expressed in US dollars per unit of country i's currency) and P_i^t represents country i's consumer prices or unit labor costs in manufacturing sector. The formula to compute real effective exchange rates in this case becomes:

$$\Delta \ln R_{i,0}^t = \Delta \ln \left(\frac{P_i^t}{P_i^0} * \frac{X_i^t}{X_i^0} \right) - \sum_{j \neq i} w_{ij}^{t-1} \Delta \ln \left(\frac{P_j^t}{P_j^0} * \frac{X_j^t}{X_j^0} \right)$$

or:

$$\Delta \ln R_{i,0}^t = \ln \frac{P_i^t X_i^t}{P_i^{t-1} X_i^{t-1}} - \sum_{j \neq i} w_{ij}^{t-1} \ln \left(\frac{P_j^t X_j^t}{P_j^{t-1} X_j^{t-1}} \right)$$

where w_{ij} are corresponding shares of countries in total foreign trade turnover of country i.

Table A1. Structure of foreign trade of Russia by country, 2004

№	Country	Exports (mln. USD)	Imports (mln. USD)	Total turnover (mln. USD)	Share in total turnover (%)	Cumulative share (%)
1	Germany	13 300	10 575	23 875	10.4	10
4	Netherlands	15 249	1 374	16 623	7.2	18
3	Italy	12 076	3 199	15 275	6.7	24
2	China	10 103	4 748	14 851	6.5	31
5	USA	6 586	3 197	9 783	4.3	35
11	Turkey	7 446	1 227	8 673	3.8	39
6	Switzerland	7 733	647	8 380	3.6	42
9	Finland	5 826	2 332	8 158	3.6	46
7	Poland	5 699	2 310	8 009	3.5	49
8	Great Britain	5 639	2 065	7 704	3.4	53
10	France	4 425	3 071	7 496	3.3	56
13	Japan	3 423	3 941	7 364	3.2	59
12	Cyprus	5 680	22	5 702	2.5	62
17	Korea Rep.	1 961	2 025	3 986	1.7	64
14	Hungary	3 223	740	3 963	1.7	65
19	Sweden	1 565	1 612	3 177	1.4	67
15	India	2 502	651	3 153	1.4	68
21	Belgium	1 824	1 175	2 999	1.3	69
16	Czech Rep.	2 280	651	2 931	1.3	71
18	Slovak Rep.	2 423	405	2 828	1.2	72
20	Spain	1 742	878	2 620	1.1	73
22	Austria	1 115	918	2 033	0.9	74
	Total non-CIS countries	**153 250**	**76 394**	**229 644**	**-**	**100%**

Table A2. Value added, productivity and wages by industry sectors, 2001- 2004

	Gross value added in 2004, current Rbls (mln)	Share in GVA	Annual average productivity growth, %	Annual average wage fund growth, %
Industry	4074.4	100.0	-	-
Electric-power industry	403.2	9.9	4.6	24.8
Fuel industry	1484.2	36.4	12.8	20.2
Oil-extracting	1137.4	27.9	15.7	16.8
Oil-refinery	97.0	2.4	6.7	21.6
Gas	173.4	4.3	0.6	32.8
Gas extraction	158.7	3.9	-0.8	34.4
Coal industry	75.6	1.9	10.4	18.8
Ferrous metallurgy	451.1	11.1	7.2	24.0
Non-ferrous metallurgy	364.0	8.9	11.7	18.2
Aluminium industry	40.7	1.0	16.2	8.2
Nikel-cobalt production	135.7	3.3	7.3	13.3
Chemical and petrochemical industry	165.4	4.1	8.7	23.7
Chemical	119.1	2.9	9.3	21.6
Basic chemicals	68.3	1.7	10.5	17.1
Petrochemical	46.3	1.1	7.8	28.6
Machinebuilding and metall-processing	588.0	14.4	9.1	28.0
Machinebuilding	476.1	11.7	9.5	27.1
Electronics	35.6	0.9	6.5	27.9
Automobile	107.1	2.6	7.0	24.3
Wood, pulp and paper industry	107.3	2.6	11.1	19.3
Wood	38.6	0.9	8.2	22.9
Pulp and paper	48.4	1.2	11.7	18.0
Construction materials industry	81.1	2.0	8.9	28.4
Light industry	31.0	0.8	10.1	16.1
Food industry	300.0	7.4	8.3	24.9
Bread	35.5	0.9	-1.4	23.8
Confectionery	33.1	0.8	5.7	28.5
Brewing	53.2	1.3	13.4	29.7
Meat	47.0	1.2	10.9	31.2
Medical industry	20.4	0.5	1.3	22.7
Typographical industry	19.0	0.5	3.6	27.6

