

**HIGH-TECH INDUSTRIES IN CHINA AND RUSSIA:
PRESENT SITUATION AND IMPACT ON ECONOMIC DEVELOPMENT**

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Abstract

The competition of major countries in the world is mainly the competition of technological innovation, and technological innovation is manifested through high technology. In recent years, the competition of high-tech industries has become the world's major economies stepping up to seize the commanding heights of the new round of technological revolution and high-tech industries. This article provides a comparative analysis of the current situation of high-tech industry development in China and Russia. China and Russia have their advantages in the development of high-tech industries, but they are also different. China's high-tech industries are relatively large in scale and develop at a faster rate, and exceeded Russia in the exports, the proportion of exports in manufacturing, and R&D expenditures. But the proportion of scientific research personnel in China is far lower than in Russia. So China and Russia should take corresponding measures to develop high-tech industries.

Keywords: High-tech industries, economic development, R&D expenditures, scientific research personnel, regulatory measures, export, competition, global economy, manufacturing, technological innovation.

Introduction

In recent years, high-tech industries have shown a rapid development momentum in the world. The development of high-tech industry and the impact on economic growth have increasingly attracted the attention of academia, industry, and governments at all levels, and there are many related research results [1].

At present, the researches in China mostly focus on the impact of high-tech industries on the overall national economy, regional belts, provinces (municipalities), single industries, and microeconomic entities. On the macro level, the impact of research and development (R&D) expenditures in high-tech industries on economic growth is positive; the number of patent applications has a significant positive impact on economic growth. In general, high-tech industry innovation factors can effectively promote economic growth [2-3].

High-tech industries can form new economic growth points by expanding the scale of the industry; through the spillover effects of knowledge and technology, drive the optimization of economic structure; through industrial upgrading, improve the efficiency of production factors, and then promote economic development [4]. The high-tech industry not only plays an important leading role in creating new growth points, transforming traditional development engines, and adjusting the industrial structure, but also helps to promote the transformation of economic growth mode [5]. At the meso-level, it is mainly reflected in the impact of high-tech industries on regional economic development.

Scholars have analyzed the present situation of the development of high-tech industries in Beijing, Shaanxi Province, Chongqing and other regions, and found that there are problems in the coordinated development of high-tech industries. They have proposed different industrial development strategies for different regions, and rationally optimize the regional layout to promote the economic development of various regions [6-11]. At the micro level, high-tech industries have a positive impact on the development of enterprises, and the larger the scale of the enterprise, the stronger the knowledge absorption capacity, the more obvious the positive impact [12].

The economic research of the other countries' experts and scholars in their own countries mainly focuses on the high-tech industry and economic globalization, the innovation of the high-tech economy, and the function of high-tech in the national economy. In terms of high technology and economic globalization, some scholars believe that in the past fifty years, the development of high-tech industries has become the main driving force of the global economy. As more and more countries and regions introduce high-tech industries, the economy is bound to be affected by the process of globalization [13]. In terms of high-tech economic innovation, the high-tech industry is the most advanced industrial field in the contemporary era. In the future, the development of the world economy will mainly be high-tech. The political economy of all countries is also concentrated on high-tech. How to maintain the innovation of a high-tech economy has become the concern of all countries. The high-tech industry is the leading industry for the development of the modern economy, used as the engine of innovations [14-15]. In terms of the function of high technology in the world economy, scholars have pointed out that the inconsistency of the growth rate of high-tech industry R&D personnel and high-tech industry in some countries affects the global and national economy [16].

Above all, the development of high-tech industries has not only changed the traditional industries and the entire world economy but has also been the "leading industry" for the economic growth of countries around the world and the "strategic industry" for enhancing national competitiveness. In the past several decades, the development of high-tech industries in the United States, Japan, Western Europe, East Asia, and some newly industrialized countries all have made important contributions to the economic growth of the country and the region. However, the present situation and development trends of high-tech industries in various countries are different, and their contribution to the economy is not completely the same. This research is dedicated to studying the current development status of China and Russia's high-tech industries, to learn from each other and complement each other.

