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Research article

Overview of iron and steel industry in China in the 20th and 21st centuries: what are the main steps of its development?

Vlada S. Groysburt, Alexey A. Maslov

National Research University “Higher School of Economics”
11 Pokrovskii Blvd., Moscow, 109028, Russian Federation

Abstract. Speaking about the XX century after the establishment of People's Republic of China in 1949 the leading trade partner of the country was Soviet Union and after the crisis in Chinese-Soviet relations in the 1960s there has been a shift towards the trade within Asian region, which once again shows that China has always been an active player on the international market because of its productions' power. The way China interacts with other regions and particular countries is an exciting topic for international relations scientists because it reflects the state of affairs of China at every step of its development. For more than 50 years, the Russian metallurgical industry has been building its relationships with China as one of the leading partners. So because Russia has passed through a stage of stagnation after the collapse of the USSR and the period of finding a new balance due to reduced domestic Russian demand, it was crucial to continue developing relations with the closest neighbors and try to catch up. However, why is international trade developing so fast? This happened as a result of the growing purchasing power of the Chinese population; domestic manufacturers are increasing their operations within the domestic market, which is making the country known for being the manufacturer of the world, in its factory. Ferrous metallurgy is used in engineering, construction, and automotive, that is, in critical sectors of the economy. Therefore, scientists and analysts pay great attention to the steel industry and its research. In order to understand the modern state of affairs in the iron and steel industry in China, authors provide an overview of the industry itself using various sources of data, such as historical review and collection of quantitative data, estimate its development to understand its weak and sharp points for the business development.

Keywords: China; ferrous metallurgy; environmental laws; industrial development

Introduction

Historically, the situation of the external trade has been an essential measurement of the state of affairs in one country, because the way of how a country integrates itself into the global markets often signifies the strength of its political and economic relationships with the outside world. As China never needed the essential goods to be imported in the country because of its variety of climates and landscapes, it soon was a place, which could offer the outside world never before

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seen goods. So since the second part of the 17th century as China was seen as one of the leading trade partners and an object of missionary work. During the Age of global discoveries, China played a significant role in the supplier in primary tradable goods and has been a successful part of international trade. This was the result of the rapid development of the country and because China has always been an essential transformational hub for many kinds of products.

The rapid development of Chinese metallurgy over the past 50 years has turned a backward and inefficient industry into a well equipped and highly competitive, which allowed China to take first place in the amount of steel produced around the world during the last several decades. The relevance of the research topic is determined by the importance of understanding different factors, which determine the metallurgical industry.

Literature review

There has been a lot of the works describing the Chinese iron and steel industry during different time history; most of them were dedicated to the 5-year plan's accomplishments and talked more about the process of organization of the industry than about the statistical data (Yin Ruiyu, 2003). More works were dedicated to the process of production, explaining the way Chinese metallurgy establishes its presence in the world (Lu Zhongwu, Cai Jiuju, Yu Qingbo, Xie Anguo, Wang Kai Zhong, 2000). However, there has been little to no statistical overview during the last year yet. This research paper is based mainly on the statistical data mentioned below.

The iron and steel industry of China has been an exciting topic for many researchers trying to find out the central economic miracle behind the rapid development of the country. As main primary sources, we tend to use *the National Bureau of Statistics of the Government of China*,¹ which has worked together with researchers from other countries in an evaluation of consumer subsidies and nutrition in different provinces in China. It proposes a major national conditions census plan, and organizes implementation after approval; organizes economic surveys of various regions and departments, summarizes and organizes essential statistical data of the country; conducts statistical analysis of national economy, scientific and technological progress, and social development, statistical forecasting, and statistical supervision, provide statistical information and advice to the Party Central Committee, the State Council and relevant departments.

The over source is *China Iron and Steel Association*² – a national industry organization in China's steel industry. Guided by the party's line, principles, and policies, this organization adheres to the scientific concept of development and believes in serving the enterprise, serving the industry, serving the government, and serving the society. They provide to the work guidelines of the enterprise-run association, adhere to market orientation, and actively provide services, reflect

¹ The National Bureau of Statistics of the Government of China. <http://www.stats.gov.cn> (accessed 15.03.2019).