Table A3.Russian Industry Growth Rates (Seasonally Adjusted) Correlation Matrix, 1999-2004

Industry/Period		1999														
		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Power Industry	1	**1.00**	-0.28	0.48	0.36	-0.38	0.15	-0.41	-0.43	0.07	0.31	0.05	0.07	0.75	-0.56	0.78
Oil-Extracting	2	-0.28	**1.00**	-0.65	-0.50	-0.23	-0.45	-0.22	0.15	-0.72	-0.85	0.70	-0.02	-0.57	0.52	-0.65
Oil-Refinery	3	0.48	-0.65	**1.00**	0.13	-0.43	0.78	-0.12	-0.52	0.29	0.52	-0.33	-0.14	-0.16	0.91	0.36
Gas	4	0.36	-0.50	0.13	**1.00**	0.45	0.27	0.52	0.38	0.82	0.60	-0.28	0.79	0.73	-0.18	0.12
Coal	5	-0.38	-0.23	-0.43	0.45	**1.00**	-0.09	0.44	0.79	0.47	0.21	-0.06	0.46	0.75	-0.56	0.78
Ferrous Metals	6	0.15	-0.45	0.78	0.27	-0.09	**1.00**	0.14	0.06	0.36	0.28	-0.01	0.33	-0.06	0.52	-0.65
Nonferrous Metals	7	-0.41	-0.22	-0.12	0.52	0.44	0.14	**1.00**	0.34	0.77	0.49	-0.54	0.47	0.72	-0.22	0.36
Machinery	8	-0.43	0.15	-0.52	0.38	0.79	0.06	0.34	**1.00**	0.19	-0.22	0.39	0.73	0.45	-0.77	0.59
Chemistry	9	0.07	-0.72	0.29	0.82	0.47	0.36	0.77	0.19	**1.00**	0.86	-0.69	0.48	0.84	0.11	0.14
Wood/Paper	10	0.31	-0.85	0.52	0.60	0.21	0.28	0.49	-0.22	0.86	**1.00**	-0.82	0.08	0.67	0.47	-0.05
Construction Materials	11	0.05	0.70	-0.33	-0.28	-0.06	-0.01	-0.54	0.39	-0.69	-0.82	**1.00**	0.22	-0.60	-0.42	-0.09
Food Processing	12	0.07	-0.02	-0.14	0.79	0.46	0.33	0.47	0.73	0.48	0.08	0.22	**1.00**	0.45	-0.51	0.16
Textile/Footwear	13	-0.17	-0.57	-0.16	0.73	0.75	-0.06	0.72	0.45	0.84	0.67	-0.60	0.45	**1.00**	-0.30	0.61
Flour/Feed Grain Industry	14	0.40	-0.54	0.91	-0.18	-0.56	0.52	-0.22	-0.77	0.11	0.47	-0.42	-0.51	-0.30	**1.00**	-0.76
Glass/Ceramics	15	-0.55	0.15	-0.82	0.12	0.78	-0.65	0.36	0.59	0.14	-0.05	-0.09	0.16	0.61	-0.76	**1.00**
Industry/Period		2000														
		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Power Industry	1	**1.00**	-0.84	0.26	0.52	-0.50	-0.20	-0.32	0.35	-0.52	0.38	-0.37	-0.46	-0.59	-0.30	0.41
Oil-Extracting	2	-0.84	**1.00**	-0.17	-0.50	0.26	0.17	0.41	-0.24	0.22	-0.18	0.13	0.30	0.29	-0.51	-0.22
Oil-Refinery	3	0.26	-0.17	**1.00**	-0.36	0.39	-0.76	-0.67	-0.63	-0.33	0.39	-0.34	-0.30	-0.79	0.49	0.12
Gas	4	0.52	-0.50	-0.36	**1.00**	-0.76	0.67	0.30	0.74	-0.35	-0.14	-0.55	-0.67	0.18	0.19	-0.75
Coal	5	-0.50	0.26	0.39	-0.76	**1.00**	-0.61	-0.60	-0.86	0.64	-0.15	0.57	0.51	-0.59	-0.30	0.41
Ferrous Metals	6	-0.20	0.17	-0.76	0.67	-0.61	**1.00**	0.83	0.75	-0.10	-0.28	-0.24	-0.31	0.63	-0.51	-0.22
Nonferrous Metals	7	-0.32	0.41	-0.67	0.30	-0.60	0.83	**1.00**	0.70	-0.28	0.04	-0.16	-0.10	0.86	-0.46	0.12
Machinery	8	0.35	-0.24	-0.63	0.74	-0.86	0.75	0.70	**1.00**	-0.44	0.18	-0.26	-0.34	0.65	0.07	-0.37
Chemistry	9	-0.52	0.22	-0.33	-0.35	0.64	-0.10	-0.28	-0.44	**1.00**	-0.67	0.77	0.74	-0.08	-0.52	0.54
Wood/Paper	10	0.38	-0.18	0.39	-0.14	-0.15	-0.28	0.04	0.18	-0.67	**1.00**	-0.21	-0.26	-0.06	0.50	-0.25
Construction Materials	11	-0.37	0.13	-0.34	-0.55	0.57	-0.24	-0.16	-0.26	0.77	-0.21	**1.00**	0.91	0.11	-0.30	0.67
Food Processing	12	-0.46	0.30	-0.30	-0.67	0.51	-0.31	-0.10	-0.34	0.74	-0.26	0.91	**1.00**	0.24	-0.30	0.88
Textile/Footwear	13	-0.22	0.29	-0.79	0.18	-0.59	0.63	0.86	0.65	-0.08	-0.06	0.11	0.24	**1.00**	-0.28	0.35
Flour/Feed Grain Industry	14	0.91	-0.76	0.49	0.19	-0.30	-0.51	-0.46	0.07	-0.52	0.50	-0.30	-0.30	-0.28	**1.00**	-0.44
Glass/Ceramics	15	-0.64	0.62	-0.23	-0.75	0.41	-0.22	0.12	-0.37	0.54	-0.25	0.67	0.88	0.35	-0.44	**1.00**

