

# Analyzing and Identifying the Factors Affecting the Global Supply Chain Competitiveness of Industrial Products

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**Abstract** - Technological progress is one of the main factors driving long-run economic growth, whether referred to some enterprises that need progress and advancement or to the national economy in general. Innovations make the production process more efficient, thereby affecting its competitive ability. Switching from an economic system that takes considerable time and labor to a technology-intensive one is what drives economic modernization. Industrial production plays a key role in shaping the competitiveness of national economy. Competitiveness index is one of the most important indicators. The purpose of this research is to analyze and identify the most significant factors affecting the global supply chain competitiveness of industrial products. The tie between them was established through the coefficient of correlation between the global manufacturing competitiveness index and the index of performance in the Russian manufacturing sector. The strongest correlation was found between the global manufacturing competitiveness index and the industrial production index, high-technology exports and R&D expenditure.

**Keywords** — Industrial Complex, Global supply chain competitiveness, Technological progress, R&D expenditure.

## 1. Introduction

Modern business is such that manufacturers and service providers have to handle things under constant competitive pressure, so the matter of survival and development is often on the forefront. Competition is one of those bricks that a market economy is built on, and its significance is evident [1], [2]. Globalization only strengthens that significance. The ability of one particular enterprise to handle competition is not the only thing that matters; so far, same ability must be demonstrated by industries and the nation in general. The ability to

handle competition is characterized by such an economic category as competitiveness [3]. The term ‘competitiveness’ is used when describing goods or products, producers or service providers, regions and even certain countries and national economies.

In the global market, any country has to produce and sale good quality and competitive products to keep being competition. According to [4], manufacturing industry is one of the keys to a competitive national economy. Manufacturing industry is what settles the gross domestic product (GDP), creates new jobs, and stands behind the economic success of the country.

Competitiveness measurement is one of the most important indicators that have a significant impact not only on specific companies, but also on the entire national economy [5]. The most well-known indicator is the Global supply chain competitiveness Index, defined by the World Economic Forum. It allows sorting 134 national economies by competitive power using indicators like macroeconomic factors, public institutions, technology, company’s performance and strategies, and business environment [2].

Competitiveness rating, defined by UNIDO, is an easy-handling tool for analysis and decision-making. National industrial competitiveness has been assessed using its Global Manufacturing Competitiveness Index since 2006 [4]. It reflects country’s ability to compete in manufacturing earnings and exports at a global level [4]. Manufacturing Competitiveness Index is basically a report on the analysis of manufacturing dynamics affecting the long-run growth rates. Such an indicator is important for both developed and developing countries, especially countries that produce raw materials. There are about 75 such countries in the world (Russia included).

## 2. Literature Review

There is a whole bunch of research papers devoted to the allocation of manufacturing drivers and their evaluation.

Article [6] indicates that countries that need to raise their competitive power should have dynamic competition superiority that rests on high R&D density, high innovation skill and high added value production. Innovation is considered one of the most fundamental elements both for countries and the companies to gain competitive power at national and international levels.

Article [7] suggests evaluating the competitive power of manufacturing industry by considering indicators like GDP from manufacturing, value added and employment level, job loss and earnings, and labor productivity.

According to [4], [8], [9], manufacturing industry is one of the keys to a competitive national economy. Manufacturing industry is what settles the gross domestic product (GDP), creates new jobs, and stands behind the economic success of the country. Manufacturing earnings and exports are stimulating economic prosperity causing nations to increase their focus on developing advanced manufacturing capabilities by investing in high-tech infrastructure and education.

Articles [10], [11], [12], [13] examine factors and principles that enable competitiveness. Authors of [10] coined a concept of driver boosting, which can be put into practice with the interaction between the State and the industry. This mechanism runs on innovation programs designed by large state-owned enterprises, advanced technology and cooperation with leading international companies.

