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Analysis on Export Competitiveness of Chinese Chemical Products

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Abstract

First of all, this paper summarizes the research progress of international Chemicals which are a kind of products that cannot be ignored in people's life and production. Under the call of national policy of fine chemical and green chemical industry, in recent years, China's chemical products output ranks the top in the world, and the export trade grows rapidly, but the export of domestic chemical products keeps a deficit in foreign trade. In the face of complex and changeable international competition and foreign trade situation, it is helpful for the sustainable and healthy development and progress of domestic economy to comprehensively analyze and elaborate the structure, competitiveness and related influencing factors of China's chemical export. This paper analyzes the research and development of international competitiveness and constructs the research framework and main research methods of this paper. Based on the research results of international competitiveness at home and abroad, the evaluation system of export competitiveness of Chinese chemicals is constructed. Secondly, this paper analyzes the export status of domestic chemicals and related manufactured products from the main body of chemical exports, chemical exports and chemical export regions. This paper analyzes the international competitiveness level of chemical products in China by using the international market share, dominant comparative advantage index and trade competitiveness index. The results show that at present, China's chemical products are still very lack of international competitiveness. In order to further analyze the factors that affect the competitiveness of chemical manufacturing industry, based on Porter diamond model and previous research results, this paper establishes a multiple regression model, and analyzes the impact of four indicators of capital, scientific research and innovation level, industrial concentration and scale economy on the international competitiveness of chemical manufacturing industry. Finally, based on the results of empirical analysis, this paper puts forward suggestions to improve the export competitiveness of domestic chemicals and related manufactured goods.

Keywords

Chemicals, International Competitiveness, Export

1. The Introduction

Chemical industry is one of the most active and important industries in the process of economic globalization and human civilization. Chemical products are used in all fields of modern social life and provide the basis for production and manufacturing in all walks of life. The number of chemicals a country can produce and the number of sophisticated technologies its chemical industry can use can even be used to measure its major economic development level. Thus, it can be seen that chemicals are related to the speed of development of national economy and society, but also linked to the quality of development.

China's chemical products are under internal and external pressure. With China's accession to the WTO, deepening of reform and opening up and trade liberalization, the development of China's foreign trade is closely related to the development of chemical foreign trade. Manufacturing exports of manufactured goods in 2018 accounted for 94.571% of the total amount of Chinese exports, including pure chemical products and related products exports already accounted for 7% of the manufacturing industrial manufactured goods exports, compared to 2015 rose 2% year-on-year, and rendering a steady trend of increase year by year, chemical exports account for an important in the national export commodities.[1]

However, the chemical trade deficit is significant. In 2018, the total value of the chemical trade deficit has accounted for 16% of the total foreign trade deficit, an increase of about twice that in 2015. China's chemical industry as a whole presents the characteristics of high import dependence and fierce international competition. On the one hand, the United States, Germany, Japan and other developed countries continue to strengthen research and development and technological innovation, with significant advantages in technology, capital, brand and industrial coordination. On the other hand, other developing countries such as Thailand, Vietnam and so on accelerate the development of basic chemical industry. The momentum is rapid. China's chemical industry is facing fiercer foreign trade competition due to its late development.

Previous studies on the competitiveness analysis of chemical import and export trade are few, and this study is more targeted. From the perspective of research methods, most of the existing articles analyze from the macro and qualitative dimensions, while this study tends to micro and quantitative analysis, which makes the analysis results more real, scientific and operational.

This paper takes chemicals as the research object, analyzes and finds out the factors and constraints affecting the competitiveness of chemicals by studying the current export competitiveness of Chemicals in China, and puts forward

[1]Data Source: China chemical industry yearbook.

countermeasures to improve the competitiveness of Chemicals in China based on the conclusion, aiming at promoting the sustainable and refined development of China's chemical industry. It is of practical significance to promote China to have the initiative position and advantage in the competition of related products in international trade. In addition, this paper is helpful to systematically clarify the export structure and development status of China's chemical products, as well as the status quo of international competition, and provide a basis for China's chemical products to enhance competitiveness and better go global.

2. Research Status at Home and Abroad

2.1. Foreign Studies on International Competitiveness of Chemicals

The study of international competitiveness began in the American continent after World War II. Since 1985, the Yearbook of World Competitiveness (WCY) was published annually to evaluate the comprehensive international competitiveness of major developed industrial countries and developing countries at that time. Since the 1990s, Germany, Britain and other old developed industrial countries have established their own international competitiveness research institutions jointly with relevant enterprises. Since then, the evaluation indexes and elements of international competitiveness have changed with each passing day, and the world pattern has also changed quietly. Most scholars of various countries use the method of "diamond system" to construct econometric model to explore international competitiveness and carry out empirical analysis and research. It provides theoretical basis for benign development of all countries and related industries.