Industry/Period		2001														
		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Power Industry	1	**1.00**	-0.51	0.11	0.32	0.19	-0.23	-0.37	0.62	0.91	-0.22	0.09	0.39	0.44	-0.18	-0.77
Oil-Extracting	2	-0.51	**1.00**	-0.84	-0.74	0.58	0.75	0.35	-0.42	-0.44	0.50	0.57	-0.47	0.87	0.03	-0.66
Oil-Refinery	3	0.11	-0.84	**1.00**	0.73	-0.70	-0.63	-0.21	0.04	0.15	-0.60	-0.66	0.36	-0.92	0.71	-0.42
Gas	4	0.32	-0.74	0.73	**1.00**	-0.78	-0.63	-0.52	0.35	0.18	-0.32	-0.84	0.05	-0.60	0.41	0.80
Coal	5	0.19	0.58	-0.70	-0.78	**1.00**	0.77	0.35	-0.24	0.37	0.13	0.97	0.06	0.44	-0.18	-0.77
Ferrous Metals	6	-0.23	0.75	-0.63	-0.63	0.77	**1.00**	0.60	-0.43	0.03	0.37	0.80	-0.01	0.54	0.03	-0.66
Nonferrous Metals	7	-0.37	0.35	-0.21	-0.52	0.35	0.60	**1.00**	-0.25	-0.15	0.50	0.51	0.43	0.13	0.10	-0.42
Machinery	8	0.62	-0.42	0.04	0.35	-0.24	-0.43	-0.25	**1.00**	0.41	0.37	-0.24	0.45	-0.06	-0.46	-0.12
Chemistry	9	0.91	-0.44	0.15	0.18	0.37	0.03	-0.15	0.41	**1.00**	-0.30	0.32	0.56	-0.43	0.26	-0.03
Wood/Paper	10	-0.22	0.50	-0.60	-0.32	0.13	0.37	0.50	0.37	-0.30	**1.00**	0.21	0.08	0.68	-0.64	-0.67
Construction Materials	11	0.09	0.57	-0.66	-0.84	0.97	0.80	0.51	-0.24	0.32	0.21	**1.00**	0.19	0.41	-0.15	-0.78
Food Processing	12	0.39	-0.47	0.36	0.05	0.06	-0.01	0.43	0.45	0.56	0.08	0.19	**1.00**	-0.50	0.25	-0.02
Textile/Footwear	13	-0.36	0.87	-0.92	-0.60	0.44	0.54	0.13	-0.06	-0.43	0.68	0.41	-0.50	**1.00**	-0.73	-0.77
Flour/Feed Grain Industry	14	0.00	-0.44	0.71	0.41	-0.18	0.03	0.10	-0.46	0.26	-0.64	-0.15	0.25	-0.73	**1.00**	0.67
Glass/Ceramics	15	-0.01	-0.74	0.91	0.80	-0.77	-0.66	-0.42	-0.12	-0.03	-0.67	-0.78	-0.02	-0.77	0.67	**1.00**

