

Analysis of the impact of resource constraint on export trade of Chinese metal products industry

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Abstract. In the era of "green economy", how to maintain rapid economic growth under the constraints of resources is one of the hot issues concerned by the government and experts. With the acceleration of economic globalization, the trend of international transfer of industries is becoming more and more obvious. China is a country with relatively rich resources and low labor costs. In recent years, China has gradually become a resource-intensive undertaking country characterized by high pollution and high energy consumption industries. The transfer of international industries has not only greatly promoted the development of China's economy, but also further increased the demand for resources in China. To realize the sustainable growth of economic development, we must adjust the relationship between trade and resources. Metal products industry belongs to China's manufacturing industry, and it is also a typical industry with high energy consumption and high pollution, which is bound to face severe resource constraints in future construction. Therefore, this paper takes resource constraint as the basic condition, discusses the influence of China's metal products industry under the new situation, analyzes the influence mechanism of resource constraint, and puts forward relevant policy suggestions.

Keywords: Resource Constraint, Metal Industry, Export Trade.

1. Introduction

In order to achieve sustainable economic growth, we must adjust the relationship between trade and resources. Especially at present, China is in the critical period of ecological civilization construction. It is the current development trend to change the mode of economic growth and accelerate the transformation and upgrading of industries with high energy consumption and high pollution. As a typical manufacturing industry with high energy consumption and pollution, metal products industry is bound to face severe resource constraints in the future. Based on this, this paper takes resource constraint as the basic condition to discuss the export trade of China's metal products industry under the new situation, which has theoretical significance and practical application value.

Metal products industry belongs to the reprocessing of steel products, including all kinds of metal tools in our life. Metal products industry also belongs to the manufacturing industry with high pollution and high energy consumption. With the expansion of the export of metal products and the continuous improvement of export delivery value, the consumption of raw materials and energy needed in the production of metal products, including iron ore, coal, crude oil, gasoline, kerosene, diesel and so on, is also greatly increased. However, since 2010, China's iron ore is only imported but not exported, while China's import of energy is also rising sharply. In the case of such a kind of resource constraints, by exploring resource constraints impact on fabricated metal products export trade, can make the relevant enterprises to correctly grasp the current resources of our country present situation, puts forward relevant policy Suggestions, can make enterprise continuously improve production technology and through the related technical reform, for the same kind of significance of reference to the manufacturing and high pollution and high energy consumption.

2. Literature review

Li Xin (2008), on the basis of explaining the development status of China's industrialization and the industrialization path of developed countries under resource constraints, analyzed the gap at home

and abroad, summarized the experience of foreign industrialization, and proposed a new industrialization path of China under resource constraints. Chao Xiaojing and Ren Baoping (2012) believe that resource utilization affects the quality of economic growth through three aspects: resource ecological environment, sustainability of economic growth and overall welfare level of residents. Through theoretical and empirical tests, it is concluded that the improvement of ecological environment and the improvement of resource utilization efficiency have positive effects on the quality of economic growth. Zhou Jian 'an (2008) believes that total resource constraint and low utilization efficiency are the main bottlenecks limiting sustainable economic development. To break the bottleneck of economic development, it is necessary to continuously improve the efficiency of resource utilization and accelerate the use of intensive resource utilization on the basis of the existing stock of natural resources, so as to achieve sustainable development.

To sum up, resource constraints will limit regional economic development and cause related industries to migrate to other countries or regions. Therefore, only reasonable transformation and upgrading and industrial structure optimization of resource-intensive industries can fundamentally promote the development of these industries.

3. Current situation of export trade of metal products industry in China

3.1 Overview of metal products industry

According to the Chinese Statistical Yearbook, the metal products industry is the reprocessing of steel products, including all kinds of metal tools in our life. Metal products are a successor industry to the ore mining and processing sector. In a technological society, metal products are the components of most finished products, such as metal piping systems, metal components, electronic components and automobile parts. The manufacturing process of metal products generally involves three basic steps. The first step is fabrication, which means that the rolled metal products, such as plates, steel or bars, are sent to the manufacturer, where they are cut or shaped. The metal is heated until melted and then poured into a mold to make the desired product. The second step is cleaning, usually with a variety of solvents to remove unwanted waste, dust, sand, etc., in order to make the metal suitable for subsequent cutting, molding, joining and rest processes. The final step is finishing, which is the surface treatment of these metal products, usually for aesthetic and anti-corrosion purposes. Generally speaking, the metal products industry involves all the instruments related to metal materials in our daily life.