² 2016–2017 China Iron and Steel Industry Monthly Report. Global Information, Inc. <https://www.giiresearch.com/report/cccm421245-china-iron-steel-industry-monthly-report.html> (accessed: 20.10.2018).

demands, standardize operations, establish and improve industry coordination and self-discipline mechanisms, and safeguard the overall interests of the industry and the legitimate rights and interests of its members. It acts as a bridge and link between the government and enterprises, continuously improve the competitiveness of China's steel industry in the domestic and foreign markets, promote the healthy development of the steel industry, and strive to build a strong steel country. It posts a lot of graphs and different information with a lot of pure data organized by different topics, spheres, and time limitations.

The other reliable source that we will use is *General Administration of Customs of the People's Republic of China*³ on its web portal, we can find all the information on the annual and monthly transportation of any good to any country; all we need to know is HS (Harmonized System Code; which is ТН ВЭД in Russia). Moreover, the Chinese government has recently opened the English version of this portal, where it is possible to find the main monthly and annual reports.

More data and graphs are obtained from the *World Steel Association*, a web page of the organization, which collects data from various recourses and according to them, provides reports.

As for the secondary sources in this part we address work a comparative study of the development model of China's iron and steel industry by Yuning Gao and Angang Hu,⁴ who analyze iron and steel from several perspectives. Their work is easy to read and provides a lot of referenced data. It approaches the analysis from several most essential dimensions: a historical retrospective, prospects of development, and international comparison through the years. It is a case study as it concentrates on the particular development model.

So, to achieve the goal of the research we use mixed methods, which includes historical retrospective, analysis of the industry using qualitative and quantitative data, as we want to approach this topic from different angles

The development of the industry

The booming economic development of China, which has been clearly expressed since the beginning of the era of reform and openness in 1978, made it possible for this state to become one of the leaders of the international economy, and even take key positions in some parameters.

The metallurgical industry contributes a lot to the economic development of the country. Metallurgy is divided into two main types: color (or nonferrous) and black (or ferrous). Nonferrous metallurgy includes copper, lead, aluminum. Ferrous metallurgy includes steel and cast iron.

Ferrous metallurgy is especially important for China, as it plays a large role in manufacturing, construction, and in real estate.⁵ Also, steel, which is a type of

³ General Administration of Customs of People's Republic of China. <http://english.customs.gov.cn> (accessed: 20.02.2019)

⁴ Gao Y., Hu A. A comparative study of the development model of China's iron and steel industry // Journal of Chinese Economic and Business Studies. 2009. Vol. 7. No. 3. P. 284.

⁵ 2016–2017 China Iron and Steel Industry Monthly Report. Global Information, Inc. <https://www.giiresearch.com/report/cccm421245-china-iron-steel-industry-monthly-report.html> (accessed: 20.10.2018).

ferrous metallurgy, is often regarded as an indicator of economic activity in a country because its production forces are the evidence of the necessity of the development of the country's both external and internal markets. Therefore, scientists and analytical experts pay great attention to the steel industry and its development as obvious evidence of the successful production powers in the country.

If we consider the development of China's metallurgy, it was slightly uneven following the political events in the country that had a direct negative or positive impact on the metallurgical sector, mostly because of the governmental forces. At the time of the founding of the People's Republic of China on October 1949, the development of the metallurgical industry in the country was at a low level. For example, the production of crude steel in 1949 was only 250,000 tons; cast iron – 160,000 tons and molded steel – 140,000 tons.⁶ During these years, the USSR rendered great assistance to the development of metallurgy and played a significant role in providing the best specialists.

Significant upheavals in Chinese political history characterize the 1960s. In addition to the deterioration of relations with the USSR, in 1966–1976, Mao Zedong initiated a “cultural revolution”, which led to a decrease in steel output in 1970 below the 1960 level.⁷ Thus, during the reign of Mao Zedong, the metallurgical industry began to develop in China, but due to the policy pursued, it did not achieve significant results.

With the beginning of the policy of reform and openness in 1978, pursued by Deng Xiaoping, China's political and economic course changed, which had a positive effect on metallurgy. Thus, the output of liquid steel rose to 25.05 million tons, the production of iron to 23.74 million tons, and the production of molded steel to 16.33 million tons.⁸ The turn towards a market-oriented policy allowed Chinese manufacturers to introduce modern technologies of foreign colleagues. Also, at this stage, the company was founded, one of the largest steel producers in the world, Shanghai Baosteel. However, until 1986, China's steel imports accounted for 20% of total imports.⁹ In the 1980s, China began to increase production, and from this period, there has been a constant annual increase in output in the metallurgical industry.¹⁰ This phenomenon can be explained by the need for the economic development of the country, industrialization, and urbanization.