2002

Industry/Period		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Power Industry	1	**1.00**	0.34	-0.54	0.50	0.88	0.41	0.61	0.26	0.61	0.22	0.15	-0.01	0.80	-0.10	0.12
Oil-Extracting	2	0.34	**1.00**	0.23	0.94	0.52	0.29	0.04	-0.07	0.18	0.01	-0.17	-0.76	0.39	-0.18	0.19
Oil-Refinery	3	-0.54	0.23	**1.00**	0.11	-0.22	-0.60	-0.21	0.23	-0.19	0.02	-0.09	-0.02	0.20	-0.21	-0.70
Gas	4	0.50	0.94	0.11	**1.00**	0.66	0.29	0.14	0.09	0.37	0.21	-0.05	-0.68	0.56	-0.68	0.52
Coal	5	0.88	0.52	-0.22	0.66	**1.00**	0.48	0.46	0.55	0.81	0.49	0.41	-0.06	0.80	-0.10	0.12
Ferrous Metals	6	0.41	0.29	-0.60	0.29	0.48	**1.00**	-0.13	0.04	0.50	0.29	0.46	-0.35	-0.09	-0.18	0.19
Nonferrous Metals	7	0.61	0.04	-0.21	0.14	0.46	-0.13	**1.00**	0.21	0.12	-0.18	0.12	0.46	0.54	0.56	-0.70
Machinery	8	0.26	-0.07	0.23	0.09	0.55	0.04	0.21	**1.00**	0.82	0.82	0.80	0.49	0.73	0.28	0.15
Chemistry	9	0.61	0.18	-0.19	0.37	0.81	0.50	0.12	0.82	**1.00**	0.88	0.73	0.10	0.69	-0.03	0.35
Wood/Paper	10	0.22	0.01	0.02	0.21	0.49	0.29	-0.18	0.82	0.88	**1.00**	0.72	0.10	0.53	-0.10	0.55
Construction Materials	11	0.15	-0.17	-0.09	-0.05	0.41	0.46	0.12	0.80	0.73	0.72	**1.00**	0.43	0.33	0.40	0.02
Food Processing	12	-0.01	-0.76	-0.02	-0.68	-0.06	-0.35	0.46	0.49	0.10	0.10	0.43	**1.00**	0.17	0.92	-0.67
Textile/Footwear	13	0.63	0.39	0.20	0.56	0.80	-0.09	0.54	0.73	0.69	0.53	0.33	0.17	**1.00**	0.01	0.12
Flour/Feed Grain Industry	14	0.02	-0.71	-0.21	-0.68	-0.10	-0.18	0.56	0.28	-0.03	-0.10	0.40	0.92	0.01	**1.00**	-0.85
Glass/Ceramics	15	-0.14	0.48	0.31	0.52	0.12	0.19	-0.70	0.15	0.35	0.55	0.02	-0.67	0.12	-0.85	**1.00**