Sapir (1996) and Wang & Cao (2017) presented the change and optimization of export structure with Lawrence index and profitability structure index BSCI. The larger the Lawrence index is, the more obvious the change of export structure is. The larger the BSCI index is, the more obviously the export structure is reasonably improved. When Lall and Weiss (2004) analyzed the similarity of export commodities and export structures between China and ASEAN countries, they used Pearson correlation coefficient to measure that the higher the correlation between the two countries, the more similar the regional export structures would be.

2.2. Domestic Research on International Competitiveness of Chemicals

It is not early for China to conduct research on the international competitiveness of its domestic industries. It was not until 1996 that expert research groups began to use the theories and methods of WCY to issue research reports every year. Most domestic scholars are good at calculating and using indexes related to international competitiveness to analyze the competitiveness of their data.

Peng Liqun (2001) believed that the export structure and industrial structure

of a country must influence and restrict each other under the background of globalization. Finding a balance between the two as soon as possible will be conducive to sustained and stable economic growth. Since the reform and opening up, the fierce international market competition and the development mode of utilizing foreign capital through the development of processing trade have promoted the continuous upgrading of export product structure. The central and western regions are beginning to reap dividends from processing trade. After China's entry into WTO, China actively implemented the strategy of rejuvenating the country with science and technology to optimize the structure of export commodities and promote the export of manufactured products.

Qu Xiaobo (2017) analyzed the export structure of certain products from four perspectives. The competitiveness of a product is empirically analyzed by using index. Yu Donghua (2017) established a panel threshold metering model and analyzed the impact of skill premium and environmental regulation on manufacturing competitiveness. Skill premium can undoubtedly promote the improvement of environmental regulation on the international competitiveness of manufacturing. In addition, He Fengyu (2017) put forward specific suggestions to improve the management of chemical enterprises. Zhou Junling (2018) made a quantitative analysis of the market share through data sorting when studying the international competitiveness of a single product. Chen Zhiheng (2019) considered the new influencing factors of international competitiveness at this stage. Meng Fanglin (2019) analyzed the productive service trade in our country in global value chain, the bottleneck of import quantity is greater than the number of export situation have not changed for many years, the export structure in the department is out of balance, slowing growth rate year by year, growth is a lack of motivation, import and export industry structure is unreasonable, the lack of advanced technology and independent intellectual property rights.

2.3. Brief Review and Summary

To sum up, domestic scholars are deepening and expanding their research on chemical export competitiveness, including horizontal comparison with chemical export competitiveness of developed chemical countries and neighboring developing countries and longitudinal time comparison. It not only reflects the gap between China's chemical manufacturing and the developed countries, but also reveals the development process of chemical industry. However, these studies are not sufficient as a whole. Previous studies are mostly from a more macro perspective, such as the analysis of the international competitiveness and export structure of the whole country's manufacturing industry, chemical and chemical industry, and major enterprises in the industry, but lack of the competitiveness of a single chemical category on the micro level. However, there are a lot of qualitative studies on export competitiveness, and the selection of factors and indicators in empirical studies is not comprehensive. Scholars have explored the influencing factors of China's chemical export structure in a comprehensive way,

paying attention to environmental protection, international economic situation and foreign direct investment, etc. The author has noticed that the research content lacks research on the influence of domestic economic and environmental policies on chemical export competitiveness. Based on previous studies, this paper will explore the export structure and current situation of China's chemicals with reference to the policy guidance of changing development mode, and use empirical analysis to explore the factors that affect the international competitiveness of chemicals.

Domestic and foreign scholars have conducted in-depth research on the export structure, competitiveness, industrial structure and enterprise scale of China's chemical manufacturing industry. The problems explained and the countermeasures and suggestions put forward provide theoretical guidance and operational methods for the development direction of China's chemical and chemical industry. For the research on the relationship between chemical competitiveness, domestic and foreign scholars have not formed a unified conclusion, but most of them believe that there is a certain correlation between the two, which provides ideas and space for further research. At the same time, the impact of chemical manufacturing on export structure and competitiveness in the global industrial chain still needs further innovative research.

3. Analysis of the Export Status of Chemical Products in China

3.1. Changes and Trends of China's Chemical Exports

The data set out in Figure 1 reveal the rapid development of China's chemical export trade. In 2009, China's chemical exports totaled us $62.017 billion, but in 2018, just a decade later, China's chemical exports totaled US $167.466 billion, with an average annual growth rate of 17% ((1674.66 − 620.17)/(620.17 * 10) * 100% = 17%) from 2009 to 2018. From 2009 to 2018, China's total export of chemicals could not guarantee a sustained and stable growth, and the overall trend of fluctuation increased. Before 2012, the export competitiveness of chemical products has a significant trend of decline; since then, the year-on-year