The end of the 20th century, namely the 1990s, stands out as a separate stage. The reason for this is that in 1995, the production of liquid steel in China reached 95 million tons,¹¹ which is more US production. This period is characterized by a significant increase in Chinese steel production, which allowed China

⁶ Gao Y., Hu A. A comparative study of the development model of China's iron and steel industry // *Journal of Chinese Economic and Business Studies*. 2009. Vol. 7. No. 3. P. 284.

⁷ China's Steel Industry and Its Impact on the United States: Issues for Congress (electronic resource). Congressional Research Service. URL: <https://fas.org/sgp/crs/row/R41421.pdf> (accessed: 20.10.2018)

⁸ *Ibid.*

⁹ *Ibid.*

¹⁰ Dua Z., Lin B. Analysis of carbon emissions reduction of China's metallurgical industry // *Journal of Cleaner Production*. 2018. No. 176. P. 2.

¹¹ Liu H. Analysis and suggestions on the lower profitability of China's steel industry // *China Steel*. 2013. No. 10. Pp. 11–18.

to become the first country in the world to produce so much steel as to become the leaders in this sector.

The next stage comes after 2000.¹² During the 10th Five-Year Plan (2001–2005), the growth in steel output exceeded the figures since the founding of the PRC in 1949, which allowed China to occupy 31.5 % of the global steel output in 2005.¹³ Internal economic processes, namely, facilitated significant growth in the third stage housing reform, carried out since 1998. This led to a large consumption of steel for construction work. External causes include China's accession to the WTO in 2000, which allowed enterprises to use steel products with permission for foreign trade operations.

The growth trend of the Chinese steel industry is also observed in the period 2010–2017. Also, it can be noted that, firstly, the release of China in recent years is slightly less than the total output of other countries, namely in 2016 – 49.0%, in 2017 – 49.2%. Secondly, in 2017, production growth was 5.7%.

If we consider the global change in steel output from 1950 to 2017,¹⁴ then a significant increase has been observed since 2000, which coincides with an increase in production in China, and therefore we can conclude that the Chinese had a substantial effect on the increase in global steel output.

The booming growth of China's steel industry has led to an increase in steel enterprises. In 1978, there was only the Bao Steel Company, whose output reached 3 million tons.¹⁵ By the year 2000, 11 enterprises had reached such a scale. In the next four years, the number of such enterprises increased by 1.5 times to 27.¹⁶ In 2009, China had about 1,200 large and small enterprises for the production of steel, including about 70 large and medium-sized enterprises. Despite this, the average size of steelmaking companies is less than 1 million tons, and the five largest enterprises account for only 28.5% of the total.¹⁷ A small number of large-scale steel producers lead to the decentralization of the steel industry, which, firstly, makes this industry more competitive, and consequently, reduces the price of products. Secondly, steel production is becoming less controlled by the government, including, for example, in such a sensitive area for China as environmental protection. Third, it is difficult for Chinese manufacturers to develop a unified policy for more active participation in the international arena.

¹² Gao Y., Hu A. A comparative study of the development model of China's iron and steel industry // *Journal of Chinese Economic and Business Studies*. 2009. Vol. 7. No. 3. P. 284.

¹³ 2016–2017 China Iron and Steel Industry Monthly Report. Global Information, Inc. <https://www.giiresearch.com/report/cccm421245-china-iron-steel-industry-monthly-report.html> (accessed: 20.10.2018).

¹⁴ *Ibid.*

¹⁵ China Iron and Steel Industry Association. <http://english.chinaisa.org.cn/do/index.jsp> (accessed: 17.12.2018).

¹⁶ Gao Y., Hu A. A comparative study of the development model of China's iron and steel industry // *Journal of Chinese Economic and Business Studies*. 2009. Vol. 7. No. 3. P. 284.

¹⁷ Analysis: To revitalize the steel industry, China must increase the industry concentration rate / The State Council of the People's Republic of China. http://www.gov.cn/jrzq/2009-03/21/content_1264930.htm (accessed: 14.02.2018).

According to data for 2017, five Chinese steel companies are included in the ten largest steelmaking companies, namely, China Baowu Group, HBIS Group, Shagang Group, Ansteel Group, Shougang Group. In fact, according to the profitability of the Chinese companies, in the list of Top 500 most successful companies in China, 52 companies are dealing with ferrous and non-ferrous production.

Although recent studies by economists associated with Goldman Sachs,¹⁸ assured that the growth of China's economy is moving towards domestic consumption beyond investment and exports, there is an upcoming new boom in the service sector, such as technology, retail, and financial sector.