3.2 Metal products industry export trade scale

The figure 1 shows that fabricated metal products export in China is in a rising before 2010, but in 2009, began to appear a reduced significantly, and in 2010 began to resource constraint condition is also obvious in our country, our country started in 2010 to stop the exports of iron ore, iron ore import trade involves only. At the same time, around 2010, China's requirements for ecological civilization continue to improve, and the discharge of three wastes has been controlled, which leads to China's related coke, fuel and other major energy consumption has a certain control requirements. After 2010, although the export volume of China's metal products industry increased significantly after 2013, it fell to a low level in 2016. The year-on-year growth rate of export trade of metal products fluctuates greatly, and whether it can be stabilized in a relatively stable state under the constraint of more resources and other conditions in the future remains unknown.

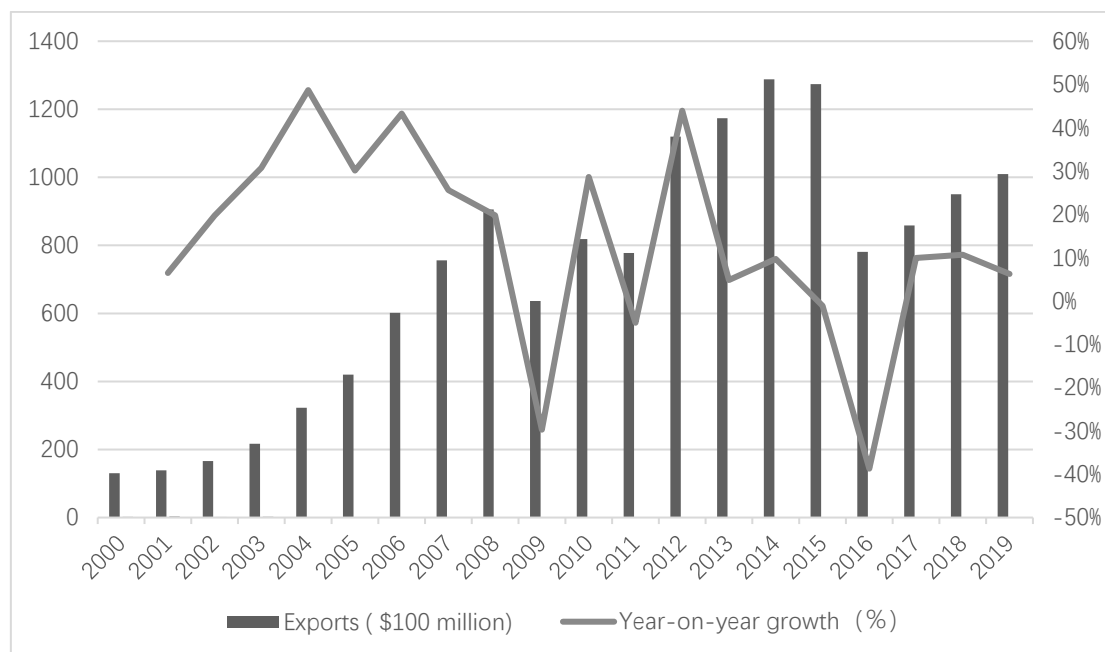


Figure 1 Export Volume of China's metal Products Industry from 2000 to 2019 Source: China Statistical Yearbook

4. Resource constraints on export trade of Metal products in China

4.1 Domestic iron ore supply capacity is insufficient, import dependence is higher

As the most basic and important raw material of iron and steel industry, iron ore is also the most important raw material for metal products industry, which is irreplaceable and non-renewable. The supply capacity of iron ore also determines the sustainable development of China's metal products industry.

The main characteristics of iron ore resources in China are as follows: there are more lean ore and less rich ore, the grade is not high, and the gap with the average level of iron ore in the world is large; The ore types are complex, with more co-associated ore and less single ore. There are few large and super large deposits, and many small and medium-sized deposits. At the same time, the proved reserves of iron ore in China account for the vast majority of lean ore, while rich ore only accounts for 2.8%. In addition, the development and utilization of iron ore resources in China is difficult, and the technical level is relatively backward. At the same time, domestic mining enterprises are also facing a high burden, which makes the comprehensive mining cost and processing cost of iron ore far higher than the price of imported iron ore. Generally speaking, China's iron ore resource endowment conditions are poor, iron ore is abundant but not rich, compared with foreign iron ore resources of huge reserves, low cost of mining and transportation, high grade, China's iron ore resources are relatively low per capita reserves, difficult mining and transportation, low grade of ore, poor quality. The growth rate of iron ore reserves also lags behind the speed of consumption, reserves decline, China's domestic supply capacity of iron ore is insufficient.