The definition standards and characteristics of high-tech industry

Whether in China or other countries, there are different expressions of the concept of high-tech; the qualitative concepts are basically the same. The content, period and characteristics of the institutionalization of high-tech industries are given in Table 1.

Table 1

The institutionalization of high-tech industries [Baidu Database]

Year	Country	Institutionalization	The definition of high-tech industry
1971	United States of America	National Academy of Sciences of the United States first proposed the concept of high technology (High-Tech) in the "Technology and National Trade"	Various production sectors that rely on advanced science and engineering technology
1979-1981	United Kingdom	British government	A group of industries containing information technology, biotechnology, and many other technologies that are at the forefront of scientific and technological progress
1982	Japan	Newsweek and Business Week have successively published "Japan's High Technology" and "High Technology Special Collection"	The technology group which is established on the basis of contemporary cutting-edge technology and next-generation science and technology
1983	France	France government	Only when a new product is produced on the production line, has a high-quality workforce, has a certain market and has formed branch technology
1996	Russia	"Russian Scientific Development Doctrine" and "Science and Technology Policy Law"	High-tech industries which are mostly create sophisticated equipment and advanced technologies. The key characteristic of advanced technologies in the production of hightech products is that they cannot be replaced by the technologies of preceding generations
1991	China	State Science and Technology Commission	The collection of enterprises engaged in the research, development, production and technical services of one or more high-tech and its products based on high-tech. It is an industry with high research and development investment and a large proportion of research and development personnel

Summarizing the definition of high-tech industries in various countries, it is not difficult to find the key technologies of the industry are often difficult to develop, but once they are successfully developed, they have higher economic and social benefits than normal. High-tech industries are knowledge-intensive and technology-intensive industries. The leading technology of the product must belong to the established high-tech field and must include the process or technological breakthrough that is at the forefront of the high-tech field.

So far, there is no uniform international standard for quantitatively defining high-tech industries. Two standards are used widely currently: one is the standard established by the US Department of Commerce. It includes four main indicators: the proportion of R&D expenditure in sales; the proportion of scientists, engineers, and skilled workers in all employees; the leading technology of the product must belong to the identified high-tech field; the leading technology of the product must include the process or technological breakthrough that is at the forefront of technology in the high-tech field [1].

The second standard is set by the International Organization for Economic Cooperation and Development (OECD) [1]. It is based on the statistics of the International Standard Industrial Classification, and mainly uses the R&D intensity which is the proportion of R&D expenditure in output value as the criterion for defining high-tech industries. Those industries with a proportion of more than 3% are high-tech industries, with 1% to 2% are medium-tech industries, and with less than 1% are called low-tech industries.

The main characteristics of the high-tech industry are as following:

- knowledge and technology are intensive, the proportion of scientific and technological personnel is large, and the staff culture and technical level are high;
- the consumption of resources and energy is low, the products are diversified, software-based, the batch is small, the update is fast, and the added value is high;
- more investment in research and development;
- high industrial growth rate [17].

Taking the information industry as an example, the output value of the information industry has accounted for 40% to 60% of the gross national product in developed countries, and the annual growth rate is 3 to 5 times that of the traditional industry.

Through the World Development Bank, the Russian Federal National Bureau of Statistics, and the National Bureau of Statistics of China, the "World Development Indicators" (2008-2018), the "Russian Statistical Yearbook", the "National Report on the Development of Russian High-Tech Industries", and the "Chinese National High-Tech Industries Statistical Yearbook (2008-2018), China Statistical Yearbook (2008-2018), and use comparative analysis methods to analyze the contribution of high-tech industries to the economy.

The present situation of high-tech development in China and Russia

To understand the current situation in the high-tech industries of China and Russia it is needed to compare and analyze such aspects as industrial scale, personnel, R&D investment, and industrial distribution.