To sum up, we would like to notice that it plays a crucial role in analyzing the industry for further work. As we see, the Chinese iron and steel industry provides a lot of opportunities for small and medium enterprises to enter the market as well as to develop the supply chains that they want.

China plays an essential role as a player in steel production in the world. Interestingly to notice, only one Chinese company in this list is private owned, which is Shangang group, which once again can be any evidence that the state-owned enterprises do not adequately control Chinese iron and steel industry, so there is a place for development of small and medium private companies, which eventually have a chance to emerge of continue to flourish separately and independently. Summing up all the said above, we can say that the ownership of the company does not play a significant role when coming into the trade market.

One of the peculiarities of the Chinese steel industry is the high demand for steel. If we compare it with the amount of steel produced, then in 2007, China produced 36.3% of the global amount of steel and consumed 34.2%; in 2017, production – 49.2%, consumption – 46.4%.¹⁹ Based on the data on the number of steel exports in 2017, China in absolute value ranks first (74.8 million tons). Nevertheless, if we take into account the amount of steel produced, which was equal to 831.7 million tons in 2017,²⁰ it turns out that China exports only about 9%. From which it can be concluded that Chinese steel production is focused on the domestic market, it means that there are opportunities to create new and improved plants as there is a high demand on the local market.

As the World Trade Organization notes, excess capacity has become a major problem in the global economy²¹. This problem is also inherent in the Chinese metallurgical industry, which is a consequence of rapid growth.

Over ten years (2007–2017), China's share in global steel production increased from 36.3 to 49.2%, given that global steel output increased from 1,350 to 1,689 million tons. This situation adversely affects the price level and performance of

¹⁸ Bloomberg, article: China will not come to the rescue in the global Iron Ore Supply Crisis. <https://www.bloomberg.com/news/articles/2019-02-14/china-won-t-come-to-the-rescue-in-global-iron-ore-supply-crisis> (accessed: 16.04.2019).

¹⁹ Ibid.

²⁰ Ibid.

²¹ Ferriola J. Steel success strategies keynote presentation // Fastmarkets AMM. <https://www.amm.com/events/amm-steel-success-strategies/presentations.html> (accessed: 24.10.2018).

Chinese steel companies. According to data provided by the World Steel Association, the utilization rate of steel production capacity in the world in 2015 was 69.7%. The capacity utilization rate of liquid steel in China in 2014 was 71.2%.²² The growth trend of overcapacity in China has been observed since 2011.

For 2016, about half of Chinese steel enterprises in China are state-owned,²³ however, the Chinese government has a relatively strong influence on the development of the steel industry as a whole. In addition to the above measures aimed at reducing production capacity, initiated by the Chinese authorities, which, for example, led to the merger of China Baowu Group and Wuhan Iron and Steel Group²⁴, a policy is also being created, the purpose of which is to upgrade equipment at enterprises, increase exports, increase output from higher value-added, stimulating the implementation of projects abroad for more investment.²⁵ The Chinese government pays government subsidies and provides loans from state-owned banks, which makes these businesses less sensitive to the environment and allows them to operate despite long-term losses.

In 2018, a slight increase in metal output by China was expected, which is estimated to be 0.6%.²⁶ Including this is due to the environmental policy pursued by the Chinese government.

At the same time, the Chinese government pays great attention to reducing production capacity. Xi Jinping emphasizes that this is the priority for structural reform, the purpose of which is to stimulate the proposal.²⁷ As the main measure for the implementation of this policy, China is conducting administrative reforms on the ground. Also in 2016, a guide was issued for the steel industry, which set the goal of reducing production capacity by 100–150 million tons in five years.²⁸

The metallurgical industry consumes a sufficiently large amount of resources and energy, the use of which in the process of increasing production will increase. The primary energy resources used in metallurgy are coking coal, liquid fuels, and natural gas.

²² China Steel Industry Development. The mission of the People's Republic of China to the European Union. 2016. <http://www.chinamission.be/eng/zgggfz/chneco/t1366481.htm> (accessed: 28.10.2018).

²³ Liu H., Song L. Issues and Prospects for the Restructuring of China's Steel Industry // China's new sources of economic growth: reform, resources and climate change. Vol. 1 / ed. by L. Song, R. Garnaut, C. Fang, L. Johnston; The Australian National University. Canberra: ANU Press, 2016. P. 339.

²⁴ Financial times digital issue. <https://www.ft.com/content/adffb2b4-4464-11e6-9b66-0712b3873ae1> (accessed: 06.03.2019).