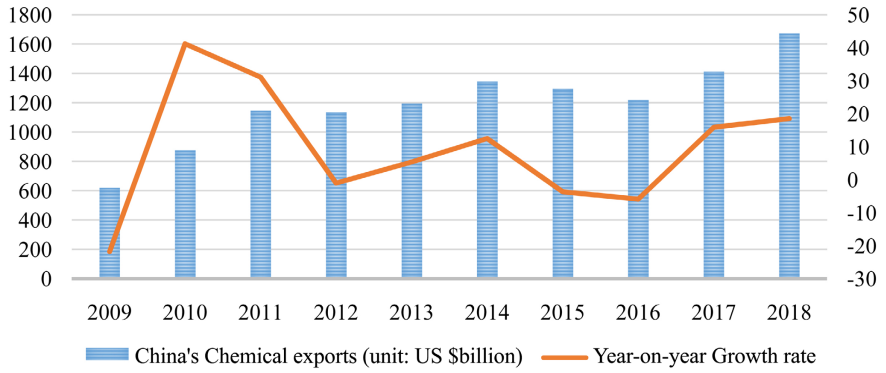

Figure 1. China's Chemical exports and Year-on-year Growth rate from 2009 to 2018 (unit: US $billion).

growth rate has fluctuated less than 20%, moreover, there was a negative growth in 2012, 2015, 2016. One reason may be that the number of agricultural labor force entering the industrial sector decreased. Another reason may be that the demand growth of bulk basic chemicals slowed down, the technical equipment, enterprise scale and industrial form of the traditional chemical industry became more and more mature, and the proportion of the chemical industry in the industry gradually decreased and the export competitiveness of chemicals has become significantly more stable.

However, the data shows that the proportion of chemical exports in total foreign trade is not high. From 2009 to 2018, the proportion of chemical manufacturing exports in foreign trade remains at about 5%, indicating that China is not yet a big and powerful exporter of chemical products, and China lacks competitive advantages in chemical industry and chemical export trade. In summary, China's chemical exports show a slight growth trend (see Figure 2).

3.2. Regional Structure Analysis of Chemical Export in China

Due to limited data, the author only calculates the export amounts of chemicals and related manufactured goods by major provinces in the eastern, western and central regions, as shown in Table 1 below.

Shandong, Guangdong, Zhejiang, Jiangsu, Jiangxi, Beijing and Hunan are the major export provinces of chemical products in China. In 2018, the total exports

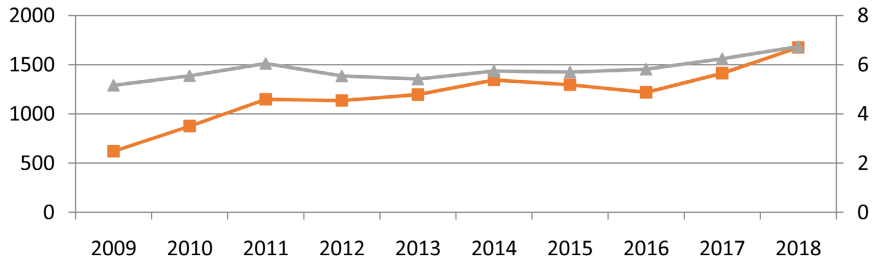

Figure 2. Change trend of China's chemical exports.

Table 1. Regional structure of chemical export in major provinces of China in 2018 (unit: USD 10,000, %).

region	exports	share	region	exports	share	region	exports	share
eastern	19,860,554.00	78.41	central	4,597,870.62	18.15	western	869,147.31	3.43
Shandong	1,564,902.00	6.18	Jilin	130,563.13	0.52	Guizhou	101,919.00	0.40
Guangdong	1,118,861.00	4.42	Heilongjiang	526,781.00	2.08	Guangxi	453,755.00	1.79
Zhejiang	6,659,803.00	26.29	Shanxi	72,109.49	0.28	Neimenggu	139,707.00	0.55
Fujian	457,568.00	1.81	Anhui	279,812.00	1.10	Shanxi	105,191.00	0.42
Beijing	3,114,356.00	12.30	Hunan	819,950.00	3.24	Ningxia	61,799.22	0.24
Jiangsu	6,945,064.00	27.42	Jiangxi	2,653,603.00	10.48	Qinghai	6,776.09	0.03
			Chongqing	115,052.00	0.45	Sichuan	267,795.00	1.06

of chemicals exceeded 10 billion US dollars in Jiangsu province (69.45 billion US dollars, accounting for 27.42% of the national total), followed by Zhejiang Province (66.598 billion US dollars, accounting for 26.29% of the national total), Beijing city (31.144 billion US dollars), 12.30% of the national total), Jiangxi province (26.536 billion DOLLARS, 10.48% of the national total), Shandong Province (15.649 billion dollars, 6.18% of the national total), Guangdong Province (11.189 billion dollars, 4.42% of the national total). The total export of chemicals and related manufactured products in the six provinces above accounted for 87.09% of the national total export of chemicals.