Competitive power is evaluated with regard to indicators outlined in [16] [17], [18]: industrial production growth rates; production pattern; investment in fixed assets, investment in R&D, export/import structure, labor productivity, depreciation on fixed assets, capital renewal, etc.

From data available [4], [5], [6], [19], [20], we know that developed innovative countries invest almost 3% of GDP in R&D, when developing countries invest only about 1%. This causes information and technological gaps to grow between developed and developing countries.

A country must be tied to other countries in order to boost one's own economic growth and social progress. Russian manufacturing industry is integrated into the world economy quite well [21], [23]. One-third of medium-sized and large enterprises do exports, and half of them have over 20% of exports in their income. Every sixth company deals with imported raw materials, every third company imports equipment. However, Russian exports continue to be prevailed by raw materials [24].

## 3. Problem Statement

Manufacturing facilities have to leverage their competitiveness in the global market and attract more financial and material resources. Because high-technology exports are a path of national economy to a certain niche in the global competitive environment, manufacturing industry is a factor behind the rates and direction of national export growth.

The existing indicators of national competitiveness, defined by the World Economic Forum (WEF), the International Institute for Management Development (IMD), etc., do not cover the competitive power of the entire industrial complex. This is why this research explores the ties between the indicators of industrial development in the context of measurements provided by the WEF in the Global supply chain competitiveness Reports [28].

## 4. Research Purpose

The purpose of this research is to analyze and identify the most essential factors driving the global-level-competitiveness of manufacturing products.

## 5. Results

Let us consider the current situation with the industrial complex of Russian Federation by following the official statistics available for public view. Table 1 shows the outturn recorded in the Russian Federation.

Table 1. Industrial Production Index in Russia, 2010/2017, in % [25-26]

Year	2010	2011	2012	2013	2014	2015	2016	2017
IPI	107.3	105.5	103.4	100.4	101.7	99.2	102.2	102.1

The Industrial Production Index (IPI) has significantly decreased in 2010/2013, but after it dropped in 2015, Russian Federation returned to its gears, and so production rates grew by 2% in 2016 and 2017.



Figure 1. Industrial Production Index in Russia

The manufacturing industry deals with all sorts of goods, including those from the International Standard Trade Classification: chemicals and related products, n.e.s. (5), manufactured goods classified chiefly by material (6), machinery and transport equipment (7), miscellaneous manufactured articles (8), non-ferrous metals (68).

National economic development is defined generally by the structure of manufacturing exports and imports (Table 2) [25], [26].

Table 2. Manufacturing Exports and Imports

Year	2010	2011	2012	2013	2014	2015	2016
Manufacturing Exports (% of total exports)	14.1	13.2	16.3	16.6	17.4	20.5	21.8
Manufacturing Imports (% of total imports)	74.5	74.9	83.1	82.3	81.9	80.9	79.6

Figure 2 illustrates that the share of manufacturing exports is not less than 22% of total Russian exports, and it slightly increases since 2011. The share of imports, however, ranged 75-83% during the same research period. As noted in [21], facilities and equipment were modernized in 2005/2014 with the use of imported devices and technologies.

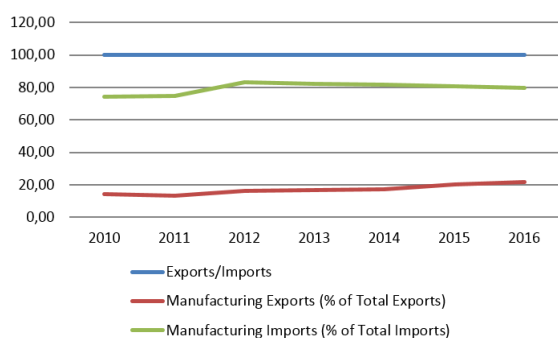


Figure 2. Share of Manufacturing Exports/Imports

Table 3 shows Russian Federation run a positive balance of trade during the research period. Exports dominated over imports through to 2016, and the gap between them is over USD 100 million. However, if we distinguish the share of high-technology exports goods, it will turn out that it was a scant 1-2% (Figure 3). Having high share of high-technology exports is a big deal for any country, as this refers to its competitive power in the world market.