²⁵ Liu H. Analysis and suggestions on the lower profitability of China's steel industry // China Steel. 2013. No. 10. Pp. 11–18.

²⁶ Issues and Prospects for the Restructuring of China's Steel Industry. P. 348.

²⁷ The State Council of the People's Republic of China. http://english.gov.cn/news/policy_briefings/2016/08/19/content_281475421118308.htm

²⁸ Full transcript of the State Council policy briefing on August 19th. The State Council of the People's Republic of China. http://english.gov.cn/news/policy_briefings/2016/08/19/content_281475421118308.htm (accessed: 04.12.2018).

Global energy consumption in 2017 increased by 2.2%, an increase of 80% due to developing countries. Even though the growth of energy consumption in China in 2017 was 3% and was lower than the average growth over ten years, in the world, it was one third.²⁹ The energy-intensive metallurgical industry makes the main contribution to the growth of energy consumption in China.

Considering the statistics for 2000–2011,³⁰ the energy consumption of the iron and steel industry in 2000 amounted to 167.92 million tons of coal equivalent. In 2011, this value was equivalent to 588.97 million tons of coal equivalent, which is 3.52 times more than in 2000. The high-energy intensity of the ferrous metallurgy is demonstrated by the fact that in 2011, it accounted for 29.39% of the total energy consumption of the industrial sector in China.

The increase in energy consumption observed in 2017, and this trend may continue, will invariably lead to an increase in the negative impact on the environment, in particular, to an increase in CO₂ emissions. Today, the world community pays special attention to this aspect.

As noted above, with the example of China, the increase in energy consumption is associated with the energy-intensive metallurgical industry. From which it can be concluded that significant CO₂ emissions characterize metallurgy. In 2017, the amount of CO₂ emissions averaged 1.83 tons per ton of liquid steel. Against the background of the fact that China's impact on the environment, including the produced amount of CO₂ emissions (in 2000, China ranked second in terms of CO₂ emissions), attracts the attention of the world community, it is especially important to consider this item. Besides, China is facing pressure from developing countries, forcing them to join international agreements aimed at reducing emissions.

When we speak about the iron and steel industry, in general, it is always thought to be the producer of crude steel, building materials, and so on, but there are many more aspects of the products that can be sold and bought.

The organization of ferrous metallurgy in China has its characteristics. First of all, the total number of enterprises in this industry is vast – there are about 1.5 thousand of them. However, this is quite easily explained if all the ferrous metallurgy enterprises in a country are divided into two groups.

The first and main ones are formed by large state-owned enterprises – full-cycle mills, steel-smelting, and rolling mills, 14 of which have annual steel production exceeding 1 million tons. Most of them were built during the first five-year plans until recently obsolete technological processes dominated them – for example, open-hearth in steelmaking. However, in the 1990s, these enterprises have undergone significant modernization, and now most of the steel is produced on them already in oxygen converters and electric furnaces. Most rolling mills use continuous casting technology.

The second group consists of many hundreds of small and medium enterprises, mostly semi-handicraft. Their technical level remains rather low, and the quantity

²⁹ BP's Statistical Review of World Energy 2018 // BP Global. <https://www.bp.com/content/dam/bp/en/corporate/pdf/energy-economics/statistical-review/bp-stats-review-2018-full-report.pdf> (accessed: 28.10.2018).

³⁰ Lin B., Wang X. Carbon emissions from energy-intensive industry in China: Evidence from the iron & steel industry // *Renewable and Sustainable Energy Reviews*. 2015. No. 4. P. 747.

of the metal is medium. They (like small coal mines) arose during the period of the “big leap forward” when almost every commune was ordered to have its production of iron and steel. Today, the course has been taken for the gradual liquidation of such enterprises.

Conclusion

This directly implies such a feature of the placement of China’s steel industry as a combination of deconcentration and concentration. The first of these features is associated with the presence of a large number of small enterprises scattered throughout almost all the provinces and counties, and the second with the leading role of large state-owned plants and factories. It is they who primarily determine the presence in the country of the five main metallurgical bases.

The ferrous metallurgy of China, like most other branches of heavy industry, was created based on the use of its forces and means. Therefore, foreign trade relations of this industry are somewhat limited, especially in export. However, due to the already mentioned poor quality of domestic iron, China is forced to import high-quality ore; in 1995 this import reached 50 million tons, and in 2001 it reached almost 110 million tons, and in 2006 reached 300 million tons (40% comes from Australia and 22–23% each – from Brazil and India). Until recently, China imported and steel products (such as pipes and rolls). However, at the current level of steelmaking, its production began to exceed domestic needs significantly, and China became an exporter of steel.