In general, China's chemical exports are generally concentrated in the eastern region. It can be seen from Table 1 that four of the top five provinces (cities) in China's chemical exports are from the eastern region. Exports of chemicals from the central region totaled us $45.979 billion, accounting for 18.15% of the national share. In 2018, chemical exports from major provinces in western China totaled us $8.691 billion, accounting for only 4.43 percent of the national total. To sum up, the export competitiveness of chemical products is the strongest in the eastern region, followed by the central region, and finally the western region. The competitiveness of chemical exports is decreasing from coastal to inland.

4. Analysis of International Competitiveness Index of China's Chemical Exports

4.1. The TC Index

Trade Competitive Index (TC Index for short) is an indicator reflecting the competition level of a certain industry sector in the international market, and its calculation formula is as follows:

$$\mathrm{TC}_{ij} = \left(X_{ij} - M_{ij}\right) \Big/ \left(X_{ij} + M_{ij}\right) \tag{4.1}$$

Type 4.1:

TC_{ij}—Trade competitive advantage index of j industry in country I

X_{ij}—Export volume of industry j in country I

M_{ij}—Import volume of j industry in country I

The TC index ranges from −1 to 1. When the index value is closer to 1, it indicates that the export trade competitive advantage of j industry in country I is greater. The closer the index gets to minus 1, the more competitive a country's exports are in that sector.

It can be seen from Figure 3 that from 2009 to 2018, the TC index of chemicals in China was generally negative, and the amount of chemical imports was larger than that of exports, lacking competitive advantage. Since 2012, China has shifted the focus of economic development from speed to quality. The economic growth rate has slowed down, but the international competitiveness of chemical products has significantly improved. Since the adjustment of domestic policies eight years ago, China's chemical trade competitiveness has been slowly improving, from the curve; the competitive disadvantage is gradually decreasing.

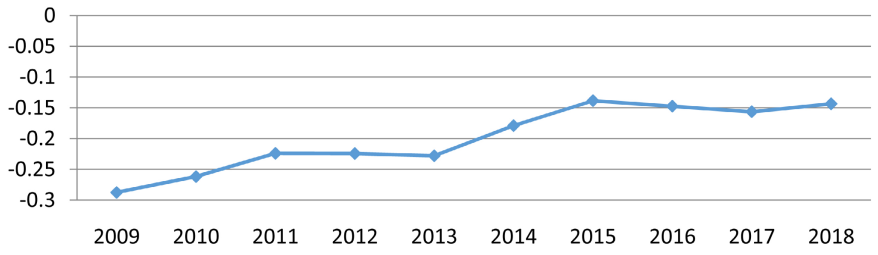

Figure 3. China chemical trade competitive advantage index.

4.2. RCA Index

The Revealed Comparative Advantage Index (RCA Index) is an important indicator to measure the competitiveness of a country's export of an industry. Its calculation formula is as follows:

$$\mathrm{RCA}_{ij} = \left(X_{ij}/X_{jt}\right)\Big/\left(X_{wi}/X_{wt}\right) \tag{4.2}$$

Type 4.1,

RCA_{ij}—Index of explicit comparative advantage of j industry in country I

X_{ij}—Export volume of j industry in country I

X_{jt}—total export trade of country I

X_{wi}—export volume of j industry in the world

X_{wt}—Total world export trade

When RCA < 0.8, the country's trade competitiveness of the product is relatively weak; When 0.8 ≤ RCA < 1.25, the competitiveness of the product is in the medium level. When 1.25 ≤ RCA < 2.5, it indicates that the competitiveness of the modified products in this country is strong. When RCA ≥ 2.5, it indicates that the country has strong trade competitiveness of the product.

As shown in Figure 4, from 2009 to 2018, the RCA index of China's chemical exports did not exceed or even reached 0.8, and the overall international competitiveness of chemical exports was very weak. In fact, since 2008, China has put forward major measures to accelerate the transformation of economic development mode and promote the deepening of reform. Chemical and chemical industry is also actively responding to the call of national policy. Since 2008, the apparent comparative advantage index of chemical manufacturing export has risen, and even has a trend of breaking 0.8. In the past ten years, the overall development level of China's chemical products is relatively stable; there is no leap in development. From 2012 to 2018, the RCA index was less than 0.6. Since 2012, China has been striving for high-quality economic development. The chemical and chemical manufacturing industry has adjusted itself, and the export of chemical products has adjusted accordingly. Aiming at the development of refined, specialized and sustainable chemical industry, the RCA index has decreased significantly, and the RCA index has a steady trend of slow rise in the following five years.