Table 3. Exports and Imports (USD, billion) [25], [26]

Year	2010	2011	2012	2013	2014	2015	2016
Exports	445.513	573.991	594.192	593.939	559.642	392.509	330.741
Imports	320.96	410.05	444.70	469.65	428.90	281.64	265.97
BOT	124.55	163.94	149.49	124.29	130.74	110.87	64.77
High-Technology Exports	5.075	5.443	7.095	8.656	9.843	9.677	6.640

In such a situation, innovations and investment into manufacturing sphere are of great significance. Russian manufacturing industry has to restore full-fledged investment and innovation.

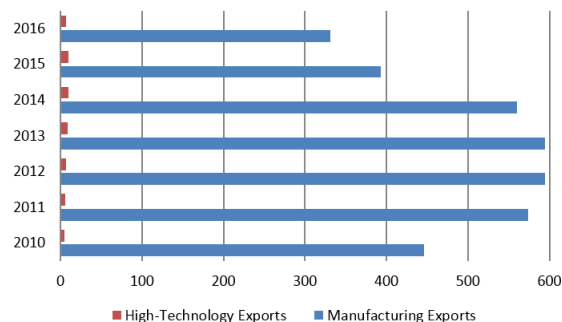


Figure 3. Share of Manufacturing Exports/Imports

Because the world tends toward more high-tech products and services, many of the most successful countries invest heavily into the so-called *national innovation ecosystems*. Such ecosystems bring together people, resources, policies and organizations to turn new ideas into commerce. The leading producing countries are constantly investing in R&D through public funds, and encouraging the private sector to do the research business by shaping joint innovation ecosystems. Those, who take part in this, benefit from the integration of government, scientists and private equity investors, who are in to create and maintain these ecosystems.

R&D covers fundamental research, applied research and experimental findings. Table 4 shows how much money was allocated for R&D during 2010/2016 [26]. From it, we can see that investments in R&D amounted to 1% of GDP.

Table 4. R&amp;D Expenditure

Year	2010	2011	2012	2013	2014	2015	2016
Actual Money Spent, RUB, million	523 377.2	610 426.7	699 869.8	749 797.6	847 527.0	914 669.1	943 815.2
Percent of GDP	1.13	1.01	1.03	1.03	1.07	1.10	1.10

Israel is the world's leader in R&D expenditure (4.3% of GDP in 2015), while South Korea took the second place with 4.3% of GDP (2015). The third position is occupied by Japan (3.3% of GDP in 2015). The Russian Federation took the 27th place with 1.1% of GDP in 2015. In 2016, R&D expenditure for Russian Federation was also equal to 1.1% of GDP. If we refer to the growth rates, allocations increased dramatically South Korea (by 0.7%), Israel (by 0.4%), and Japan (0.2%), compared with 2010. In the Russian Federation, R&D expenditure decreased by 0.03%. However, if we take the changes fairly, then the expenditure curve kept within the 1% range during those years (Figure 3).

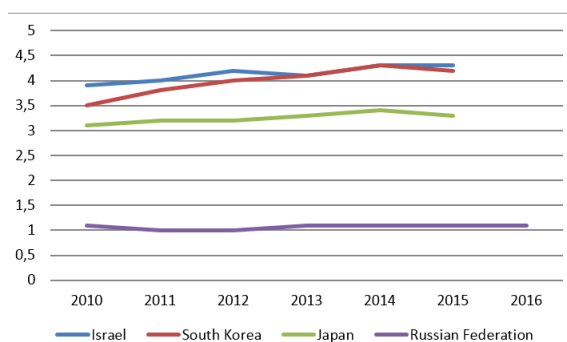


Figure 4. R&amp;D Expenditure, % of GDP

Talented, hard-working and skilled employees are one of those essential drivers of manufacturing competitiveness. Their education and development call for a reliable and well-funded education infrastructure, and involvement in R&D.