From the perspective of industrial scale, China's high-tech industry has formed a relatively large scale, and some sectors have become highly competitive in the world market and have a large share. Throughout 2008-2017, the main business income and total export volume of high-tech industries in major countries in the world show that China is in a leading position. In terms of total exports, in 2008, China's total exports of high-tech industries were US\$340,118 million, 1.5 times that of the United States and 67.1 times that of Russia during the same period [18-19]. In 2017, China's total exports of high-tech industries reached US\$504,381 million, which were 4.5 times that of the United States and 54.9 times that of Russia during the same period. Overall, the export value of China and Russia's high-tech industries is on the rise, and the average annual growth rate is 4.5% and 6.8% respectively (Figure 1). In terms of the proportion of high-tech industry exports in manufacturing, from 2008 to 2017, the proportion of high-tech industries in the United States and Japan in the manufacturing industry has shown a downward trend as a whole [18-19]. The United Kingdom has continued to maintain its above 20%; the trends in China and France are basically the same, basically showing an upward trend before 2015 and a downward trend after 2015; Russia as a whole shows an upward trend and maintains a ratio of about 10% (Figure 2).

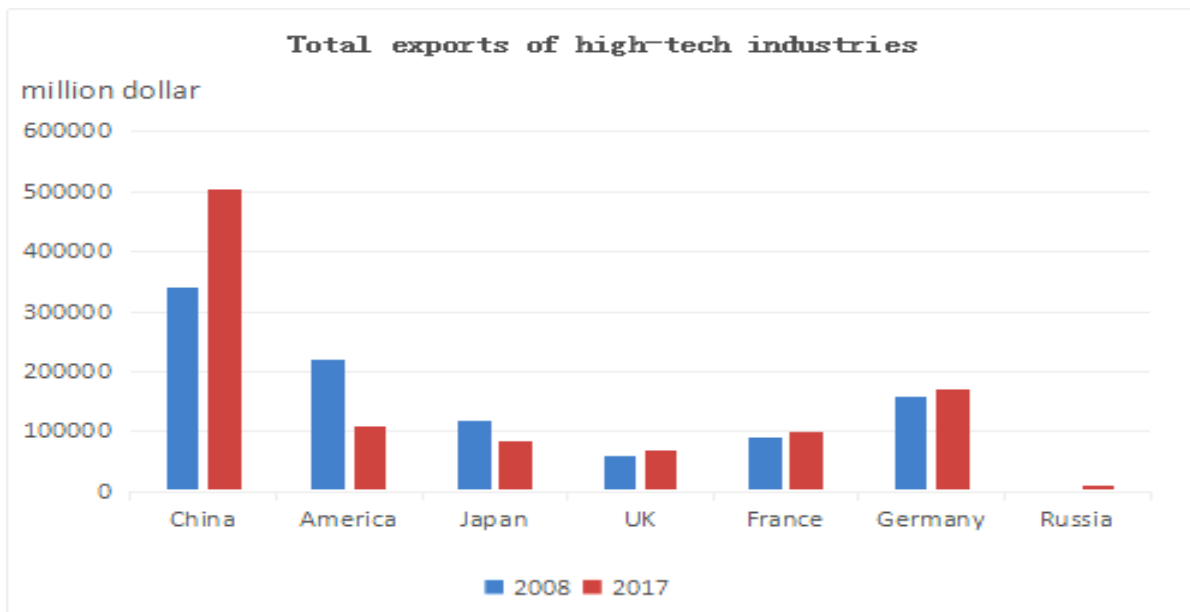


Fig. 1. Total exports of high-tech industries in major countries (2008-2017y) (World Development Indicator2008-2017; China Statistical Yearbook (2008-2017))