4.3. International Market Share

The international market share can comprehensively evaluate the international

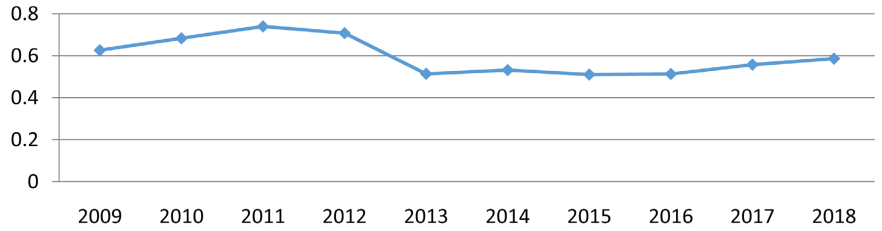

Figure 4. Indicative comparative advantage index of Chinese chemicals.

competitiveness of a certain product in a country, indicating the product's competitive strength in the international market competition, especially reflecting the degree of realization of the product's international competitiveness. The formula of the international market share index is:

$$\mathrm{WMS}_{ij} = X_{ij} / X_{wj} \tag{4.3}$$

In Formula (4.3):

WMS_{ij}—World market share of *i* country j products

X_{ij}—Export volume of *j* industry in country I

X_{it}—Total export trade of country I

The high market share value can indicate the country's strong international competitiveness of this category of products. Through the dynamic analysis of the changes in China's chemical products in the international market share, the changes are in its international competitiveness.

As shown in **Figure 5**, the international market share of China's chemical products is generally between 6% and 8%, which has not yet reached one-tenth of the world market. In 2009-2012, with the rapid development of China's economic aggregate, the international market share of China's chemical products also increased rapidly. However, since 2013, China's economic growth has slowed down and entered a new normal. The international market share of chemical products has declined slightly, and it fluctuated slowly from 2014 to 2018. Therefore, it is concluded that the competitiveness of China's chemical products in the international market is relatively weak.

5. Analysis of Factors Influencing the International Competitiveness of China's Chemical Exports

5.1. Theoretical Basis and Model Construction

The diamond system model proposed by Michael Porter (1990) is an important theoretical source of the measurement model in this article. However, in the actual quantitative research of this article, it is difficult to quantify variables such as the strategies and opportunities of chemical companies, the demand conditions of chemical companies, and auxiliary industries in the diamond model. It cannot meet the requirements of data statistics. Scholar Lourdes Moreno used scientific and technological capital investment as an independent variable when establishing an econometric model to explore the influencing factors of the competitiveness of the domestic manufacturing industry. Obtaining the corresponding

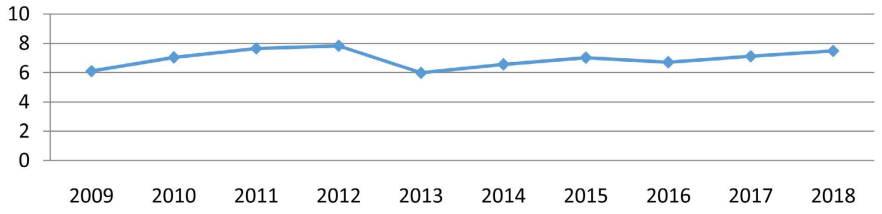

Figure 5. International market share of China's chemical products (%).

variable of scientific and technological progress has a significant positive role in promoting the total export volume. In the well-known Kim-Marion model, the trade competitiveness TC index is used as the dependent variable to express the competitiveness level of the domestic manufacturing industry. The overall value of TC index is negative, the import amount of chemicals is greater than the export amount, and it lacks competitive advantage; the advertising density is used to reflect the market competition; the ratio of the total net assets of the industry to the number of employees reflects the manufacturing industry Capital intensity: The ratio of the sales income of the top 4 companies to the total sales income of the industry reflects the intensity of the country's manufacturing industry. In the test results, industry intensity has a significant negative hindrance to international competitiveness. In addition, the test results of other variables conform to the hypothesis of the diamond model theory.

The scholar Pei Xiaohua (2008) systematically compiled the research results of the predecessors and established an independent, scientific and operable measurement model. Based on his research results and combined with the current statistical data conditions of China's chemical industry, this article selects five variables to construct the measurement model of this article:

1) Per capita net value of fixed assets. The diamond model proposes that professional production factors constitute the country's industrial competitiveness. The chemical industry is a capital-intensive industry. This article takes the per capita net value of fixed assets of the industry at the end of the year as a reference test indicator for resource endowments.

2) Investment in scientific and technological research and development. In the fierce international competition, science and information technology, as independent production factors (similar to capital and labor), also have a decisive impact on their international competitiveness from the perspective of the cost and quality of chemical products. Therefore, this article uses scientific research funding to investigate the impact of technological innovation on the competitiveness of chemical products.

3) Industrial concentration. The average size of the chemical industry can be used to explore the size of the industrial scale economy of the industry. In the chemical market, the degree of industrial concentration can reflect the intensity of market competition from a certain level, and can also reflect the power of representative large enterprise groups in the chemical-related industries, that is, enterprises that export chemicals and related manufactured products.