2003

Industry/Period		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Power Industry	1	**1.00**	0.35	0.05	0.53	0.55	0.15	0.02	-0.06	-0.02	-0.09	0.05	0.64	0.00	-0.14	-0.78
Oil-Extracting	2	0.35	**1.00**	-0.62	0.57	-0.49	0.28	-0.51	0.36	0.19	0.29	0.78	0.76	0.60	0.59	0.23
Oil-Refinery	3	0.05	-0.62	**1.00**	-0.41	0.71	-0.18	0.71	0.25	-0.28	-0.37	-0.52	-0.11	-0.03	-0.02	-0.39
Gas	4	0.53	0.57	-0.41	**1.00**	-0.05	-0.44	-0.72	-0.09	0.36	0.77	0.09	0.42	0.81	-0.23	-0.26
Coal	5	0.55	-0.49	0.71	-0.05	**1.00**	-0.07	0.60	-0.28	-0.13	-0.32	-0.68	0.00	0.00	-0.14	-0.78
Ferrous Metals	6	0.15	0.28	-0.18	-0.44	-0.07	**1.00**	0.34	0.21	0.05	-0.70	0.53	0.29	-0.36	0.59	0.23
Nonferrous Metals	7	0.02	-0.51	0.71	-0.72	0.60	0.34	**1.00**	-0.01	-0.51	-0.80	-0.31	0.01	-0.49	0.41	-0.39
Machinery	8	-0.06	0.36	0.25	-0.09	-0.28	0.21	-0.01	**1.00**	0.13	-0.06	0.61	0.42	0.42	0.40	-0.09
Chemistry	9	-0.02	0.19	-0.28	0.36	-0.13	0.05	-0.51	0.13	**1.00**	0.50	0.08	-0.14	0.19	-0.49	0.33
Wood/Paper	10	-0.09	0.29	-0.37	0.77	-0.32	-0.70	-0.80	-0.06	0.50	**1.00**	-0.06	-0.05	0.58	-0.55	0.13
Construction Materials	11	0.05	0.78	-0.52	0.09	-0.68	0.53	-0.31	0.61	0.08	-0.06	**1.00**	0.61	0.27	0.66	0.32
Food Processing	12	0.64	0.76	-0.11	0.42	0.00	0.29	0.01	0.42	-0.14	-0.05	0.61	**1.00**	0.64	0.74	-0.46
Textile/Footwear	13	0.53	0.60	-0.03	0.81	0.00	-0.36	-0.49	0.42	0.19	0.58	0.27	0.64	**1.00**	0.04	-0.51
Flour/Feed Grain Industry	14	0.23	0.46	-0.02	-0.23	-0.14	0.59	0.41	0.40	-0.49	-0.55	0.66	0.74	0.04	**1.00**	-0.16
Glass/Ceramics	15	-0.72	0.08	-0.65	-0.26	-0.78	0.23	-0.39	-0.09	0.33	0.13	0.32	-0.46	-0.51	-0.16	**1.00**

2004

Industry/Period		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Power Industry	1	**1.00**	0.51	-0.57	0.74	0.79	-0.53	0.49	0.41	-0.11	0.31	0.40	-0.74	-0.19	0.34	0.36
Oil-Extracting	2	0.51	**1.00**	-0.94	0.33	0.22	-0.18	-0.03	0.70	-0.62	-0.05	0.92	-0.32	0.35	-0.64	0.13
Oil-Refinery	3	-0.57	-0.94	**1.00**	-0.19	-0.19	0.22	-0.02	-0.56	0.61	0.21	-0.87	0.40	-0.17	0.44	0.06
Gas	4	0.74	0.33	-0.19	**1.00**	0.77	-0.47	0.45	0.48	-0.04	0.69	0.33	-0.44	0.35	0.36	0.14
Coal	5	0.79	0.22	-0.19	0.77	**1.00**	-0.31	0.74	0.24	0.32	0.32	0.10	-0.83	-0.19	0.34	0.36
Ferrous Metals	6	-0.53	-0.18	0.22	-0.47	-0.31	**1.00**	-0.60	0.27	0.49	0.02	-0.19	0.19	-0.06	-0.64	0.13
Nonferrous Metals	7	0.49	-0.03	-0.02	0.45	0.74	-0.60	**1.00**	-0.37	0.12	-0.16	-0.06	-0.62	-0.35	0.76	0.06
Machinery	8	0.41	0.70	-0.56	0.48	0.24	0.27	-0.37	**1.00**	-0.19	0.56	0.68	-0.15	0.56	-0.58	0.57
Chemistry	9	-0.11	-0.62	0.61	-0.04	0.32	0.49	0.12	-0.19	**1.00**	0.17	-0.75	-0.33	-0.59	0.04	-0.14
Wood/Paper	10	0.31	-0.05	0.21	0.69	0.32	0.02	-0.16	0.56	0.17	**1.00**	0.03	0.10	0.55	0.04	-0.26
Construction Materials	11	0.40	0.92	-0.87	0.33	0.10	-0.19	-0.06	0.68	-0.75	0.03	**1.00**	-0.11	0.57	-0.29	0.63
Food Processing	12	-0.74	-0.32	0.40	-0.44	-0.83	0.19	-0.62	-0.15	-0.33	0.10	-0.11	**1.00**	0.53	-0.03	-0.66
Textile/Footwear	13	-0.02	0.35	-0.17	0.35	-0.19	-0.06	-0.35	0.56	-0.59	0.55	0.57	0.53	**1.00**	-0.07	-0.15
Flour/Feed Grain Industry	14	0.07	-0.39	0.44	0.36	0.34	-0.64	0.76	-0.58	0.04	0.04	-0.29	-0.03	-0.07	**1.00**	-0.53
Glass/Ceramics	15	0.48	0.81	-0.84	0.14	0.36	0.13	0.06	0.57	-0.14	-0.26	0.63	-0.66	-0.15	-0.53	**1.00**

Source- CEA_HSE, Development Center calculations