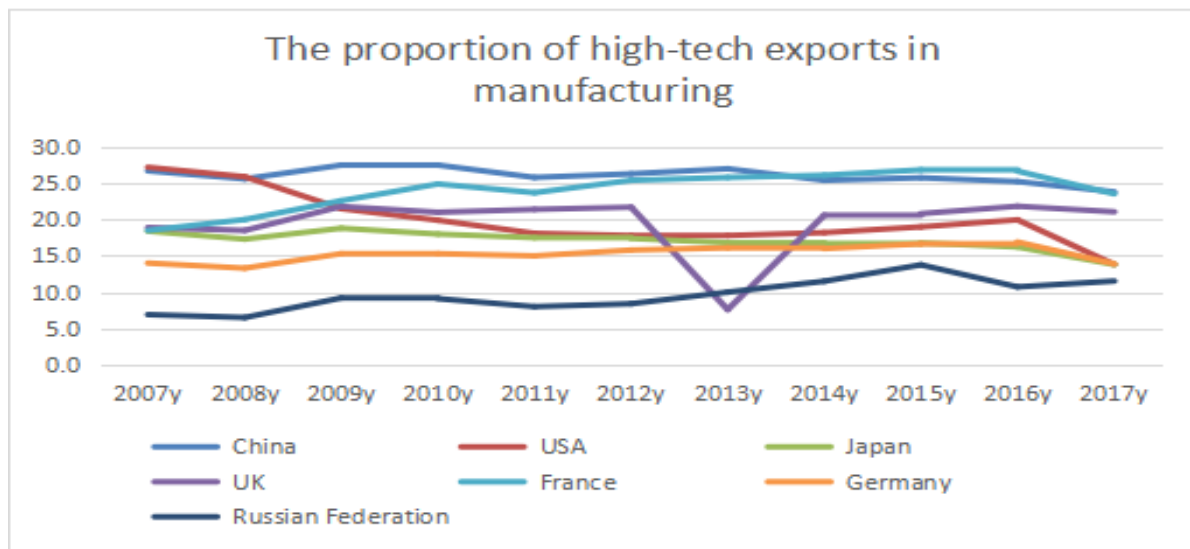


Fig. 2. The proportion of high-tech exports in manufacturing in major countries (2008-2017y) (World Development Indicator2008-2017)

From the Number of departments and R&D personnel perspective, after more than 20 years of development, the number of high-tech sectors and the number of employees in China has generally increased. From 2008 to 2017, the number of Chinese high-tech enterprises showed a trend of first rising, then falling, and then slowly rising. The total number increased from 25817 in 2008 to 32027 in 2017. In 2011, the number has shown a downward trend. Since 2012, it gradually picked up again. The number of employees has increased from 9,447,700 in 2008 to 13,176,645 in 2017, but has declined since 2016 [19-20]. According to statistics of incomplete data from Russia, the number of high-tech sectors in Russia has also been increasing in recent years. The R&D personnel in this article are mainly professionals engaged in the conception and creation of new knowledge, new products, new procedures, new methods or new systems, as well as professionals engaged in project management. Comparing the number of R&D personnel per million people in China and Russia, China has shown a continuous upward trend since 2009 [19-24].

At the same time, the number of R&D personnel in Russia was much higher than that in China, and remained at about 3,000 per million people (Figure 3). There are also data showing that high-tech industries provide more opportunities for Russian employment, and the number of employees' accounts for about one third of the total number of employees in Russia. In terms of the number of R&D personnel in a million populations as a measure of a country's high-tech industry indicators, Russia lags behind the average level of developed countries such as the European Union, the United States, and Germany, while China lags far behind Russia. There is still a lot of room for China to develop the number of scientific researchers.