Table 1 China's iron ore production and import volume from 2008 to 2019
Source: China Iron and Steel Industry Yearbook

Year	Amount of imported iron ore (ten thousand tons)	Domestic iron ore Production (ten thousand tons)
2008	44358.78	78014.11
2009	62777.92	88456.76
2010	61864.47	108016.1
2011	68608.49	133502.49
2012	73455.27	132730.04
2013	81941.36	152212.89
2014	93269.43	152671.67
2015	95284.4	138128.90
2016	102412.43	127173.09
2017	107473.69	122937.33
2018	106404.79	76337.43
2019	106894.91	84435.62

4.2 Coal resources are in short supply and energy consumption is huge

The main energy needed for the production of metal products is coke, coal, crude oil, kerosene, diesel oil, natural gas and so on. Although China is rich in coal resources, but China is also the world's largest coal producer and consumer, but China's coking coal resources are relatively insufficient, coking coal reserves only account for 27.65% of the total coal reserves in China. At the same time, the regional distribution of coking coal in China is also extremely unbalanced, north China and northwest and other local areas are relatively concentrated, but the eastern coastal areas are relatively poor. And the current in the coastal areas of the state encourages the iron and steel industry to transfer the background that the industrial development in the coastal provinces is faster, based on this, the reserves of coal resources in the coastal provinces is not satisfy the huge demand, such as coke resource distribution brought about by the high transport costs has become a restricting our coastal fabricated metal products one of the development of the resource bottleneck.

On the other hand, with the continuous expansion of the export quantity of metal products, behind the continuous improvement of the export delivery value of metal products, the energy consumption in the production process is also rising sharply. As high energy consumption industries, strengthen energy conservation and emissions reduction work in China, high energy consumption, does not conform to the development needs of the "green economy" in our country, will inevitably face the corresponding controls, which requires the enterprise to improve technology, the introduction of clean energy, improve the current situation of the high energy consumption, it also has improved the production cost of enterprises. Therefore, high energy consumption is also a major resource constraint faced by the development of metal products industry.

5. Empirical research

5.1 Model setting and variable selection

5.1.1 Model setting

As mentioned above, the data indicators selected in this paper are mainly factors influencing the export trade of metal products. In this chapter, linear regression method will be selected to conduct empirical analysis on the impact of resource constraints on the export trade of China's metal products industry. Since China's metal products industry is mainly limited by iron ore import and energy consumption, the resource constraint index is quantified by China's iron ore import volume (X1) and energy consumption of metal products industry (X2). In addition, according to relevant research and analysis of export trade reality, the export of metal products industry is also affected by some other

factors, so the exchange rate of RMB to US dollar (X3), internal R&D expenditure of enterprises (X4) and China's GDP(X5) are selected as other relevant variables.

The model set in this paper is:

$$\ln Y_k = \alpha_0 + \alpha_1 \ln(X_1) + \alpha_2 \ln(X_2) + \alpha_3 \ln(X_3) + \alpha_4 \ln(X_4) + \alpha_5 \ln(X_5) + \delta \quad (1)$$

Where, α_0 is a constant term, α_1 、 α_2 、 α_3 、 α_4 、 α_5 are used to represent the elastic coefficients of the five influencing factors respectively, δ represents the random error of the model, and The export value of China's metal products industry in period K is represented by Y_k .

5.1.2 Variable selection and data sources

This paper adopts time series data for analysis, so relevant data from 2000 to 2019 are selected to obtain regression samples, from which the impact of resource constraints on export is obtained.

(1) Explained variables

The explained variable of this paper is the export volume of China's metal products industry.

(2) Core variables

The core variable of this paper is resource constraint intensity, and the import amount of iron ore and the energy consumption of metal products industry are selected to quantify.

(3) Control variables

GDP is used to reflect China's economic development level.

The exchange rate fluctuation of RMB against US dollar in international trade will have a certain impact on the export of metal products.

The internal R&D investment of metal products enterprises and the improvement of production technology often have an impact on the production and manufacturing of metal products, which will affect the export trade volume.