4) Economies of scale. The chemical manufacturing industry is an industry with obvious characteristics of economies of scale. When the production scale of enterprises continues to expand, the actual production cost per unit will decrease accordingly. This article uses the average sales of chemical enterprises in China (i.e.: operating income) as a measure of the economies of scale in the chemical industry index.

5) In this paper, the RCA index, which is an explicit comparative advantage index, is used as a dependent variable index to examine the international competitiveness of China's chemical exports. Establish a logarithmic model: $InRCA = \alpha + \beta 1InPFA + \beta 2InTI + \beta 3InCI + \beta 4InAS + \varepsilon$.

Among them, the dependent variable index is the RCA index; the independent variable indexes are: per capita net fixed assets at the end of the period, PFA, divided by the chemical industry net fixed assets at the end of the year divided by the industry's end-of-year employees The number of people; scientific research funding TI indicates the proportion of scientific research funding support in the operating income of chemical products; the chemical industry concentration CI is expressed by the proportion of the top 20 listed chemical export companies in the operating income of the entire industry; the average scale of chemical enterprises AS is represented by the chemical industry The value of product exports divided by the total number of companies.

5.2. Regression Analysis

This article selects a total of 10 years from 2009 to 2018 for empirical measurement model testing. All data are from the "China Statistical Yearbook", "China Chemical Industry Statistical Yearbook" and "China Science and Technology Statistical Yearbook", and the financial statements of listed chemical companies Income.

Since this article selects time series data, it is necessary to do a co-integration test on the observed variables to verify that the relationship between the variables is balanced and stable. First, the unit root test of each variable can be obtained, and the level series and the first difference of each variable are not all stable. In this paper, D represents the second-order difference, c in the test represents a constant, t represents a trend, and k represents a lag order. The test values of D (InRCA) and D (InAS) are all less than the critical value of the significance level of 5%, and the test values of D (InPFA), D (InTI) and D (InCI) are all less than the critical value of the significance level of 1%. After inspection, InRCA, InAS, InPFA, InTI, and InCI are second-order single integers, and they are stationary sequences after second-order difference. Secondly, linear regression is performed through OLS. The results are shown in Table 2 below.

The test results show that the residual ADF test value meets both the significance level of less than 5% and the significance level of 10%, indicating that the residual sequence is stationary and there is a long-term equilibrium relationship between the variables. The model can be regressed (Table 3).

Table 2. ADF unit root test structure of each variable.

Sequence	Trend type (c, t, k)	ADF test t statistic	critical value (1%, 5%, 10%)
D (InRCA)	(0,0,0)	−2.4377	−2.8472, −1.9983, −1.6011
D (InPFA)	(0,0,0)	−20.1199	−2.8472, −1.9983, −1.6011
D (InTI)	(0,0,0)	−3.5743	−2.8159, −1.9267, −1.6001
D (InCI)	(0,0,0)	−5.2039	−2.8433, −1.9887, −1.7773
D (InAS)	(0,0,0)	−2.4928	−2.8433, −1.9887, −1.7773

Table 3. Residual ADF unit root test results.

ADF test t statistical value	critical value (1%, 5%, 10%)
−2.1174	−2.8983, −1.9973, −1.5798

5.3. Model Checking and Analysis

The regression result is InRCA = −1.9472InPFA + 0.3091InTI − 0.3760InCI + 0.6210InAS. The result shows that the F value is 64.9917, which means that the equation is significant, indicating the significant competitive advantage of chemical exports, RCA and net fixed assets per capita, market concentration, and economies of scale It has a significant linear relationship with scientific research funding. The adjusted R2 is 0.9323, which indicates that the fitting effect of the model is better. The DW value is 2.8782, indicating that there is no serial autocorrelation. Per capita net value of fixed assets at the end of the period is significant at a significance level of 1%, and TI, CI, and AS are significant at a significance level of 5%.

The model regression results are as follows **Table 4**.

The net value of fixed assets per capita at the end of the period has a negative impact on the export competitiveness of chemical products. When the per capita net value of fixed assets changes by 1%, the export competitiveness index of chemical products drops by 1.9472%. The test results show that China's chemical industry is in strong international competition. It shows that capital investment cannot effectively improve the competitiveness of the chemical manufacturing industry, and suggests that the country may have redundant capital construction and low value-added chemical products flooding the market. For example, in the development of low-level investment expansion in China's magnesium-zinc inorganic chemical products and tire industries, the prices of products have fallen in the international market, which has damaged the export competitiveness of their products, and at the same time aggravated energy and environmental resources. Scientific research funding and technological innovation can obviously promote the export competitiveness of the chemical manufacturing industry. When the scientific research funding input index increases by 1 unit, the competitiveness index of chemical products exports increases by 0.3091,

Table 4. Model regression results.