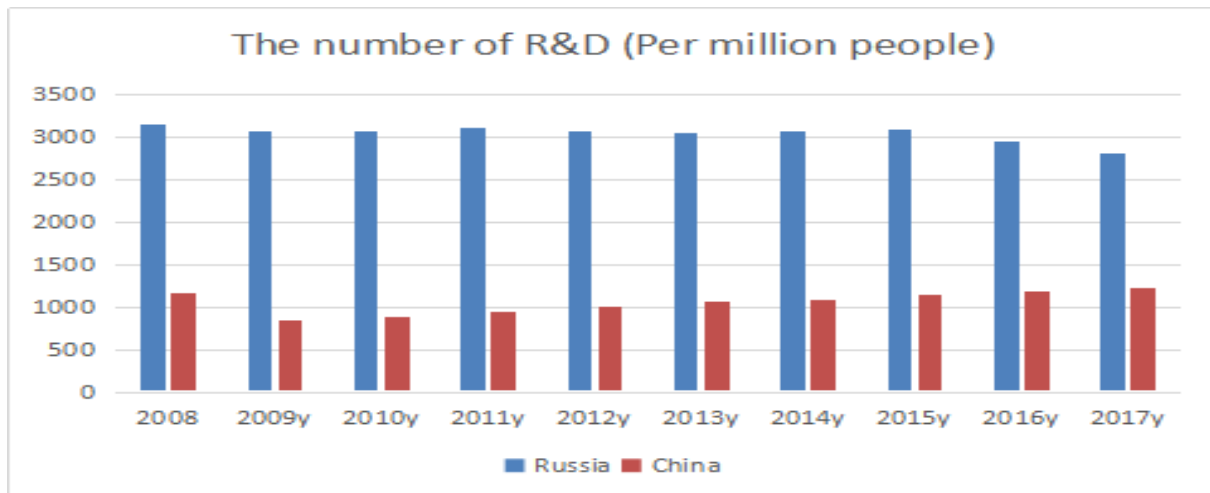


Fig. 3. The number of R&D (Per million people) in China and Russia(2008-2017y) (China Statistical Yearbook(2008-2017y); Chinese National High-Tech Industries Statistical Yearbook (2008-2017y); <https://eng.gks.ru/>)

From the funding perspective, the investment in R&D expenditure reflects the importance a country attaches to the field of scientific research and invention. The International Organization for Economic Cooperation and Development defines a high-tech industry as a high-tech industry where a company's R&D expenditure and the industry's output value are more than 3% [24]. According to this standard, in 2008, the proportion of R&D expenditure in China's high-tech industry to the output value of the industry was 8.09%; the proportion in 2012 was 10.3% [20-21]; due to the lack of data on the total output value of the high-tech industry in 2017, the proportion of R&D expenditure in that year cannot be calculated in detail. However, looking at China's overall investment in high-tech industries in the past decade, it is on an overall upward trend. Russia's investment in scientific research funding is much higher than that of China (Figure 4). In terms of the ratio of R&D expenditure to GDP, China is showing an upward trend year by year, while Russia remains at 1% [18-20]. In terms of the corresponding royalties of intellectual property rights, China's royalties are relatively high, and they have increased by multiples after 2017 (Figure 5).