Table 2 Variable description and data sources

Variate	Description	Data Sources
Y_k	Export volume of China's metal products industry (US \$100 million)	China Statistical Yearbook
X_1	Imports of iron ore (10,000 tons)	China Iron and Steel Industry Yearbook
X_2	Energy consumption of metal products industry (10,000 tons of standard coal)	China Energy Statistical Yearbook
X_3	Internal R&D expenditure of metal products industry enterprises (ten thousand yuan)	China Science and Technology Statistical Yearbook
X_4	China's GDP (USD)	China Statistical Yearbook
X_5	Exchange rate (billion US dollars)	State Administration of Foreign Exchange

5.2 Data Analysis

In this paper, SPSS software is selected to perform regression analysis on the above-mentioned relevant data from 2000 to 2019. The data used are all logarithmic substitutions to study the impact of relevant factors on the export trade of China's metal products industry.

It can be seen from Table 3 that the linear regression model of this study is:

$$\ln Y_k = 6.186 + 1.246 (X_1) + 0.144 \ln(X_2) + 0.068 \ln(X_3) - 0.974 \ln(X_4) - 2.384 \ln(X_5)$$

Among them, X_1 is the import volume of iron ore, X_2 is the energy consumption of the metal products industry, X_3 is the R&D internal R&D expenditure of the metal products industry enterprises,

X4 is China's GDP, X5 is the exchange rate of RMB against the US dollar, often Quantity represents random error, and Y_k represents the export trade value of China's metal products industry.

Table 3 Regression coefficient table
Coefficient^a

	Unstandardized coefficients		Standardized coefficients		t	Salience
	B	Standard error	Beta			
(Constant)	6.186	4.061			1.523	.150
lnX1	1.246	.300	1.479		4.160	.001
lnX2	.144	.575	.104		.251	.806
lnX3	.068	.035	.192		1.955	.071
lnX4	-.974	.409	-1.118		-2.378	.032
lnX5	-2.384	1.259	-.365		-1.893	.079

Dependent variable: ln(Exports of metal products)

Table 4 is the test of the significance of the model. It can be seen from the table that the F value is equal to 45.811, which is the result of the F test. According to the calculation of F value, the P value is less than 0.001, indicating that the model is statistically significant, and further indicates that there is a linear relationship between the export value of metal products industry and the import volume of iron ore and other independent variables.

Table 4. ANOVA

ANOVA ^a					
Model	Sum of squares	Degrees of freedom	Mean square	F	Salience
Regression	10.103	5	2.021	45.811	.000b
1 Residual	.617	14	.044		
Total	10.720	19			

Dependent variable: ln(Exports of metal products)

Predictor: (Constant), ln(Exchange rate), ln(R&D), ln(Import volume of iron ore), ln(Energy consumption), lnGDP

It can be seen from Table 5 below that the mean of the standardized residuals is 0 and the standard deviation is 0.858, which is close to 1, indicating that the standardized residuals approximate a standard normal distribution, and the assumption that the predicted value is an unbiased estimate of the observation is reasonable.

Table 5 Residual Statistics a

	Min	Max	Average	Standard deviation	Number
Predictive value	4.765615	7.093487	6.367699	.7291981	20
Residual	-.3244942	3.615049	.0000000	.1802769	20
Standard predictive value	-2.197	.995	.000	1.000	20
Standard residual	-1.545	1.721	.000	.858	20

Dependent variable: ln(Exports of metal products)

5.2 Description of results

The results of multiple linear regression show that the regression model has significant statistical significance (F value is equal to 45.811, P value is less than 0.001), and the independent variable can explain 92.2% of the export trade volume, with a high degree of explanation. Among them, the import volume of iron ore, the total energy consumption and the R&D expenditure within enterprises are

positively correlated with the export trade volume of the metal products industry; China's GDP, the exchange rate of RMB against the US dollar are negatively correlated.

(1) Resource constraints

The quantitative indicators of resource constraints are increasing year by year, which means that while the metal products industry continues to expand production and export, the iron ore and energy required must also continue to increase. The stronger the resource constraints, the higher the production cost of enterprises, which will indirectly increase the price of export commodities, and will inevitably inhibit the export of metal products in the short term. However, the data used in the empirical part of this paper is the 20-year data from 2000 to 2019, which is a long-term trend test. From the model, resource constraints are positively correlated with the export of metal products. This is because in the long run, in order to reduce production costs, enterprises will inevitably continue to develop new technologies and improve production efficiency. The strengthening of resource constraints will instead prompt enterprises to continue to improve and become more competitive in the international market. This is consistent with the previous theoretical analysis.