There are also favorable natural prerequisites for the development of non-ferrous metallurgy in China – in the form of rather large reserves of bauxite, polymetallic, and many other ores. Due to the successful development of this industry by 2000, the total volume of production of non-ferrous metals has already exceeded 5 million tons per year. In the production of primary aluminum, zinc, lead, tin, antimony, tungsten, bismuth, the country reached the first, in the production of molybdenum, magnesium, vanadium – the second, titanium, gold, silver – the third, copper and lithium – the fourth place in the world.

China's steel output has had a significant impact on the global level. Shortly, a slowdown in growth rates is possible due to the ongoing state policy in the environmental field in order to reduce emissions to the environment. Besides, the Chinese government has set the goal of reducing excess production capacity in the metallurgical industry, which is above the global level, which cannot but harm the output of metallurgical products.

Nevertheless, it is possible to predict the continued growth in the production of Chinese metallurgy, but, most likely, at a slower pace. Besides, five Chinese steel companies are among the top ten in 2017. These facts demonstrate the success of Chinese metallurgy, in contrast to the Russian, which is highly dependent on external conditions. The reasons for the successful development of China's metallurgical complex may include such factors as low labor costs, the need for industrialization and urbanization, which directly increase the level of operation of metallurgical products, as well as a high level of domestic consumption. For example, China-initiated housing reform has helped increase the steel industry's need for steel products. Thus, the Russian government can follow the policy

pursued by China to increase production capacity. Namely, to increase the consumption of metallurgical products at the expense of the construction sector and especially machine building, which at this stage uses quite a bit of metal, therefore, there is room for growth.

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Vlada S. Groysburt, graduate of MA programme “Socioeconomic and Political Development of Modern Asia”, Faculty of World Economy and International Affairs, National Research University “Higher School of Economics”. E-mail: vlada-95@mail.ru

Alexey A. Maslov, Ph.D. in World History, Professor in History, Head of School of Asian Studies, National Research University “Higher School of Economics”. E-mail: amaslov@hse.ru

Научная статья

Обзор металлургической промышленности Китая в XX и XXI вв.: этапы становления и развития

В.С. Гройсбург, А.А. Маслов

Национальный исследовательский университет «Высшая школа экономики»
Российская Федерация, 109028, Москва, Покровский бульвар, 11

В 1949 г. основным торговым партнером Китая был Советский Союз, но после кризиса в китайско-советских отношениях в 1960-х гг. произошел сдвиг в сторону торговли в азиатском регионе – еще одно свидетельство того, что Китай всегда был сильным игроком на международном рынке благодаря мощному производству. То, как Китай взаимодействует с другими регионами и отдельными странами, является интересной темой для ученых по международным отношениям, поскольку отражает положение дел

в Китае на каждом этапе его развития. Уже более 50 лет российская металлургическая отрасль строит отношения с Китаем как с одним из основных партнеров. Поскольку после распада СССР Россия пережила стадию стагнации и период нахождения нового баланса из-за сокращения внутреннего спроса, было крайне важно продолжать развивать отношения с ближайшими соседями и пытаться наверстать упущенное. Но почему международная торговля развивается так быстро? Это происходит в результате растущей покупательской способности населения Китая, отечественные производители наращивают свою деятельность на внутреннем рынке, что делает страну известной в качестве мирового производителя на своем собственном заводе. Черная металлургия используется в машиностроении, строительстве и автомобилестроении, то есть в ключевых отраслях экономики. Поэтому ученые и аналитики уделяют большое внимание металлургии и ее исследованиям. С целью понять современное состояние черной металлургии в Китае, авторы дают обзор самой отрасли, используя различные источники данных, такие как исторический обзор и сбор количественных данных, оценивают ее развитие, рассматривают ее слабые и сильные стороны для развития бизнеса.

Ключевые слова: Китай; черная металлургия; экологические законы; промышленное развитие

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Сведения об авторах:

Гройсбург Влада Станиславовна, магистр востоковедения, Школа востоковедения, Национальный исследовательский университет «Высшая школа экономики». E-mail: vlada-95@mail.ru

Маслов Алексей Александрович, доктор исторических наук, профессор, руководитель Школы востоковедения, Национальный исследовательский университет «Высшая школа экономики». E-mail: amaslov@hse.ru