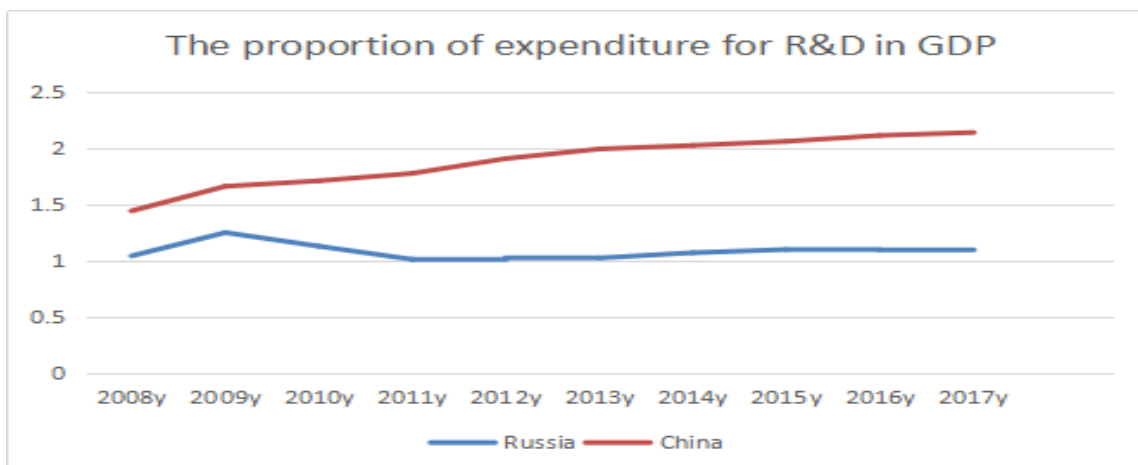


Fig. 4. The number of R&D (Per million people) in China and Russia (Chinese National High-Tech Industries Statistical Yearbook (2008-2017y); <https://eng.gks.ru/>)

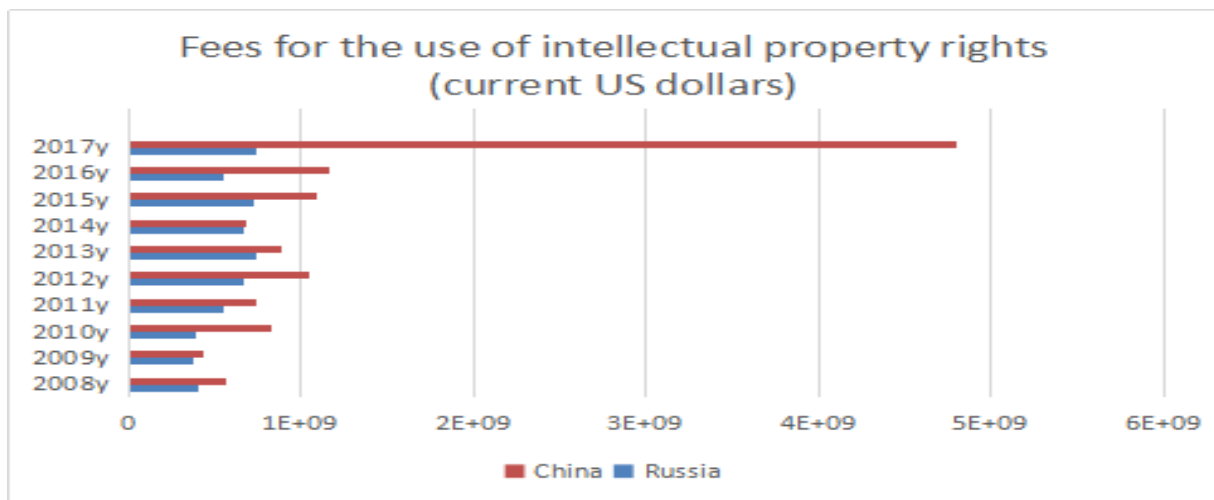


Fig. 5. The fees for the use of intellectual property rights in China and Russia(2008-2017y) (World Development Indicator; Chinese National High-Tech Industries Statistical Yearbook (2008-2017y); <https://eng.gks.ru/>)

In terms of geographical distribution, China's high-tech industries are currently concentrated in the coastal regions of Guangdong and Jiangsu, with Tibet being the least. This is closely related to the earlier development of China's eastern coastal areas, where the state's investment in the eastern area is much higher than that in other areas, and Tibet is a plateau area, which is not convenient for development. Russia's high-tech industries are characterized by uneven development and are currently concentrated in Moscow, Moscow Oblast, and St. Petersburg.

The impact of high-tech on economy

Since the 1980s, the vigorous development of high-tech industries has had a huge impact on the world economy and opened up an unprecedented bright prospect for human society. Comparing the present situation of high-tech industries in China and Russia, it is not difficult to find that high-tech industries have a greater degree of contribution to the GDP. Generally speaking, it is manifested in the promotion of economic aggregates, economic restructuring and upgrading, and improvement of comprehensive benefits.