(2) R&D expenditures of enterprises

From the model, it can be seen that the internal R&D expenditure of enterprises is positively related to the export of metal products industry. As a manufacturing industry with high energy consumption and high pollution, the metal products industry will continue to improve the production technology of products and improve production efficiency when the internal R&D expenditure of enterprises continues to increase, thereby relatively weakening the restrictions on energy consumption of the metal products industry. When the company's internal R&D expenditure continues to increase, it will promote the production and manufacturing capacity of the metal products industry, so it will also promote the export trade of the metal products industry.

(3) GDP

The regression coefficient of GDP is negative, which means that as China's economic development level is higher, the export trade of metal products industry has declined. This is because the metal products industry belongs to the low-end manufacturing industry. With the development of our country's economy, the demand for the improvement of the manufacturing value chain continues to increase. Our country's industrial focus has begun to shift to the high-tech level, and vigorously adjust the industrial structure. Therefore, for manufacturing industries with high pollution and high energy consumption, such as the metal products industry, our country has begun to continuously transfer the industrial chain to other developing countries. It can also be seen from the data that the export trade volume of our country's metal products industry in recent years has decreased year by year.

(4) Exchange rate

The regression coefficient of the exchange rate is negative, indicating that the exchange rate has an impact on the export of metal products. Under the indirect pricing method, an increase in the value indicates a depreciation of the RMB against the US dollar, and a decrease in the value indicates a relative appreciation of the RMB. According to the theory of international trade, the relative appreciation of the RMB means that the purchasing power of the exporting countries has declined relatively. Therefore, the rise of the exchange rate is not conducive to China's exports, so the coefficient of the exchange rate is negative.

6. Suggestions for the export of metal products industry under resource constraints

6.1 Expand the source of iron ore and ease the pressure of resource constraints

The first is to make full use of the international market and expand the source of iron ore imports, thereby diversifying price risks and trade risks. Reduce the dependence on iron ore from Australia, Brazil and India, and increase the amount of iron ore imported from Peru, Canada, Chile, Sweden and other countries, so as to realize the diversification of iron ore import sources. The international iron ore market and our country are also two-way dependent, and our country is also a major importer

of iron ore in the world. Therefore, our country's metal products industry enterprises should make full use of the buyer's advantages, adopt a new model of joint procurement through cooperation between various enterprises, and use platforms such as enterprise associations to enhance their negotiating ability in the international market and establish an iron ore industry that is beneficial to our country. The international rules and order of iron ore import, and grasp the right to speak in iron ore pricing.

Secondly, for large-scale metal products industry enterprises, we can give full play to the advantages of technology and talents, and cooperate with foreign mining enterprises in the form of shares or joint ventures, and directly invest in foreign mining enterprises to realize the mode of overseas mining, which can diversify the risks of operation. , so as to avoid fluctuations in iron ore prices due to fluctuations in international iron ore supply and demand.

6.2 Accelerate technological innovation and optimize export structure

The metal products industry is a low-end manufacturing industry. In order to promote the development of export trade, transformation and upgrading are imperative. Enterprises should first increase investment in funds, talents and scientific research, increase the research and development of high-tech, and improve the ability of independent innovation and the competitiveness of products; in terms of funds, strive to obtain government financing credits, financial subsidies and tax incentives. In terms of scientific research, strengthen cooperation with universities, scientific research institutions, and national key laboratories of the steel industry; in terms of talent training, jointly cultivate talents with universities, establish a competitive salary system and a good scientific research environment, attract domestic foreign high-tech talents.

As a manufacturing industry, the metal products industry should also actively implement the "going out" strategy, strengthen exchanges and cooperation with overseas enterprises, introduce advanced foreign technology, management concepts, production equipment, etc., and constantly update and understand the needs of foreign steel markets. At the same time, domestic metal products industry enterprises should also change their investment concepts, increase investment in overseas, and choose countries with relatively rich iron ore and coke to invest in and build factories on the basis of overseas market inspections output in place of the product output. This can not only avoid trade frictions, but also reduce the pressure on resources and the environment faced by domestic factories.

6.3 Enhancing the level of energy price management

To increase the tax cost based on the purchase of iron ore, coke, coal and other resources, the ad valorem tax can be restricted. Under such circumstances, the rising cost of purchasing will prompt enterprises to attach great importance to technology, thereby improving the level of innovation and their own competitiveness, reducing dependence on foreign resources and improving the utilization rate of energy. At the same time, a stepped price level can be designed to give certain price subsidies to enterprises that export high-end manufacturing products or high-tech products in terms of imported resources, but the categories and scope of high-tech products and high-end manufacturing products must be strictly formulated to motivate enterprises. Improve the quality of exports and the impetus for technological development, thereby promoting new developments in the metal products industry.

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