Variable name	Coefficient	t
PFA	−1.9472	−4.7099
TI	0.3091	3.20077
CI	−0.3760	−7.6379
AS	0.6210	2.7111
Adjusted R2 = 0.9323	DW = 2.8782	F = 63.9917 (0.0000)

indicating that technological innovation is undoubtedly a good medicine to improve the quality and competitiveness of chemical manufacturing products. At the same time, the production equipment is updated in a timely manner. Accelerating the iteration of types and improving production efficiency all contribute to the improvement of the export competitiveness of chemical products.

The market concentration of the chemical products industry has a negative impact on the international export competitiveness of chemical products. When the market concentration index increases by 1 unit, the export competitiveness index of chemical products will drop by 0.3760. When the industrial concentration is high, the domestic competition of the chemical industry is low, indicating that the export competitiveness of chemical products is weak. In addition, the regression result data shows that the impact of economies of scale and market concentration on the export competitiveness of chemical products is not directly inversely proportional, but the effects of the two on the regression results are in opposite directions. Enterprise economies of scale have a positive effect on the export competitiveness of the chemical product manufacturing industry. When the chemical industry scale economy index increases by 1 unit, the export competitiveness index of chemical products will increase by 0.621, indicating that the greater the average sales income of chemical products companies, the higher the production efficiency of the chemical manufacturing industry, and vice versa. The chemical industry is one of the industries that combine resources and technological endowments. The research and development of many chemical products not only relies on chemical agents, but also requires efficient production lines and advanced technical equipment. Therefore, the chemical industry is an industry with significant economies of scale. As mentioned above, one of the reasons why the competitiveness of China's chemical manufacturing industry has encountered development bottlenecks and speed-up is difficult is that China has not yet formed a good and effective chemical industry enterprise scale economy, especially to achieve refined professional division of labor and maximize production efficiency. For a long time, various regions have developed the chemical industry freely and decentrally, often at the expense of environmental resources and production raw materials, only large-scale chemicals and basic chemicals, ignoring that fine and green chemicals can bring competitiveness to the overall product and industry.

5.4. Research Results

Through the empirical analysis of multiple regression model, the influencing factors of chemical export competitiveness in China were studied. The results show that economies of scale and the intensity of scientific research investment have positive effects on the export competitiveness of chemicals. Market concentration and net fixed assets per capita negatively hinder the export competitiveness of chemicals.

Through the model test and analysis, nearly a decade of chemical industry in China still has the problem of low investment structure and redundant construction, lack of high added value, and have high technical content of chemicals and related products, at the same time full of overproduction of low value-added products market, make domestic demand by the high value-added chemicals mostly rely on foreign imports, The current situation of long-term deficit in chemical foreign trade is difficult to change. This not only shows that China cannot improve the export competitiveness of chemical products by relying on a large amount of capital and resources input, but also shows that the chemical industry urgently needs to adjust the development mode and pay attention to the quality of development.

6. Policy Suggestions on Improving the International Competitiveness of China's Chemical Exports

Since the reform and opening up, chemical industry has always been an important industry related to the international people's livelihood. Its export amount is directly related to whether a country can maintain a long-term trade surplus advantage. For a long time, China has always maintained a foreign trade deficit in chemical products, although the products manufactured in the field of chemical products are complete, but most of them lack the international competitiveness of export.

6.1. Encourage and Strengthen Technological Innovation

Only by increasing investment in research and development, accelerating scientific and technological innovation, and improving the production technology, efficiency and production tools and equipment of chemical manufacturing industry, can the international competitiveness of China's chemical products and related manufactured products be continuously improved. Although the technology of some products in China's chemical industry is close to or has reached the international advanced level, the vast majority of high-level and high-tech products can only get basic samples in the laboratory, and few can truly achieve industrial mass production and put into real life.

Chemical innovation technology includes: First, product innovation. Continuously increase parts and product categories, so that the quality of products continuously improved. Second, technological innovation. Continuous in-depth research and development of chemical and chemical manufacturing technology

with higher conversion rate, better input-output ratio, lower energy consumption and less pollution. Third, the introduction of advanced chemical equipment to produce chemical products. Fourth, the transformation of traditional production lines, so that automation, information technology production can be into practical application. Among them, the investment in chemical technology is greater than the investment in chemical product research and development, especially the research and development of basic chemical technology, which is a common tool in the chemical industry, and the first strengthening of basic chemical technology is conducive to promoting product innovation. The state should also encourage major scientific research institutions and chemical manufacturing enterprises to become innovation subjects; provide corresponding incentives, product tax exemptions and other policies; encourage institutions of higher learning to cooperate with enterprises, transport high-quality talents for chemical and chemical enterprises, and better play the role of enterprises as market subjects. The overall development of chemical manufacturing industry not only depends on the introduction of technology, but more importantly, based on and introduction, independent innovation, let the country's chemical go out.