Such practice is of exceptional important, because manufacturers tend to rely heavily on the nation's ability to skill up in the sphere of advanced manufacturing and innovation technologies. Hence, developed countries are likely to spend more on education, and so get a higher number of highly skilled employees.

R&D specialists are people with specialist knowledge, engaged in developing and creating new knowledge, products, processes, methods or systems, who are involved in managing related projects. They are also graduate students involved in R&D activity.

Table 5. R and D Specialists (per a million of population) [26]

Year	2010	2011	2012	2013	2014	2015
R and D Specialists	3088	3125	3094	3073	3102	3131

The number of R and D specialists in the Russian Federation was during the considered period in the range of 3.000 people per a million of population. The leaders in this category were defined to be Denmark, South Korea, and Sweden, where the number of R and D specialists was more than 7 thousand people in 2015 [26].

Since 2006, the Global supply chain competitiveness Index (GCI) has been a key figure in filtering nations by competitive power, while the manufacturing competitiveness has been measured using the Global Manufacturing Competitiveness Index (GMCI) [4], [27]. Both evaluation procedures, when one measures the competitive power of any country in general, and the competitive power of its national manufacturing industry, are focused on the key government/market forces that drive the competitiveness. These drivers not only enable the competitive advantages of many countries, but also shape the global production landscape.

The indicators of national/manufacturing competitiveness are defined basically by surveys, so we addressed the 2010 Statistics of Industrial Development of the Russian Federation to tie the GMCI to performance in the manufacturing sector. The tie between them was established through the coefficient of correlation between the GMCI and some of the performance characteristics (Table 6).

Table 6. Correlation Coefficient

Correlation between GMCI and:	Figure
– R&D Expenditure	0.71
– IPI	0.96
– Manufacturing Exports	0.41
– High-Technology Exports	0.88

Based on data in Table 6, we can assume that the strongest correlation was found between the global

manufacturing competitiveness index and the industrial production index, high-technology exports and R&D expenditure. Though Russian Federation, competitiveness tends to decrease, and it fell to 20th place in 2010, to 28th in 2013, and to 32nd in 2016 [4].

Thus, we end with the following areas that are a problem in terms of global supply chain competitiveness: scientific component of production, new equipment and tooling, and poor innovation.

## 6. Discussion

This research provides results on the tie between the GCI and the indicators reflecting industrial development in the Russian Federation. The target tie was established through the analysis of changes in the GMCI and indicators like the outturn, exports/imports, the share of manufacturing exports/imports, R&D expenditures in full-scale value and in percent of GDP, and the number of R and D specialists. Aside from tracing those changes that occurred during the 2010/2016, we found the correlation between them and the GMCI. This allowed us to identify the most essential factors driving the global-level-competitiveness of manufacturing products.

In contrast to some authors, like those who published [16], [17], [18], we suggest considering not only the key indicators that characterize the manufacturing industry, but also how strong is the tie between these indicators and the global rank, which allows determining what areas need boosting to increase the competitiveness.

In [14], authors considered using a comprehensive method to assess the competitive power of an enterprise that uses market data to benefit. The main contribution here is a mixed approach to assessing manufacturing competitiveness and its reference model. However, this model does not address the global level of competitiveness and does not provide info for managerial decision-making.

## 7. Conclusions

Our research shows that manufacturing competitiveness, to a great extent, depends on the share of high-technology exports. Numerical analysis proves that scientific potential development is needed in the sector. Statistical data analysis available from [26] shows that R&D expenditure has been at 1% of GDP since 2010, while other developed countries invest about 4-5%, and this figure tends to grow. The number of highly skilled and educated R&D specialists in the Russia Federation is within the range of 3-3.1 thousand people per a million of population, while the best world figures are over 7 thousand people, which is more than 2 times higher. This resulted in a drop in

GCI. Thus, Russian Federation dropped by 12 places on the index through 2016.

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