High-tech industries can form a new economic growth point. The driving force of high-tech industries on the economy is much higher than other industries. Studies have shown that 60-80% of economic growth in developed countries is driven by technological progress, and the proportion of high-tech industries in the industry has reached 30-40% [25]. Although the proportions of China and Russia are relatively low, the existing high-tech industries have played an irreplaceable role in the new economies of the two countries.

High-tech industries can adjust and optimize the industrial structure. The development of high-tech industries can not only radiate and influence traditional industries, and promote the upgrading of traditional industries with modern technology, equipment and advanced technological processes; but also improve the technological content of traditional industrial products, and can also promote the differentiation and substitution of traditional industries. Both China and Russia have used information technology and new material technology to transform traditional manufacturing, biotechnology to transform traditional agriculture, and the use of forestry technology, water conservancy technology, and resource technology to improve the environment.

High-tech industries can improve enterprise technological innovation ability and market competitiveness. The efficiency and risks of the high-tech industry have attracted the attention of many businesses. With the increasing demand for high-tech products in the society, the gradual development and improvement of the high-tech industry and the strong support of the government have reduced its risk and made a large number of businesses invest in business and get huge profits.

In addition, high-tech industries not only play an active role in promoting the coordinated development of social resources and the ecological environment, but also play an important role on the road to economic globalization. In short, the growth of high-tech industries will produce a strong multiplier effect, drive the development of related industries, and thus drive the rapid growth of the entire national economy, which is bound to have a long-term and far-reaching impact on the economies of China and Russia.

Conclusion

High-tech industries are on the rise in both China and Russia. China's high-tech industries are relatively large in scale and develop at a faster rate. They have exceeded Russia in the exports, the proportion of exports in manufacturing, and R&D expenditures. But the proportion of scientific research personnel in China is far lower than Russia.

In response to these shortcomings, Russia should further expand the scale of the high-tech industry market and expand product demand. There was a widely used argument that "the Russian market is too narrow for modern start-ups" [20-21]. For China, it is necessary to increase the investment of scientific research personnel in terms of funding and treatment, expand the proportion of scientific research personnel, and provide continuous development momentum for the high-tech industry.

Due to data limitations, this article is only based on part of the present situation of high-tech industries in China and Russia, and analyzes the impact on the economy as a whole. Compared with other industries, the impact of high-tech industries on the economy needs to be further improved.

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ВЫСОКОТЕХНОЛОГИЧНЫЕ ОТРАСЛИ В КИТАЕ И РОССИИ: СОВРЕМЕННОЕ СОСТОЯНИЕ И ВЛИЯНИЕ НА ЭКОНОМИЧЕСКОЕ РАЗВИТИЕ

Аннотация

Конкуренция крупнейших стран мира представляет собой во многом конкуренцию технологических инноваций, которые проявляются в настоящее время через высокие технологии. В последние годы крупнейшие экономики мира активизировались, конкурируя в высокотехнологичной сфере, для захвата лидирующих позиций на рынке на новом витке технологической революции. В данной статье проводится сравнительный анализ современного развития высокотехнологичной промышленности Китая и России. В исследовании определено, что Китай и Россия имеют различные преимущества и ограничения в развитии высокотехнологичных отраслей. Высокотехнологичные отрасли Китая относительно крупны по масштабам и развиваются более быстрыми темпами, опережая Россию по объему экспорта, доле экспорта в обрабатывающей промышленности и расходам на НИОКР. Но доля научно-исследовательских кадров в Китае гораздо ниже, чем в России. В соответствии с этим сделан вывод о том, что Китай и Россия должны учитывать как собственный потенциал, так и опыт друг друга при выработке мер по развитию высокотехнологичных отраслей промышленности.

Ключевые слова: высокотехнологичные отрасли, экономическое развитие, расходы на НИОКР, научно-исследовательский персонал, регулирующие меры, экспорт, конкуренция, мировая экономика, обрабатывающая промышленность, технологические инновации.