6.2. Accelerate the Adjustment of Chemical Manufacturing Structure

At present, the industrial structure of chemical products in China is no longer adapted to the competition situation in the international market compared with foreign chemical products. With the continuous improvement of domestic economic level and technological level, the structure of domestic chemical manufacturing industry and related chemical industry should be adjusted constantly. Domestic demand for high value-added chemicals is strong, but the corresponding domestic productivity cannot meet, a large number of high value-added chemicals rely on imports.

First, industrial structure can be adjusted by industry and product. First, from the perspective of the industry, we should firmly implement the policy of changing the development mode, develop a refined and resource-saving chemical industry, and constantly optimize the industrial structure by upgrading from low value-added to high value-added. Second, economies of scale and specialized collaboration help restructure existing chemical and chemical manufacturing industries. Excessive concentration within the industry should be avoided, and enterprises can trade freely to the maximum extent in the market, forming a benign industrial pattern with large enterprises as the main and small and medium-sized enterprises as the auxiliary and coordinated development. Third, adhere to the development of new fields of fine, sustainable chemical and chemical manufacturing, can shift the focus to chemical manufacturing new materials, information chemicals, tires, organic chemical raw materials, etc. Appropriately adjust the development of shrinkage inorganic chemicals, intermediates, coatings, dyes, etc., to promote rational distribution of product production. Quite a number of

chemicals, such as inorganic salts, have seen overinvestment, excess production capacity or the trend of excess production capacity. Properly inhibiting their development is conducive to promoting their transformation and upgrading and ensuring the healthy development of the industry. From the point of view of products, China should focus on improving the added value of chemical products, focusing on organic chemicals, chemical fertilizers, rubber and other special chemicals, synthetic new chemical materials and other products that are in great demand in the domestic market, and paying attention to fine chemical products and green chemical products with advanced technology and high added value. In the market competition, spontaneous and active filtering has been obviously backward, the lack of export competitiveness of the product.

6.3. Define Chemical Export Strategy and Policy

Under the background of sino-US trade frictions and disputes, the petrochemical industry will undoubtedly be affected. In 2017, China's petrochemical manufacturing exported 25.1 billion DOLLARS to the US, ranking the top four of China's export industries to the US, accounting for 6% of the total amount of goods exported to the US in that year. In the short term, liquidity risk cannot completely eliminate the negative impact of oil commodities, but chemical products are not the focus of sino-US trade friction due to the significant foreign trade deficit. In the long run, the fundamental purpose of the US trade war is to give a heavy blow to China's low-end manufacturing industry and hinder China's industrial upgrading and transformation. The chemical and chemical industries of China and the United States differ greatly in starting time, so the two countries have competitive advantages in the division of labor, which is highly complementary in nature. However, China should not only be satisfied with the export of chemical products in the field of basic chemistry, but should take this opportunity to focus on the accumulation of chemical technology to improve the industrial chain. The export of chemical products can be especially refined and specialized in the middle and high-end manufacturing industry, so as to enhance the international competitiveness of the export of domestic chemical products.

At present, the export quantity of most high value-added chemicals in China is less than the import quantity, and the export price is low, and the import price is high. Many chemicals are still in the backward stage of exporting raw materials and energy. Relevant government departments must pay attention to it. It is short-sighted to rely only on the economic benefits created by the export of raw materials and energy. Based chemicals with high quality and low price in China has open the door to the international market, enhance the international competitiveness in the short term, but that doesn't mean that our country should meet this, our country is not power, chemical industry from manufacturing power into chemicals manufacturing power, should first realize the productivity gap with other countries of advanced chemical engineering, Secondly, we should guide relevant industries to be refined and green through national policies and strive for a dominant position in the global chemical industry chain.

Firstly, through an overview, this paper analyzes the research and progress of domestic and foreign scholars on international competitiveness, and constructs the research framework and main research methods of this paper; then, based on the research results of international competitiveness at home and abroad, this paper constructs the evaluation system of domestic chemical and chemical export competitiveness. Secondly, this paper analyzes the export status of domestic chemicals and related manufactured products from the main body of chemical exports, chemical export commodities and chemical export regions. Three main indexes: international market share, explicit comparative advantage index and trade competitiveness index, open the empirical analysis part of this paper. The calculated data show that the international competition level of China's chemical products is relatively low at this stage. The econometric model further explores the main factors affecting China's chemical export competitiveness. Based on the previous research results, this paper establishes a multiple regression model to analyze the impact of capital, scientific research and innovation level, industrial concentration and scale economy of the industry on the international competitiveness of chemical products. Finally, according to the results of empirical analysis, this paper puts forward some suggestions to improve the export competitiveness of domestic chemicals and related manufactures.

Conflicts of Interest

The authors declare no conflicts of interest regarding the publication of this paper.

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